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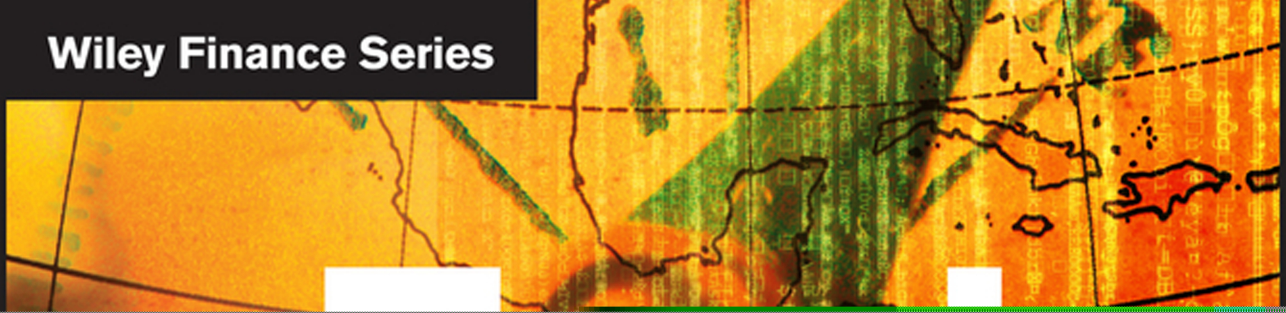

The Trade Lifecycle

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The Trade Lifecycle

Behind the Scenes of the Trading Process

Second Edition

ROBERT P. BAKER

WILEY

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To the memory of my dear mother

Contents

Foreword from the First Edition

Trading has evolved from a humble apple grower wanting a stable price for his produce come harvest time, to a complex and exciting industry comprising a significant share of the global economy.

Trading is the fundamental activity of investment banks, hedge funds, pension funds and many other financial companies. There is no better way to understand the workings of a financial entity than to follow the progress of a trade through its lifecycle and all the activities performed upon it.

This book will dissect a trade into its components, track it from conception to maturity and describe the raison d'etre of the business functions of a financial entity all arising from the processing of a trade. Having seen the full path of a trade, the reader will gain a more complete view of the world of finance which will answer some fundamental questions such as why, what and how people trade.

Derivatives are complex variations of standard trades. By contrast and comparison with the lifecycle of standard trades the reader will glean a better understanding of these often misunderstood financial instruments.

Together with the trade itself, the book will explore essential activities such as booking, confirmation, settlement, risk management, legal obligations, finance and control functions such as credit, market risk and auditing. Almost every person working in an investment bank or hedge fund has a large part of their work connected to the lifecycle of a trade. It is the glue by which all the departments are bound and the aggregated success or failure of each trade determines the survival and growth of the entire organisation.

The book also draws on real life experience of the trading floor. The sights and sounds of the action are brought to life to allow the reader to see how abstract concepts are actually practised. Detailed case studies illustrate how financial business problems were solved with varying degrees of success. There is also a unique description of the world of the quantitative analyst – a function that few people understand.

WHY THIS BOOK?

Many volumes have been written on the business side of trading and related activities such as market risk management. Although particular areas of the processes behind trading have been explained, I have not found the complete lifecycle of a trade fully described in one book. I feel a thorough end-to-end guide would be of interest to:

- anyone seeking work in the financial services industry
- people already in the industry who want to see how their work fits into the organisation as a whole
- those with an interest in the activities of a financial entity. They could include clients, academics, pension holders and people making investments of all sizes
- people selling products and services to the financial sector such as software vendors.

The importance of the financial sector to the world economy has been brought into focus by many recent events: the credit crunch, the collapse of companies such as Lehman Brothers and a recession affecting most countries across the world. The result has been a demand for better inspection and regulation of trading activities. No longer is it sufficient for firms to return profits, they have to convince investors, shareholders and regulators that they are employing due diligence and managing risks.

In writing about the trading process, my aim is to reveal all areas subject to potential risk. Once a risk is known, it can be monitored and managed even if the eventual decision is not to take action – forewarned is forearmed.

Although any financial entity engaged in trading activities will have already arrived at a set of processes spanning the trade lifecycle, these are not always performed in an optimal fashion; they may have evolved more by historical accident than by design. A careful reappraisal of the *entire* trading processes can lead to:

- a reduction in risks
- exposure of weaknesses
- lower operating costs
- elimination of wastage
- better overall awareness leading to more confidence in the trading process.

I hope that this book might encourage all participants in the trade lifecycle to look again at their activities and those of their colleagues and see where improvements can be made to reduce risk and enhance the reputation of a battered industry.

Gaining employment in the financial sector is becoming increasingly competitive. It is no longer sufficient to have the skills and experience in one business function. Applicants must demonstrate an understanding of where they fit into the organisation and have the ability to communicate with other business functions – every activity in the trade lifecycle being connected to others. This book is written with a view to helping this understanding.

I have tried to make the book a readable progression through all the important activities and components of the trade lifecycle. Detailed explanations are given where necessary, but the book is intended as a comprehensive overview and therefore I have avoided too much detail where it might hinder the reader's ability to see the full picture.

Any mistakes are mine. All views expressed are entirely my own.

Foreword to the Second Edition

Since the book was first published in 2010, many changes have been occurring to trading. The most significant is in the field of regulation. Investment banks and other financial institutions are now subject to more regulations which cut deep into the way they are allowed to operate. This is both on a macro level affecting the way they are structured and on a micro level in how individual trades are executed and processed. Thus a section of the second edition is devoted to regulation.

Feedback from the first edition included a desire of the readership to know more about asset classes – this chapter has been expanded.

A common confusion is the difference between asset classes and financial products. A chapter of the book seeks to remove this confusion and further the understanding of how products behave by 'following the money', that is examining the cashflows of several commonly traded products.

Quantitative analysts play a vital role in finance but are little known and understood. A chapter is therefore devoted to shedding some light on this business function.

In training courses based on the book, I have frequently been asked what working in capital markets and on trading floors is really like. This edition tries to give the reader a flavour of these experiences including real life case studies.

Finally, I have in the course of my career come to the realisation that one of the greatest impediments to delivering successful IT projects is a phenomenon I refer to as 'The IT divide'. This second edition describes the problem and some possible solutions.

Preface

This book is divided into five parts.

Part I is entitled **'Products and the background to trading'**. It starts with a chapter on trading giving an overview of trading in general as well as that related to the financial services industry. The next chapter is a background to risk which is another important theme of the book. We then look into specific trades by examining the cashflows associated with each. Chapters follow on asset classes and derivative products. Part I concludes with a look at three important aspects of trading – liquidity, price and leverage.

Part II is **'The trade lifecycle'**. It starts with an anatomy of the trade which is the core element of the lifecycle. Then the lifecycle is analysed in detail followed by a chapter on cashflows and asset holdings which are directly influenced by the lifecycle. We then move on to four methods of direct monitoring of trades throughout their lifetime: risk management, market risk control, counterparty risk control and accounting. There is a discussion of P&L attribution followed by a full description of the business functions in the lifecycle (i.e. the people). Then there is a chapter on regulation including Credit Value Adjustment (CVA) – a subject growing in importance.

Part III **'What really happens'** lifts the lid on the trading floor with chapters on insights into the real world of capital markets – here be dragons, case studies of real projects, the 'IT divide' and quants in capital markets.

Part IV **'Behind the scenes'** looks into processes, new products, testing, data, reports and calculations.

Finally, in Part V, the **Appendix** summarises the risks arising from the trade lifecycle.

Acknowledgements

I would like to thank my colleague Geoff Chaplin (of Reoch Credit Partners LLP) for his inspiration and guidance that allowed this book to come into existence.

I would also like to thank Meirion Morgan and Andrew Gates for giving up their time and sharing their considerable professional knowledge with me.

Special thanks to my sister Mandy for her diligence in checking the whole book for grammar and readability.

This book would not have been possible without the help of Thomas Hyrkiel, Jenny Kitchin and many more at the publishers John Wiley & Sons.

Finally I thank my wife Nechama for her constant love and support, my children and grandchildren for reminding me what is important in life and my father for all his advice and guidance.

About the Author

Robert Baker (London, UK) works as a consultant in the development of financial software and in training. Robert has over 20 years of commercial programming experience of which the last 13 have been in the financial sector, primarily as a quantitative developer sitting between traders, quants and programmers. He has been involved in credit derivatives for 10 years, and has held positions at ABN Amro, Barclays Capital, UBS Warburg, Rabobank, Royal Bank of Scotland and at the hedge fund Solent Capital. Robert also has experience of project management across a wide range of asset classes and financial instruments from plain vanilla to complex exotics. He holds a degree in mathematics from the University of Oxford.

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PART One

Products and the Background to Trading

CHAPTER 1
Trading

In this chapter we introduce the concept of trading which underpins the whole book and go on to look at factors influencing trading, market participants, how trading occurs and related topics.

1.1 HOW AND WHY DO PEOPLE TRADE?

People engage in trade primarily for one or more of the following reasons:

- Require more or less of a product

  We go shopping because we need things. The same is true of financial products. One person buys something that another person has in surplus and is prepared to sell.
- To make profit

  If someone anticipates that he can buy for less than he can sell and has the ability to hold a product long enough to take advantage of the price differential, he trades.
- To remove risk

  Sometimes we need protection. We are worried that future events may cause our position to deteriorate and we therefore buy or sell to reduce our risk. The ship is safe, fully loaded in port today, but how will it fare exposed to the open sea tomorrow?

1.2 FACTORS AFFECTING TRADE

In order to understand trading we will proceed to discuss the motivation behind why trading occurs.

TABLE 1.1 How a trade affects currency exposure

Item	Exposure for buyer (Company A)	Exposure for seller (Company B)
EUR	Increased	Decreased
JPY	Decreased	Increased

Product appetite

Everybody wants to buy as cheaply as possible, but some people have a greater need for a product and will be willing to pay more for it. Our appetite for a product will determine the price at which we buy. Conversely, our desire to divest ourselves of a product will affect the price at which we are prepared to sell.

Risk appetite

Risk is not necessarily an undesirable concept. Different people and organisations have a different attitude to risk. Some people make money by owning and managing risk. They are prepared to service other people's desire to reduce risk. Many trades arise because some people will pay money to reduce risk and others will accept money for taking on risk.

Exposure

Whenever a trade occurs, both counterparts have each increased and reduced their exposure to something. For example, if Company A buys yen and sells euros to Company B, then A has increased its exposure to yen and decreased its exposure to euros and B has done the opposite (see Table 1.1).

The EUR-JPY foreign exchange transaction has resulted in the trading of one exposure for another.

Even when something is bought for money, the seller has increased his exposure to the currency of the money he receives. Someone living in New York and trading in dollars does not consider receiving more dollars as a risk because he is not exposed to changes in exchange rates. But in international commerce most market participants do worry about exposure to all currencies including their domestic currency which may attract less deposit interest than an alternative, making holding money in that currency less attractive.

1.3 MARKET PARTICIPANTS

We use the example of a forward trade to illustrate various market participants. Other trades such as spot trades (immediate buy and sell) and options (rights to buy and sell in the future) have similar participation.

Producer

Imagine an apple grower owning a number of orchards. His product sells once a year and his entire income is dependent upon the size and price of his harvest. He can take steps to maximise his crop but he can do little to predict or control the price. He would rather have a fixed and known price for his produce than be subject to the vagaries of the market price at harvest time. How does he achieve a fixed price? He enters into a forward trade with a speculator obliging him to supply a fixed quantity of apples in return for a guaranteed price. He has now removed price uncertainty (or risk) and can concentrate on producing enough apples to meet his obligation.

Consumer

A cider manufacturer requires a certain supply of apples in six months' time. He is willing to pay more than the current market value to guarantee fresh stock is available when it is useful to him. His desire is to reduce his exposure to fluctuation of supply.

Speculator

A speculator takes a view on the likely direction of price change. If he sees a future shortage of apples, he will buy forward contracts now and hope to take advantage of his ability to supply later. He will take the opposite position and sell forward contracts if he forecasts a future glut. He is a risk taker, prepared to take advantage of other market participants' desire to reduce their level of risk.

Market maker

The market maker brings together buyers and sellers. He creates a market where it might be difficult for them to trade directly. He doesn't require the produce himself, nor does he have a view on the direction of price change; he is the middleman. He makes the market more efficient and helps to ensure prices reflect supply and demand.

1.4 MEANS BY WHICH TRADES ARE TRANSACTED

This section explains how trading actually takes place.

Brokers

Individuals and small financial entities cannot always get direct access to market makers. This may be due to their unknown credit worthiness, their small volume of trading or their specialised nature. They must rely on brokers to transact their trades.

A broker, in return for a commission, will act on their behalf to execute a transaction at a given price or at the best possible price.

Sales departments of investment banks also have a broking function. Customers of the bank may request orders for financial instruments which the sales force transacts on their behalf either at their own bank or using their contacts with other banks.

Exchanges

An organised trading exchange is a safe and reliable place to trade. Prices are published, there is a plentiful supply of all products covered by the exchange and counterparty risk is virtually eliminated. There is a set of products traded, each one is well-defined, eliminating legal risk and liquidity is maintained by the guarantee of a market in each of the products.

Market participants buy or sell a product with the exchange taking the other side of the trade. Members of the exchange ensure that the exchange has sufficient funds to cover any transaction and the members themselves are vetted to ensure they behave according to the rules of the exchange. Examples of exchanges are:

- London Metal Exchange
- Chicago Mercantile Exchange
- New York Stock Exchange.

It is increasingly common for trading to be conducted electronically. Most exchanges have moved beyond open outcry, where participants shout out or visually indicate their requirements and prices. Electronic exchanges work by having participants sending in orders and setting prices across a network of computers connected to the main exchange which publishes all the information simultaneously to all subscribers. This creates a virtual market place: the traders can operate from their own locations without ever meeting their counterparts.

Breaches of security are a greater risk to electronic exchanges – it is essential that the participants are bona fide members of the exchange and that their details, prices and orders are kept secure. There is also communication risk where a computer or network fails in the central exchange or in one location, preventing some or all members from access to the market data.

Over-the-counter

Exchange trades are limited to:

- members of the exchange
- certain sets of defined products
- times when the exchange is open.

If trading is required without these restrictions, it has to be done directly between the counterparties. This is known as over-the-counter (OTC) trading. There is increased flexibility because the counterparties can agree to any trade at any time but the absence of an exchange carries greater risks. Nowadays, much OTC trading is covered by regulation to ensure, inter alia, that both counterparties are competent and knowledgeable enough to trade, and understand the risks entailed.

1.5 WHEN IS A TRADE LIVE?

A trade is live between the time of execution and the time of maturity. Final delivery may sometimes occur after the maturity date, in which case although the trade has no value at maturity, it does still bear the risk of non-delivery. Even when a trade has matured it may still feature in trade processes, such as for compilation of trading statistics, lookback analysis, auditing or due to outstanding litigation.

1.6 CONSEQUENCES OF TRADING

Once a trade has been executed, there will be at least one exchange of cash or assets at some future time ranging from within a few hours or days for spot trades, to many years for trades such as swaps, to unlimited periods for perpetual bonds. (Assets here include cash.)

Apart from exchanging cash or assets, the trade itself has value while it is still live. So all processes and risk analysis must work with both the cash or asset exchanges and the intrinsic trade.

The buyer and seller are holding different sides of the same trade. Although at execution the price they agreed was the same for both, the value of each side of the trade may vary over time.

Here is an example that shows how a trade has two independent sides that result in intrinsic value and exchange of cash.

On 11th January X buys a future contract from Y in EUR/JPY where he will in six months pay one million EUR and receive 137.88 million JPY (that is a 6m future at 137.88).

On 11th April, the three-month future price is 140. X holds but Y buys a three-month future from Z.

On 11th July, both futures settle.

X pays EUR 1m and receives JPY 137.88m

Y receives EUR 1m from X, pays JPY 137.88m to X

Y pays EUR 1m to Z and receives JPY 140m from Z

Z receives EUR 1m and pays JPY 140m

So instead of Y buying a new trade (the three-month future), he could simply have sold his side of the original (six-month future) trade with X to Z. The fair price of the sale would be the amount of yen that would result in a value of JPY 2.12 million (140 – 137.88) on 11th July.

We see that through the life of a trade it has past, current and future cash or asset exchanges and it has intrinsic value. Concomitant with these exchanges come their associated risks and processes.

In financial terms, a trade converts potential to actual profit and loss with every exchange of cash or assets.

1.7 TRADING IN THE FINANCIAL SERVICES INDUSTRY

So far we have discussed some of the general issues of trading. Now we will focus on trading within the financial services industry. This includes investment banks, hedge funds, pension funds, brokers, exchanges and any other professional organisations engaged in financial trading. We exclude from this list retail banking services and private investments.

Market makers in a financial institution are sometimes referred to as 'front book' traders and typically their 'open' positions are held for a maximum of three months – often very much less. In contrast, the risk takers or speculators are often called 'back book' traders or the 'prop desk' and they may hold positions to maturity of the transaction (though they can also be very short-term traders).

Two types of trading policy

Where a trade is completed very soon after execution with a single exchange of cash or assets (a spot trade), there is no policy required for how to treat it. The only course of action is to accept the change in cash or assets caused by the trade. However, where the trade remains in existence for a period of time, there are two policies that can be adopted.

One is to buy with a view *to holding a trade to its maturity*; the other to buy with the expectation of *resale before maturity*. Sometimes it is unknown at the time of purchase which policy will be adopted. At other times, changes in market conditions may force the purchaser to alter his course of action. Most trading participants in the financial services industry engage in buy and resell before maturity, whereas private individuals apply both policies. To a large extent the decision is dependent upon:

- the reason for entering into the trade
- the view on direction of market conditions which affect the value of the trade
- the possibility of resale – is there a potential buyer willing to buy it before maturity?

Why does a financial entity trade?

We divide our discussion into the principal types of financial entities.

Investment banks These institutions have a large customer base. Some of these customers are drawn from the retail banking arm usually connected to major banks. Due to their size they can offer a range of financial services and draw on expert advice in many different fields. They benefit from economies of scale and because they trade in large volumes, enjoy lower bid/offer spreads making their trading cheaper. They are sometimes referred to as the 'sell side' of the industry because they are supplying products for the market place. Investment banks are active in trading activities in order to:

1. Service their clients

   The clients come to the bank with requirements that are satisfied by trading. The bank can either act as the middleman or broker to execute trades on behalf of the client who has no access to counterparties or it can trade directly with the client and either absorb the trade or deal an equal and opposite trade (known as back-to-back) in the market place, making a profit by enjoying lower trade costs.
2. Proprietary trading

   Most investment banks have proprietary (or 'prop') desks with the aim of using the bank's resources to make profit. The financial knowledge and skills base within the bank should enable it to understand the complexities of trades and take a realistic view on the future direction of the market in order to generate revenue for the bank.
3. Offset risks

   By engaging in a range of financial activities, the bank may have substantial holdings in various assets. These could expose the bank to risk if the market price moves against them. Therefore much of the trading of investment banks is to offset these risks.

   Examples:
   - too much holding in a risky foreign currency – trade into less risky or domicile currency
   - too much exposure to a particular corporate debt such as holding a large number of bonds – buy credit protection by way of credit default swaps.
4. Broaden their client base

   Just as a shop selling sports equipment might decide to appeal to more customers or better service its existing customers by expanding into sports clothing, so an investment bank might trade in new areas or products to provide a better service to its clients. The bank will constantly review its current service in the light of:
   - what the competition is providing
   - what clients are requesting
   - what are likely profit-making ventures in the future.

Some trades done by the bank do not make money or might even lose money, but are justified to attract new business or to service important clients.

The image of a bank is very important. The product of banking is money, from which it cannot distinguish itself (it can't provide better banknotes than its competitor!) so the diversity and quality of its services are the means by which it seeks competitive advantage.

Hedge funds Hedge funds are established to make profits for their investors. In return, the fund managers usually get paid an annual fee plus a percentage of any profits made. The funds are generally constructed to adopt a particular trading strategy. All other risks and exposures that occur as a by-product of following that strategy are offset or hedged. Hedge funds are like the consumers in the financial industry and therefore known as being on the 'buy side'. They engage in trading in order to pursue their strategy and manage their risks.

Pension funds and other asset managers Asset management is a generic group of financial companies of which pension funds are the most well known. They trade for very similar reasons to hedge funds. They want to maximise the return on the assets they hold for their clients or employees. They usually take a long-term view and are more risk-averse.

Brokers Brokers facilitate trades by bringing together buyers and sellers. They do not take upon themselves positions or trade risks. They do, however, require many of the trading processes described in the trade lifecycle section of this book with the additional complication of having two counterparties on every trade (one purchaser, one vendor).

1.8 WHAT DO WE MEAN BY A TRADE?

A trade can be a single transaction or a collection of transactions that are associated together for some reason. In this book, we use the former definition.

A trade is an agreement between two counterparts to exchange something for something else. This book will concentrate on financial trades, which means those involving financial instruments.

Examples of financial trades are:

- 1000 barrels of West Texas intermediate crude oil for USD 6015
- 1000 Royal Bank of Scotland ordinary shares for GBP 33.50

- LIBOR floating rate for five years for 35 basis points per quarter
- GBP 1 million for JPY 151 million in six months' time

There are many reasons why a trader might transact such trades. To take advantage of expected price rises one would buy (or sell for expected falls). If a large change in price was expected (volatility) but the direction was unknown there are trading strategies (involving call and put options – see Chapter 5) to profit from such a situation. Some trading is motivated by the expected shape of future prices known as the term structure or curve of an asset such as WTI crude oil.

In addition trades are often transacted as hedges to limit exposure to changes in market conditions caused by other trades. We examine hedging in Chapter 10.

The trading parties must agree:

- what each side is committed to supplying
- when the agreement takes effect
- how the transfer is to be arranged
- under what legal jurisdiction the trade is being conducted.

A trade is in essence a legally binding agreement creating an obligation on both sides. It is important to consider that from the point of agreement, the trade exists. If one side reneges on the trade and nothing is actually transacted, the other side will have legal recourse to compensation.

Trading has benefits and risks. It is an everyday activity we sometimes take for granted, but a transacted trade requires processes to be undertaken from conception to expiry. We will examine the journey of a trade and its components and in doing so will explore the activities of a financial entity engaged in trading.

Trading encompasses many types of trades. Some are standardised with very few differences from a regular template. They are traded in high volumes and require little formal documentation. For example, buying a share in an exchange-listed security would require only the security name, deal date and time, settlement date, quantity and price.

Other trades are far more specialised. They may have hundreds of pages of documentation and take months to put together. They will be traded individually and no two trades will be alike. Even these more complicated trades however are usually made up of components built from simpler, standard trades.

1.9 WHO WORKS ON THE TRADE AND WHEN?

In Chapter 15 we will discuss the various business functions. Table 1.2 shows a summary of the most general activities of each business function and at what point they are performed.

TABLE 1.2 Business Functions at points in trade lifecycle

Business function	Before trade	While live	After maturity
Sales	Arrangement		
Legal	Checking documentation	Dealing with queries, disputes	
Structurer	Arranging trade		
Trader	Testing trade	Execution, active risk management	
Market risk	Checking limits	Monitoring	
Counterparty risk	Checking limits	Monitoring	
Trading manager	Approval	Reviewing performance, monitoring	
Product control		Booking, valuation, reporting	
Operations		Confirmation, settlement	
Finance		Reporting	Reporting
Audit		Auditing	Auditing
IT	Systems – development and support		

1.10 SUMMARY

There are many reasons why people might trade. Financial trading is undertaken by a broad range of companies specialising in various areas and strategies. A trade has both common and specific properties and can be transacted in many different ways. The various business functions within a financial entity will perform their activities at different stages in the trade lifecycle.

CHAPTER 2
Risk

Risk is a major part of trading. Not only do most traders need to actively manage risks that arise from their trading (market risk) but the actual processes in the trade lifecycle carry various types of risk. Here we present an introduction to the concept of risk in general.

2.1 THE CONCEPT OF RISK

The German sociologist, Niklas Luhmann, defined risk as 'the threat or probability that an action or event will adversely or beneficially affect an organisation's ability to achieve its objectives'.

In the financial services industry, the term *risk* often denotes the market risk of holding trading positions. Risk management is then the action taken by traders to control this risk. This is an important type of risk and one to which we will devote a chapter of this book (Chapter 10), but it is by no means the only source of risk to an organisation engaged in trading. Whenever we use the unqualified term *risk,* we mean the wider connotation of risk as in Luhmann's definition.

2.2 RISK IS INEVITABLE

Imagine you own £10,000 in cash and decide to store it in the proverbial shoebox under the bed. You are now certain that you have protected your money – there are no risks attached. Correct? Unfortunately, things are not quite as safe as you think. Firstly, it could get stolen or there could be fire or flood. Secondly, if you leave the cash there long enough, the denomination of bank notes could cease to be legal tender and banks and shops refuse to accept them. Thirdly, inflation of prices might reduce the real value. In addition to these risks of losing all or part of your money, you are also foregoing the ability to invest your money for profit.

In reality there is no such thing as being of free of risk. All activities incur some sort of risk. Trading and its associated processes have many risks; the important thing is to be aware of risks and choose how to deal with them.

2.3 QUANTIFYING RISK

In order to quantify and manage risk, one must define:

- the event upon which the risk is to be measured
- the probability of the event occurring
- the loss entailed if it occurs
- the means by which some or all of the risk can be mitigated
- the cost of mitigating risk.

Both probability and loss calculations are very important in order to have an appreciation of the risk. A catastrophic event that occurs with a remote probability may require greater protective action than an everyday event that causes a small loss.

In practice, it may be difficult to quantify either the probability or the amount of loss entailed or both. With finite resources, an organisation will need to spread the amount it spends on protection against risk according to priorities. However, even an estimation of risk should aid the process of assigning priority. Also, in deciding a future course of action, the organisation should weigh the benefits against the risks in order to arrive at a fair decision as to how to proceed.

In Table 2.1, we give three examples of risk events, a rough estimate of the probability of occurrence, the amount of loss should the event happen, the selected remedial action and the estimated cost of such action.

TABLE 2.1 Examples of risk events

Event	Prob	Amount of loss	Action	Estimated cost
Client does not pay on time	30%	USD 1500 per late payment	Hire debt collectors	USD 2000 per month
Error in documentation leading to loss of deal	0.1%	Unknown – depends on deal	No action	Zero
Company exceeding capital adequacy limit	Once a quarter	Regulator could impose fine but hasn't yet	Improve financial reporting	USD 10,000

2.4 METHODS OF DEALING WITH RISK

There are four main ways to deal with risk:

- Ignore

  An event carrying risk may be considered of negligible impact and so can be totally ignored. Alternatively, it may be more expensive to protect against the risk than to let the event occur – sometimes an organisation just has to take the hit.

  For example, the loss to a hedge fund of being without electricity is negligible compared to the cost of installing its own generator.
- Minimise

  If it is impossible or too costly to remove the risk altogether, steps can be taken to either lessen its impact or reduce the probability of it occurring.

  The skydiver may carry two parachutes in case one malfunctions. (He would rather not think about the probability of both not working!)
- Avoid

  Again, if it is too difficult to protect against a risky event or the benefits are not sufficient to justify the possible damage entailed, the risk can be totally avoided.

  For example, the market risk department might rule that a trade is so risky it cannot be transacted despite the potential profit.
- Remove

  Removal of risk is certainly desirable, but often difficult to achieve.

  An example of risk removal is house insurance. One transfers the risks associated with owning a house to an insurance company. (Obviously there is still a residual risk that the insurance company will default on its obligations, but legislation and regulation generally make this probability negligible.)

2.5 MANAGING RISK

A successful organisation relies on good management. One key feature of management is assessing weaknesses and taking steps to tackle them. In order to do this, a good understanding of risk is essential. Many business functions within a financial entity are partly or fully concerned with the management of risk. All trading activities entail risk. As different parts of the trade lifecycle give rise to different risks, the success of the trade is dependent on the knowledge of its risks and the management of them. Since risk in all its manifestations is part of the business of financial trading, the company that can manage its risk best will be at a distinct advantage.

It should be said that managing risk is distinct from being risk-averse. There are many reasons why a trading desk might take on market risk and manage it successfully. Similarly an institution may decide on a more risky course of action because the likely benefits outweigh the possible losses. As long as the potential risks are understood and estimated, it can be said that risk is being managed.

2.6 PROBLEMS OF UNFORESEEN RISK

No stakeholders in a business – investors, managers, employees and customers – want unforeseen risk. Due to its sudden effect, the organisation is ill-equipped to deal with it and its consequences are unknown. One of the major causes of the recent credit crunch was the failure of many organisations to take into account a particular risk: that so many American sub prime mortgage borrowers would be unable to repay their debt. Unforeseen risk points to poor management and supervision and reduces confidence in the financial entity. If risk is present, it should be identified and then sensible decisions can be taken about how to manage it.

2.7 SUMMARY

A financial entity must accept that risks are an unavoidable part of the trading process. When an adverse scenario arises, it will fare better and be able to keep costs down if it is proactive in uncovering them, estimating their probability and effect and deciding best how to deal with them. Controlling risks does not necessarily mean being cautious in business – aggressive trading can reap big rewards. But recognising risk in all its manifestations is a fundamental part of managing the trading process.

CHAPTER 3

Understanding Traded Products – Follow the Money

To gain an understanding of financial trading one must distinguish between the concept of an asset class and that of a financial product. These terms are often confused. The aim of this chapter is to define a set of common financial products. In the following chapter we discuss asset classes. A financial product (or 'product') is a contract between two parties which determines an exchange of money or assets. There are many specific products tailored for the needs of one or both parties, but here we will discuss a set of common products existing in the financial world with a well-defined structure.

To help remove the confusion between products and asset classes, let us consider the everyday case of buying a sack of potatoes and the less frequent purchase of a washing machine. Essentially the process of acquisition of potatoes and washing machines is the same: you spend money and receive goods. However, since the type of vendor, the layout of the store, the delivery mechanism and various other factors are different, we normally view these two acquisitions in different ways. We may say that potatoes are in the asset class of perishable food and washing machines are in the asset class of domestic appliances. So the underlying process is the same but the asset classes are different.

The same is true for financial products. Buying shares is intrinsically the same as buying aluminium, sovereign bonds or purchasing dollars in exchange for euros. However, since the people and trading environments of each of these trades are very different, we generally group them into different asset classes. (The examples above corresponding to equities, commodity, fixed income and foreign exchange (FX)). The processes for dealing with each of these trades will normally depend on the asset class rather than the product itself.

As we have seen, some products exist in more than one asset class. Every asset class has a suite of possible products. A financial institution organises its traders, sales staff, middle office and controllers around each asset class rather than around each product.

A trade is an actual instance of a product. There are two parties to any trade, often referred to as counterparties or counterparts. Many products make reference to other parties or events. For example, UBS might buy Ford Motor Company shares from BNP Paribas. The two parties to the trade are UBS and BNP Paribas. Once purchased, UBS will have to claim dividends from Ford and not from BNP Paribas, so UBS will have to make Ford aware of its acquisition.

Some products make reference to events or entities. A swap trade (described below) needs at least one reference entity for its float leg (or two for a float-float swap). The reference will state the date, time and nature of the entity to be taken into consideration. An analogy might be to betting on a horse. The customer purchases the bet from the seller (the bookkeeper) but any winnings are dependent on the reference entity in the bet (the horse and the race). The horse itself knows nothing of the trade.

As mentioned, financial products are contracts. We can analyse the product by looking at the terms and conditions of the contract, but it is often easier to examine the cash or asset flows. The product is uniquely defined by the following:

- date
- value
- direction
- type of cashflow (cash or physical).

The cashflows are the mechanics of how the trade works from start to finish. The value of the trade is something different. Value is a function of the expected worth of future cashflows. Note the keywords *expected* and *future* – these involve a view of how the underlying market forces will change over time. So do not confuse cashflows, which are determined at the start of the trade by the type of product being traded, with value which varies over the lifetime of the trade.

For a consistent approach, let us consider each product from our point of view as a trader who is buying something. We shall use the following graphical notation:

- A down arrow indicates something we are contractually obliged to part with.
- An up arrow indicates something we are contractually expecting to receive.
- A grey arrow indicates money (cash) in our own currency.
- A black arrow indicates something other than money or cash in a foreign currency.
- A straight line indicates a fixed amount.
- A dotted line indicates an unknown amount.

3.1 SPOT TRADES

A spot trade is the purchase of an asset for cash. It is the simplest financial product and is often referred to as an outright because, once the cash and assets are exchanged, there is no residual obligation on either party – the trade is settled outright.

FIGURE 3.1 Cashflows on spot trade

In Figure 3.1, we are buying a fixed quantity of something in exchange for cash.

Notice that the actual exchange does not necessarily take place when the trade is agreed. There is a gap known as the settlement period, which could be anything from a few hours to three days after transaction. However, everything is committed at the time of transaction and the size of payment and assets is fully determined and cannot be changed.

Examples of spot trades in various asset classes are:

- Commodity: We buy 1m troy ounces of Gold from Commerzbank at USD 1000 per troy ounce.
- Equity: We buy 10,000 Ford Motor Company shares from BNP Paribas at USD 17.32 per share.
- FX: We buy 10m Swiss Francs from RBS at exchange rate of 1.118142 francs per US dollar.
- Fixed income: We buy 5m IBM Bonds from Chase Manhattan at 92.88 cents per bond.

Note that when purchasing an equity or a bond, we have settled outright with the counterparty (BNP Paribas or Chase Manhattan in the examples above) so they have no further financial responsibility or liability, but we now own an active financial instrument and will need to manage it in order to draw dividends or coupons in the future from the issuer (Ford Motor Company or IBM respectively). An analogy is to purchasing home insurance from an insurance broker. Once the broker has sold the insurance he is finished with the deal; in the event of a claim you would have to go straight to the insurer.

3.2 FUTURE (FORWARD)

The definition of a forward or future is very similar and the resulting cashflows are identical. There are some technical differences explained in section 5.1 but for now we shall consider them as one.

As the name implies, a future is a product that will result in an exchange of assets sometime in the future, although the price and amount is agreed now. Also, the trade is legally binding as from now. It is very similar to a spot trade with a very long settlement period. Since the agreed price now and the prevailing market price at time of exchange may be different, both parties will have to come to an agreement for the fair price of the product, taking into account expected future prices.

Futures can be physical or cash settled as shown in Figures 3.2 and 3.3 respectively. Physical settlement means an actual exchange of cash for asset at the future time. Cash settlement means that at settlement, we take the difference between the prevailing market price and the price at which the trade was agreed and one party pays that cash difference to the other.

Figure 3.2 shows a physical futures exchange. We agree now that at a future time (known as the future settlement date), we will pay cash and receive a fixed amount of a commodity. All the exchanges are therefore known from now.

However a cash settlement future works differently. Suppose we agree now to buy 1m troy ounces of gold from Commerzbank at USD 1000 per troy ounce for cash settlement in six months from today. If, in six months' time, gold was trading at USD 1010 per troy ounce, Commerzbank would owe us:

$$\text{USD } (1010 - 1000) \times 1 \text{ million } = \text{ USD } 10 \text{ million}$$

They would pay USD 10m in cash and no gold would change hands.

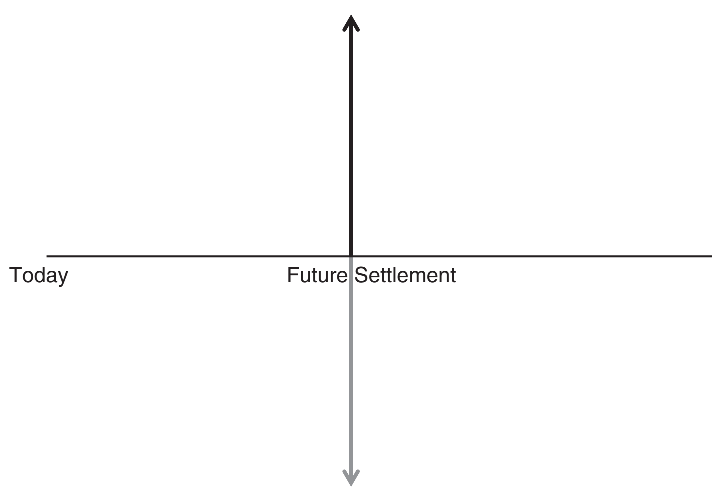

FIGURE 3.2 Cashflows on physical future trade

FIGURE 3.3 Cashflows on cash future trade

If, on the other hand, the price in six months fell to USD 994, we would have to pay:

$$\text{USD } (1000 - 994) \times 1 \text{ million} = \text{USD } 6 \text{ million.}$$

3.3 LOAN

Loans are common in everyday life. If we are the borrower (the purchaser of the loan) then we receive money now and pay back that money plus interest at a fixed time in the future. If the agreed interest rate is fixed, say 5% per year, then the size of the two cashflows is defined from the beginning.

Figure 3.4 depicts our cashflows if we borrow money for future repayment at a fixed interest rate.

Some loans can be based on floating rate interest, as in Figure 3.5. This means the parties agree that the interest rate will be based on some reference index plus an agreed margin on top as shown in Figure 3.5. For example, LIBOR plus 200 basis points (one basis point is 0.01% so 200 basis points is 2%). The size of the repayment cashflow will not be determined until just before it is due. At a pre-agreed time known as the fixing date (say 11am two business days before repayment is due), the parties will look at the prevailing LIBOR rate (this is a published figure) and determine the size of the repayment. For example:

- Size of loan: GBP 10,000,000
- LIBOR rate at fixing: 3.45%
- Size of repayment will be: 10,000,000 × 5.45% = GBP 545,000.

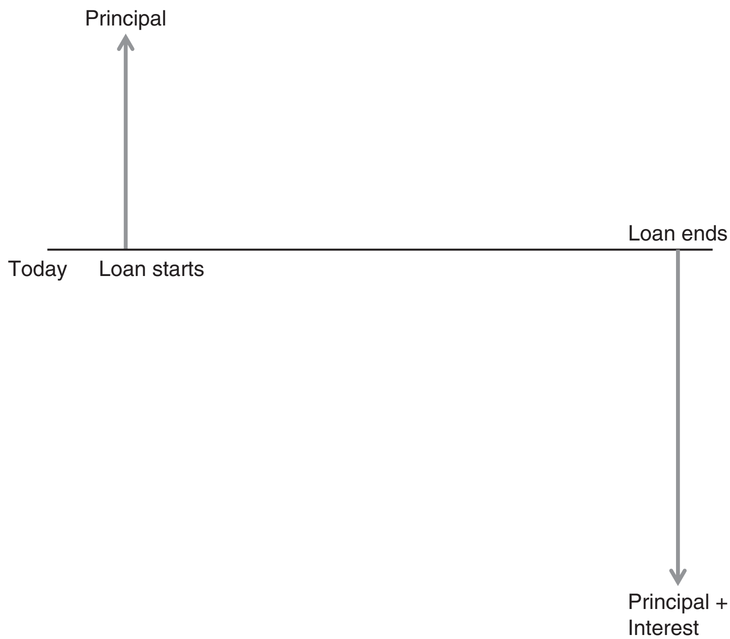

FIGURE 3.4 Cashflows on fixed loan

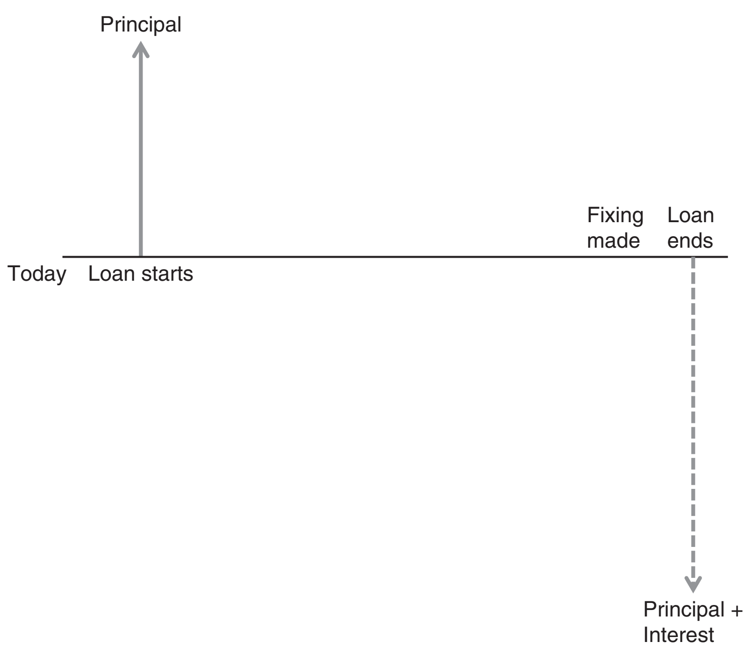

FIGURE 3.5 Cashflows on floating loan

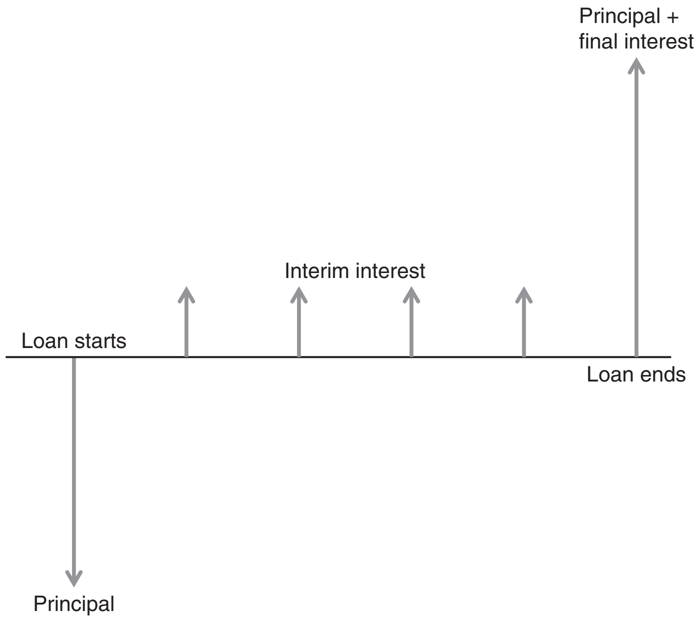

FIGURE 3.6 Cashflows on deposit with regular repayments

3.4 DEPOSIT

A deposit is, in effect, the opposite of a loan. We give money to the counterparty today and expect the money returned plus interest at some future time. Some deposits attract interim interest at regular periods (annually or semi-annually). Others receive one interest payment at the end. In both cases, the original deposited amount is repaid at the end of the deposit period.

Figure 3.6 shows a deposit with repayment interest at regular intervals and the final receipt for the principal plus the last instalment of interest.

3.5 SWAP

The term swap is very general, giving rise to many meanings (e.g. commodity swap, FX swap, credit default swap etc). However, when otherwise unqualified, it is taken as being an interest rate (IR) swap.

The simplest form of interest rate swap is a trade with several pre-defined settlement dates and a nominal notional amount of money that is never exchanged. One side (by convention the buyer) pays a fixed amount on each settlement and the other side pays a floating amount determined by some reference index (such as LIBOR). This is known as a fixed for floating swap (see Figure 3.7). The size

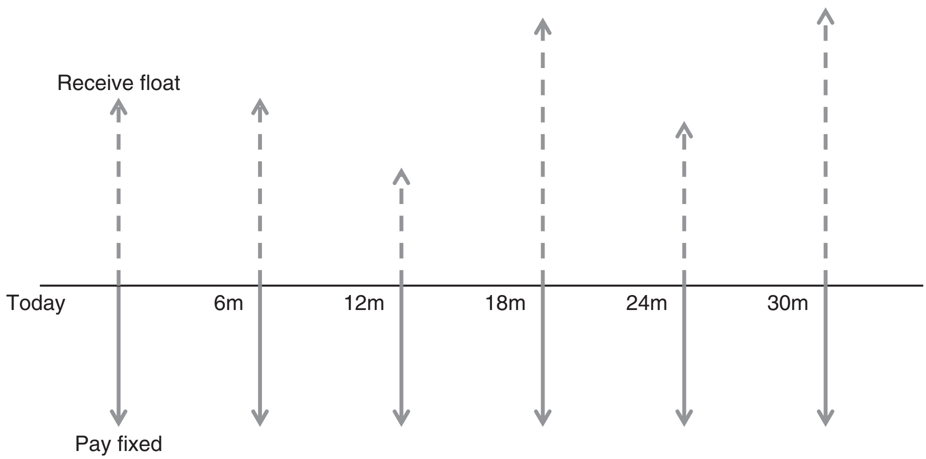

FIGURE 3.7 Cashflows on swap trade

and direction of each settlement is unknown at time of transaction. Shortly before each settlement date, the two sides determine the amount to be paid or received by looking at the reference index (a process known as fixing; the date is known as the fixing date).

For example, the IR swap is defined by:

- Notional USD 1m.
- We pay fixed rate of 3%.
- We receive float of LIBOR USD 6m rate.
- Settlement every six months for 2.5 years.

Suppose that just before the first settlement, after the trade has been running six months, a fixing of the reference index (LIBOR USD 6m) is taken and found to be 2.5%.

So we pay 3% of 1 million and receive 2.5% of 1 million. This results in us making a net payment of USD 5000.

Now, at the second settlement after 12 months, suppose the reference index is 3.2%. Therefore we pay 3% of 1 million and receive 3.2% of 1 million. So we receive net USD 2000.

This process continues for each settlement period of the swap.

Common variations are floating-floating and currency swaps. A floating-floating swap is where both sides have a floating amount determined by two different reference indexes. For example, we pay LIBOR USD 3m and received LIBOR USD 6m (the 3m being a different index to the 6m).

A currency swap (not to be confused with an FX or foreign exchange swap) is where the two sides are in different currencies. For example, we pay fixed 3% of a dollar notional and receive a floating rate in euros based on LIBOR EUR, which is then converted to dollars at the prevailing foreign exchange rate on fixing day to determine the direction and size of settlement.

Although there is always a notional amount in any interest rate swap, this is never actually exchanged. It is only used for determination of amount to be paid or received.

3.6 FOREIGN EXCHANGE SWAP

Not to be confused with currency swaps, a foreign exchange swap is the exchange of one currency for another now (after a short time for settlement) and the reverse exchange at some point in the future. The dates and amounts in each exchange are agreed and fixed at time of transaction. Figure 3.8 shows an example of this.

In this example, we agree to pay USD 1 million and receive JPY 101 million in two days from now and then to receive USD 1 million and pay JPY 103 million in three months from now.

The USD amounts are the same, but the JPY amounts are different to take into account the difference between USD and JPY interest rates over the next three months. It is very common in foreign exchange swaps that one currency has the same amount exchanged at both times.

The FX swap is in essence a spot foreign exchange trade simultaneously transacted with a future foreign exchange trade.

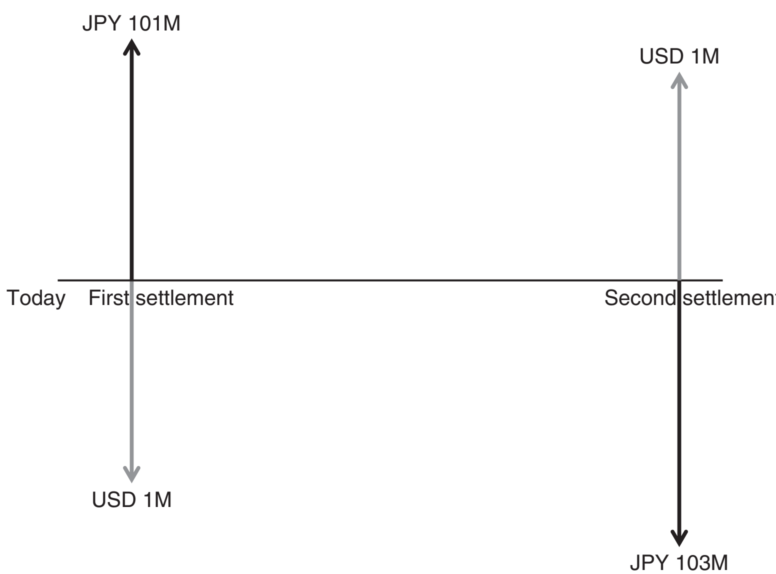

FIGURE 3.8 Cashflows on FX swap trade

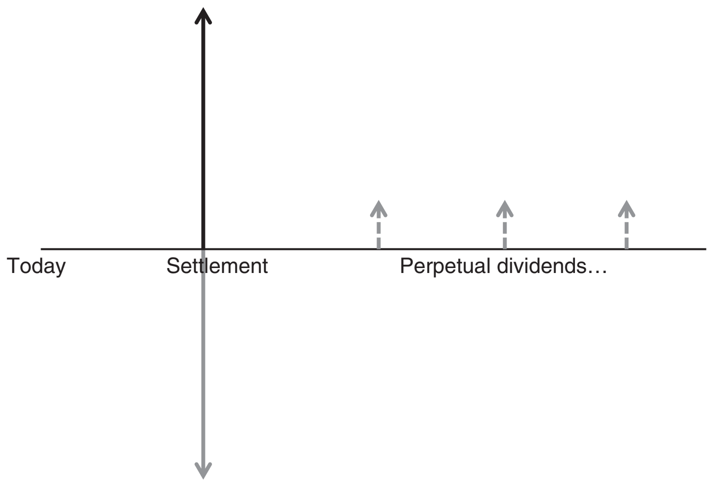

FIGURE 3.9 Cashflows on equity spot trade

3.7 EQUITY SPOT

A fuller description of equity can be found in section 4.3. For now we will consider an equity trade, which is depicted in Figure 3.9. The purchase of an equity (or share or stock) in a company entitles the buyer to partial ownership of that company. However we need to distinguish from whom we are buying.

If we buy equity directly from the issuing company when it is first issued, we pay cash and receive goods (that is, a share certificate proving the equity entitlement). This is a regular spot trade with the extra consideration of dividends. If the company makes profits, it may decide to distribute them to its shareholders. The time of dividend payments is regular and predictable; the size of the payment is unknown and could sometimes be zero, so we depict it as a dotted line. Note that equity ownership has no maturity. Therefore the potential to receive dividends is everlasting unless the company closes or the shares are sold.

If, on the other hand, we buy equity from a secondary source (such as somebody who bought it directly from the issuing company), the trade is a simple spot trade. Once we have done the trade, our counterparty has no further obligations. It is the purchaser's responsibility to inform the issuing company to transfer ownership in order to attend and vote at shareholder meetings and be able to claim dividends.

There are a standard set of financial transactions where the underlying entity is equity. So we can buy futures, options and swaps on equities. These are described in this chapter for those products. The fact that the underlying entity is equity does not change the cashflows of these trades. The only difference is that at the end of, say, a physical equity option, one may be left holding equity and at that point the dividend cashflows will apply. Whereas, had the option been on silver, one may be left holding silver and there would not be any dividends.

3.8 BOND SPOT

For a fuller description of bonds, see section 4.4. As for equity, we need to distinguish from whom we are buying the bond.

If we buy it from someone other than the issuer, it is a standard spot trade. We receive a bond and can redeem the coupons on the bond for cash from the issuer (but not from the counterparty).

We are therefore going to examine the cashflows when we purchase a bond directly from the issuer. The various parameters of a bond which determine the time and size of its cashflows are set by the issuer at the time of issuance. It is possible to create a huge variety of different bonds by varying these parameters, but there are some characteristics common to all bonds. If we purchase a bond, we give up some cash (the purchase price) and receive a financial instrument that obliges the issuer to pay us cash (by redemption of a coupon) at a time or various times in the future. Bonds have a:

- notional amount – this is used to determine the size of each coupon
- schedule of coupon dates
- redemption – this is the final cash amount we receive (aside from any coupons) at the maturity of the bond.

We have restricted the illustration of cashflows to three common types: a fixed coupon bond (Figure 3.10), a floater (Figure 3.11), and a zero coupon bond (Figure 3.12).

Perhaps the simplest type of bond is one that pays fixed coupons. Here all the cashflows are known at the outset of the trade. We give the issuer the purchase price at the start of the trade and they pay fixed coupons at periodic intervals until the bond reaches maturity. At that time, they pay the last, fixed coupon plus the redemption amount which is set at 100 by convention.

A floating coupon bond (also known as a floater) pays a coupon based on a reference entity. The coupon is fixed just prior to the due date in the same manner as swap fixings described above. Hence we know the time when coupons will be due, but we do not know the amounts until just before payment.

A zero coupon bond pays no coupons. We pay the purchase price at the start and receive the redemption at the end so there are just two, fixed cashflows.

3.9 OPTION

Options are discussed in section 5.2. Here we shall discuss the cashflows related to the purchase of an option. Remember that the value of an option is very different from the cashflows. The value diagrams are also in section 5.2.

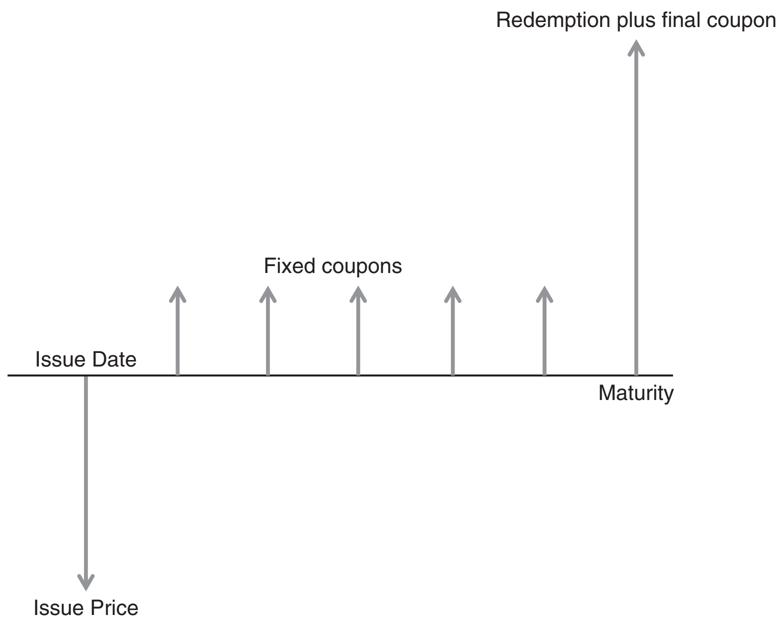

FIGURE 3.10 Cashflows on fixed bond

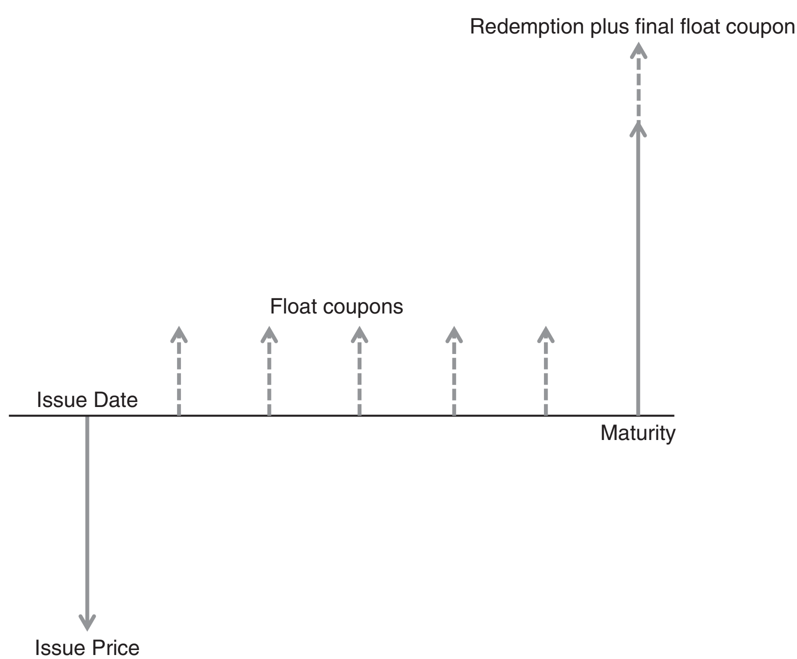

FIGURE 3.11 Cashflows on floating bond

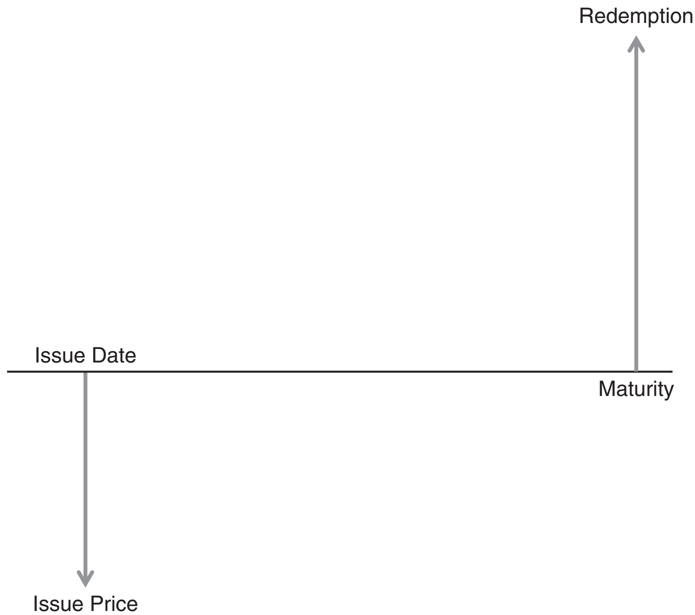

FIGURE 3.12 Cashflows on zero coupon bond

The basic mechanics of purchasing an option are the payment of a fixed premium at the start of the trade and the possibility of a payout at some future time, depending on how market prices change relative to an agreed fixed price, known as the strike.

A European option can, by definition, only be exercised at one time in the future. This means the time of the payout cashflow is known from the start. Whether there will be any payout at all and the size of the payout, cannot be known until the exercise date.

American options can be exercised at any time up to the final exercise date (effectively the close of the trade). Therefore both the time and the size of the payout cashflow are completely unknown. The buyer can exercise at any time or not exercise at all.

Options can be either physical or cash. Figure 3.13 shows the payout in black, representing a physical return should the option be exercised. A cash option would calculate the value of the physical underlying entity at payout and convert that amount to cash, so nothing other than cash would be exchanged.

Note that options can be applied to most asset classes. For example, a physical equity option, if exercised, would pay out in shares. A physical commodity option would pay out in some commodity, such as cocoa beans or palladium. This is a good example of how a financial product transcends the asset class and has the same features and cashflows across all asset classes.

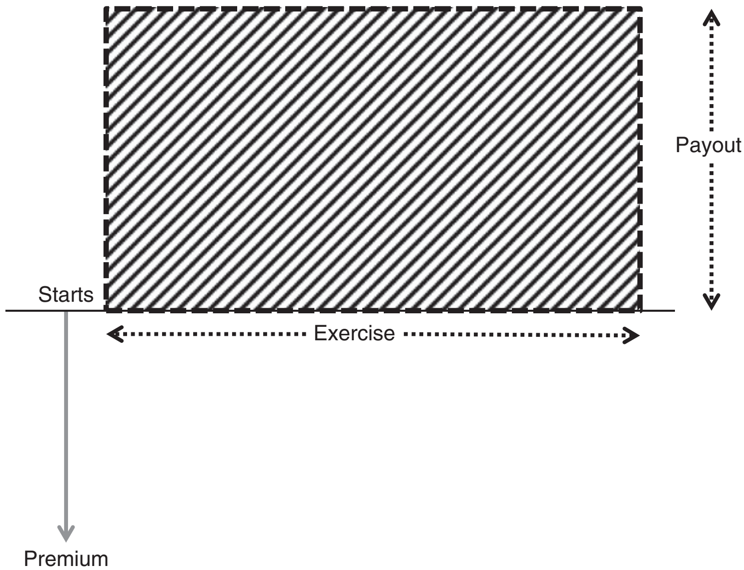

FIGURE 3.13 Cashflows on an American option trade

3.10 CREDIT DEFAULT SWAP

A credit default swap (CDS) is a contract between two parties referencing an entity or asset: a buyer of protection, also known as the seller of risk; and a seller of protection also called the buyer of risk.

A simple example would be:

JPMorgan buys protection from Banco Santander referencing Ford Motor Credit (Ford Motor Credit is the reference entity). The contract would have a specific term, say five years; an agreed notional amount, say USD 10m; a pre-agreed premium, typically called the ‘CDS spread’, say 800bp = 800 basis points = 8% per annum – so the annual premium is approximately 10m × 800/10,000 = USD 800,000 per annum; an agreed list of ‘credit events’; and other details including payment method on a credit event.

A credit event triggers the termination of the contract and a capital payment. Typical credit events include bankruptcy, failure to pay, or restructuring of outstanding debt. In the context of credit derivatives, the term ‘default’ is often used to mean ‘credit event’ (in contrast, ‘default’ for bond assets typically only means failure to pay).

When a credit event occurs, the seller of protection pays either:

- physical settlement: USD 10m in return for USD 10m notional of Ford Motor Credit debt; or
- cash settlement: a net sum representing USD 10m less the value of Ford Motor Credit debt in the marketplace.

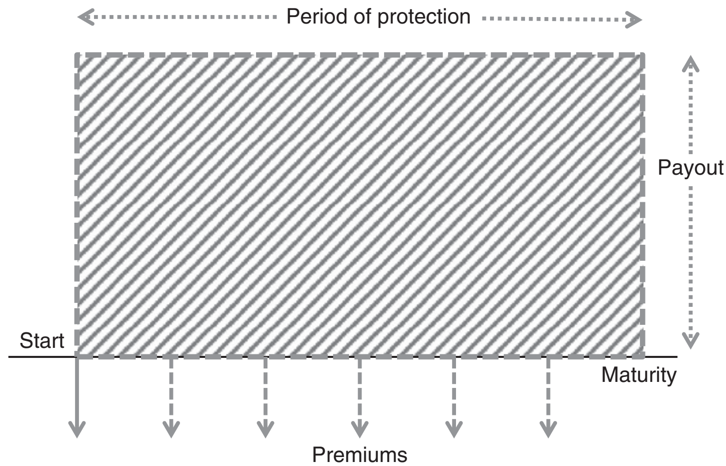

FIGURE 3.14 Cashflows on CDS

In summary, a CDS is an insurance policy. Generally the purchaser of insurance pays a sum of money at regular periods and these payments are known as premiums.

The seller (or writer) of a CDS will only pay out in the event of a default which is determined by a legally defined event or events. Once default has been triggered the whole trade ceases and no more premiums are paid. That is why only the first premium is shown as a solid line in Figure 3.14 because it is bound to occur, while the others are depicted as dotted lines.

The amount and time of payment are impossible to know at the start of the trade hence the striped rectangle of possible times and amounts. Here we are showing a CDS which pays in cash.

3.11 SUMMARY

Financial products differ from asset classes. A good way of understanding how a financial product works is by examining its cashflows.

Some trades have fixed dates and amounts, some have fixed dates and variable amounts, whilst others have one fixed starting cashflow but the others are unknown at time of trade. Many trades have no guarantee of receiving any cash or physical return for the purchase price. Both counterparties to a financial trade will understand the composite cashflows and enter into the trade if these cashflows accomplish what they wish to achieve.

CHAPTER 4

Asset Classes

In the previous chapter we described some common financial products. These products all have an underlying entity upon which the trade is based. These entities are generally grouped into common sets known as asset classes.

Traders are normally organised into desks, each desk trading the same class of assets. Processes that flow from these trades are also divided by their asset class.

Large parts of the trade lifecycle are generic: trades are executed, booked, confirmed and settled. But the actual implementation of these processes may vary from one class of assets to another. Here we discuss some common asset classes, their particular features and how they affect the trade processes. This chapter makes reference to products described in the previous chapter but there the emphasis was on comparing trades by looking at their cashflows whereas here we see other aspects of the trades and how they fit into their asset class.

4.1 INTEREST RATES

Interest rates are based around the lending and borrowing of money in a particular currency.

The underlying market force affecting the pricing of interest rate products is the interest rate in that currency hence the name of the asset class.

Money can be borrowed for different periods of time (known as *term*) and the major set of financial products in interest rates are divided into three terms

- short term (less than one year) are known as cash or money market trades
- medium term (usually from one to two years) are futures
- longer term (two or more years) are swaps.

Interest and the time value of money

Interest is paid to attract lenders to part with money which they could otherwise have used for purchasing other assets or kept for security. A person making a loan to someone else will therefore charge interest to compensate for the loss of opportunity to use his own money and because there is a reduction in his liquidity meaning that he has less ability to cope with sudden demands on his money such as to pay wages or fix broken machinery.

The result of charging interest when money is loaned causes an effect known as the 'the time value of money'. In essence this effect means that money in the future is worth less than money now. This is not to be confused with inflation which is caused by price rises. (The two are similar and are correlated to each other but here we confine the discussion to interest rates.)

In mathematical terms,

$$\text{Future value} = \text{Present value} \times (1 + \text{interest rate})$$

So if I have 100 pounds and the interest rate is 5% per annum then, in one year, my 100 pounds will be worth

$$100 \times (1.05) = 105 \text{ pounds}$$

$$\text{Present value} = \text{Future value}/(1 + \text{interest rate})$$

So if I am expecting 100 pounds in one year with 5% interest per annum then my present value of that future 100 pounds is

$$100/(1.05) = 95.24 \text{ pounds}$$

So we see that money is worth less over time. How much less depends on two facts.

- prevailing interest rates – the higher the rate, the less money is worth
- time – the longer the time period, the less money is worth.

Management of cash is vital to any organisation; too much cash is an under-utilisation of the organisation's assets, too little cash increases costs (due to having to borrow more money) and increases risk.

Since different organisations have continuously changing cash requirements there is a very active market in trading cash products. These products come into the asset class of interest rates.

Interest rate participants

We can divide the market on interest rate products into three groups of participants:

- Central Banks (such as Bank of England, Federal Reserve) – these organisations inject cash into their country's money supply, set the lowest level of interest rate (known as the base rate) and are lenders of last resort

- Banks (who are generally lenders of money)
- Commercial organisations such as industrial companies (who generally need to borrow money).

All interest rates derive from the base rate. This is the rate the central bank will charge for secured overnight lending.

Banks will lend to each other at a slightly higher interest rate than this base rate. The average interest rates at which banks are currently lending is known as LIBOR (London Interbank Offer Rate).

Banks will charge a yet higher rate to commercial organisations and others. This rate will depend on the credit worthiness of the organisation and how much profit the bank is trying to make.

Let's now examine the interest rate asset class.

The asset class of interest rate products

Here we describe typical products which are commonly grouped into the asset class of interest rates.

Deposit A deposit (or loan) is a simple instrument. One counterparty gives an amount of currency to another counterparty, expecting its return on a future date. At agreed regular intervals, interest will be paid by the receiver to the depositor.

A deposit can be unsecured or secured. When secured, the receiver has to provide some collateral to the depositor and in the event of default, the collateral will be forfeited.

The market for very short-term loans and deposits is known as the money market. Here money can be borrowed overnight, for a few days or for a few months.

A very secure form of short-term lending is known as the repo market (repo is short for repurchase). Here the borrower sells a highly secure bond such a US Treasury bond at an agreed price for repurchase at an agreed future price. The purpose of such a transaction is to borrow money more cheaply by using the bond as collateral.

Deposits oil the wheels of financial markets by ensuring participants can acquire cash and proceed with other trading. When short-term lending becomes expensive, as we saw in the credit crunch of 2008, raising money for all other trading is negatively impacted.

Future As explained in the previous chapter, a future is an agreement to transact at some future time with the price decided now. If we speak about a future on aluminium, it is quite easy to see how that future is applied. Not so with a future on interest rates. Interest rate futures are very common products but what do they mean and how do they work?

An interest rate future is a means to trade on what interest rates will be in the future. They are priced as 100 − interest rate. So if interest rates are expected to be 5% in March, the March future will be priced at 95.

An interest rate future is an agreement between buyer and seller to deliver in the future an asset which pays interest. The price of that underlying asset is locked in now.

For example, I need to borrow money in 6 months' time and I am worried that interest rates may rise between now and when the loan starts. If I sell an interest rate future now and buy it back at the time of the loan, I can mitigate (hedge) the negative effects of an interest rate rise. Suppose interest rates now are 3% so I can sell a future today for 97 (100 − 3).

If rates rise to 5% in 6 months, I will be able to buy the future back at 95 (100 − 3).

So I have made a profit on the two future trades (sell now at 97, buy later at 95) which will help to offset the increase in interest charges.

Futures are standard products traded on exchanges, as opposed to forwards which can be any over-the-counter (OTC) agreement between counterparties. (See section 5.1 for a fuller explanation of forwards and futures.)

Futures have standard contract sizes, tick sizes and contract months. For example, US Treasury five-year T-note futures are traded in lots with $100,000 notional at maturity.

Their contract months are set at March, June, September and December.

Their tick size is 1/32. This means that prices are always expressed as whole numbers plus a certain number of 32nds. You cannot quote a price with a fractional part less than 1/32, for example 1/64 or 1/100.

Swap Technically, a swap is an agreement to exchange one asset for another, however when used without a qualifier it means interest rate swaps (as opposed to equity, foreign exchange (FX) or other asset class swaps). Within the same currency, swaps can be customised to the requirements of the counterparties, but the standard trades are float-for-fixed and float-for-float between different indices. Swaps have agreed fixing periods throughout their life when money is transferred.

Float for fixed One counterparty pays fixed currency. The other pays a floating rate dependent on an agreed index such as LIBOR.

Float for float One counterparty pays a floating rate based on one index (e.g. Euribor) and the other pays floating based on a different index (e.g. TIBOR)

Although there is an agreed notional for a swap trade, this is only a nominal figure used to calculate the amount owed at each fixing. Swaps are used when a counterparty wants to hedge his exposure across different indices, or when he wants to transfer his payment streams from fixed rate to floating or vice versa.

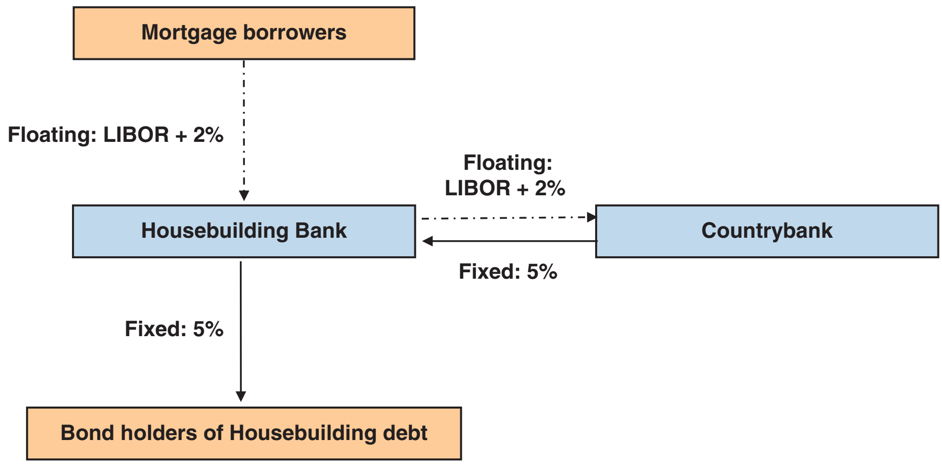

FIGURE 4.1 Motivation for a swap trade

Example Housebuilding Bank receives floating rate mortgage repayments (at LIBOR + 2%) from its customers and needs to service the debt arising by means of a bond it has issued which has fixed coupon payments (5%) (See Figure 4.1).

Housebuilding enters into a swap trade with a counterparty (Countrybank).

Housebuilding receives 5% from Countrybank and pays its bond holders.

Housebuilding pays LIBOR + 2% to Countrybank which it receives from mortgage borrowers. Now, Housebuilding has removed his exposure (risk) to interest rate changes.

The combination of deposits, futures and swaps traded in one currency constitutes the market data necessary to produce an interest rate curve. This determines how much that currency will be worth in the future based on information available today. Interest rate curves are used extensively in the financial world. Most trades rely on the interest rate curves to discount future cashflows. The higher the future interest rates in a currency, the less money in that currency will be worth.

Interest rate products are traded in their own right by dedicated trading desks and are also traded as hedges for more complicated trades or cashflow scenarios (as in the swap example above). In most currencies they are very liquid products.

FRA A forward rate agreement (FRA) is a forward contract, an over-the-counter contract between parties that determines the rate of interest, or the currency exchange rate, to be paid or received on an obligation beginning at a future start date. The contract will determine the rates to be used along with the termination date and notional value. With this type of agreement, it is only the differential that is paid on the notional amount of the contract. It is paid on the *effective date*. The reference rate is fixed one or two days before the effective date, dependent on the market convention for the particular currency. FRAs are OTC derivatives. An FRA differs from a swap in that a payment is only made once at maturity.

Many banks and large corporations will use FRAs to hedge future interest or exchange rate exposure. The buyer hedges against the risk of rising interest rates, while the seller hedges against the risk of falling interest rates. Other parties that use Forward Rate Agreements are speculators purely looking to make bets on future directional changes in interest rates.

The discount curve

As well as being important in their own right, the class of interest rate products is vital for construction of the discount curve. We saw in the previous chapter that most trades give rise to cashflows in the future. If we are going to assess the worth of future cashflows we cannot take them at face value. Those due sooner are worth more than those due later because of the time value of money. Therefore we need a means to weight future cashflows according to their depreciation over time. This can be done in many ways; one of the most common is to construct a discount curve.

The discount curve determines the rate at which the value of money decreases over time. It is constructed by taking an active (liquid) set of interest rate products – deposits, futures and swaps – and using their prices to imply a set of factors at future time periods known as discount factors.

By definition, the discount factor for today is 1.0. Tomorrow money will be worth slightly less, so the discount factor will be something less than 1.0 and so on with the discount factor monotonically decreasing over time but always being between 0 and 1. Table 4.1 shows an example set of discount factors.

Once we have derived a set of discount factors, we can apply them to any future cashflows to determine a present value. So if we have two future cashflows of

TABLE 4.1 Discount factors

Date	Discount Factor
Today	1
1 week	0.99900
2 weeks	0.99823
1 month	0.99623
3 months	0.98976
6 months	0.97951
9 months	0.97023
1 year	0.96721
18 months	0.95983
2 years	0.95427
10 years	0.61394

100 pounds in one year and 100 pounds in 10 years from now, we can look up in the table the one-year and 10-year discount factors and see that their values will be

$$100 \times 0.96721 = 96.721 \text{ and}$$
$$100 \times 0.61394 = 61.394 \text{ respectively.}$$

Since products in all asset classes require discounting of their future cashflows, we see the importance of the discount curve and hence interest rate products to the whole of financial trading.

Interest rates are therefore a fundamental asset class used by all other asset classes.

Removing credit effects

The aim of building a discount curve is to quantify the time value of money. Whenever two counterparties engage in a deal they have to take into account the risk of default and will charge a premium to mitigate this risk; the greater the chance of default, the higher the risk. This credit effect distorts the price of the product which could be a deposit or swap used in building the discount curve and hence the discount curve is altered and no longer reflects purely the time value of money.

An alternative instrument which is better at removing the effect of credit is the *Overnight Indexed Swap* (OIS). This is a swap in which one party pays fixed and the other pays the geometrical average of all overnight interest rates in the period of the swap.

Overnight interest rates carry very little credit default risk and so are 'purer' indications of interest rates.

The OIS seller offers the purchaser a fixed leg reflecting his view of how overnight interest rates will average out over a given period of time. By looking at the prices of OIS trades, it is easier to see the likely direction of interest rates (and hence the time value of money) unencumbered by credit effects.

One of the problems caused by the collapse of Lehman Brothers and the resulting credit crunch was that even major banks were reluctant to lend to each other. This meant that LIBOR (interbank trading) was trading at 354 basis points (3.54%) above the equivalent OIS. Normally the difference is between 10 and 15 basis points (0.1 to 0.15%)

Tradeflow issues

The asset underpinning an interest rate trade is simply the currency. For the purposes of tradeflow, this can be defined very easily – there are a limited number of currencies in the world and each has a very exact meaning and nomenclature. The settlement and delivery mechanism involves having a nostro account in the currency. There are no odd units of transfer, no security documentation and no warehousing issues.

Interest rate products do not have the notion of a buyer and seller, as the same asset is being transacted either by a loan or a swap. Therefore, it is important that trading processes can distinguish the two sides of the loan and the swap and know exactly who is paying and who is receiving during the lifecycle.

When accounting for interest trades in a currency other than the reporting currency, it may be necessary to provide two values – one for the actual amount in the traded currency and one for the reporting currency equivalent.

For instance, a trade might result in USD 600,000 being held in the USD nostro account. The trade report might show:

USD 600,000
EUR 426,994

This allows the reader to see the native USD amount which will stay unchanged day on day, but to be able to aggregate all the trades into a single reported figure in EUR.

4.2 FOREIGN EXCHANGE (FOREX OR FX)

Foreign exchange trades are the biggest asset class by trading volume. According to the Bank of International Settlements, in 2010 there was an average daily turnover of almost $4 trillion of which about 37% were spot trades.

From ancient times, countries, regions and towns have had their own money and there has been a constant need to convert from one money to another. Nowadays with global industrial and commercial trading there has never been a greater need for foreign exchange.

In essence, foreign exchange is an intuitive and easy asset class. We can readily understand what it means to change money and we often do so when travelling abroad.

Many of the foreign exchange financial products are similar to those of interest rates and those described in the previous chapter.

Spot

A spot foreign exchange trade is an immediate transfer of currencies. (Immediate meaning within a few days of execution as dictated by the conventional settlement date for standard trades or by mutual agreement for OTCs.)

Futures and forwards

As for interest rate trades, a future is an exchange-traded standard contract and a forward is any OTC agreement between two counterparties. In essence, for foreign exchange they are delayed spot trades. The exchange rate is agreed upon execution and the future exchange of currencies is mandatory upon the agreed date. The difference between futures and forwards is explained in section 5.1.

Currency swaps

When talking about swaps in the FX asset class one must be careful to distinguish between two trades with very different properties. A *currency swap* (sometimes known as a *cross currency swap*) is the foreign exchange equivalent of an interest rate swap. They are a common way of trading fixed and floating cashflows, the only difference being that there is the added ingredient of the exchange across more than the single currency.

Example A two-year quarterly payment swap with notional 50 million EUR. A pays fixed 4.5% GBP, B pays LIBOR + 1% EUR. This means every three months, we make a fixing on LIBOR EUR rates and we make a fixing on the spot GBP/EUR exchange rate.

Suppose at one fixing time, LIBOR EUR was 3.7% and 1 pound was worth 1.2 euros.

A would pay 4.5% of EUR 50 m × 1.2 = EUR 2.7 million
B would pay 4.7% of EUR 50 m = EUR 2.35 million
So netting, A would owe B a total of EUR 350,000.

FX swap

This instrument is very different from the cross currency swap described above. As explained in the previous chapter on financial products, it consists of a spot plus a forward. The difference in exchange rates between now and the end of the trade creates the swap. This difference is the result of the difference in interest rates between the two currencies (see FX drift later in this chapter).

It is important to note that neither party to the trade ends up with any FX risk.

The most common reason for trading an FX swap is to fund a temporary need for one currency using another currency as collateral. FX swaps are at their most liquid (ie most heavily traded) at terms less than one year but recently there has been an increase in trading over longer terms.

Baskets

A possible variation of FX trades is to exchange a basket of currencies. For example:

sell: JPY 500 million and USD 7 million
receive: EUR 4 million and GBP 50 million

This creates the need to simultaneously monitor the exchange rate of many currency pairs. As the FX spot markets are very efficient, there is virtually no possibility of arbitrage (that is to make a risk-free profit by placing two equal and opposite trades at the same time benefitting from the difference in quoted prices on the two trades) Therefore, in our example, we would need only to take into account the following currency pair prices: JPY/USD, EUR/USD, GBP/USD.

Reporting currency

Even beyond direct trading in foreign currencies, many companies need to be aware of FX prices and FX risk because of reporting currency.

The reporting currency is the currency in which the books and records of the company are kept. Therefore a Swiss watch maker who buys gold on international markets in dollars and sells to customers in the United States in dollars is still subject to foreign exchange because they will report their revenue, profits and expenditure in Swiss Francs. They could be making a steady profit on their direct business activities but still be losing money if the Dollar/Swiss Franc rate moves against them.

Banks who deal foreign exchange may often have to undertake a second set of trades to convert to their reporting currency; this further increases the volume of foreign exchange trades dealt. For example, a European bank spot trader deals in the USD/GBP market (known as Cable). He may buy dollars for euros at the start of his day, deal the dollars for pounds all day and then at the end of the day convert whatever he holds back into euros.

FX Drift

FX forward rates can be completely derived from FX spot rates and the interest rates in the two currencies of the exchange. This is known as FX drift and is not the same as risk. Risk will exist on any future trade unless the FX forward exchange rate is locked in now (see Figure 4.2).

Suppose we want to know the EUR/USD forward exchange rate in one year. The spot rate today is EUR 1 = 1.2 USD. EUR has a one year interest rate of 3% and USD 4%.

Now if I exchange EUR 100 into USD today, hold for one year and then exchange back to EUR, because of the arbitrage free nature of foreign exchange markets, this has to be the same as leaving the money in EUR for the year.

Option 1

I leave the money in EUR, it will earn interest at 3% and grow to EUR 103.

Option 2

I convert it to USD today and receive USD 120.

I earn one year's interest at 4% so it grows to USD 124.8

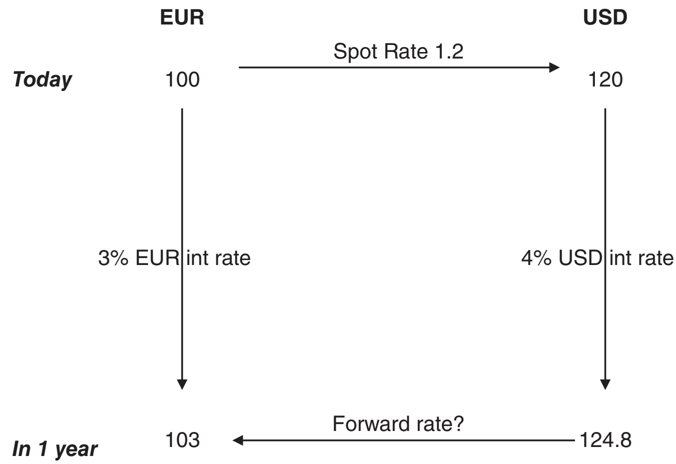

FIGURE 4.2 FX drift

Now the two options have to be the same, therefore the forward exchange rate must mean that EUR 103 = USD 124.8 making the forward rate 1.21165.

So we see how forward foreign exchange rates are completely determined by spot rates and the two interest rates. This means that banks and other financial institutions do not need to calculate and store forward foreign exchange rates.

Tradeflow issues

In foreign exchange there is no concept of purchasing an asset with a currency, because both sides of the trade involve currencies. Trade lifecycle systems have to maintain at least two entries for the currency and more for baskets. This can present problems when, for example, the system has been designed for other asset classes and is being adapted for FX. Also, the problem of not having purchase and sale leads to errors where staff are not used to dealing with FX.

One of the biggest sources of error arises from the direction of the quoted FX rate. If we write EURGBP 1.154 does that mean you receive 1.154 EUR for every 1 GBP or the other way around? What if the quote is written EUR/GBP? Every time somebody in the trade lifecycle needs to know the exchange rate, he must understand the quote convention in the system he is using. If data flows between different systems during the lifecycle, both systems must understand if they are using the same convention or if it requires inversion. All parties to the settlement process – the two counterparties and their custodians – must have the same interpretation of this exchange rate.

Another problem with FX is the existence of various different nomenclature for designating the two currencies of the trade (in a standard non-basket trade), where one is the reporting or home currency. For example, a Canadian bank dealing CAD against USD may use any of these pairs of terms in Table 4.2.

TABLE 4.2 Terminology of FX pairs

CAD	USD
Domestic	Foreign
Riskfree	Risky
Base	Foreign

The underlying asset in a basic foreign exchange is the currency pair. But it is possible that a simple FX spot trade could involve four currencies. The same Canadian bank may exchange EUR for JPY and report in USD.

Then the trading system needs to cope with:

- domestic: CAD
- foreign 1: EUR (sell)
- foreign 2: JPY (buy)
- reporting: USD.

Now the trading and accounting systems will need to know the CADUSD exchange rate and two of CADEUR, CADJPY and EURJPY (the third can be derived from the other two).

The foreign exchange asset class has many of the benefits of interest rate trades, such as a small number of easily defined underlyings (there is a relatively small set of currency pairs available for trading) and easy transfer of assets with very liquid prices.

4.3 EQUITY

Equities are synonymous with shares and stock. They entitle the owner to a part of the company which has sold them. By giving up capital to finance the company, the purchaser of equity hopes to receive a share in the profits. This is a payment known as a dividend. Dividends vary in size and date of payment. There are many different types of shares:

- ordinary – the regular share in the company
- preference – shares with extra rights sometimes including a guarantee of a fixed dividend and greater chance of reimbursement should the company be wound up
- cumulative preference – similar to preference, but certain rights can be carried forward into future years should they not be paid in the current year
- redeemable – the company can buy them back at a future date.

Financial entities buy shares because they expect a return on their investment, both in the form of dividends and a rise in the price of the share. Very often the price of the share is a reflection on the likely dividend to be paid.

Public shares are bought and sold on trading exchanges. There may also be over-the-counter share trades directly between two counterparties.

Synthetic equities (index)

A market has developed for the purchase of a synthetic equity product known as an index. Examples of equity indices are the DAX, Dow Jones Industrial Average and the French CAC 40. The purchaser does not own any real shares in any company; he holds an abstract combination, whose price is determined by the price movements of a defined set of constituent entities. This is a very useful product for someone wanting a representative sample of large French organisations, but not to be overly exposed to the price vagaries of any one of them.

Futures and options also exist on indices as they do for real equities.

Lifecycle issues pertinent to equity trades

Equities are a mature asset class with a straightforward exchange of currency for asset. However, there are some extra issues affecting the processing of equity trades.

With so many different shares in existence, it is very important that the exact identity of the share being traded is recorded. This would include the full name of the company and its mnemonic, the description of issue and, where applicable, the exchange upon which it was traded. For example:

- Full name: Xray Yacht Zebra Trading Co.
- Mnemonic: XYZ
- Type: Ordinary Shares of GBP 0.50
- Exchange: LSE (London Stock Exchange).

Either a custodian would be employed or the operations department would be responsible for registering the shares with the company issuing them in order to qualify for dividends. They would also have to keep the share certificates and prepare to accept and account for dividend payments.

The middle office would have to keep track of ex-dividend dates (see section 8.7).

Trading of equities could be on any number of shares, but certain equities are traded in multiples of common sizes, known as board lots or round lots. Sizes different from board lots are known as odd lots and might incur higher trading costs.

Index equities should be distinguished from real equities in the trade processes because they bear no dividends and documents, such as share certificates.

4.4 BONDS AND CREDIT

We combine bonds and credit because all bonds except risk-free sovereigns carry credit risk. From a trade process perspective they are often treated separately so we begin the section with a discussion of all types of bonds and then move on to other instruments bearing credit risk. Bonds are related to (short-term) interest rates and the somewhat arbitrary asset class distinction is maturity related with anything under one year being regarded as in the interest rate class. In addition, credit risky bonds and 'risk-free' sovereign debt are often regarded as different asset classes.

Bonds

Apart from raising capital by selling shares in the company, there is an alternative by which the company borrows money. This could be a simple bank loan and would be dealt through a retail bank. However, for large capital amounts it is highly unlikely that a single bank would have the funds and the desire to lend by itself. To overcome this problem, companies issue bonds. Purchasers of bonds pay capital to the company, which is repaid to them at the end of the period (term) of the bond. The lenders are rewarded by receiving interest in the form of coupons, in most cases throughout the term of the bond.

Fixed income is another name for the asset class comprising of bonds. The term fixed income is used because, once a bond is issued, the expected income is known. This contrasts with equities, where dividend payments are unknown. Another difference with equities is that bonds have a termination date. A further distinction is that many bonds are issued by governments wishing to raise finance, whereas all equities are corporate.

Sovereign debt Government bonds are known as sovereigns. Rating agencies do not apply credit ratings to sovereigns except where bonds are issued in a currency other than one controlled by the government. In theory, debt issues in the currency of the government itself are risk free to that currency, because the government can always print more money to repay its debts. (Of course the foreign exchange risk would have to be taken into account. For example, Zimbabwean government bonds are risk-free in Zimbabwean dollars, but as the country's economy declined, the worth of its currency declined, making a sizeable foreign exchange discrepancy.)

Types of bond In order to get a flavour of the difficulties involved in handling bonds, we shall look at some of the common variations. As mentioned, all bonds have a starting date (issue date) when the purchaser pays and a maturity date when the purchaser receives his money back (redemption). The intervening period characterises the type of the bond. In theory, any set of regular or irregular coupon payments can be made at any prearranged date or dates. Here, however, are some common bond types:

Fixed bonds The bond pays the same coupon at regular intervals with the last coupon usually coinciding with the redemption payment. The coupon is quoted as an annual percentage of notional.

Payments are usually quarterly, semi-annually or annually. All coupon amounts can be exactly determined.

Floating Rate Note (FRN) When the coupon is paid at variable rates, the bond is known as a floating rate note or floater. The exact payment is determined only just before the coupon date and is derived from a benchmark index, such as LIBOR. The process of determining the coupon is known as a fixing. The coupon is often an amount over the benchmark (e.g. LIBOR plus 50 basis points). This is known as the margin.

Zero coupon bonds These bonds pay no coupons. The bonds are offered at the issue date for a discounted price (e.g. 63%) and are redeemed at maturity for par (100%). The gain to the purchaser arises from this price differential and is an alternative to the coupon payment of standard bonds. This means the issuer does not have to worry about having to find intermediate income to service the coupon payments.

Amortising bonds Sometimes the capital borrowed is repaid to investors in instalments, rather than all at the end. Then the notional of the coupon is reduced over time. Although the fixed coupon rate remains at say 8%, the notional might have reduced from 200,000,000 to 100,000,000, resulting in a lower coupon payout.

Asset backed securities Some bonds are secured using debts owed to the issuer itself. These commonly arise from mortgages (mortgage backed securities or MBS) or credit card repayments. They are amortising bonds, but the amortisation is unknown at time of issue. If the underlying debtors, such as homeowners, repay their mortgages early, then the debt outstanding on the bonds is reduced accordingly.

For simplicity in this example, the payments assume a very crude calculation of dividing the annual rate in half to get the semi-annual payment. In reality, the calculation is more complex taking into account the number of days between coupon payments.

Example of coupon payments Table 4.3 shows several different types of bonds and their coupon dates and payment amounts.

Other features Some bonds combine fixed and floating cashflows; others have clauses specifying when payments are made that depend on market prices. Floating rates can be capped at a minimum level (known as a floor) or restricted to a maximum (known as a cap). Convertible bonds can be converted into equity. Bonds can be denominated in one currency, but pay coupons in another currency, according to pre-determined or market exchange rates.

TABLE 4.3 Example coupons on various types of bond

	20-Mar-09	20-Sep-09	20-Mar-10	20-Sep-10	20-Mar-11	20-Sep-11	20-Mar-12	20-Sep-12	20-Sep-13	20-Mar-14
Regular fixed										
Fixed	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5	5.5
Notional	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn
Payment	27.5m	27.5m	27.5m	27.5m	27.5m	27.5m	27.5m	27.5m	27.5 m	27.5 m
Regular float										
Float	5%	5.5%	6%	6.25%	6.5%	6.25%	6.25%	6.5%	7	6.5
Notional	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn	1bn
Payment	25m	27.5m	30 m	31.25 m	32.5 m	31.25 m	31.25 m	32.5 m	35,000,000	32,500,000
Amortising fixed										
Fixed	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5%	5.5	5.5
Notional	1bn	1bn	1bn	1bn	800m	750m	700m	500m	500m	500m
Payment	27.5m	27.5m	27.5m	27.5m	22m	20.625m	19.25m	13.75m	13,750,000	13,750,000
Amortising float										
Float	5%	5.5%	6%	6.25%	6.5%	6.25%	6.25%	6.5%	7	6.5
Notional	1bn	1bn	1bn	1bn	800m	750m	700m	500m	500	500
Payment	25m	27.5m	30m	31.25m	26m	23.4375m	21.875m	16.25m	17,500,000	16,250,000

Tradeflow issues One of the key tradeflow issues relating to a bond is capturing its true definition.

Due to the limitless possibilities of coupon types and payments, the safest way of defining a bond is by its set of cashflows. To pass a series of cashflows around the processes of the trade lifecycle is not always practical however. So, if the bond conforms to a type and standard set of conventions, its definition can be encapsulated by a finite set of fields. It should always be the case that these fields will lead to an exact set of cashflows. A missing or ambiguous set will lead to improper booking and management.

Here are the standard fields required:

- Identifier (ISIN, CUSIP etc.)
- Name of issuer
- Seniority – bonds are issued at different levels of seniority. This affects the order in which creditors are paid in the event of default
- Currency
- Description – a summary of the bond. For instance, Ford SEN 5.5% 2012
- Type – whether fixed or float, amortising or fixed notional
- Day count convention – used to calculate the exact coupon payment
- Business day convention – when a coupon is due on a weekend day or holiday, this convention indicates when the coupon should actually be paid
- Holiday calendar – used in conjunction with the business day convention to determine when is a holiday
- Issue date
- Maturity
- Fixed coupon (for fixed bonds)
- Margin (for FRN)
- Reference for fixing (e.g. LIBOR, used only for FRNs)
- Frequency – this is the frequency of coupons
- First accrual date – sometimes the first coupon is paid at an irregular interval from the issue date
- Short first coupon – suppose the first accrual date was two months after the issue date for a semi-annual bond. This could mean the first coupon is paid after two months or is deferred and paid after eight months (two plus the regular six)
- Redemption – the amount paid back at maturity: normally set at 100%.

When non-standard bonds need to be processed, extra fields may need to be added or the bond marked in such a way that the user of the system treats it as non-standard.

A feature of bond prices is that, for historical reasons, they are sometimes quoted in eighths or sixteenths. Although these can be rounded into fractions, it is helpful if the systems can preserve them in their native price state to make it easier to read and to avoid rounding errors.

Overview of bonds and credit As we have seen, the booking and processing of bonds can be complicated. It is necessary to keep track of coupon fixings and notional fixings (for amortising bonds) and manage the documentation in the form of bond certificates. Also the coupon payments need to be received and accounted for.

Other credit risk bearing instruments

Credit as an asset class really refers to credit risk. Although all investment institutions have been managing counterparty risk ever since trading with counterparties began, credit risk products are relatively new to the financial industry.

What is credit risk? You cannot go and buy a unit of credit risk like you can buy copper or Lloyds Banking Group shares. It is a synthetic product existing as a structured or derivative trade. Its primary manifestation as a traded product is as an insurance policy against a particular name defaulting. The market has developed in the last 15 or so years, with the underlying trade being the buying and selling of this credit risk and associated structures. Chapter 5 on credit derivatives will explore the nature of the products themselves; here we focus on the asset class and its application to the trade lifecycle.

Why is credit risk different? As it is fundamentally an insurance policy, the trading of credit risk confers a different area of emphasis to other products. There is a greater degree of legal risk so documentation becomes more important.

Legal risk Insurance is a guarantee that one party (the provider) will pay the other party (the purchaser) if a certain event (trigger) occurs. The purchaser pays a fee (premium) for this insurance. The whole contract relies on the precise definition of the trigger event and on trust that the provider will pay out if required. To bolster confidence in the insurance market, providers of insurance are regulated by independent bodies. These ensure that companies have the means to satisfy claimants and that they will fulfil the insurance obligations they have undertaken.

The purchaser of any insurance must be happy that he will get paid when the event is triggered. Both sides to the insurance must understand the trigger and for that they require full and complete documentation and sometimes additional legal assistance.

Documentation As the market for credit risk has developed, some products have become more standard. The International Swaps and Derivatives Association (ISDA) provides industry standard documentation for a variety of products including credit default swaps. In the same way that one more readily trusts a light bulb approved by the British Standards Institution (BSI), so financial organisations are more likely to trust ISDA documentation.

Documentation for non-standard credit risk trades, such as a cash collateralised default obligation, can run into hundreds of pages. This documentation needs to be maintained throughout the trade lifecycle; individual trade processes may extract relevant parts of it.

Example of a credit product In order to get a feel for credit risk we can look at an example of a credit default swap (CDS):

- France Telecom Senior Subordination has a five-year CDS maturing 20 March 2012.
- Bank A purchases the CDS from Bank B and pays 62 basis points premium per year at quarterly intervals on a notional of EUR12 million.
- This means that A will pay EUR 62/10,000 × 12,000,000 per year which is EUR 18,600 per quarter to B, unless and until France Telecom defaults. This is known as the payment or premium leg.
- Should France Telecom default, B will have to pay EUR 12 million to A, less any recovery. (Recovery is the amount a name will pay to its creditors upon default. This varies according to the seniority of debt and is discussed below.)

This is known as the recovery leg.

Definition of default The whole credit risk market depends on a precise definition of default and an ability to see when default has occurred. There are several technical definitions of default, the most obvious being when a company goes into liquidation or when an issuer of debt cannot repay its obligations. This latter definition led to the bizarre situation of the US government nearly being in technical default when it failed to have its budget approved in the mid 1990s. At the time companies such as Coca Cola were considered safer than the US government!

Once the definition of default is apparent from the documentation, the processors of the trade, such as middle office, need to watch for indications of default. In the event of default, they need to prepare back office for reception or payment of the amount insured. Generally, a default does not creep up unexpectedly: steep rises in CDS spreads for a name, or a sharp drop in its equity price are good indications that default may be approaching.

Measuring credit worthiness The credit spread is the premium required by an insurer to provide insurance on a name. It is a measure of the credit quality of the name. Secure names have low spreads; risky names have high spreads. The market indication of credit spread is through credit default swap prices. CDS prices exist at various durations (tenors) the most liquid being five-year. It is also common to see quotes for one, two, three, four, six, seven, 10, 12 and 15 years.

Example Indicative CDS spreads of one name given in basis points for various tenors (see Table 4.4).

TABLE 4.4 Indicative CDS spreads

	1 yr	2 yr	3 yr	4 yr	5 yr	7 yr	10 yr	15 yr
Tesco PLC	68.6	75.9	81.4	79.5	78.3	73.3	70.9	70.4

The problem with monitoring credit swaps for valuation and risk purposes is that many are illiquid at some or all tenor points. This leads to some of the data engineering techniques, described in Chapter 20 on data.

Another measure of credit worthiness is the credit rating issued by rating agencies.

There are three main rating agencies, Moodys, S&P and Fitch. Some of the problems of using credit ratings are:

- credit rating is only a band not an exact figure. For example AAA may cover names with CDS premiums between five and 50 basis points
- the agencies might disagree as to the rating of any name or they may not supply a rating
- agency rating classifications have been called into question since the recent credit crunch and ensuing recession as, in many cases, they did not predict the imminent default of a name.

Many institutions trading credit risk will use a combination of CDS premiums and rating agency classifications to gauge the credit worthiness of a name.

Recovery A very important feature of the credit risk market is that recovery rate is a key input in the valuation of credit risk products. This piece of market data cannot be measured or known until default actually occurs (and sometimes quite a while after). For calculation and trading purposes this number is estimated or implied. If you know the price of a particular CDS contract and the input CDS premium, then the recovery can be mathematically implied. This will only apply to standard contracts whose price is known; generally the recovery rate is estimated based on historical defaults of similar names and seniority of debt.

The imprecision caused by this input makes the quantitative approach to credit risk very different from the precise world of interest rates and foreign exchange. Risk managers, used to dealing with these other asset classes, must alter their approach when working with credit risk and its underlying recovery assumptions.

Since there are thousands of bonds currently being traded, identification becomes a major issue. Common identifiers like ISIN, CUSIP and SEDOL have been adopted. Each financial entity may also have its own way of identifying bonds. It is important that the correct static data references are available to link and identify bonds across different identifiers.

Bonds are susceptible to credit risk. If the issuer defaults, future coupon payments and the final redemption are put at risk. For monitoring this risk, the issuer of the bond must be known in addition to its legal parent. A legal database may therefore be required.

Ultimately bonds and equities are linked because they derive from the same underlying company. It may therefore be necessary to provide combined fixed income and equity information in the form of reports to users who have an interest in this connection.

4.5 COMMODITIES

Commodities are the oldest asset class. Since they have been traded over a long period of time before market standardisation took place, many conventions and idiosyncrasies have developed, which can make processing them difficult.

Origin of financial trading

In order to understand how financial trading began, let's look at one type of commodity trading to which we can all relate.

The market for apples consists broadly of

- grower
- manufacturer (or consumer)
- speculator
- facilitator.

The grower works the land, invests in machinery and labour and wants the security of a guaranteed price when he comes to sell his apples. Having gone to so much trouble he doesn't want to be subject to the vagaries of the apple market; he wants to concentrate on producing the maximum possible size and quality of his apple crop.

The manufacturer could be someone like a cider maker. He needs to be able to rely on a guaranteed size and price of apple crop. He can then eliminate his raw material risk and concentrate on production of cider.

The apple speculator takes risk in exchange for profit. He has no interest in buying or selling apples themselves and therefore the actual price is not relevant to him, be it high or low. He does however take a keen interest in the apple market, understands the factors affecting it such as weather, blight and consumer demands and can therefore offer financial products to both buyers and sellers of apples and take profit in order to help them offset their risk.

The facilitator brings all of the market participants together hence creating a market place for apples and financial products based on apples.

Typical activities in the market place might be:

- buying and selling apples now
- buying and selling apples at a later date for a fixed price
- options to buy and sell apples later
- insurance against apples not being grown (because of bad weather etc) or not being available (due to high demand).

Let's consider how one of the market participants, the grower, can take advantage of financial products in apples. Supposing that this year he breaks even if his crop sells at 5p per apple.

His profit curve (or straight line in this case) looks like Figure 4.3.

As the price rises above 5p, he starts making more profit. If it drops below 5p he makes a loss.

Now if the grower were to sell a future in apples, he would have the curve in Figure 4.4.

The light grey line shows the future. As prices rise, the profit in the sale of the future decreases and the opposite as prices fall.

The net effect of this trade combined with growing apples at cost price 5p is that whether prices rise or fall the grower always makes a profit. At every price, the profit on the future together with the profit on sale of apples is greater than zero.

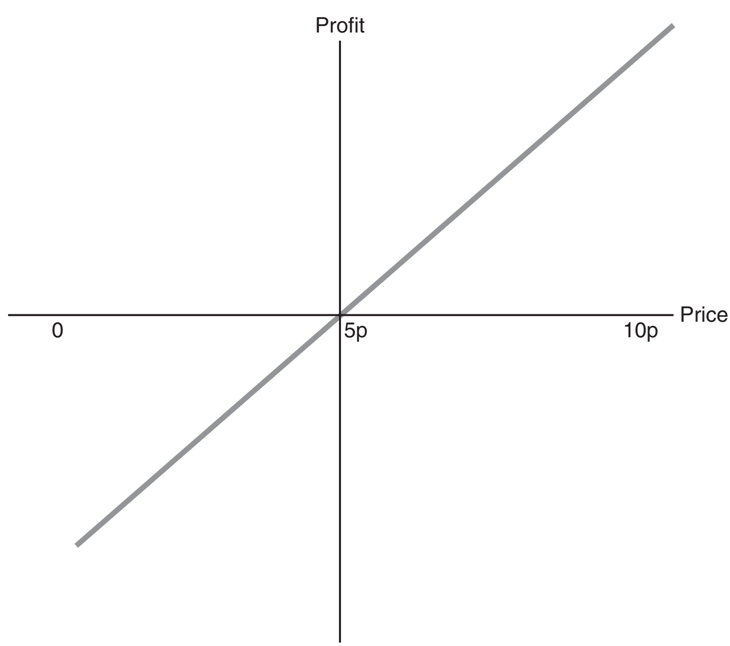

FIGURE 4.3 Profit curve

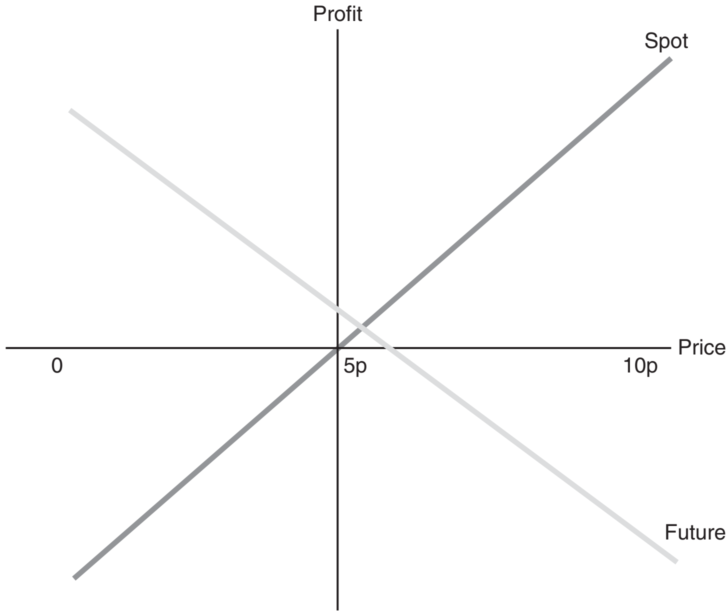

FIGURE 4.4 Profit curve with future

So if the grower can find someone prepared to sell a future at the right price and timed for when his apples are ready for market, he can lock in a profit and remove his price risk.

The speculator will be selling such futures contracts hoping to find other market participants such as cider manufacturers who will want to buy the equivalent contracts. In this way he can offset his risk and charge a profit in the difference between buy and sell prices.

What are commodities?

A commodity is something that is common between different suppliers. It can be defined by its size and quality. The buyer can be certain that he is getting the same object no matter where he purchases it.

Characteristics of commodities:

- odd units of trading
- possibility of physical delivery
- intrinsic utility
- old markets
- diversity.

Due to the range of possible commodities, they tend to be subdivided and traded in smaller groups. Loosely, we can categorise them into agricultural, animal products, energy, precious metals and industrial metals.

Agricultural commodities Agricultural commodities include:

- corn and wheat sold in units of 5000 bushels on the Chicago Board of Trade (CBOT)
- cocoa sold in units of 10 tons on the New York Board of Trade (NYBOT)
- cotton sold in units of 50,000 lbs also on NYBOT.

Animal products Examples of animal products are:

- live cattle, units of 20 tons on Chicago Mercantile Exchange
- lean hogs, units of 20 tons also on Chicago Mercantile Exchange.

Energy The two biggest traded energy products are:

- West Texas Intermediate Crude Oil, traded in units of 1000 barrels on New York Mercantile Exchange (NYMEX) and the Intercontinental Exchange (ICE) and
- Brent Crude also in 1000 barrels units on ICE.

Other energy products include heating oil, propane and natural gas.

Precious metals There are four main precious metals all in units of troy ounce. Gold and silver traded on CBOT; platinum and palladium on NYMEX.

Industrial metals Industrial metals are traded in metric tonnes on the London Metals Exchange (LME). They include aluminium, aluminium alloy, copper, lead, nickel, tin and zinc.

OTC commodities

Above we have listed exchange-traded commodities but in fact the over-the-counter (OTC) market in commodities is bigger. OTC trades may be on any exchange-listed or non-exchange-listed commodity and can be on amounts different from the standard exchange lot sizes. In the case of energy, for instance, there are hundreds of grades of oil and related products which the refiners will produce and consumers will buy. Particular grades of oil have become the standard traded product in their field for financial markets, due to their liquidity and volume of trade. The exchanges can only offer the main products, but specialist oil brokers will obtain prices for many of the smaller, derivative oil products.

Localised nature of production

Most commodities are grown, smelted or produced in particular localities. They are subject to local forces, such as natural events and changes in political circumstances. Bad weather, forest fires, earthquakes and political turmoil can drastically affect supply in one region and become a major factor in the market price.

Traders and salesman are dependent upon good knowledge of all the factors affecting supply and production. Commodities demand very specific research.

Time lag

If there is a sudden demand for a commodity it may take considerable time for the supply to catch up. Many commodities are stockpiled to meet short-term requirements, but they will not be able to cater for more sustained demand.

Utility of commodities

When dealing with commodities, it is important to bear in mind that the underlying is not a synthetic financial instrument but a real product. Although commodities are traded as financial products with the expectation of profit, they hold residual utilitarian value. This means they cannot default and be worthless, unlike, for example, a corporate bond. There is some minimum price which reflects this intrinsic usefulness of the product. (The exception is with perishable goods and livestock which can obviously wither or die.)

Precious metals as a currency

A currency is an accepted medium of exchange. It is relied upon to retain its value either because it contains intrinsic worth, such as gold or silver, or it has token value, but is guaranteed by government. Precious metals can therefore be treated as currencies or as commodities with intrinsic value.

This dual nature of gold and silver makes it possible for trade processes to consider them as an extra currency alongside euros and dollars, or as commodities alongside tin and aluminium. A decision has to be made as to which will be a better fit, depending on the organisation trading them.

Physical settlement

Since commodities are traded between producers and consumers who require physical delivery, any financial entity involved in trading must either be able to cope with physical delivery or convert it into cash before delivery is made. Many contracts offer a choice of physical or cash settlement. Middle and back office procedures must be aware of the type of settlement. Some metals are held in warehouses and oil on barges, so physical settlement could simply mean transfer of ownership documents while the commodity remains in situ. But other commodities do present problems – not many financial entities want to own inventories of cattle and wheat and would not have storage facilities for crude oil and pork bellies!

Other tradeflow issues

Trading in and settlement of commodities can be complex.

Settlement can be defined by using an average of prices rather than the price on the date of settlement.

As an illustration of the complexity involved in settlement prices, here is a quote from the trading at settlement (TAS) rules on NYMEX for Brent crude oil:[1]

> Trading at settlement is available for the front two months except on the last trading day and is subject to the existing TAS rules. Trading in all TAS products will cease daily at 2:30 PM Eastern Time. The TAS products will trade off of a 'Base Price' of 100 to create a differential (plus or minus) in points off settlement in the underlying cleared product on a 1 to 1 basis. A trade done at the Base Price of 100 will correspond to a 'traditional' TAS trade which will clear exactly at the final settlement price of the day.

As in the examples above, commodities are traded in lots of specific amounts and units. Processes must be able to cope with this range of units and rules.

As we have seen, commodities are not homogenous and are not like other asset classes. Therefore great care must be taken when designing processes and systems for commodity trades, so that currently traded and potential trading products are catered for.

4.6 TRADING ACROSS ASSET CLASSES

Sometimes traders want to take advantage of price discrepancies between closely related asset classes. There may be a hedge strategy, whereby there is perceived limited market risk, the multiple trades involved cancelling out exposure to the underlying asset or assets – this is known as basis trading.

Examples of basis trading:

- spot and futures on the same underlying instrument
- credit default swaps and bonds on the same underlying bond.

There may also be no arbitrage, but the trading strategy is such that one is only interested in the relative positions of two different instruments or asset classes.

[1]Quoted from New York Mercantile Exchange website.

Some examples:

- in the next six months aluminium will be more in demand than copper and its price will be relatively higher
- Eastern economies will fare better than European economies and hence their currencies will be stronger
- long-term interest rates will rise and commodity prices will fall.

For trading across asset classes, it is important that the trader can book and view all parts of his portfolio for price and risk. This can be particularly challenging when different systems are used for different asset classes. Other business functions have similar aims, especially when they are monitoring risk at a trader level.

Trading across asset classes may involve more than one of the support functions such as use of the interest rates' back office and commodities' back office and hence increase risks of miscommunication.

4.7 SUMMARY

The main asset classes are interest rates, foreign exchange, equity, bonds, credit and commodities. Each has its own set of typical products. The manner in which each asset class is traded leads to differences in the trade lifecycle. A bank establishing a trading operation within one of these asset classes must take into account these issues. An individual moving from one asset class to another must be aware of their differences.

CHAPTER 5

Derivatives, Structures and Hybrids

Any trade that derives from an underlying asset, but does not involve the direct purchase or sale of that asset, is known as a derivative. Common classes of derivatives are forwards and futures, swaps and options. Derivatives are often divided into linear and nonlinear.

5.1 LINEAR

The simpler set of derivatives is linear products. This means that the payoff is related linearly to the spot price of the underlying asset. (We disregard unexpected or unknown extra payments, such as share dividends, from this consideration.)

Suppose on 3 January 2014 you purchase a six-month forward silver contract at USD 17.05 per troy ounce. The profit or loss six months later is shown in the example in Table 5.1.

Clearly the profit is linearly related to spot price. The same is true for swaps.

TABLE 5.1 Profit at various final spot prices

Spot price on 3-Jul-14	**Profit per unit**
15.05	−2
16.05	−1
17.05	0
18.05	1 etc.

Differences between futures and forwards

In the financial industry, there are some technical differences between trades called forwards and futures as outlined in Table 5.2, although the overall purpose is the same, namely to lock in a price now for some exchange of assets in the future.

TABLE 5.2 Futures vs. forwards

Futures	Forwards
Exchange traded directly by the counterparties or through intermediaries who deal on their behalf	Direct agreement between the two counterparties with no other involvement
The exchange is the ultimate counterparty for each side of the trade so there is no counterparty risk (except for the credit worthiness of the exchange itself)	Counterparties bear full risk themselves. If the other side defaults they lose all expected money that cannot be reclaimed during insolvency and legal proceedings
Trading is in specific quality and quantity of the underlying	Any mutually agreeable trade is transacted
Daily margin must be posted by the counterparties which will fluctuate as spot prices change	Unless there is a specific collateral agreement between the two parties, no money will change hands until the forward date

5.2 NONLINEAR

When the payoff versus spot price is nonlinear for some or all spot prices then we say the trade is a nonlinear derivative. The most common nonlinear product is an option.

An option can be on any underlying financial or non-financial instrument. The option trade references the underlying instrument in order to determine the exercise procedure but the option trade is separate from the underlying unless and until exercise occurs.

A call option is the right but not the obligation to buy an instrument or commodity at a specific price at or before a particular time in the future.

A put option is the same as a call option except that it refers to the sale rather than purchase of the underlying.

We can illustrate the call option by the example from outside finance in Figure 5.1. Groucho wishes to sell his piano – he wants 1000 euros for an immediate sale. Harpo thinks this is a good price, but he wants to check the market so he gives Groucho 50 euros as a non-refundable means to hold the sale for one week at the same price. If Harpo finds similar pianos on sale for 1200 euros he will return to buy it for 1000 euros from Groucho (known as exercising his option) and then sell it making a 150 euros profit (200 - 50). If he finds pianos are cheaper he will simply buy elsewhere (and accept the loss of 50 euros).

As the profit and loss (black line) in Figure 5.1 shows, Groucho has limited his loss to 50 euros but his profit rises linearly with the market price of pianos. Note that the value of the option is a curve (grey line) and hence the option has nonlinear value.

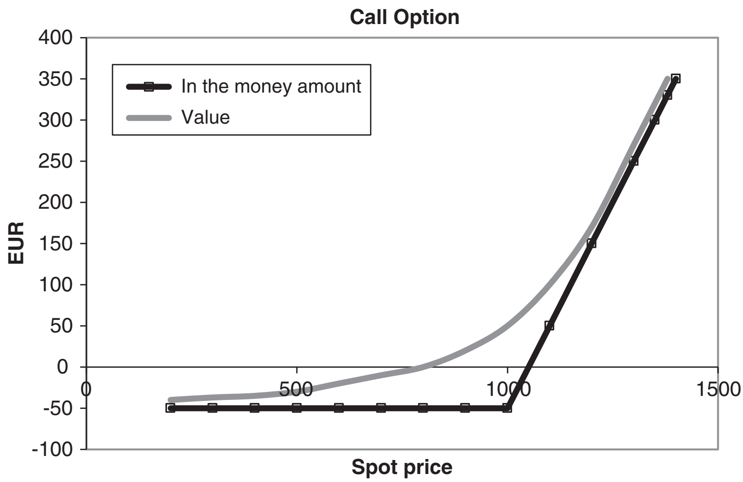

FIGURE 5.1 Call option

A put option is like an insurance policy. Groucho may insure his piano for 1000 euros and pay 50 euros per year to the insurance company. This is essentially a put option. If the piano is stolen or damaged, it is worth nothing but Groucho receives 1000 euros. If nothing happens to the piano, Groucho could sell it at its market value (and will only have lost his 50 euros premium).

As Figure 5.2 shows, profit rises as market price falls, but the maximum loss is still limited (in this case to the 50 euros premium).

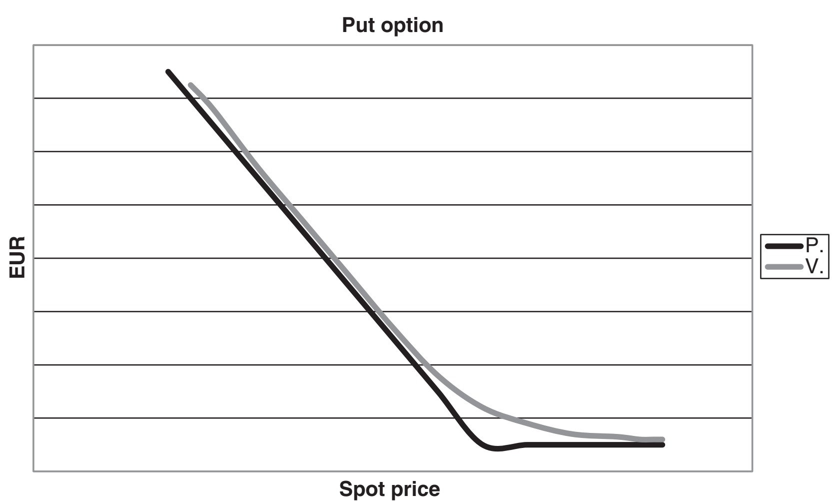

FIGURE 5.2 Put option

Trade process issues relating to options

Options can be applied to any underlying instrument. The processes involved in dealing with options are somewhat different from those of linear trades.

Exercise Exercise is the taking up of the option to buy or sell the underlying in the option contract. The traders, middle office and back office have to be prepared for the possibility of exercise, as described in section 8.9.

Optionality The cash flows on an option cannot be completely determined from the time of execution, because of the uncertainty of exercise. This means that all processes must be able to cope with a possible but not certain flow of assets.

Leverage The purchaser of an option has a maximum loss, which is simply the premium paid. The writer (or seller) of the option potentially has an unlimited loss. In the case of a call option on Coca Cola struck at $10, if the price at exercise is $1000, the writer of the option would have to purchase the underlying shares for $1000 in the market place and receive only $10 from the option buyer, making a huge loss. It could get even worse if the underlying price climbs even further, as can be seen from the put graph in Figure 5.2.

A put option has a limit because the underlying price cannot fall below zero, but even so, there could be a huge loss to the writer as for call options.

The potential to gain or lose more than the original amount invested is known as a type of leverage. People and systems trading leveraged products need careful supervision. Most of the spectacular downfalls of finance houses have arisen on leveraged trades.

Even though the purchaser of options is not putting the assets of the financial entity at undue risk, he is subject to leveraged counterparty risk which the credit control department will need to be aware of.

One way of containing leveraged risk is to trade out of the position when the amount becomes too large. For example, in our call option case the writer of the option might put a limit at spot price of $30 and enter a trade to reverse his exposure or sell the trade he holds in the market. Obviously he will still make a big loss by doing so, but at least the loss is contained. A common problem is that people hang on to bad trades because the cost of trading out of them is high, even though it will be much higher if nothing is done.

The above strategy for dealing with leveraged positions only holds good for liquid products. If no buyer could be found for the trade it wishes to sell, an organisation could be left holding onto a rapidly deteriorating situation with no way of stopping it.

Another, better way of managing leveraged risk is to use hedging. Hedging is a process of transacting one or many additional trades in order to offset the risk of a currently held position. For example, if I sell a call option on an equity, I could buy the underlying equity as a hedge. If the price rises, I will lose money on the option, but that loss will be exactly offset by the gain in holding the underlying (the hedge). Although there may be a transaction cost in putting on the hedge, the exposure to the equity price will be covered and the risk is controlled. Hedging will be discussed in greater detail in Chapter 10 on risk management.

Other examples of leveraged positions include the following.

Selling short This means entering a trade with a commitment to selling an underlying in the future that the trader does not hold at time of execution. The trader expects the market price to fall so that he can purchase it cheaper than the agreed sell price. This is a linear trade as the profit is linearly related to the spot price. But it is leveraged because, if the price starts rising, the trader will have to commit an unknown size of funds to buying the underlying in order to fulfil his trading obligations.

Credit default swaps As credit default swaps are an insurance product, they are leveraged trades. This is illustrated in Table 5.3.

Suppose a five-year credit default swap trades at 200 basis points per annum. If spreads stay fairly constant, the buyer of protection will have paid about 1000 basis points over the life of the trade (equivalent to 10% of the notional). On the other hand, the seller of protection will pay 100% of the notional (less recovery) in the event of default.

Risk managers and control departments have various ways of dealing with leveraged risk. They may insist that the trading desk posts a reserve into an account to be held for losses on leveraged trades; they may allow some degree of leverage, but under limits; or they may enforce a hedging strategy as can be seen in the example in Table 5.3.

TABLE 5.3 Leverage

Product/Term	0–1 month	1–3 months	3–12 months	1 year–5 years
Short call options	2×	4×	8×	15×
Short put options	1/2×	1/4×	1/8×	Maximum loss
Short sell	1×	3×	5×	10×
Writing credit	1/50	1/25	1/10	1/5

Explanatory notes:
For options and selling short we assume spot prices will change more over a greater period of time.
2× indicates the loss is double the change in spot price 8× when the loss is eight times etc.
For products involving the writing of credit insurance, loss is a fraction of the total payout in the event of default. (For example, if the maximum credit loss were USD 50 million, the 3–12 months tariff would be USD 5 million.)

When leveraged trades are naked (ie they are not covered by hedges for whatever reason), the problem of marking infinite or very high maximum exposures arises. To do this they may use a tariff for estimating assumed maximum loss.

5.3 SOME OPTION TERMINOLOGY

Options have a specific terminology to describe their characteristics. Here we explain some of the more common terms:

European

These options can only be exercised on the maturity date.

American

These options can be exercised at any time up to and including the maturity date.

Bermudan

Somewhere between a European and American. There is more than one exercise opportunity, but not a continuous set as for American options. It could be that the exercise is allowed periodically (eg one day every three months) or there is a period of no exercise (e.g. the first five years) and then exercise is allowed every day thereafter (e.g. for the final six months).

At-the-money

This describes the current position of the option. At-the-money means that the strike is the same as the current spot price.

Out-of-the-money

Means the current spot price is below the strike price for call options or above for put options and so would not be exercised if exercise were today.

In-the-money

Means the current spot price is above the strike price for call options or below for put options and so the option could be exercised if exercise were today.

Swaption

A swaption is an option with the underlying being a swap. Swaptions generally refer to options on interest rate swaps. A payer swap gives the purchaser the right to enter into a swap paying fixed and receiving floating. A receiver swap gives the purchaser the right to enter into a swap paying floating and receiving fixed.

5.4 OPTION VALUATION

There are certain parameters used in option valuation:

Spot price
The current market price of the underlying (market data, changes every day).

Strike price
The price at which the option was struck (trade data, fixed).

Interest rate
For one-currency trades, this is derived from the interest rate (or discount) curve for that currency. For foreign exchange and other options involving multiple currencies, there will be several interest rate curves (market data, changes every day).

Time to maturity
The amount of time left until the option matures (based on trade data, changes every day).

Call or put
Whether the option is a call or a put (trade data, fixed).

Volatility
This is a well-defined measure of price variation over a given time period. See Chapter 24 on data for more information.

These six pieces of information are inputs to the valuation model for options, which is normally based on the classical Black Scholes options pricing formula.

5.5 EXOTIC OPTIONS

Having defined the basic option, which is known as a 'plain vanilla' or 'vanilla', we go on to discuss exotic options. Any trade based around a vanilla option, but modified in some way is known as an exotic option.

Examples of exotic options

Here are some examples of exotic options.

TABLE 5.4 Resettable strike

Date	Spot price for date	Resettable strike value
Start date	Irrelevant	124
After 3 months	130	143 (the bigger of 124 and 110% of 130)
After 6 months	108	124 (the bigger of 124 and 110% of 108)

Resettable strike There may be a clause in the option contract that allows for the strike to be changed during the life of the option. Suppose a USDJPY option is struck at 124. After every three months, the contract allows the strike to be adjusted to be the maximum of 124 and 10% over the spot price on the resettable fixing date, as shown in Table 5.4.

Barrier options There are three standard barrier options: an upper barrier, a lower barrier and a double barrier. Each one can be knock in or knock out.

Knock in

This means that the option cannot be exercised unless the barrier has been hit at some point in the lifetime of the option.

Knock out

This means the option can never be exercised if the barrier is reached.

Average trades In vanilla options, the payout is determined by the spot price on the maturity date (for European style) or on the date of exercise (for American style). In average option trades, the average spot price over several time periods is used to determine the payout.

Basket options As mentioned in section 3.2 on foreign exchange as an asset class, baskets of currencies or other underlyings can be traded. An option on the basket would set a strike at the total equivalent worth of one currency of all the currencies in the basket. The valuation of baskets requires several interest rates and cross volatilities between each of the currency pairs in the basket.

Ratchet options (Cliquet) This is a series of forward start options, each one beginning when the previous one terminates. The strike is set at the beginning of each period, such that the option is at-the-money.

Digital or binary option Instead of the payoff being the difference between the strike and spot upon exercise, a digital option has a pre-determined payoff amount. It is similar to a bet: if the spot finishes above the strike (for a call option), the purchaser receives a set amount, if not he gets nothing.

Issues with exotics

As exotic options are by definition special trades, the people involved in trading and processing them must be aware of the following issues:

- Exotic derivatives generally require more ongoing attention than other trades. Very often the spot price must be carefully tracked at all times during the life of the option. Although middle office is used to marking spot prices once a day for valuation, this is more complex, because the spot price may be required continuously to see, for example, if a barrier has been breached.
- A strict legal interpretation must be given as to what constitutes the current spot price, otherwise the counterparties might be in conflict over whether and when a trade is knocked out or exercised.
- Traders who execute the trade and decide on exercise must work closely with middle office which books and processes the trade, including the administration of exercise procedures.
- All the control functions must fully understand the risks associated with exotic trades.
- All of the contract details of these trades must be entered into a system that is capable of holding them.

5.6 STRUCTURES AND HYBRIDS

A structure is one very specialist bespoke trade or a set of different trades bound together to produce a required set of exposures. The structure may encompass many types of derivative and spot trades. A hybrid is similar to a structure, but straddling different asset classes.

For instance, an Australian processing company wants advice from the structuring desk of an investment bank:

- They produce bronze from copper and tin.
- They sometimes require aluminium and silicon.
- They buy raw materials in USD and sell to all parts of the world particularly in Europe and Japan.
- They have a floating rate loan on their plant payable in AUD.
- It takes six months from acquisition of raw materials to sale of product.

Staff on the structuring desk will ascertain which risks the processing company wants to reduce or eliminate and which risks it is happy to live with. They will then put together a combination of derivative and simple products, to try to handle the risks according to the client specification. When they think they have come up with a solution, they will test it using indicative and historical market data. They will then write a report or prospectus for the client, illustrating in non-technical language the proposal and explaining all the costs and assumptions involved. The client will pay a fee for the consultancy and if he likes the proposal, he may engage the bank to trade on his behalf.

In addition to investigating client requests, structured trades may arise from gaps or mismatches in the market. For example, if credit spreads are high reflecting poor credit worthiness, but bond prices are high reflecting the opposite, a structure might be put together to take advantage of the difference, with little or no inherent risk.

The lowest common denominators of any structured or hybrid trade are the cashflows. The structurer is, in essence, trying to massage the cashflows to produce the maximum likely returns, while containing the risk to acceptable areas and sizes. This is by no means an easy task: cashflows may be occurring on different dates, the amounts may be unknown and there are the complications arising from the optional component of many derivatives.

Structures are, by their very nature, individual trades or groups of trades. They are therefore hard to process in a systematic way. This often means they are treated as exceptions outside the normal trade processes. Every time an exception is allowed, all the trade lifecycle processes have to cope with the exception. This means the exception cannot be so easily aggregated with trades in the normal process and all business functions have to know how to manage and control the exception. This can be expensive in terms of time devoted to the exception and in terms of the extra operational risk incurred.

Where the structure consists of a group of smaller, simpler trades, it is important that the constituent trades are marked with their links to the overall structure. That way the risk assessment can be done on the structure as a whole.

Structured trading can, however, be a very profitable part of the business. With the control and support functions understanding and managing the trade processes, structurers can look beyond one asset class or one type of trading. They can evolve safe and profitable strategies for taking advantage of market conditions and enriching the services the financial entity can provide to its customers. Additionally, they can be a research arm, testing and pioneering new products and business areas.

Structured trades generally take longer to come to fruition and require a greater degree of scrutiny from business functions, such as the legal department.

5.7 IMPORTANCE OF SIMPLER PRODUCTS

Whenever a trading desk is involved in derivatives it needs to make use of simpler products to manage its risk. Thus a future may require a spot trade; an option may require a future and a spot trade; all trades may require deposits and foreign exchange futures and spots. A network is established where the more complicated trades require the simpler trades.

One of the most important desks is the treasury desk, which holds the money that traders can borrow in order to finance their trading. The treasury will pool all the requirements of the traders and attempt to borrow money at the lowest rate available. It will then lend out from the pool it has acquired to the other trading desks, charging them for this service. Internal charging is usually seen as good business practice, as it leads to efficiency and costs are shown where they are incurred.

For instance, without charging for finance, the efficiency of the treasury desk in achieving cheap funding may be obscured by inefficiencies in the swap desk, and nobody would know where the fault lay.

To promote interaction between trading desks, the seating arrangement once played an important part: spot traders and treasury needed to be accessible to everybody. More derivative products were closer to quants, and structurers close to traders of all products with which they were involved. With modern electronic communications, the physical seating has become less important, but face-to-face communication is still optimal, especially for important decisions or for complicated discussions.

The evolution of trade processes and systems is such that the simpler products had a mature and active market before derivatives arrived on the scene. The legacy systems were designed to work with the products available when they were being developed and so, when derivatives processing was required, either new systems had to be built from scratch or the existing ones modified.

Although most organisations arrange trading desks according to asset class, the support and control functions are very often grouped by product type. For instance, there might be separate IT systems for spot, nonlinear and option trades – each one crossing many asset classes.

5.8 TRADE MATRIX

Differences in processes arise from:

- different underlying asset classes
- different type and complexity of trades.

This can be represented as a two-dimensional table with the various asset classes in one dimension and the range of trade types in the other as shown in Table 5.5.

Control and support must be provided for every product type in every asset class. This can be done vertically (e.g. equities for every product type), horizontally (e.g. options for every asset class) or with a mixture of both. The decision should take into account availability of systems, distribution of knowledge, trade volumes and complexity and a range of related issues.

TABLE 5.5 Trade matrix

<table>
<tr><th>Asset class</th><th>Interest Rates</th><th>Foreign Exchange</th><th>Equities</th><th>Fixed income</th><th>Commodities</th><th>Credit</th></tr>
<tr><td>Product type</td><td colspan="6">Spot trades
Forwards and Futures
Swaps
Vanilla options, swaptions
Exotic options
Structures and Hybrids</td></tr>
</table>

5.9 SUMMARY

Financial products can be broken down into two distinct categories – linear and nonlinear. Some of the most common nonlinear products are options. There are many types of option ranging from vanilla to exotic. Structures and hybrids are complex products built from combinations of simpler ones.

CHAPTER 6

Liquidity, Price and Leverage

Before moving on to the trade lifecycle, this chapter considers three important aspects connected to trades themselves.

6.1 LIQUIDITY

Here we look at one of the most important factors that influences a trader's appetite to trade outside of market prices themselves.

Two types of trading

An apple grower wanting a fixed price for his crop come harvest time enters into a forward trade with an apple wholesaler and receives a guaranteed price from which he can budget for the future. The trade he has agreed will not be re-traded with another counterparty; the apple grower is happy to see the trade through to maturity and collect profit for supplying apples.

A metals trader in an investment bank can see the future price of lead is lower than should be the case, based on industry fundamentals, and so buys lead futures. He has no intention of waiting for the futures to expire into a delivery of lead – he will sell his futures when he believes the time is right.

Whenever a financial entity wants to sell a trade executed with one counterparty on to a new counterparty, there must be a market for that resale to occur. Many trades are conducted with the expectation of being able to re-trade at any time and therefore require continuous markets to be available (or at least during normal trading hours). Others may have fewer potential buyers and sellers.

What is liquidity?

When a market has an abundance of buyers and sellers, we call it liquid. When there are few, we call it illiquid. Liquid markets have the advantages of:

- competitive prices
- small bid/offer spreads
- plenty of information about the products
- availability to buy and sell as required.

Asset liquidity

In addition to specific markets and products having variable levels of liquidity, so individual assets have liquidity. One asset may have greater utility than its peers and hence be more liquid. For instance, certain bonds are more popular than others, because they can be used as collateral in the repo market.

Measuring liquidity

It is hard to give a precise measure for liquidity and it is misleading to compare liquidity across different markets as each will have its own idiosyncrasies, but the best indicators of liquidity are the difference between bid and offer prices and total volumes of trades being conducted in a given time period.

Risks associated with liquidity

The two areas where liquidity needs to be considered are:

- trading products
- using market prices for valuations.

There is nothing wrong with trading products that are illiquid, provided that the trader himself and the control functions around trading are aware and take into account the illiquid feature of the trade.

Similarly, illiquid market prices can be used for valuation, provided that it is made clear to all readers of valuation reports that they are using illiquid data.

There is a risk if a product or price changes from being liquid to illiquid. This can happen in certain markets and requires the trading support teams, such as middle office, to be aware and mark the trade or price accordingly.

If a product is traded with a false assumption of liquidity, it can lead to an unrealistic reliance on its market value.

A valuation based on market prices that are not as liquid as assumed can also cause decisions to be made based on false assumptions.

It is therefore important to take into account liquidity whenever a piece of market data is being used or trade is executed and watch for changes in liquidity over time.

6.2 PRICE

Although price is a common term used freely in everyday life, in financial trading it has various meanings.

Over-the-counter price

The price of an over-the-counter (OTC) trade is the amount the buyer will pay and the seller will accept to transact the trade. It is only applicable to the instant the trade was executed: one second later the price may be different. Another pair of counterparties transacting a different trade with the same terms and conditions at exactly the same time as the first trade may reach a different price. The price of an OTC may be derived from a similar process to that of a house for sale:

1. Look at prices of similar houses recently traded.
2. Assess the advantages and disadvantages of this particular house compared to its peers and estimate the price difference these features will make.
3. Take into account the vendor's desire to sell and the purchaser's desire to buy.

Exchange price

An exchange or market place often insists that participants publish prices, which they are committed to honouring, for standard trades conforming to known terms and conditions. The prices are normally quoted as bid/offer. The price is therefore common to anyone wishing to transact, but prices will still vary over time.

Broker price

Brokers bring together buyers and sellers and often publish prices. From the price perspective, they are very similar to exchanges.

What can we infer from price?

Exchange trades are generally more liquid because of the guaranteed supply of participants. The price is therefore a better indication of market sentiment. Since many products are valued using prices of other products, it is important to find a realistic market price. If trading is liquid, the price is likely to be more useful. Many product and risk control functions in financial entities will accept liquid trade prices, but will be wary of illiquid prices.

For example:

The risk based on a quoted price is calculated as 16,000 euros.

If the quoted price were liquid, the risk allocation remains as 16,000 euros.

However, if the price were illiquid, the allocation is set more conservatively at 20,000 euros.

Generally a price for a trade will only be considered liquid if a few (say, three to five) brokers or any one exchange is quoting prices for that trade.

Cost of unwind

Unwinding a trade means reversing all the asset flows and commitments of the trade in order to arrive at a situation where it is as if the trade had not been executed. The cost associated with this process is very dependent on the liquidity of the trade. To give an example: someone thinking of buying a new car may be swayed by how easily he could resell the car if he found it was not to his liking. If there were a great demand for that model, resale might not involve much reduction in price. But if the model were illiquid, the owner might have to come down considerably to persuade someone to take it off his hands. Since most traders are very concerned with the cost of unwind, the price of a trade is affected by its liquidity.

It may not be possible to unwind very bespoke or structured products, because there is nobody in the market place who wants the exact product. In such cases, the trade will be broken into its constituents to be unwound separately. But this will probably involve additional costs.

Volumes

In the local supermarket, the more one buys of an item, the lower the price. In financial trades, it is likely to be the reverse. Since, within reason, it is harder to resell large quantities of an asset, people are less willing to take on the trade and this means the price will rise. Usually exchange and other quotes are for standard quantities or they state the maximum quantity applying to the quoted price. The volume of a trade is the quantity of the underlying asset transacted.

For example, a European investment banking holding a large quantity of Japanese yen and wanting euros, might ask several foreign exchange spot traders to sell the yen rather than putting it all through one trade.

6.3 LEVERAGE

When a spot trader buys aluminium he pays in full on the settlement day as depicted in Table 6.1. Whatever happens to the price of aluminium, there is no additional payment

TABLE 6.1 Leverage on various trades

Trade type	Buyer	Seller
Spot	No leverage	No leverage
Future	Leverage partially offset by margin call	Leverage partially offset by margin call
Forward	Leveraged	Leveraged
Option	No leverage on trade but leveraged counterparty risk	Leveraged
Insurance such as credit derivative	No leverage on trade but leveraged counterparty risk	Leveraged

required to meet his obligations arising from the trade. We say that spot trades are not leveraged.

When a bank sells a put option, it receives the premium and pays nothing. If the trade is exercised, it will have to pay the difference between the strike and spot price at exercise. The bank has paid nothing upfront but has created a possible future pay out. Hence we say that options are highly leveraged.[1]

Futures and forwards are leveraged in a different way as can be seen in Table 6.1. The parties to a forward agreement pay nothing until the transaction is settled and then they pay the difference between spot and the forward price. The future trade is similar, but the degree of leverage is partially offset by margin payments to reflect the spot price fluctuations between when the deal is executed and when it is settled.

We define leverage as the use of borrowed capital or debt to increase possible return on investment.

From the point of view of the purchaser of the put option, he has paid the premium and may receive many times the premium as a pay out, should the option be exercised. His bank will, however, be concerned for the leveraged counterparty risk – see Chapter 12 on counterparty risk.

Advantages of leverage

The investor can use leverage to buy more investment potential per dollar he invests. For example, a share trades at 10 dollars, an option on 100 shares costs a premium of 10 dollars. An investor with 1000 dollars could buy:

- 100 shares outright or
- 100 options giving him control of 10,000 shares.

[1]Leverage and 'gearing' are both terms applied to the 'more than one for one' change in the value of the asset compared to an identical sum invested in the underlying asset.

This process is sometimes known as gearing – a small investment leading to a much bigger reward potential. With finite capital available, it is very tempting for investment organisations to use leverage to 'create' more investment opportunity.

Disadvantages of leverage

Leverage creates risk – it has the potential to overstretch the investor by making him liable to pay more than he has available in the form of capital. Even if one is owed money, this can be a problem because of counterparty risk. Both market and counterparty risk control departments try to measure and control leverage. As well as internal limits, regulators place external limits on the permitted degree of leverage.

Measurement of leverage

Leverage arises when there is a definite or possible debt. Forward settling and insurance-based products create leverage. Options can be considered as insurance products. Sometimes leverage can be quantified, other times it is limitless. Here we look at the degree of leverage in some common products.

A six-month cash settled forward trade of notional one million units is set at forward price 10 cents.

Table 6.2 shows that there is a maximum loss to the buyer of 100,000 in the event that spot drops to zero. The seller, on the other hand, has an unbounded loss if the spot price should rise.

Call option trades have similar behaviour: if the price rises the profit to the buyer (and loss to the seller) is unlimited. If prices fall there will be no payout.

Put options always have limited downside, because the price of the underlying cannot fall below zero. When prices rise beyond strike there is no pay out.

Derivatives on asset classes such as shares and commodities can exhibit huge spot price variations and so estimation of leveraged positions is an issue. For interest rate products and bonds the price fluctuations are generally tighter and hence leverage is more manageable.

TABLE 6.2 Maximum loss

Spot price on expiry (cents)	Buyer receives (dollars)	Seller receives (dollars)
0	−100,000	100,000
10	0	0
20	100,000	−100,000
100	900,000	−900,000

Products such as credit derivatives have enormous leverage. The premium received on providing protection on a company defaulting is a lot less than the amount of pay out should the company default. The problem is compounded by the pay out being very unpredictable, because it is dependent on the recovery rate which is not known at all before default and sometimes not until well after default has occurred.

In cases where leverage cannot be determined, an estimate will be made. This will take into account the following.

Current market position

This includes market predicted forward prices, which will give some indication of the likely payment obligations.

Time The longer the debt exists, the greater the likely change in price. So leverage can be divided into time intervals – the shorter intervals having less estimated leverage than the longer ones.

Asset class As mentioned, some products have greater volatility of prices than others. Sometimes there are known factors that affect the longer-term prices, such as the mean reversion property exhibited by oil prices.

Monitoring of leverage Even though estimation of leverage is often required, it can be tempered by the fact that it is rare for asset prices to suddenly jump up or down by more than a few standard deviations of their current level. Provided there is continual monitoring, upward or downward trends can be detected and acted upon. This means that the degree of leverage can be controlled, even in trades that have potentially unlimited loss or gain, assuming that the trade has enough liquidity to allow it to be reversed when required.

6.4 SUMMARY

Before trading, a trader will take into account the liquidity of a product. A trade can have different types of price depending on how and where it is being traded. Organisations and individuals need to be aware of the leverage on a trade in order to fully understand the risks of trading it. These risks can fall on the buyer, seller or both.

Part Two

The Trade Lifecycle

CHAPTER 7

Anatomy of a Trade

A trade ticket is the combination of all details relating to a trade. In order to discuss the lifecycle of a trade, we begin by looking closely at the components of a trade ticket. These will vary according to the type and asset class of the trade being transacted.

7.1 THE UNDERLYING

This is the basis for the trade. It is the fundamental unit upon which the trade is constructed. The actual underlying will depend upon the asset class. The underlying could be:

- a particular share traded on an exchange (equity)
- a bond (fixed income)
- two different currencies for exchange (foreign exchange)
- one currency for future exchange or swap (interest rate)
- a particular measure (size, weight, volume) of a real substance (commodity)
- some other financial instrument.

We will divide the ticket into the major sub categories that apply to most trades and give a specific example to illustrate the concepts. Our example details appear in small print in each of the categories below.

Suppose My Trading Bank bought 20,000 Cadogan Petroleum ordinary shares quoted on the London Stock Exchange from The Bank Next Door on 3 June 2009.

7.2 GENERAL

Some features are required by all parts of the trade process and hence do not fall into any one sub category. Among these are the identification details. These ensure that all processes know which trade they are acting upon and the status of the trade, so that it is clear where the trade currently sits.

Identifier: E091003
Asset class: Equity
Type: Spot
Status: Awaiting confirmation
Trade Date: 3 June 2009
Transaction time: 11:09 London (GMT+1)
Transaction location: London.

7.3 ECONOMIC

These are all features of the trade relating to the value of the trade such as the date, size, asset identifier and price.

Buy or Sell: Buy
Notional: 20,000
Ticker: CAD
Exchange: LSE
Currency: GBP
Price: 10.38p.

7.4 SALES

Certain trade details are recorded purely to reward the salesperson arranging the trade. These have no bearing on the economic value of the trade or on any future trade process. Salesmen are generally rewarded according to the size of the trade and the possibility of profit it affords using a formula to determine the number of *sales credits* the trade has generated. When sales commissions are allocated, the number of sales credits is used as a measure of each salesperson's performance.

Salesperson: Tanya Carter
Sales credits: 150.

7.5 LEGAL

As mentioned above, many trades are transacted at high volume and with standard agreements. However, more specialised or complicated trades may have legal addenda which form part of the terms and conditions of the agreement. This is commonly a document which will be attached to the trade ticket in soft or hard copy. It comprises a master agreement, a schedule relating to the master agreement, both of which are standard for all trades of the same type with the same counterparty, and a confirmation that is specific to the trade itself.

Legal: No special instructions

Jurisdiction: England.

7.6 BOOKING

After execution, the trade will be accounted for at several layers within an organisation. Internal processes require a description of where to place the trade. The details are very much driven by the way the organisation arranges its books and records.

Desk: Equity trading

Folder: European stock

Trader: Giles Milner

Assistant: Mark Best

Trading book: GBP Equity trading.

7.7 COUNTERPARTY

It is essential to know all the details of the counterparty in order to confirm and settle the trade successfully, to investigate queries and process any post execution requirements.

Counterparty: The Bank Next Door

Department: London interbank

Branch: London City

Address: The Old Grange, Wickmore Street, London

Payment Type: SWIFT

Payment Code: UIT TRY XXX XXX

Counterparty reference: LCE393_93B

Settlement Date: 5 June 2009

Special Settlement Instructions: None

Delivery Type: Delivery versus Payment.

7.8 TIMELINE

Every trade has certain key events which occur during its lifetime. In order to understand how a trade works, it is useful to consider its timeline.

Dates relating to a trade

Most organisations will refer to these key dates using the following definitions:

Trade date The date upon which the trade is agreed and executed. From this point the trade is live and has exposure to market forces.

Maturity date The date the trade closes or expires. All of its cashflows are known; the trade no longer has exposure to market forces.

Final delivery date The date upon which all cash flows are settled; there is no longer any counterparty risk.

Fixed cash or asset exchange dates These dates apply to trades that have at least one exchange of cash or assets prior to the final delivery date such as swaps or loans.

Value date The date upon which the exchange of cash or assets is supposed to occur. In some sets of terminology, this is known as the settlement date.

Settlement date The date upon which the exchange of cash or assets actually did occur.

Unknown cash or asset exchange dates When certain future cash or asset exchanges have uncertain amounts they have the value date and settlement date as for fixed flows.

Fixing or reset date The date a flow is fixed according to some piece of market data or other agreed criteria. From this date, the size of the cash or asset flow is completely determined.

Example

The hedge fund Fencing LLP requires a one-year loan from Capital Bank for EUR 50,000. The agreed interest is 10%. Table 7.1 shows key dates on a trade.

TABLE 7.1 Dates associated with a trade

Date	Action
15 Sep 2008	**Trade date – no money changes hands yet**
17 Sep 2008	Value date – EUR 50,000 is due to go from Capital to Fencing
17 Sep 2008	Settlement date – the money is transferred
15 Sep 2009	Maturity date – the trade expires but no money changes hands
17 Sep 2009	Final delivery date – Fencing pays EUR 55,000 (principal + interest)

Note: in this example there are no fixing or reset dates because the cashflows are fixed and known from the trade date.

7.9 SUMMARY

A trade has many attributes. These are grouped and used for different processing functions throughout the trade's lifecycle. Some of these attributes relate to dates which form the timeline for the trade so that activities are performed in the correct sequence.

CHAPTER 8

Trade Lifecycle

In this chapter we describe the full lifecycle of a trade. We examine the processes enacted upon it at each of the various stages from conception to maturity and beyond. This should provide a comprehensive guide to the background to trading within investment banks.

8.1 PRE EXECUTION

Systems and processes need to handle two common pre trade situations. Both cases outlined here give rise to a virtual trade ticket necessary for keeping all of the requisite trade details. The virtual trade can then be converted into an actual trade if and when it is executed.

Provisional trades

For a complicated or structured deal comprising many parts, the trading parties might design a provisional trade. They will agree on a period of time for due consideration and amendments before a final execution date. There may also be conditions and penalties if one side pulls out of the agreement to trade.

Such provisional trades will need to be circulated to interested parties such as:

- the legal department for scrutiny
- market risk control to stress test
- credit risk control to determine whether sufficient credit facility (or line) is available with the particular counterparty
- trading desks to prepare other trades required to hedge the risk of the provisional trade.

Many investment banks and hedge funds have special non-trading portfolios for such provisional deals. These maintain the division between real and virtual trades, but allow for the provisional trades to filter through required checks and processes and make it easier to convert the provisional trade into reality when the execution is enacted.

Risks associated with provisional trades The extent to which a provisional trade carries a legal responsibility must be clear and transparent to anyone acting upon or using that trade. Falsely assuming a provisional trade to be completely abstract could cause loss and is therefore a risk.

Additionally, there may be clauses attached which make one or other party liable if they do not follow certain causes of action by given deadlines. Examples are:

- supplying information to the counterparty
- guaranteeing that the organisation can meet its responsibilities
- completing due diligence
- signing a contract.

Operational processes would need to be put in place to ensure such obligations are acted upon well before the deadline.

A clear risk exists if the provisional trade automatically becomes live when a counterparty does not withdraw by a given date.

There may be a tendency to apply less stringency with the writing and checking of a provisional trade ticket because it is not real. This bears risk because, in the event the trade is executed, it might be simply transferred to a live trading book with the falsely applied assumption of accuracy. Review of provisional trades before execution is essential.

A system designed to capture and process real trades must bypass all provisional trades, so that they do not contribute to any official books and records. This requires proper design to ignore provisional trades, carry out thorough testing and ensure the correct implementation by people involved in entering them into the system.

Orders

When a trader is instructed to carry out a trade, the instruction is called an order. Orders can arise from:

- a salesman communicating between clients and traders
- electronic requests by clients or other financial entities
- automatic generation. Examples are stop orders where an instrument must be sold when its price falls to a specified level and limit orders where an instrument is bought once its price reaches a specified level.

The order may be unconditional and hence definitely result in a trade or be conditional upon price, time or some other factor. Orders may be aggregated to make trading more efficient.

TABLE 8.1 Orders

Order type	Size (pounds of aluminium)
Buy	70,000
Sell	60,000
Buy	95,000
Buy	85,000
Sell	90,000
Net	Buy 100,000

For example, metals trader Mandy has the orders in Table 8.1 on her books.

She will execute one trade to buy the balance, which is buy 100,000 pounds thus satisfying the five individual orders and reducing her transaction costs.

Risks associated with orders An order is an instruction to trade and therefore it is important that orders are correctly input and processed. As orders and trades may not match one to one, it is useful to have a means by which trades can be reconciled against their composite orders for audit or tracking purposes and to prevent mistakes. Any trading process must have the capability to deal with orders where they exist.

There may be a tendency to assume that once an order has been instructed, the deal is done. Since execution of a trade is distinct from order capture, there is a possibility that due to human error, machine malfunction or process delay, the trade may not yet have been created.

Since pending orders will give rise to trades and rebalance the organisation's exposures, it is essential that known orders are visible to traders and market and credit risk functions.

8.2 EXECUTION AND BOOKING

Now we come to the point where the trade becomes live and legally binding on both counterparties.

Execution

When both parties have agreed to a trade, the trade is said to have been executed. This could occur in a number of ways.

Telephone The spoken word has no lasting record. Even when telephone calls are recorded, which is now the norm in the financial sector, there is the possibility of one or other party mishearing or misunderstanding the details, information being omitted or language communication problems, any of which could lead to a claim that the trade was incorrectly executed. Most trades dealt on the telephone will be backed up with some form of written communication. Although outlawed by many organisations, some trades are transacted on mobile phones. This carries real problems: the trader may be away from his desk and hence away from proper systems to implement the trade.

Email Although details are in writing and subject to less ambiguity than trades transacted over the telephone, emails have dubious legal validity and carry a risk of impersonation. It is difficult to prove who the person sending the email actually was. Another problem with emails is if one side sends an email with full trade details and the other replies ‘yes’ or ‘confirmed’ – are they actually agreeing to the same trade? Timing delays between emails being exchanged could lead to doubts as to if and when execution actually occurred.

Electronic chat This is very similar to email but has the advantage of almost immediate reply, reducing some of the timing problems.

Electronic systems Electronic systems can be unique to a financial entity or used by the whole market as for broking systems. Electronic systems can be fast, accurate and eliminate human error. Details can be checked, confirmed and seen by all relevant parties and automatically fed to processing systems removing the need for secondary booking.

They will only work, however, for standard trades conforming to the templates with which the system was designed. Also, they rely on all parties having constant access to the system. When lines go down due to power cuts or natural disasters for instance, there must be alternative means to gain access to trade details and if necessary, continue trading.

The risk of sabotage or industrial espionage must also be considered. The electronic system only works if all its users have full confidence in its integrity and accuracy.

In person The old-fashioned, open outcry exchanges involved two traders talking or signalling their agreement to a trade. These are almost obsolete, but nowadays salesmen often meet their clients in person and will transact deals using portable computers or written notes with a signature. It is essential that these trades enter the proper booking systems quickly and accurately.

Post In an age where communication happens instantaneously, it may seem curious that some trades are still executed by post. Cashflow collateralised debt obligations, for example, might have contracts running to hundreds of pages, comprising legal ISDA agreements and precisely defining complicated cash waterfalls for the movement of money over time. These trades are sent out, reviewed and only come into effect when signed and returned by post.

Booking

When a trade is executed, a record must be created. In the London Stock Exchange of old, this used to be the stock jobber (market maker) making a note on his dealing pad. Nowadays, nearly all trades are recorded electronically. The principles of booking remain the same, however: all trade details need to be recorded together with the time and place of transaction. Usually both counterparties make separate records, unless one is responding to an offer by another on an electronic exchange. In this case, although the trade ticket is written once, the system will send out full details to both sides, so effectively there are always two records. Once a trade is booked it confers full legal responsibilities on both sides to deliver the obligations associated with it.

As explained above, there are many parts to a trade ticket. Traders are busy and keen to assess the impact of their trades immediately. Hence, when two traders agree a trade, they may only record the sections relevant to them, which will be economic, and some basic internal booking and counterparty details. It will be left to their trading assistants or other business functions, such as middle and back office, to complete the ticket. Also, traders have a penchant for jotting down trades on a pad, known as a trade blotter and it will be left to others to input the trade into the correct booking system. (This is not an eccentric quirk of the trading profession – if a manager tries to insist the trader books a trade in full, he may be impairing the trader's ability to carry out his primary responsibilities of trading and risk management. The loss entailed by this should be weighed against the losses caused by partial or inaccurate booking.)

Straight Through Processing In essence, execution and booking should be simultaneous processes. So the quicker a trade reaches the booking system from the time it was executed and the fewer people involved in booking it, the lower the risk of errors.

The paradigm to which many organisations aspire is known as Straight Through Processing (STP). This means all actors in the trade lifecycle are working with the same data. The trade is entered once at time of execution, with all its details and the system carries the trade through all its checks and actions throughout the organisation. Every amendment is noted alongside the trade and a full audit of who did what and when is available, reducing many risks associated with booking.

There are risks associated with STP. A fully automated system means that mistakes are fully automated. The machine cannot respond to potential or actual errors unless it has been programmed to do so. Due to the varied nature of trade booking errors, the design of the system cannot be relied upon to catch them all and, even when they are caught, the process requires human beings to take appropriate action. Also, some business functions are required to *merely* check trades in the STP. Since checking is a passive activity, it is easy for mistakes to slip by.

STP systems are often expensive to produce and, once fully implemented and tested, there is a resistance to adapt or modify them. This means that when the business evolves and new trade types are transacted, there is a tendency to shoehorn them into the existing system. The desire to make the system do something for which it was not designed can lead to many errors, often occurring at unexpected times or in exceptional, but nonetheless, damaging circumstances.

We believe that STP systems require the utmost planning and wide consultation with all users before being implemented. The future growth of existing business and expansion into new business must be taken into account; everybody concerned must be aware of what the system can and cannot do.

8.3 CONFIRMATION

The process of confirmation involves representatives of both counterparties to a trade agreeing to all the particulars of the trade (except internal details). This role is usually carried out by the back office. The actual method of confirmation will vary according to the nature of the deal. In reality, there are two activities: matching and confirmation.

Matching

Before confirmation of a trade can begin, both counterparties must match their records to ensure they both have a record of the trade and that they are referring to exactly the same trade. In a high volume-trading environment, this may not be quite so easy. Ideally, each party to the trade execution (the traders) will have recorded the other party's trade identifier at the time of booking. If not, the trade can be matched by its time, trader and some headline details.

For example:

Yvonne at Ordinary Bank records a sale USD 5.05 million of US Treasury bonds at 15:05 on 13 January.

Zena at Special Bank has a record of 5.055 million of the same asset being bought from Yvonne at the same time.

The records are not identical, but the two interpretations are close enough to assume they refer to the same trade and hence start the confirmation.

Where a trade cannot be matched at all, it is likely that either it was never received and executed by the counterparty or it was dealt with a different counterparty and the counterparty details were misbooked. In the latter case, the real counterparty will be trying to match and will contact the counterparty who made the error, so the mistake will be identified and corrected.

For example:

A trades with B, but A has recorded that it traded with C.

A attempts to match with C, but C has no record.

B attempts to match with A, and the mistake is identified.

Confirmation

Once the trade is matched, all the details must be confirmed. There are three circumstances upon which a trade may need to be amended during confirmation.

1. Omission

   If details are omitted, they will need to be agreed and added. Unless they affect the value of the trade these details can generally be decided by the back office itself without recourse to the traders who executed the trade. If an important economic clause, for example the currency of the trade, was omitted, then the traders would need to agree to its inclusion. If the omission has only occurred in the ticket of one counterparty, it is likely the other counterparty can supply the missing data.
2. Error

   An error may have occurred on one side. The confirmation process should identify it and then either it will be accepted and corrected or there will be a dispute as to which interpretation is correct. This dispute may be settled between the counterparties themselves or, in serious cases, by an independent arbiter or court of law. It is rare that anyone will deliberately try to misrepresent a trade he transacted, as it may endanger his reputation in future trading. With a limited number of counterparties, there will be internal pressure to settle disputes so that trading possibilities remain open for both sides.

   The one exception is where a conflict arises either after a period of time or after significant movements in the market place. Here the difference in value of the trade between the two interpretations could be significant and make resolution more difficult.
3. Ambiguity

   Where a particular trade detail is incompletely filled out, it could lead to ambiguity. Generally, consulting the traders as to their intention behind the ambiguity will resolve the issue.

Confirmation risk If an organisation has a speedy and efficient confirmation process it will deal with errors efficiently and gain a reputation for being a good partner in business. Since confirmation is a two-way process, other organisations will quickly see how effectively the process is being conducted and inferior individuals and organisations will be exposed.

The longer mistakes remain in the trade lifecycle, the more costly they are to correct. The confirmation process is essential to ensure a smooth trading practice.

Feedback from confirmation It is inevitable that mistakes will sometimes be made on trade booking and the confirmation process will correct them. The people carrying out confirmations are, however, in a very good position to assess the booking procedure and systems and advise on improvements. Common or costly errors and omissions can be reported back to those responsible for booking, and better systems and processes for checking and catching mistakes can be designed.

Internal confirmation (reconciliation) between different input systems is another aspect of confirmations. Once a match has been found, it is useful if the corresponding trade identifier is attached, so that a trade can be fully audited through all the systems.

For example, a copper spot trade with identifier CST0014 is entered into the front office system *Jeopardy* and later is entered into the middle office system *Resolute* with automatically generated identifier 342002. If the trade in Jeopardy can hold the ID 342002 and the trade in Resolute can hold CT0014, the tracking process is enhanced by this double incidence of cross-reference.

8.4 POST BOOKING

The trade is live – several processes must now be enacted to see it on its way.

Trade scrutiny

Once trades are booked in the trading system, they require scrutiny to ensure they are correct and fit in with the other processes comprising the trade lifecycle. Middle office has the responsibility for this scrutiny (see section 15.6).

Enrichment

The person booking the trade may not have all the trade details to hand at time of booking. Therefore, these missing details must be completed later. They are unlikely to comprise economic details but could include counterparty, settlement or custodian information. This process may involve liaison with the original trader and with the counterparty or custodian.

Cashflows

At this point a calculation of the expected cashflows relating to the trade may be performed. This is useful to check that everything relating to the valuation of the trade is complete. Cashflows also define the responsibilities that the trade has devolved on the organisation trading it and are an alternative and meaningful representation of the trade for many subsequent processes.

Fees and duties

Once a trade has been executed it may incur certain duties. Examples are:

- broker fees (for buying or selling)
- stamp duty when an equity is purchased (but not when it is sold)
- exchange charges on a per trade basis
- commissions to external parties for arranging the trade
- legal fees (if the firm does not use its own lawyers).

These fees must be recorded, checked and payment arranged by the due date.

Error reporting

If anything is amiss it should be reported at this stage to allow maximum time for correction. This also prevents errors spreading through later processes which, in the case of settlement for example, could be costly.

8.5 SETTLEMENT

A trade might have been executed, booked and confirmed and is legally binding on both parties, but until settlement, nothing physical has changed hands. Settlement is the process by which the counterparties to a trade fulfil their obligations to exchange. We often think of a trade as A buying something from B, and then A would exchange cash in return for a financial instrument, document or commodity. However, many trades involve both parties transferring cash. Examples would be:

- foreign exchange where one currency is exchanged for a different one
- interest rate swaps where one party pays a fixed amount every six months, the other side paying a floating amount dependent upon the current rate of an agreed index, such as LIBOR
- credit default swaps where one side pays a fixed premium per year and the other side will only ever pay if the underlying asset defaults.

The importance of settlement

Few activities in the trade lifecycle carry as much importance as settlement. Settlement is a physical exchange, materially affecting the assets held by the trading party. As in any business or personal situation, whenever money leaves the door, it must be carefully checked. The person authorising payments for settlement bears great responsibility. Most organisations will insist on two different individuals being involved in the settlement – requiring either two signatures or, in the case of an electronic settlement, two authorised operators. Senior staff are generally employed directly or in a supervisory role in this task because they will have greater experience to spot mistakes or suspicious transactions.

Settlement instructions

A key part of the trading ticket is the details for settlement. These are known as settlement instructions. The two main types of settlement instructions are Delivery versus Payment (DvP) and Free of Payment (FoP). The former requires both parts of the exchange to happen simultaneously and will generally involve the generation of one settlement instruction between the client and the custodian. The latter allows for there to be two distinct settlements at different times and hence there will normally be two settlement instructions between client and custodian – one to expect a receipt of cash or security and one to make a payment.

Custodian

The custodian holds cash, securities or both on behalf of a trading entity and can effect a transfer with the custodian of the counterparty. The custodian also has knowledge of local trading practices, providing valuable advice to his client. He can supply transfers at a customised level of security to meet the requirements of the trading party – a large transaction requiring a greater level of encryption and participant identification than a smaller one.

Cash or physical

As mentioned above, any of three different entities could be involved in settlement – cash, documentation or physical commodity.

Cash This will involve an account being credited or debited by the settlement amount. As bank accounts are generally only held in their domicile currency, institutions trading in foreign currencies will either need to hold domestic or offshore accounts in those currencies or employ the services of a bank in the country of the currency being traded.

Documentation Share certificates, bonds, loans, warrants and insurance guarantees are all examples of documents that may be traded. These may be held by the counterparty themselves or stored by the custodians. They are vulnerable to being lost, stolen or damaged and are costly to replace.

Physical commodity When commodities are traded, they often involve the exchange of physical goods ranging from grown produce, such as coffee beans, through precious metals to barrels of crude oil. The recipient of such a commodity transfer will need to provide shipping from the warehouse, factory, depot or port where the goods are to be collected, and safe storage once transportation is complete.

Cash settlement of commodities

Many banks and hedge funds have no interest in using bought commodities: they buy in order to resell them at some point in the future. Therefore, they do not require physical delivery and in fact would not know what to do if a lorry load of aluminium arrived on their doorstep!

Such traded commodities remain in the same warehouse or place of storage after settlement – only the document of ownership being exchanged.

Many forward and future trades stipulate cash settlement for commodities. This involves one counterparty paying in cash the difference between the agreed future price and the prevailing market price on settlement day.

For example:

> In May, Helen buys 45 tonnes of coffee beans for November delivery at an agreed price of USD 140 per tonne.

On the day of settlement in November, the price is USD 150 per tonne. Instead of receiving coffee, she will receive USD 10 per tonne in cash. (Had the price fallen, she would have to pay the price difference.)

Nostro accounts

Deriving from the Latin word *noster* meaning ours, the term ‘nostro account’ is used to describe a cash account held in our name by you. Nostro accounts must be held with a local clearing bank, so Bank A may have a:

- EUR nostro account in France with Bank F
- JPY nostro account in Tokyo with Bank J and a
- HKD nostro account in Hong Kong with Bank H.

Part of the process of settlement is to update the various nostro accounts. Additionally, transfers between nostros may need to be enacted to ensure they stay within overdraft limits or to prepare for imminent withdrawals.

In order for the finance department to understand the true position of the institution, it needs to gather together all the current nostro account details supplied by the back office. For examining past settlements in the event of a problem, the nostro will be the indicator of exactly how much was paid or received and when.

Risks

The process of settlement brings the following risks:

1. Theft

   A big risk in the settlement process is theft. This could occur where the settlement process is intercepted by criminals or where staff involved in the process (including those writing or operating a computerised settlement system) divert part or all of the money to their own bank accounts.

2. Cost of recovery

   The settlement process may fail if money is transferred to the wrong account, too much is transferred to the correct account or the transfer is on the wrong day or at the wrong time. Even if there was no deliberate attempt to steal money, it may cost a significant amount to recover it and may cause severe embarrassment.

3. Legal

   Settlement is a legal obligation arising from execution of a trade. If a counterparty fails to settle the right amount at the right time and according to the given settlement instructions, he risks being sued by the wronged party. The legal process, even if settled out of court, will be expensive and time consuming.

4. Reputation

   Any missed or erroneous settlement will cause damage to the reputation of the counterparty at fault. Trading works to a large extent on trust and poor settlement will quickly lead to trading lines being reduced or withdrawn. A failure to settle will arouse doubts as to the competence of the organisation concerned because trading is one of the main activities of investment banks and hedge funds, and because settlement is the most visible face of the institution to its peers.

5. Unexpected charges

   A party to a trade may be expecting a large receipt of money upon settlement. If that settlement is delayed for any reason, it will lose the use of that money, which could involve not being able to pay off a debt charged at a daily interest rate.

6. Other trades

   A counterparty may have a trade with settlement expected on a given day. It may then have executed a subsequent trade, anticipating using the first trade settlement to pay the second trade in cash, financial instrument or commodity. A delay on the first settlement will have knock-on effects for other settlements dependent upon it.

   As discussed later, in order to limit the losses involved in the event that a counterparty defaults, most investment banks and hedge funds impose limits (known as trading lines) on the maximum amount that a given counterparty can owe at any one time. (These lines will vary between different counterparties – the more secure having greater line.) While a trade remains unsettled it is using up some of this line and may prevent opportunities for more trading with the same counterparty.

Advantage of quick settlement

Possession is nine tenths of the law. However binding a trade upon its participants and however strong the regulation and law enforcement authorities might be, there is no substitute for a quick settlement. This means both sides have confidence that whatever they have traded will quickly come to fruition and risks will be reduced. Many exchange-traded instruments have stipulated settlement periods. These are often one or two days after execution to allow each side to arrange and carry out the settlement details, although it is increasingly common to see same-day settlement now that many processes are automated.

Multiple settlement dates

Some trades require more than one settlement. A good example is a bond which might pay 5% coupon every three months through the life of the bond plus a redemption and final coupon upon maturity. Each settlement is regarded as a separate process and all of the above explanation applies to it. The trading agreement will specify the full settlement schedule and what to do if a settlement falls on a non-trading day such as at the weekend or on a public holiday. (Typically the next business day will be used, but there may be exceptions when the next day is in another month or is the final payment.)

Breaks

A major part of back office time is spent tracing ‘breaks’, where a settlement has not been enacted. These breaks are very expensive in time and human resources. Sometimes huge numbers of unpaid settlements are built up, because operations do not have time to chase them. It may seem obvious that breaks will either cause loss of profit where the firm is not paid, or cause reduction in future profit, where mis-settlements are realised later and claimed back by counterparties. Yet there is very often reluctance to invest time cleaning up breaks – they are often swallowed up in the general, huge costs involved in investment banking.

8.6 WHAT HAPPENS OVERNIGHT

The quiet of the night allows banks to run several processes on trades booked the previous day and carry out machine intensive calculations and the creating of reports for staff to be ready when they come into work the following morning.

Individual trade and aggregation with other trades

The trade is an agreement imposing responsibilities upon the trading parties. It has many processes performed upon it and remains as an individual unit throughout its lifecycle.

To the internal financial entity that traded it, the trade is often considered in aggregation with other trades. The aggregation may be done in many ways. Here are some examples:

- asset class
- trading book
- maturity
- currency
- counterparty
- exposure to different market data.

At some point the trade must be joined into the various aggregation and reporting processes. This generally occurs at the end of day roll in the first night after it is booked.

Some business functions examine individual trades, some look at groups and some do both. For example, the legal department will generally scrutinise an individual trade whereas finance will look at the overall effect of a group of trades in a book or department. Market risk will examine both how individual trades and the whole portfolio stand up to market price changes.

Thus, the trade has a duality of existence as an individual and as part of a compound or many compounds.

Date and time

Trade tickets have certain dates when events happen. For example, the actual trade date, one or many settlement dates, maturity date and final delivery date. Processes and calculations work on whole calendar days and not on part days. (The only exception is booking, where time might also be recorded to help with matching and confirmation.) Since time of day is not relevant but actual date is, we need to have clearly defined dates.

Internal and external trade dates Trades are transacted in a given jurisdiction that may be different from the location of either or both counterparties. For legal purposes, the trade will follow a stipulated time zone (usually that of the jurisdiction) and all dates on the trade are relevant to that time zone – this is the external date. However, internally it must be grouped with other trades. An internal process, say the end of day calculation, must run on all trades taken together. Therefore, the trade needs the concept of an internal date; the end of day for an organisation determines which date that should be.

Deciding time for end of day In most organisations, people arrive at work in the morning and leave in the evening, so it is an easy decision to set the end of the previous day and start of the next day at some point in the night. In a multi-timezone trading environment where trades are being executed and booked around the clock and staff are always on the premises, deciding the end of day may be harder. Usually the organisation will fix the end of day on the basis of its principal trading time zone.

For example, if Bank TwentyFourSeven trades on both the Chicago Mercantile Exchange and has extensive Australian commodity dealings, but is based in Germany, the bank may take the middle of the German night as its end of day. This may lead to problems where a trader is dealing with Australian trades just before or just after German midnight – the timestamp on the booking could be used for determining the internal trade date.

Note that it is irrelevant that the counterparty has a different time for its end of day. The internal date does not affect processes between counterparties which will use the external date. (This mutual external date will be agreed at execution and checked at confirmation.)

End of day roll Every time the end of day is reached, the trades will be rolled into the next day and for internal purposes, a new day will begin. For accounting and monitoring, the trades are often split into the following subdivisions:

1. New
   Those that have been dealt in the previous day and are appearing on the books for the first time.
2. Amended
   Those that were amended the previous day. Some systems treat an amended trade as a new trade, but they will have a link to the original trade for prior reconciliation.
3. Deleted
   A trade may be deleted because it was mistakenly booked or because both counterparties have agreed to rescind it. Generally auditors will require deleted trades to remain in the system (suitably marked) and have processes for dealing with them, because it is dangerous to allow business functions to simply remove them.
4. Expired
   When the trade rolls past its maturity, it is said to have expired. It may still require processes to be performed on it, such as delivery, but it no longer makes a contribution to profit and loss.
5. Open or current
   All other trades are open or current. The end of day roll marks the process by which previously new or amended trades become current.

Overnight processes The night is a good opportunity for time-consuming and resource-hungry processes to run. It is also the first chance a new trade has to be aggregated with other trades.

Many valuation, risk generation and reporting processes run overnight. These include:

- P&L
- market risk
- counterparty risk
- balance sheet
- trading activity
- calculation of collateral requirements.

Pre overnight checks Overnight processes rely on complete and accurate input data. It is very annoying for any business function staff to arrive at work in the morning and find the overnight processes have failed due to a lack of good data. Much time has been lost and it may be difficult to run processes during the daytime when people are working. One solution would be to have staff available at night to check systems have run and correct any errors that arise. This is usually expensive and does not do much for morale. An alternative is to have the system perform a mini calculation earlier in the evening before people leave. This must be sufficient to detect most errors, but it is not too time-consuming.

Getting the balance between human and machine activity on overnight processes will depend on cost, intricacy of processes required and quality of staff. It is possible to automate virtually all the activities or to have all but the heavy calculations performed manually. Here is an example of a mixed human and machine end of day process:

16:30–17:30 End of day market data is ready for overnight processes

17:30 Middle office checks quality of data

18:00 Pre overnight process is run

18:30 Middle office checks process has run and corrects any errors

22:00 Overnight process begins:

Trades are rolled

Calculations are performed

Reports are generated

08:00 Middle office checks reports and if satisfactory, distributes to relevant parties.

Amalgamation between systems

Where a finance house trades different asset classes, it may have different systems performing valuations. These systems must be coordinated so that output results can be combined for aggregated reporting. It is of course necessary that amalgamation occurs after all contributing systems have completed their end of day processes successfully.

Dependencies across different systems mean that the designer of an overnight process must allow time to cope with overrun.

Stale data If a process fails to run, it may have left stale data in a position where new data is expected. Subsequent processes may inadvertently assume the stale data to be new and use it.

If data is missing completely or too big or too small, it will either cause the system not to run or to produce obviously incorrect results. Stale data, on the other hand, is potentially more dangerous, because it can easily go undetected and is a common source of calculation and reporting errors. Some systems provide comprehensive diagnostics to allow the user to examine exactly which data was used in all calculations; others are rigorous in their checking of input data to ensure it is not stale. The old adage of garbage in, garbage out, particularly applies here.

8.7 CHANGES DURING LIFETIME

The trade has experienced its first night, has made a contribution to P&L and risk control reports and is now extant in the system. This section discusses changes that might occur to the trade during its lifetime. We also consider payments or receipts due on assets arising from the trade. Changes to assets will require processes whether or not they are booked separately from trades. For convenience, we group them with other trade changes.

The trade should have all its details and components fully confirmed and readily available to all processes that require trade data. If the system is operating correctly, each time any trading report is run, the trade should appear on it. Each day until its maturity, the trade is assumed to be identical to the previous day unless one of the events listed below occurs.

- changes as a result of corporate actions to assets holdings
- changes as a result of market data
- counterparty changes
- changes to the trade
- changes in underlying
- changes as a result of asset holdings.

We begin this section by discussing a group of events known as corporate actions. These involve an issuer of a security (bond or equity) distributing benefits or when the structure of the issuer changes.

Dividends

At certain times, companies may pay dividends to their shareholders. These are discretionary and depend on the financial health of the company. (Even preference shares usually have delay clauses, so are not guaranteed.) When a dividend is due, the financial entity holding the stock must accept the dividend and account for the money received in its books and records. Processes must be in place to perform these activities and a business function must be made responsible for performing them.

Although dividends do not affect the trade itself, they should have reference to the trade from which they arise, so that P&L can be properly accounted.

When making a dividend announcement the issuing company will state the payment date, the date of record and the ex-dividend date – all of which should be recorded on the trade details.

For example:

> Segro PLC announces a payment of 1.4p per share to be distributed on Friday 20 June 2008 to all recorded shareholders on Friday 6 June 2008, ex-dividend date Wednesday 4 June 2008.

Therefore if an institution held Segro shares on or before 4 June, it will expect dividend payment on 20 June even if it has subsequently sold those shares. These dates and the dividend amount need to be recorded against the trade so that the correct dividend will be processed on the correct date.

Coupons

A sovereign or corporate body wishing to raise capital may issue bonds. Bonds pay coupons at regular intervals. These coupons may be fixed or floating or both. A fixed coupon is a known amount, such as 5% of the notional. A float amount is based on an index such as LIBOR, plus a given number of basis points. Some bonds pay floating coupons for a period and then fixed for the remainder.

An example coupon schedule is shown in Table 8.2.

Accrual date is the date used for coupon calculation; payment date is a fixed number of days after the accrual date when the coupon is actually paid.

Although the dates of coupon payments are usually known when the bond is issued, floating coupon amounts can only be known on the accrual date. In this case, a process will need to be performed to consult the relevant index on the relevant day

TABLE 8.2 Coupon schedule

Accrual date	Payment Date	Amount	Type
30 Jan 2007	1 Feb 2007	LIBOR + 40bp	(float)
30 Jul 2007	1 Aug 2007	LIBOR + 40bp	(float)
30 Jan 2008	1 Feb 2008	4.85%	(fixed)
30 Jul 2008	1 Aug 2008	4.85%	(fixed)

and 'fix' the coupon. The fix is made on the accrual date, so that the receiver knows the exact amount to expect on the payment date.

Other corporate actions

Mergers, demergers, rights issues and other changes to issuers of equities and bonds will alter the size and value of the assets held.

Changes as a result of market data

Several trades are dependent on market data during their lifetime.

Fixings Apart from floating bond fixings described above, many trades require fixings against market data during their life. Each counterparty to the trade must find and record the relevant fixing to ensure:

1. All processes and calculations can work with the anticipated flow.
   Until the fixing is made, calculations must use an estimated value from the best available market data. For example, a CHF floating swap rate of LIBOR + 30bp due to be fixed in one month, might use the CHF one-month LIBOR. This will change daily causing the input to the calculation to change. After fixing, this rate will be known and so the cashflow can be fully defined in the system.
2. Correct settlement of cash (or asset) flow on payment date.
   Just as in trade confirmation, both sides must agree on fixings affecting all asset settlements. A fixing made from a published reference indicator such as LIBOR will not be subject to misinterpretation or dispute, but some fixings are from more bespoke criteria and therefore each party to the fixing will want to ensure they have recorded it correctly. An example fixing might be the average of five broker prices quoted between 14:00 and 15:00 on the fixing day.

Products using fixings The following products are affected by fixings from market data.

Swaps Any swap agreement which has a floating leg will require a fixing for every accrual date in a similar way to a bond.

Trades using average market rates Many trades use an average of market data across many dates to arrive at a figure used for settlement. An example might be an oil future trade that uses the quoted oil price over the last 30 days of the contract, rather than just the price on the last day. In any trade using average market rates, the fixings for every date in the average must be recorded.

Trades changing in behaviour according to market data Some more exotic trades actually change their behaviour according to changes in market data (see Chapter 11). Such changes will materially affect the asset flows in the trade and therefore market data fixings must be recorded on all relevant days, so that the trade can be properly managed. For example a nickel barrier option has:

- spot USD 13,800
- strike USD 15,000
- lower knock out barrier of USD 12,000.

This means that if the price of nickel falls below USD 12,000 at any time, the option expires and the buyer receives nothing.

Another example is a convertible bond trade which, depending on certain conditions, converts from a bond into an equity. Since systems may treat equities and bonds as completely different trades or there may be a separate system to handle each, a convertible may require considerable work to process it properly.

Counterparty changes

If the counterparty changes its settlement details (such as its custodian or bank account) then the settlement process will need to be alerted and act on the change. This involves changes to the trade and are separate from the settlement of asset flows.

Collateral

If a collateral agreement is in place, margin must be calculated on a daily basis and then a cash transfer executed between the parties. This has to be performed all the time the trade is in existence. See section 12.7 for a fuller discussion of collateral.

Changes to the trade

Trades can be altered during their lifetime by various events.

Settlement One or many settlement dates may exist in the trade. Settlement is discussed in a separate section.

Amendment Both sides might agree an amendment to the trade at any point in its life. The amended trade will have an effect on all processes and calculations. Conceptually, it is the equivalent of deleting the old trade and creating a new one with the amended details. Many systems treat it thus, but record the original trade on the amended trade to ensure a proper audit trail.

Cancellation Both sides might agree to cancel the trade. Auditors will generally insist that records of the trade are kept in the system. Some processes such as P&L Explained (see Chapter 14) will measure the effect of cancellation on the day it was done. Simply removing a trade without trace is not sensible, so cancelled trades do flow through trade systems.

Exercise and maturity These are covered in separate sections below.

Exotics Some exotic derivatives such as knock in and knock out options (see Chapter 5) require careful monitoring of market data to see when they are approaching limit conditions. Sometimes a combination of machine and human process is used, whereby the machine is allowed to conduct a preliminary check. If the limit is a long way off, no further action is required. If it is close, the machine sends a warning and the human takes over, monitoring the market to determine if and when it was exceeded.

Changes in underlying affecting the trade itself Trades are executed on a wide variety of underlying assets. Many of them will not change their details during the lifetime of the trade, such as gold, Japanese yen and US Treasury bonds.

Those that do change, however, may result in a different asset holding or a monetary payment as described above (dividends, equity holdings). A different type of underlying does materially affect the trade, rather than the assets resulting from the trade. The prime example is credit. If protection is bought or sold involving a corporate or sovereign name, a credit event on that name will cause certain payments or receipts, as defined in the trade contract. Moreover, for single name protection the trade will expire upon a credit event. Trades which are susceptible to changes in their underlyings need careful monitoring to ensure that any changes are noted.

Management of changes

It is difficult for any one process to detect and record changes, because they can occur over diverse areas – the trade itself, a wide variety of market data, a counterparty, an asset (dividends, bonds), changes to an underlying (credit events). A common technique in handling many of the possible changes is to use a diary. The diary may consist of events, the trades and underlyings they relate to and the action to be taken.

Each day the diary is opened and all events for that day are processed.

Table 8.3 shows example actions common to both middle office and back office, but in reality there would be separate reports for each business function.

When events occur every day (such as margin calls or the possibility of a credit event) they can be given their own process.

When there is no predicted date such as for a trade amendment, a process will need to be undertaken on demand and cannot be diarised.

TABLE 8.3 Example diary entries for one day

Trade(s)	Event	Underlying	Action
T110	Coupon payment date	Bond: BRD2020	Expect receipt
T304, T30	Averaging date	Nymex WTexas Oil	Fix
T737,T373	Swap fixing	LIBOR CHF	Fix
T167	Settlement date	Fix/Float GBP	Settle
T35, T36, T37	Ex-dividend date	Segro PLC	Record
T22	Maturity date		Process expiry
T772	Close to knock-out	EUR/JPY	Check market

Risks

Changes to a trade or its assets cause risks to the institution holding the trade. One of the biggest risks is that changes are missed. Then:

- counterparties may demand unexpected payments
- opportunities for receiving money may be passed up
- undesired increase in exposure may occur.

Another risk is that the change is detected and reported but no action is taken. This has a similar effect to missing the change. It is important that the institution understands exactly what trade changes are likely or unlikely to happen when a trade is executed. Procedures should be put in place for every possible change.

The institution must organise itself such that changes are communicated to all relevant parties within it. For example, a credit risk department might detect credit events promptly in order to manage counterparty exposure, but neglect to inform a trading desk that has just traded its first credit derivative.

8.8 REPORTING DURING LIFETIME

Even when a trade has not changed it will need to be tracked and reported upon every day of its existence. The reporting has been briefly mentioned above and is discussed in greater depth in Chapter 25.

8.9 EXERCISE

At some point during the life of an option trade, the buyer has the right to exercise the option. In a call option, this means the right to buy the underlying asset at the strike price. For a put option, it is the right to sell the underlying. Exercise is a very important component of an option trade and processes must be in place to deal with it.

Exercise date

This is the final date by which notice of exercise must have been given. The trade details will stipulate the hour of the day and the means by which exercise is performed.

The style of the option is very important in defining whether there is one single or a range of exercise dates.

- American options can be exercised on any day from the start of the trade until the exercise date
- European options can only be exercised on the exercise date
- Bermudan options are a mixture – there is a period during which they cannot be exercised and then a period when they can be exercised on many or all dates. (The name Bermuda derives from the island which lies between Europe and America.)

When to exercise

Exercise is an economic decision. If the option purchaser stands to gain more by exercise than to let the trade expire unexercised, he will exercise. Generally if the spot price of the underlying asset is greater than the strike, a call option will be exercised and the reverse for a put option.

It is usually clear ahead of the exercise date whether the option is 'in-the-money' and therefore worth exercising or 'out-of-the-money' and not. However there are borderline cases where the exact market data close to exercise must be known and conveyed to the person making the exercise decision. Generally the trader who dealt the trade or someone on his desk will make the decision and the middle or back office will give the counterparty notice of exercise.

Cash or physical

The trade will stipulate whether exercise is performed into cash or into a physical asset. When the exercise is physical, the seller sometimes has a choice of exactly which asset to deliver. For example, the trade may stipulate one of a set of bonds all being the equivalent to a defined benchmark bond. The seller can then choose the bond that is cheapest for him to buy in the market for delivery to the purchaser, or one that he currently owns.

For cash exercise, the difference between spot and strike is used to calculate the optional component of the trade and that is delivered as a cash payment to the purchaser in the currency of the trade.

Exercise as a process

The exercise date is another (possible) settlement date in the trade lifecycle. The size of the settlement is unknown and could be zero, involving no processing. The institution buying options must be able to manage the additional tasks of deciding whether to exercise and informing the counterparty of exercise. One selling options must expect exercise and be ready to deliver the amount and type of asset required. For American and Bermudan options, there is the added complication of several possible exercise dates.

Both counterparties to an option will need processes for monitoring the relevant market data to determine exercise. This monitoring may begin from straight after trade date because it affects the value of the option. When options get close to their exercise date, alerts need to be triggered to warn decision makers and implementers to take action.

Fugit

Some option traders like to attach a date known as a fugit to the trade. (This can be added as a diary item – see section on trade changes.) Fugit comes from the Latin *tempus fugit*, time flies. In this context, it means the first date at which an American style option is likely to be exercised.

Risks associated with exercise

There are obvious risks, such as poor communication between traders and middle office, leading to exercise being missed when it should have occurred or being performed when it should not have occurred.

There is also a problem when market rates are very volatile and an option is at-the-money. A sudden swing could take the option into the money and make it worth exercising. Systems showing market data must be accurate and up-to-date – the timing of market data may be as crucial as its actual value.

Another issue arises from at-the-money options with volatile market data. When a trader expects an inflow of assets, he takes steps to hedge his position and reduce his risks. The problem of last-minute decisions about option exercise is that the asset changes cannot be managed so effectively, and this can result in greater hedging costs or greater exposure.

8.10 MATURITY

The trade's maturity date is agreed and set out in the trade details during execution and booking. The following are features of a trade that reaches maturity:

- The trade is no longer subject to market risk.
- All of its cashflows are known and fixed even though they may not have been settled.

- The trade no longer makes a contribution to P&L.
- The trade changes from being live to being expired.

Reporting processes that deal with live trades will no longer report on a matured trade. Other processes used for audit and historical purposes may report on matured trades.

Final settlement date

This is the date on or after the maturity date when the final settlement has been made and no more exchanges of cash and assets need to occur. This is the point when the trade ceases to have counterparty risk. Unless there is a subsequent dispute, the final settlement date represents the date when the counterparty becomes irrelevant to the trade.

8.11 EXAMPLE TRADE

In trading language:

a. 2Y Swap
b. Fixed: GBP 3%
c. Float GBP LIBOR + 30bp
d. Nominal GBP 10m
e. Freq: semi
f. MF
g. Act / 365
h. Payment: 2bd
i. Holiday Centre: London
j. TD: 9 June 2009.

Translation

a. This is a two-year swap with
b. one side fixed paying 3% notional in GBP.
c. The other side is floating rate set at LIBOR fixing plus 30 basis points (which is plus 0.3%).
d. The nominal for calculation is GBP 10 million.
e. Payment is made semi annually using a
f. modified following business day convention and
g. an actual divided by 365 day count convention.
h. Settlement date for each fixing is two business days after the accrual date.
i. Business days are defined as working days in London.
j. Trade is transacted on 9 June 2009.

The trade lifecycle

9 June 2009

10:28 Trader checks he has sufficient counterparty line to deal

10:29 Trader checks this trade will not breach his personal and desk trading limits

10:30 Deal executed by trader

11:05 Trading assistant books basic deal details into booking system

11:25 Middle office book rest of trade into system, asking trader to confirm missing details

11:30 Trading system generates accrual and payment dates for this trade

14:00 Back office begins deal matching

14:40 Back office faxes confirmation to counterparty

14:45 Counterparty phones with queries on settlement details

15:50 Confirmation agreed with counterparty

17:30 Official market data download enters valuation system

18:30 Pre overnight process completes satisfactorily

20:30 Overnight process begins

20:30 This swap trade enters valuation and reporting system

20:30–03:00 Trade is valued and reported in a slew of overnight reports on a single and aggregated basis.

10 June 2009

07:30 Trader checks his P&L and the new trade have valued correctly. Also checks a variety of trading reports including P&L explained (see Chapter 14)

08:00 Product control check P&L and other overnight reports

08:00 Market risk start using the new trade to view current market exposures, VaR etc.

08:00 Credit risk monitor effect of trade on counterparty exposure.

11 June 2009

Trade appears on weekly balance sheet report.

30 June 2009

Trade appears in its first month end report.

11 June 2009 to 9 December 2009 (first accrual date)

Trade appears every day on all relevant reports and is monitored. Trader will hedge expected cashflows. Management will monitor profitability of trade and exposure it has caused. Control functions will ensure that market, credit and other risks are known and contained within appropriate limits.

9 December 2009 (first accrual date)

11:00 LIBOR fixing is taken and entered into trading system

11:02 Trading system calculates a net receipt of GBP 34,000 is due on payment date

11:30 Back office confirms payment amount with counterparty and rechecks settlement instructions.

11 December 2009 (two business days after accrual date)

07:00 Settlement instruction is generated

08:30 Settlement is enacted

08:45 Back office check payment has arrived of the correct amount (and so on for all accrual and payments).

9 June 2011 (expiry date)

11:00 LIBOR fixing is taken and entered into trading system

11:02 Trading system calculates a net receipt of GBP 37,500 is due on payment date

11:30 Back office confirms payment amount with counterparty and rechecks settlement instructions

20:30 Trade rolls off system and is booked into matured trades system. It no longer appears on trading and P&L reports.

13 June 2011 (final settlement date, two business days after expiry date)

07:00 Settlement instruction is generated

08:30 Settlement is enacted

08:45 Back office check payment has arrived of the correct amount.

8.12 SUMMARY

A series of processes are applied to a trade at different stages of its life. Any person working in investment banking should understand these processes, when they occur and how they affect the trade. Managing various parts of the trade lifecycle is the core activity of most business functions in the bank.

CHAPTER 9

Cashflows and Asset Holdings

The trade is an instruction to carry out various asset and cash exchanges at one or many points after execution. The trade lifecycle is a means by which executed trades are turned into cash and assets.

We define cash to be an amount of money denominated in any recognised world currency. An asset is a holding of something other than cash. It is convenient, however, to have one term to describe the flow of cash or assets. So in this book, we use the generic term ‘cashflow’ to mean the flow of either currency or commodity.

An asset holding is a position in currency or commodity. A cashflow will add to or subtract from the holding. The effect of a trade is to change the holdings by means of cashflows. A holding differs from a trade because it does not expire.

Holdings are defined by type and amount. For example, a bank might have the assets listed in Table 9.1.

Let us work through an example trade and see how holdings and cashflows come together. We are going to use the more unusual case of physical settlement to show the movement of commodity as well as currency. The holdings are listed in Table 9.2 and the cashflows in Table 9.3.

Bank de Nord based in France buys a European call option on gold

Today: 22 July 2009

Strike: USD 1000 per troy ounce

Delivery: physical

Notional: 1m troy ounces

Maturity: 1 year

Premium: USD 0.2 per troy ounce

FX: 1 EUR = 1.15 USD on 22 July 2009.

We can summarise the generic effects on holdings and cashflows of different times in the trade’s life in Table 9.4 and in Figure 9.1.

TABLE 9.1 List of assets

Asset type	Unit	Amount
GBP		3,400,000,000
USD		77,254,590
CHF		19,584,020
EUR		270,030,992
Palladium	Troy ounce	31,230
Cocoa	Tonnes	732,400
WTI Crude oil	Barrels	2,341,892
Shares in France Telecom		74,504
Shares in BP		1,703,200

TABLE 9.2 Holdings

	USD	Gold (oz)	EUR	Notes
Before trade	0	0	500,000	1
Fx for Funding	200,000	0	326,807	2
Trade settlement	0	0	326,807	3
Bank loan	1,000,000,000	0	326,807	4
Exercise	0	1,000,000	326,807	5

TABLE 9.3 Cashflows

Date	Asset	Amount	Notes
22 July 2009	EUR	–173,913	2
22 July 2009	USD	200,000	2
24 July 2009	USD	–200,000	3
22 July 2010	USD	1,000,000,000	4
26 July 2010	USD	–1,000,000,000	5
26 July 2010	Gold	1,000,000	5

Notes

1. Before the trade is entered into, Bank de Nord holds EUR 500,000, no USD or gold.
2. Bank de Nord is about to execute the trade and so converts enough of its EUR holding into USD to be able to settle the trade; this involves two cashflows: one out of EUR and the other into USD.
3. Two days after execution the trade settles and Bank de Nord must pay its premium in USD to the counterparty. This involves one cashflow out of USD.
4. Exercise day is 22 July 2010. On that day, the spot price of gold is USD 1010 per troy ounce, making exercise worthwhile. Bank de Nord contacts its counterparty to indicate it wants to exercise its option. On the same day it needs to arrange funding to purchase such a large quantity of gold. There is one cashflow which is the loan of USD 1bn coming into its account.
5. The exercise of the option actually occurs on the exercise settlement date which is 26 July 2010. This involves the purchase of gold at the struck price of USD 1000. There are two cashflows, payment of USD and reception of gold.

TABLE 9.4 Holdings and cashflows

Before Trade	Original set of holdings	No cashflows
On execution	Original set of holdings	Anticipated cashflows
During life	Some holdings are altered as cashflows occur	Actual cashflows may have occurred and anticipated cashflows remain
After maturity	New set of holdings	No more cashflows

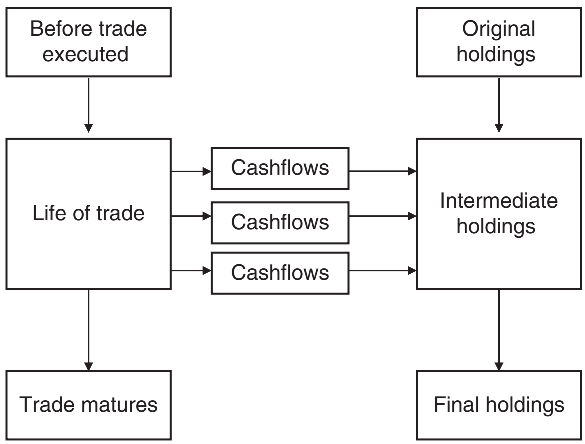

FIGURE 9.1 Cashflows and holdings

Note that the cashflows can be of three distinct types:

- known date and known amount
- known date with unknown amount (eg floating rate notes or swaps)
- unknown data and amount (eg options or insurance products).

9.1 HOLDINGS

Holdings are not static. Interest payments and other charges may add to or detract from their size.

How to treat asset holdings is often a very tricky question in considering lifecycle trade processes. Much emphasis is placed on the trade, because it is the focus of the institution's activities and it has a clear start and finish point. Holdings fall into a somewhat ill-defined region of the lifecycle because:

- they have no defined start and finish points
- they arise both because of trades and independently of trades – an institution might have a holding for historical reasons or through non-trading activities
- they are not of direct relevance to traders, being the by-product of trades and other activities.

There are many reasons why the holdings are just as important as the trades. They require accurate and comprehensive processes to manage them. Holdings:

- determine the composition of the balance sheet
- can be used to check if trade processes have worked
- reflect the value of the financial entity
- are subject to risk
- enable trading to occur by funding trades and acting as collateral for trades.

We saw above that holdings can be consolidated into type and amount. This allows us to treat a holding generically in the processes no matter whether it is lead, cattle or currency.

9.2 VALUE OF HOLDING

The holding has two aspects of value. Its amount is the expression of its value in its native unit of holding. In order to get an aggregated view across all holdings, it is, however, necessary to convert each holding into a common unit. This is done via the reporting currency.

Table 9.5 shows an example list of holdings with reporting currency EUR.

By looking at current market prices for each holding, it can be converted into an equivalent amount in the reporting currency. These amounts can be summed for an expression of the overall value.

Another reason for representing the value in the reporting currency is to get an idea of risk. Each holding is a risk to the company holding it, because market prices may change. A feel for the exposure to each underlying holding can be determined

TABLE 9.5 Example list of holdings with reporting currency EUR

Asset	Native Currency	Value in native currency (m)	Value in reporting currency (m)
GBP	GBP	6.4 m	7.070
USD	USD	77.25 m	52.751
CHF	CHF	19.58 m	12.898
EUR	EUR	270 m	270.000
Palladium	USD	5.85	3.995
Cocoa	USD	0.1725	0.118
WTI Crude oil	USD	1.23	0.840
France Telecom shares	EUR	0.256	0.256
BP shares	GBP	0.004	0.004

by varying the market price of each one individually and seeing the overall effect on the total reporting currency value (see Chapter 10 on risk management).

Due to these two aspects of value, most financial entities will keep track of the amount they hold in the native unit and value it daily in the reporting currency. To convert everything into reporting currency and lose the native amounts would be unwise, because it would be hard to see whether a change in value was caused by an underlying change to the amount held or by a change in market prices.

To value a holding we need to mark it against the medium for reporting, which is usually known as the reporting currency. This only holds for current prices and so the value is only a snapshot in time. By converting to the reporting currency, we can aggregate all holdings into one amount. We can perform generic risk analysis by varying market prices and looking at their effect on this total value.

There are two main approaches to handling both trades and holdings. Either they can be processed in different systems or consolidated into one. Since trades and holdings are fundamentally different objects, it is sometimes very hard to integrate them because each one has to be treated differently. One possible solution to this problem is to treat a holding as a perpetual trade. In this way:

- value of the holdings and the trades can be consolidated
- risk can be monitored and managed across both simultaneously
- consolidated reporting of asset holdings and trades is facilitated
- actions on holdings such as interest payments can be handled the same way as actions on trades.

9.3 RECONCILIATION

Whether or not holdings and trades are integrated, there needs to be a means by which trades can make cashflows and these cashflows cause a change in the holdings. The nostro accounts, described in section 8.5, are a means of holding foreign currency. Nostros only apply to cash holdings. Alternative means must be found for handling security holdings (such as equities) and commodities.

At various points in the trade lifecycle, a reconciliation needs to be made between actions the trade should have caused and what has actually occurred. Among these reconciliations, is a check between the historic cashflows of the trade and the actual change in holdings. If the cash, commodity and security holdings are in one system, each with the same way of reporting, the job of reconciliation becomes much easier and less error prone.

Much middle and back office time is spent chasing issues arising from non-reconciliation. Sometimes it turns out to be unnecessary as there really was no problem but the systems were inadequate to perform a true reconciliation. At other times, there is no mismatch reported, but in reality there are differences. Either fault is expensive and puts the company at risk.

9.4 CONSOLIDATED REPORTING

The aim of consolidated reporting is to be able to report answers to questions, such as

- What is our total holding?
- What will be our total holding in six months' time with the current trades on the books?
- Are we making money?
- Where are we making money?

All business functions benefit from having information reported in a consolidated format. Having to interrogate different systems for different pieces of information makes reporting much harder. Also, different systems will store results in different ways and at different levels of detail. It may thus be impossible to aggregate across systems to the required level of detail. Even when data is stored in different systems, the aim should be to maintain it at its lowest possible level – that way aggregation can be done later and information is not being lost.

9.5 REALISED AND UNREALISED P&L

A trade with expected cashflows can be valued and compared to the value at execution and thus a profit or loss recorded. This is unrealised P&L, because it is not certain. Market forces might alter the amount of the cashflows (for trades such as options). Even when the future cashflows are known, their value is still dependent upon interest rates and foreign exchange.

Realised P&L is when a trade is bought at one price and sold for a different price – the change in value is certain.

A change in asset holdings is a realised profit or loss in the unit of the holding. The P&L in the reporting currency is however unrealised until the asset is sold, because it is still exposed to the market price of the asset. For example, if as a result of a day of trading my CHF holding has gone from 2.5 million to 3.3 million, I have a realised P&L of CHF 0.8 million. But if I report in euros my P&L can only be estimated from the CHF/EUR rate and is therefore unrealised.

9.6 DIVERSIFICATION

Most financial entities will try to maintain a balance in the range and size of the assets they hold. On the one hand, they want to diversify their risk, not putting all their eggs in one basket. On the other hand, they want to be able to manage the risk on assets they know and understand and not be caught holding an asset for which they have little expertise.

As traders tend to deal in specialist areas, it is left to business managers to define a diversification strategy and market risk to monitor the breadth and depth of exposure to different assets across the organisation.

9.7 BANK WITHIN A BANK

Traders must raise funds to make their trades. They can do this from the treasury desk at their own institution or go into the market to borrow money. Additionally, they must post collateral on exchange-traded deals and on OTCs, where the counterparty insists on a collateral arrangement. In risky areas, traders or trading desks may have to keep reserves of cash ring-fenced and separate from their trading activities, in order to make up for market reverses. That way it is the individual rather than the institution that carries the market exposure.

For all of these reasons, many firms set up internal bank accounts for individual trading desks or for traders within the desks. These might be over a range of currencies and receive interest when in credit or pay interest when overdrawn. This is a tighter way of binding the traders to the cash holdings of the firm and ensuring that the cost of funding, collateral and risk is attributed to those using it. The responsibility of managing one's own account is thought to be more motivational than managing an account shared across an entire division or the entire company.

Of course any money held in these individual accounts belongs to the firm and shows in the balance sheet. The disadvantage of their use is the extra processing and reporting required to keep accurate records – for small hedge funds or asset managers this may outweigh the advantages.

9.8 CUSTODY OF SECURITIES

Trades on certain assets such as equities and bonds involve the transfer of documentation relating to the asset holding. In the case of equities, the purchaser or holder of shares must prove their ownership in order to receive a dividend. The same is true for bond holders in respect to coupons and the final redemption. Securities can be either registered or bearer.

Registered securities

The issuer will maintain a list of the holders of the security typically by employing a registrar or transfer agent. The essential details such as the name and address of the holder and the quantity and date of holdings will be recorded. When a dividend or coupon payment is due, the issuer will easily be able to arrange payment to the registered list of beneficiaries.

The owner of the registered security must still anticipate payment and check that they have received the correct amount and that there was no mistake in the registration process. When changes occur, such as selling some or all of the holding or purchasing additional holdings, the registry must be updated accordingly.

Bearer securities

These securities are not registered and are more commonly associated with bonds. The issuer will print certificates which provide proof of ownership. When a sale is processed, the seller will transfer the relevant number of certificates to the purchaser. Bearer securities are very similar to ordinary bank notes in the sense that anyone holding them can claim full rights of ownership. Although it is the responsibility of the issuer of a security to make payments in accordance with the schedule of coupons, these payments cannot be automated because the issuer is unaware of the holders. Therefore the bearer will initiate the payment process by presenting the coupon (which is a detachable part of the certificate) to the issuer.

Clearly bearer securities present the risk of loss or theft. In addition, they place the burden on the holder to claim his payment. If he is late he will be missing the interest he could have earned on the payment had he claimed it on time.

Use of custodians

Where a custodian is employed to handle and hold securities such as shares, the custodian will normally receive the dividends. The custodian will be expected to check the details, collect the payment and pass it on to the true owner.

9.9 RISKS

When trades, cashflows and asset holdings do not match up there are problems. Either the systems are not reporting what is going on, or the processes are not being properly executed – both sources of major operational risk. Since these activities and measures are so intrinsic to the whole trading process, it is important that proper systems and controls are in place for managing them.

9.10 SUMMARY

Trades cause cash and assets to change hands. Such transfers are handled by various lifecycle processes and carry their own risks.

CHAPTER 10
Risk Management

In this chapter, we consider the management of a very specific type of risk which is on-going through the life of a trade or group of trades. Even though it is commonly known as risk management, the term is used in the context of market risk actively managed by traders and not in relation to counterparty, operational, reputational, legal and other risks. As explained earlier, trading involves actual and potential flows of assets. The price of assets varies according to market conditions and so trading carries with it market risk. We define risk management as the process of managing this market risk.

We now look at how risk management impinges on different people in the trade lifecycle.

10.1 TRADERS

Risk management forms a major part of the daily life of the trader. By trading, a trader is taking on positions that expose him to the risk of market prices changing.

Desirable exposure

This exposure might be desirable, as in the case where he expects the market to move in a certain direction and wants to take advantage of this move and convert it into profit. For instance, expecting the price of sugar to fall, the commodities trader sells a future in sugar. When the future is due for delivery he can go into the market and purchase the sugar to satisfy the obligations of the future at, hopefully, a lower price than he received for it.

Undesirable exposure

When the trader is uncertain of the direction of a particular market price, he will not want to be exposed to it. He may be uncertain either because he has no clear view or because he has no expertise or interest in that particular market – any exposure he has acquired is as a by-product of another trade. For example, our sugar trader knows all about sugar, but has no expertise in foreign exchange. His sugar trade is in dollars but his domestic currency is yen and so he will automatically be exposed to the USD/JPY exchange risk by dealing in sugar.

10.2 RISK CONTROL

The control department's interest in risk management is to ensure that it is being carried out, that limits are being adhered to and that management and other relevant people are cognisant of all the market risk in the organisation. Chapter 11 describes the market risk control function in detail.

10.3 TRADING MANAGEMENT

The trading managers will also monitor risk. They need to ensure that traders are keeping to the approved trading strategies. Part of these strategies will involve staying within limits set by the management and the market risk control department. If these limits are breached, the management will have to offer explanations and may be involved in tactical fire-fighting to reduce exposure.

10.4 SENIOR MANAGEMENT

Senior managers have to balance legitimate risk taken in order to make profit, with unnecessary risk – putting the assets of the financial entity in potential danger. They need to ensure proper risk management is being conducted at all levels of the organisation. They also need to monitor the size and composition of the market risk to ensure it is manageable and balanced. In effect, they are acting as referee between traders and risk control.

10.5 HOW DO RISKS ARISE?

In order to get a feel for the various market risks that can arise, let us look at a selection of common trades, their risks and how they can be offset. The risks described in Table 10.1 relate to those which are actively managed by traders. (Other market risks, such as prospective dividend yields, lending fees and taxation, also affect the price of a trade but may not be actively risk managed.)

TABLE 10.1 Exposures

Trade	Exposures	Offset by buying or selling
Spot	Spot price, interest rate, FX	Spot, interest rates, FX
Futures/Forwards	Spot price, interest rate, FX	Spot, shorter dated future/forward, interest rate, FX
Options	Spots, futures, interest rate, FX	Spot, futures, interest rates, FX
Bonds	Credit of issuer, float or fixed income interest rates	Credit default swap, interest rate swaps
Group of equities	Many equity prices	Trade on index or individual equities

Spot trades

Entering into a spot trade will increase or decrease the exposure to the underlying asset (currency, equity, bond, commodity etc). If funding was needed to put on the trade, there will also be an exposure to interest rates. Additionally, there may be some foreign exchange risk. This applies even with a non-foreign exchange asset where, for instance, the reporting currency of the institution is different from that of the trade.

Futures and forwards

The promise to buy or sell at a fixed price in the future obviously brings exposure to the underlying spot price and interest rates with again the possibility of foreign exchange risk.

Options

Unlike forwards, the option delta risk is non-linear. Unique to options is volatility risk, known as vega (see section 10.9).

Exposures to fixed or float income streams

These can be offset by swaps going the other way. For instance, someone expecting income from a fixed coupon bond can offset his exposure by selling fixed for float swaps.

Exposure to debt

Debt products, such as bonds, create exposure to the default of the issuer. This can be offset by purchasing credit protection in the form of products, such as credit default swaps.

Exposure to group of products

A group of different underlying exposures might have their risk offset by trading a basket or index product.

10.6 DIFFERENT REASONS FOR TRADES

Many trades crop up frequently as a means of offsetting risk. When used in this context, they are known as hedging trades. Some trades have been created expressly for the purpose of offsetting risk and act like insurance products in everyday life – a good example is the credit default swap. Other trades started life as a means of offsetting risk and then became traded in their own right, such as interest rate swaps.

One of the most common hedging trades is spot foreign exchange, which is also actively traded for non-hedging purposes. Generally speaking, more complicated trades use less complicated trades for hedging.

10.7 HEDGING

Whether the risk is desirable or undesirable it still requires careful handling. It must be monitored and action taken when it reaches what the trader considers an unacceptable level. The process of managing risk on current exposures by buying and selling other trades is known as hedging.

Whatever policy is adopted for hedging, the trader has to watch and act upon a wide variety of circumstances. He needs to:

- know his current exposure to all underlying market risks
- know the acceptable limit of these risks
- decide the best method of hedging, assess its benefit in reducing his exposure and calculate the cost of putting on hedging trades.

All the time he is monitoring his positions and his risks, which will be changing as the market data changes. Whenever he puts on a trade or investigates a potential trade, he must be aware of how this will affect all his market exposures. The process of trading has been compared to keeping hundreds of saucers spinning on top of poles. It calls for the ability to process vast amounts of information and make very quick decisions.

10.8 WHAT HAPPENS WHEN THE TRADER IS NOT AROUND?

The requirement to hedge applies to all traders, but the degree of connection to the ever-changing market data landscape varies. Some trading strategies require constant adjustments to market conditions, others need less attention. The question then arises as to how positions and risks are managed when the trader is away from the desk.

Availability of other traders

Most trading desks consist of more than one trader. If a trader is temporarily away intra-day, sick or on holiday, other traders trading the same or similar products can step in to maintain the risk management on his behalf. In fact it has become a regulation that all staff connected to the front office activities of investment banks take a period of two weeks away from their positions each year. This is to allow any irregular or illegal activities to be noticed without the perpetrator being around to cover his tracks.

Many markets are open around the clock, especially in interest rates and foreign exchange. When traders in one place go home for the evening they may hand over their risk management to those in another location. On at least one occasion, London traders in exotic foreign exchange trades stayed at their desks throughout the European night, dealing on the Australian and Asian markets.

This has occurred on other trading desks too when important news affecting the economy is due at night. One example is a bank providing food and sleeping facilities for traders on the night of a tight American presidential election.

Stop and limit orders

When no other traders are around to deal on their behalf, the traders can set up automatic orders to be executed when certain market conditions arise. These orders may be placed with brokers or via an electronic exchange.

Stop orders To limit the loss incurred in holding on to a position or to prevent erosion into a profit, a stop order can be placed. This means the order is activated when the price falls below or reaches above a certain value, depending on the direction of the holding.

For example, aluminium is trading at USD 1.972 per metric tonne and Brenda holds aluminium. She places a stop order to sell at USD 1.962 to prevent her being exposed to unlimited losses should the price of aluminium start falling.

Conversely, Colin is short GBP which is trading at 1 GBP for 1.65 USD. He places a stop order to buy at 1.68 to prevent exposure to high rises in the price of GBP.

Limit orders If a trader does not want to buy at current prices but wants to take advantage of a drop in prices overnight or while he is away, he can place a limit order. This guarantees the upper limit for a purchase, or conversely the lower limit for a sale.

10.9 TYPES OF RISK

We shall now discuss the types of market exposures which require risk management. An overview of the techniques for calculating these exposures can be found in Chapter 26.

Risk measures

The risk measures are designated by Greek letters of the alphabet, except for Vega which is the brightest star in the Lyra constellation. It was also known as Kappa which is a Greek letter, but this is less common nowadays.

Delta This is a measure of how the price of a trade moves when the underlying asset price moves. The value of delta may change as the underlying asset price changes. For example, an option in IBM shares might have a delta of close to one when well in-the-money – that is, every dollar change in IBM share price leads to a one dollar gain in option value. Conversely, when well out-of-the-money, a change in IBM share price of one dollar results in a negligible change in option value, so the delta is close to zero.

Gamma Gamma is a measure of how delta changes. In the example above, when the option is well in or out-of-the-money, the delta stays very similar as spot changes and so gamma will be very small. Near to the strike price, the delta changes quickly indicating a high gamma. Gamma is a second order measure and is equivalent to the second differential of trade value, with respect to underlying spot price.

Vega (sometimes known as kappa) Vega measures the change in trade value caused by a change in the volatility of the underlying asset. Volatility is an input to many trade calculations such as options. Because of the way options are priced, an increase in volatility makes both put and call options worth more.

Rho Rho is a measure of the exposure to interest rates. Interest rates have a bearing on the price of many trades, even when they are on other underlying asset classes. Rho is calculated in a very similar manner to delta, except that the interest rate curve is bumped and the change in trade value caused by the bump is measured.

Theta Theta is a measure of how the trade value changes as time passes. Usually the trade is revalued as if the current date were one or seven days hence, keeping all market data constant and the difference in value is the theta or time decay. Although time decay is unavoidable, it is useful to have a measure so that planning for the future can be undertaken.

Additional risks for credit products

Since credit derivatives have a different set of input market data, they have some additional risks beyond those described above.

Default risk (or jump to default) A default is a binary, irreversible event – a name has either defaulted or it has not. Default risk is a measure of the change in trade value when one name in isolation is assumed to have defaulted, with the payout determined by the recovery rate.

Recovery rate This is calculated on every name in the credit derivative by increasing the recovery rate for that name, leaving all the others unchanged, revaluing the trade and finding the difference in value caused by the recovery rate change.

Correlation risk This is a measure of how a change in correlation affects the trade value. The precise mechanism for perturbing the correlation will depend on which type of correlation assumption is being used in pricing the trade. A common type of correlation used for pricing a single tranche of a CDO is *tranche correlation* which is the single correlation assumption for all assets in the reference pool. Suppose it is 4%. Then the correlation risk is calculated by revaluing the CDO with a tranche correlation of 4.01%, the difference between this value and the original being the correlation risk.

Since recovery rate and correlation are major factors on the credit derivative and are notoriously difficult to estimate, their sensitivity measures are very important to give a feel for how much they affect the value of the trade.

Risks in general

The advantage of the sensitivity calculations we have described is that they are all expressed in the same terms as the valuation of the trade itself. For example, if the trade has an NPV expressed in euros then the theta risk will also be in euros. This means aggregating risk for many trades is easy, so that an entire portfolio or trading book can be managed effectively.

Dreaming ahead

Predicting how the future might look is an important part of risk management. With a complicated trading book, many anticipated future trade events and cashflows and a plethora of future market data, it is sometimes very difficult to work out what the trades will look like at some point in the future, let alone their future values.

Dreaming ahead began as a trading exercise and developed into an additional risk management tool in a front office trading system. Imagine that we are standing six months from now and assume no new trades have been traded. What will our portfolio look like? Which trades will have expired, which will have received coupons and dividends? Which will be near to exercise?

Now take the predicted future values of market data. The six-month forward FX rate of today will be the dreaming ahead spot rate, the 12-month forward will be the new six-month rate and so on.

Taking the dreaming ahead trading and market data landscape, we can revalue our portfolio and attempt a glimpse into the future. Of course this method assumes that today's future prices are an accurate prediction of what will actually happen, but provided we are aware of the assumptions being made, the exercise may be useful.

10.10 TRADING STRATEGIES

Before examining hedging strategies, it is worth mentioning that the kind of hedging employed will be determined by the overall trading strategy. It is beyond the scope of this book to discuss trading strategies in detail, but we point out two types of trading.

Front book

The aim of this type of trading is for a trader to take advantage of his position as a market maker. He takes no view on the future direction of the underlying market nor does he seek a profit from directional trading. In fact he seeks to eliminate his exposure to market changes by a complete hedging of market risk. His profit comes from buying low and selling high on the same products, often by means of the bid/offer spread and typically within a short period of time (generally less than a day and often as short as a matter of seconds).

Back book

The trader has a view on the future direction of the underlying market and wants to profit from his view. The view might be:

- prices will go up – he will then be long the underlying (buy now, sell later)
- prices will go down – he will be short the underlying (sell now, buy later)
- he does not know whether prices will go up or down, but thinks they will move sharply in either direction (this is called being long volatility).

The back book trader will construct his portfolio by buying and selling trades to capture the direction he expects. He will also use hedging to eliminate extra risks and limit existing risks if his predictions are wrong.

10.11 HEDGING STRATEGIES

The aim of hedging is to offset potential future loss. Hedging costs money because every new trade has to pay at least the bid/offer spread plus an operational cost. There may be additional costs, such as transaction or handling fees and stamp duties. Every trader will evolve his own strategy to offset his risk in the cheapest and safest manner. Here we discuss two general examples of hedging strategies.

Delta hedging

Remember that delta is a measure of how much the trade gains (or loses) in value for every unit change in spot price. Delta hedging seeks to reverse the delta risk by entering into a trade, creating an equal and opposite change in value to the original trade for a movement in the spot.

Suppose we bought a call option with notional 10,000 on the French CAC share index which is now trading at 3402. At this time, our delta is 0.5 which means we gain 5000 if CAC rises to 3403, but lose 5000 if it falls to 3401. Now, if we sell a future on CAC with notional 5000 at 3402, we should reverse our position.

Now let us suppose that when spot reaches 3422, the delta is 0.7 and at 3382 it is 0.4, as seen in Table 10.2.

It can be seen that as delta changes, the hedge fails to eliminate all of the risk. A delta hedging strategy requires constant hedging in order to achieve its purpose. After a while, many hedges will have been put on. The idea then is that the overall book of original trades plus hedges can cover most or all of the potential deltas arising from changes in spot. The hedging strategy is applied to the book, not the individual trade.

Stop-loss hedging

The purpose of this strategy is to limit the losses caused by the market going against the direction it was expected. There are several ways of achieving stop-loss. As we

TABLE 10.2 Delta hedging

Price	Delta	Gain from option of increase of 1	Gain from future of increase of 1	Total gain
3401	0.5	−5000	5000	0
3403	0.5	5000	−5000	0
3421	0.7	−7000	−5000	−2000
3423	0.7	7000	5000	1000
3381	0.4	−4000	−5000	2000
3382	0.4	4000	5000	−1000

mentioned, there are stop-loss trades that are activated at certain market prices. In addition, a call or put option can serve a similar purpose.

Suppose that a trader expected nickel prices to rise. If he bought a put option on nickel, when prices fell below the strike he would gain and offset the other losses in his portfolio. Before the price falls to strike, the option is not making an impact on either profit or loss (apart from the fixed premium he has paid). Thus his downside has been capped, leaving him the ability to take advantage of potentially unlimited upside.

10.12 SUMMARY

Good risk management is intrinsic to the success of a financial trading organisation. It involves the formation of a sound strategy and skilful implementation by means of hedging techniques. Risks must be identified, quantified and controlled. Management, risk control and trading functions must co-operate to use risk to further profit in a controlled and transparent manner.

CHAPTER 11

Market Risk Control

The purpose of the market risk control department in a financial entity is to monitor and control the exposure to market risk. Market risk is the risk to changes in market conditions.

We can illustrate market risk with a simple example. Suppose one buys an oil painting as an investment. The price paid for the painting was GBP 150,000. The value of the painting on any given day is the amount someone in the market will pay for it – this could be more or less than the purchase price. We say the oil painting is subject to market risk. The risk is the amount that is lost by a change in price. If the painting could only be sold for GBP 100,000, the risk would be GBP 50,000. In this case, it is only subject to one type of market fluctuation, but in general an asset can be subject to many different market forces. In addition to looking at day-to-day price fluctuations we can look at market risk in other ways, for example VaR – what is the maximum loss I could reasonably expect to make in a day (week, month, etc) – and some of these approaches are addressed below.

Of course for a painting, market risk is one of the less important risks – fire, damage and theft are other more relevant risks. For financial assets too there are other risks – legal (can we be sure we own it?), counterparty (credit) risk, documentation risk and others. This chapter just assesses market risk.

Before examining the process of market risk management, let us look at various ways to consider market risk.

11.1 VARIOUS METHODOLOGIES

Measurement of market risk is not an exact science. A market risk control department might employ one or many of the common methodologies we describe below. In addition they may develop their own means to monitor market risk tailored to the products their company trades.

Scenario analysis

One technique for assessing market risk is to use scenario analysis. This means creating a set of market conditions and assessing how much the firm would have gained or lost under those conditions. The difference between that and the current position is the risk. The scenarios might be run as relative to current prices or as absolute values. Examples of relative scenarios would be:

- all share prices down 3 standard deviations
- all bond prices down 30%
- all market data inputs down 25%.

Absolute scenarios could be:

- foreign exchange rate between GBP and USD set at 1.00
- recovery rates for credit products at 1%
- all shares set to their lowest point in the last two years.

Alternatively, scenario analysis might try to replicate the effect on the market of a particular event in history such as:

- Black Wednesday (16 September 1992)
- 9/11 (11 September 2001)
- Lehman crisis (15 September 2008).

The process here would be to move each piece of market data by the same proportional amount and direction it moved on the day of the event in question.

The purpose of scenario analysis is to measure the risk caused by something unusual but not impossible occurring and to factor in some correlation between different types of market risk (as opposed to sensitivity analysis which perturbs each set of market data independently).

Value at Risk (VaR)

VaR is another risk measure. It attempts to state the maximum loss that will occur within a period of time. Since the maximum loss is in effect unlimited, the VaR puts a probability on the maximum loss occurring. For example, there is a 95% probability that the maximum one-day loss will be 12 million euros. In other words, 19 times out of 20 the loss will not exceed 12 million euros. The converse is that once every 20 times (about once a month) the loss will be more. It may not be very comforting to the board of a firm to know that VaR is likely to be exceeded once a month, but it is an industry standard measure and helps to make comparisons with other organisations to compare their risk exposures.

Usually VaR is computed over an aggregation of trades in one division or from the whole organisation. It is given target limits and breaches of these limits require action in the same way as other market risk limit breaches.

The VaR calculation Here we explain the processes involved in calculating VaR.

1. Decide the time horizon VaR is quoted over a time interval known as the time horizon. Since market data changes every business day, the most common time horizon is daily. Some less liquid trades may receive market data updates less frequently, in which case VaR may be quoted over a week or month. Due to the time effect of risk, the longer the time horizon, the greater the risk. Comparisons between different VaR figures must take into account the time horizon on which they are being quoted.

2. Assemble the market data This is far from simple. The market risk calculation is in theory attempting to replicate every possible combination of market data. Some simplifications have to be made because each piece of market data is technically a random variable and its connection (or correlation) to other market data is very hard, if not impossible, to determine.

3. Decide the calculation methodology There are two basic approaches – stochastic or historical.

- Stochastic processes

  If a piece of market data is assumed to be a normal distribution then we can ascribe different probabilities to different values. For example:

  1% probability of 140,

  5% probability of 155,

  50% probability of 182 and so on.

  This removes the need for a large amount of data but ignores correlation between different market data.
- Historical data

  We go back over a certain period of market data, apply every day-on-day change in all market data to the set of trades under examination and for each day we get a different total value. Suppose we call them $V_1, V_2, \ldots V_{200}$ for 201 different dates of data (which give 200 differences). We then take the 1% worst value and say that we are 99% confident that the loss due to market data will not exceed that value. This method suffers the drawback of being totally dependent on one period of history. If, for example, we took the last two years, we are assuming that future market changes are likely to mimic data changes only from the last two years.

4. The calculation The heart of any VaR calculation is the valuation of the trade or portfolio under consideration with one set of market data. The task is then to vary the market data in enough ways and enough times to produce realistic probability measures for the risk.

The more scenarios considered, the more realistic the market risk output. Therefore, market risk managers are always seeking better hardware to run their processes, more market data and faster computational capabilities. Usually this reaches a point where more calculations do not significantly alter the output risk and then the increase in the number of iterations can cease.

Problems with VaR The use of VaR as a measure of risk has become less fashionable. Stress and scenario testing are taking over because VaR does not predict how much you will lose if an event occurs. VaR is very dependent on correlation between various market forces. This gives rise to two problems. Firstly correlation tends to vary considerably. Secondly in crisis situations correlation tends to be very high.

Instantaneous measures of risk (sensitivity analysis)

The market risk control department may want to see how an instantaneous change in underlying price affects the value of a trade, book, department or the entire financial entity. The most common measure of instantaneous risk is known variously as DV01, PV01 and delta – equivalent terms denoting the first order derivative, that is the change in value given a small change in underlying.

DV01 can be measured across multiple trades by taking each underlying and changing its price by a small amount, calculating the change in aggregate value of trades.

For example, suppose aluminium has a spot price of 2230 dollars per tonne. The DV01 of aluminium would value the book with current prices (say it is 5,030,440 dollars). The aluminium price would be moved to 2231 and the book value recalculated (say it is now 5,037,625). Then the DV01 of aluminium is 7185 dollars (5,030,440 – 5,037,625).

The DV01 can be analysed for each underlying to give a feel for where the market risk is distributed.

In addition to DV01 there are other first and second order risk measures such as time decay (theta), rate of change of delta (gamma), correlation between market forces, default event risk, volatility (vega) and interest rate risk (rho). These are described in Chapter 10. The market risk control department will allocate limits to each of these risk measures and analyse them on a regular basis to determine if and where there have been any breaches.

Apart from some foreign exchange and interest rate risk common to most products, linear products only have one exposure to risk – the underlying spot price. Derivatives, such as options, have several risks known collectively as 'the Greeks'.

Dependency upon one set of prices These sensitivity measures give some idea of how much exposure exists, given current market prices. Market risk control generally works from reports produced overnight and so they are a maximum of one day behind the current situation. Of course, as prices change, the sensitivities change with them, so delta might be 0.5 at spot 450 but 0.7 if spot moves to 475. The risk calculation will try to provide a realistic measure of how much is lost if prices move by a given number of standard deviations from their current position.

11.2 NEED FOR RISK

Trading cannot be undertaken without risk. Any trade or asset held by the institution is at risk. The success of any trader or trading department is measured by how they make use of the capital they are provided with for investment and trading while keeping within their risk limits.

A firm engages in trading a variety of products in multiple asset classes. The primary responsibility of the market risk control department is to know the amount of exposure and where that exposure lies. Then, in the event of an emergency, senior management will have enough information to make important decisions. Additionally, the institution will be protected from one individual or one desk bearing too much risk and endangering the entire company.

11.3 ALLOCATION OF RISK

Risk is divided into layers within the trading organisation. An example might be:

- individual traders
- trading desks
- division or department
- company wide.

Mindful of the regulatory limits, the board of the firm will decide the total amount of risk available. They will then allocate risk to each division and the managers of the division will allocate it across the trading desk. Each desk head will allocate his allotted risk according to the trading strategy of his individual traders.

For instance:

Overall risk: 1 billion

Interest rate division: 100 million (risk to interest rate changes)

Linear products desk: 10 million

Jenny (deposits): 1 million

Karen (futures): 4 million

Linda (swaps): 5 million.

11.4 MONITORING OF MARKET RISK

Once the risk limits have been set, the market risk control department will monitor them. It does this over different periods of time – daily, weekly and monthly – and for each of the layers of the organisation described above. Various calculations might be performed.

Illiquid products

Sensitivity analysis is possible when prices are easily available, but when a product is illiquid, it is very hard to give it a realistic measure of risk. Generally more risk would have to be allocated to illiquid products as it would cost more to trade out of them should that be necessary.

New products

When a new product or asset class is traded by the company, the market risk control team must become acquainted with it, so that some reasonable predictions can be made as to its risk profile. The problem with new trades is that there is little empirical risk data about them other than that derived from simulations. The trade has not yet been subjected to real market forces. Market risk control is generally wary of new trades. It might:

- assign a high risk to them
- limit their trading until the market is sufficiently mature and more experience is gained as to their behaviour.

The latter policy may not suit the traders, who know full well that the opportunity to really profit from a new trade is a direct consequence of their competitors having less knowledge of the product. Any advantage they might have will be reduced if the trading is limited in size or diversity of product.

11.5 CONTROLLING THE RISK

Periodically, perhaps once a week in normal circumstances, the head of market risk will meet the head of each trading desk to discuss his market risk profile. The purpose of this dialogue is to continually review the limits to make sure they are fair and reflect the current trading environment and also to discuss any breaches.

If a limit has been breached there are various courses of action that might be taken.

Take steps to repair breach

Breaches of limits are often just taken as a ‘heads up’ warning. The first response may simply be to increase the limit on a temporary basis. Longer term the trade or trades causing the breach might be reversed to reduce the risk. The trading manager might, however, argue that this is expensive and cause the loss of the expected profit from the trade.

Exception to limit

This might be granted for a fixed time in order to allow the trader to cash in on an expected profit or because of particular adverse conditions that are expected to be only temporary. Exceptions are generally recorded to prove that market risk control made the trading team aware of them. Obviously, too many exemptions will defeat the purpose of putting limits in place.

Changing the limits

The internal allocation of limits between traders might be altered to allow the one who is over the limit to take some risk from another who is under the limit. Alternatively, the trading manager might ask for extra risk to be granted. In this case, another desk or division would have to give up some of their risk to make up the difference. The reallocation between departments may require intervention of senior management in cases where risk will not be relinquished voluntarily.

Posting reserve

The traders might be so keen to keep their current positions that they will post money from their profit and loss account into a reserve account to cover the additional risk. This effectively reduces the risk because, if the money were needed, it would be taken from the reserve which is free of exposure to market risk.

Do nothing

The trading manager might provide reasons why the breach should be allowed, promising to take remedial action and ask for time to put this in place. The control department should return to review the situation after the time has expired.

11.6 RESPONSIBILITIES OF THE MARKET RISK CONTROL DEPARTMENT

Staff in the market risk control department are officers of the financial entity. They provide independent assessment of the market risk to which the institution is exposed and are accountable to the board or senior management.

Requirements

Aside from good sources of market data and sufficient calculation resources, market risk departments are very dependent on reliable trade valuation, which, as mentioned, lies at the heart of the process. They must be fully versed in the specifics of the valuation model and know its expected behaviour for extreme values. They must also understand the trades they are testing. Perhaps an analogy could be made with a pharmaceutical company that must understand the components of a drug it is testing and the workings of the human body upon which the drug will act. They must test in a variety of human conditions, especially for the unusual and more extreme states.

Relationship with front office

Ultimately, all the revenue for the trading section of a firm comes from the front office. That means all employees are dependent on the traders for their jobs, including those in the market risk control area. In addition, it is the granting of risk to trading departments that allows them to generate revenue. Hence there is a possible conflict of interests between market risk control and front office. The problem is compounded in good times, when the pressure of a successful trading desk making large profits for the organisation may lead to a relaxation in the risk limits themselves or the application of them.

In theory, there should be a three-way professional tension involving the board or senior management who allocate risk, traders who use the risk and market risk control who monitor and report on the risk. Generally, the balance of power between traders and risk control varies according to the risk appetite of the organisation.

11.7 LIMITATIONS OF MARKET RISK DEPARTMENTS

It should be clear that market risk control departments do not prevent disasters from occurring. The expectation is that, should something unusual happen, they will be able to provide the necessary data on the risk profile of the organisation at various macro and micro levels so that the extent of the damage can be assessed.

Also, they cannot possibly measure every possible disaster. Nobody can determine how much or in what way the future replicates the past. Market risk control lives in the world of the unknown, but uses the theory of probability to give some feel for exposure to risk. Understanding the limitations of market risk is very important in order to put an appropriate level of credence on its measurements.

Everything correlated

Market risk allocates risk on an asset-by-asset basis. Interest rate traders are given so much interest rate risk; commodity traders, commodity risk and so on. Most of the measurements of risk (with the exception of scenario testing) also consider each risk type separately. This means there is an implicit assumption that one type of market risk is not connected to other types of market risk. This assumption is not always correct – we have observed several episodes in the recent and distant past that have caused markets to react in concert across the range of asset classes. This means that in times of crisis markets are ultimately correlated to each other.

The tails

As mentioned, the change in asset price follows a mathematically described pattern, known as a random variable. Two or more random variables can be modelled together assuming some level of correlation between them. So we could investigate the relationship between oil prices and USD/EUR exchange rates. These models are often quite informative. But when we reach the extreme case, known mathematically as the tail of the graph, different factors come into play and cause the standard model to become less reliable. A lot of economic and mathematical work has gone into predicting tail behaviour, such as the various copula models used in credit derivatives. It is the tail that is most interesting to market risk control which is very concerned with what may happen in extreme cases.

The human factor

Risk analysis is a mathematical exercise; valuations do not have emotions. However, an important point to bear in mind is that the drivers for the valuations are the various input data and input data comes from prices set by human beings reacting emotionally as well as intellectually to events around them. Although the human factor in market risk cannot be precisely quantified, it should be taken into consideration and studies on past crises can reveal trends in human and hence market behaviour.

Balanced approach

A conservative approach would assume the worst on every occasion. This might prevent unexpected risk being incurred but could paint an overly bleak picture and restrict justified trading and profit-making potential. An optimistic approach, on the other hand, might falsely represent the true state of risk. When conveying risk information to management and regulatory authorities, the market risk control department should state the methods they adopted in arriving at their risk forecasts. They might also give a range of risk outputs according to more and less conservative measures to allow their readership to decide how cautious they would like to be in their interpretation.

11.8 REGULATORY REQUIREMENTS

Here we summarise some early regulatory requirements. A fuller discussion of regulation can be found in Chapter 16.

Basel II

The regulatory authorities adopted a set of rules known as Basel I (later superseded by Basel II). Some of these incorporate controls on levels of market risk. Here we shall briefly outline the three pillars of Basel II and then discuss one market risk limit arising from them known as capital adequacy ratio.

1st Pillar – Minimum capital requirements This sets rules that are more closely aligned with a bank's actual risk of economic loss (including a capital adequacy ratio set at 8%)

2nd Pillar – Supervisory committee 'Supervisors will evaluate the activities and risk profiles of individual banks to determine whether those organisations should hold higher levels of capital than the minimum requirements in Pillar 1 would specify and to see whether there is any need for remedial actions.'[1]

3rd Pillar – Market discipline This 'leverages the ability of market discipline to motivate prudent management by enhancing the degree of transparency in banks' public reporting to shareholders and customers'.[2]

Capital Adequacy Ratio (CAR)

A financial entity has an amount of capital. The regulatory authorities allow the institution to have a maximum amount of risk at any given time, this risk being linked to the capital by a value known as CAR.

$$\text{CAR} = \text{Capital}/\text{Risk}.$$

Basel II set the CAR at 8%. As this did not prevent the credit crunch in 2008, many governments are currently pressing regulators to review these rules.

A value of 8% means that for every 100 dollars of capital, the institution can have a total risk of 1250 dollars. (100/1250 = 0.08)

One of the issues with the calculation of CAR is the precise quantification of risk. Some products have greater susceptibility to market risk than others, and so some sort of weighting has to be applied to each product. For example, cash is nearly risk free and so has less weighting than mortgage loans, which in turn are less risky than uncollateralised loans.

The reason for the CAR limit is to give some confidence that the institution will be able to repay some of its debt should market forces act against it.

[1] Quoted from the Second Basel Accord (Basel II), issued by the Basel Committee on Banking Supervision

[2] Ibid.

11.9 SUMMARY

Trades are subject to market risk. Managing this market risk is essential to prevent widespread losses when the market changes adversely. The market risk control department sets appropriate limits for trading, monitors market risk and reports breaches to ensure that the firm has control over its market risk. In some senses the market risk department can be thought of as the largest trader within the bank – controlling all other traders and sometimes (though rarely) initiating large trades itself.

CHAPTER 12

Counterparty Risk Control

As soon as a trade is executed with a counterparty, an exposure to counterparty risk is created. Counterparty risk is when, for whatever reason, the counterparty will not fulfil their contractual obligations. The department concerned with vetting counterparties is generally called the 'credit risk' department – not to be confused with credit market risk (ie risk to changes in credit spreads).

12.1 REASONS FOR NON-FULFILMENT OF OBLIGATIONS

The non-fulfilment of the counterparty's obligations manifests itself in non-settlement or delayed settlement. Non-settlement could be because of:

1. Company default
   After executing a trade, the counterparty has ceased to be a trading entity and can therefore no longer settle the trade. This would usually arise because of some legal change of status, such as filing for Chapter 11 of the US Bankruptcy Code or going into administration.
2. Court order
   A court order freezing the company's assets would make settlement impossible.
3. Dispute
   A counterparty might refuse to settle a trade pending resolution of a dispute regarding an individual trade, or because there is outstanding litigation between the two companies involved in a trade, even though it might not be related to that trade.

In these scenarios, absolute non-settlement is unlikely. Some redemption of promised assets is usual, but these would be subject to delay and reduction in amount. For example, a creditor owed money by a liquidated counterparty at a senior subordinated debt level may only receive 40% of the full amount and might have to wait months or even years for payment.

Delayed settlement

Delayed settlement could be due to:

- ambiguity in the trade contract
- the contract may not be clear as to exactly when settlement is due or the terms of settlement might have been misinterpreted by one or other counterparty leading to a delay in expected settlement.

Mistakes in settlement process

Many settlements fail and need to be reprocessed. There are a variety of reasons for this – see section 8.5.

12.2 CONSEQUENCES OF COUNTERPARTY DEFAULT

If a settlement is delayed, not paid in full or completely missed, this will have many consequences for the company expecting it.

The first likely consequence is loss of money. Losses caused by counterparty defaults reflect badly on traders, managers, risk departments and the entire company. Many trading desks have collapsed because counterparties failed to pay their debts, even though the trading strategy was sound and correctly implemented. A counterparty default can, in one event, cause more damage than several other risks over a long period of time.

The asset that was expected to arrive on a certain date will not be there and steps will have to be taken to replace it or to manage without it. For example, if a consignment of gold bars from counterparty X was due by Wednesday and was supposed to be shipped to counterparty Y on Thursday, a delay of even one day might result in complete loss of the second trade or penalties for late delivery.

Much trading depends on managing expected changes in asset holdings, including cash transfers. When these fail to happen, trading is thrown out of balance, hurried decisions need to be made and more costly firefighting measures are required.

12.3 COUNTERPARTY RISK OVER TIME

Like many other types of risk discussed in this book, counterparty risk is time dependent. The longer money is owed, the more chance there is that it will not be paid.

TABLE 12.1 Example limits at different time periods

Time Period	Limit (EUR)
Under 3 months	10 million
3–6 months	5 million
6–12 months	3 million
12 months–5 years	2 million
Over 5 years	1 million

Counterparty risk control departments take this into account and generally measure risk and allocate trading limits as functions of time. These take the form of time intervals (known as buckets).

For example, Table 12.1 shows the trading limits Cautious Bank has with Adventure Finance.

12.4 HOW TO MEASURE THE RISK

Delayed settlement is primarily due to operational processes failing to work for one or both of the counterparties to a trade. The assessment of delayed settlement risk is mainly dependent on estimation of these risks (see the sections on booking, confirmation and settlement).

Here we consider the risk of non-settlement.

The amount at risk is comprised of:

- the total exposure to a given counterparty
- the probability of non-settlement by that counterparty
- the amount lost in the event of non-settlement.

The first of these can be measured fairly accurately by investigating all the outstanding trades with a particular counterparty. The total exposure is dependent upon the size and nature of the trades and not on the characteristics of the counterparty.

The latter two do not depend upon trades; they are hard to measure and vary between different counterparties. To arrive at an estimate of these amounts, the credit worthiness of the counterparty must be examined. Counterparty risk control departments employ various models. The most common are based on ratings allocated by rating agencies, such as Standard and Poor's, Moodys and Fitch. A counterparty with a high rating (AAA, AA+ etc.) is by definition less likely to default.

In addition, the amount of loss in the event of default (also known as the recovery rate) is estimated by ratings agencies. This is usually based on historical recovery rates of similar companies to the one under consideration.

Expected loss

Expected loss = (Probability of default) × (amount lost if default occurs on one unit of exposure) × (size of exposure)

The two key factors to be estimated are therefore probability of default and amount lost should default occur. The latter equals one minus the recovery rate where the recovery rate is the amount of money recovered on default. If, for example, one holds a bond that defaults, the issuer may still pay 40% of the bond's notional upon default and so the loss would be $(1 - 0.4) = 0.6$ of the exposure.

Historical values do not however predict the future. Some counterparty risk departments use adjustments to historical values based upon factors such as economic considerations.

One approach, which has been found to be unrealistic, is to use credit default swap rates to build an implied default rate curve for a counterparty. This is useful for deriving a risk-neutral measure for trading but provides a biased estimate for predicting future default rates. It is very similar to deriving future interest rates by using current interest rate trade prices. The bias comes because the traded forward instrument comprises the estimate of future rate plus a reward for taking risk. This extra reward component means that typically the risk-neutral measure over-estimates the future value.

Credit exposure

Now let us consider the credit exposure created by one trade. The exposure is defined as the amount the company that is owed money (or other assets) would lose if the counterparty defaults on the trade in question.

By considering the exchange of assets over the life of the trade, we can derive this exposure in each of the reporting time buckets.

Take the case of a simple loan. Cautious Bank lends JPY 200 million to Adventure Finance at 4% annual interest rate for nine months with the only repayment being at the end of the contract. Here there are two asset flows:

First settlement date: Cautious Bank pays Adventure Finance JPY 200 million.

After nine months, Adventure Finance pays Cautious Bank JPY 206 million. (4% APR means 3%[1] of 200 million in nine months.)

In between these two flows, Cautious Bank has a credit exposure because it is owed money. The time and amount of money is known. The counterparty risk control department will now say that in the 6–12 months bucket, there is an exposure of JPY 206 million.

Total Exposure = sum of all expected flows.

[1]We assume an actual/actual day count convention to simplify the calculation.

Now let us consider two cases where the exact exposure cannot be known. Firstly, Cautious Bank transacts a two-year swap with Adventure Finance. Cautious pays 5% and receives LIBOR + 75bp, with quarterly payment dates, notional of deal GBP 10 million. The exact cash flows in a fixed-float swap cannot be determined in advance – we don't even know which side will end up owing money. Therefore the counterparty risk department will apply some sort of limit to where interest rates might be over the course of the trade – say between 0.5% and 3% – and will then calculate the maximum amount which could be owed between this range. Then each payment date would have a credit exposure that would be aggregated into its time bucket.

A harder case would be where Cautious Bank buys a call option on France Telecom shares. The current price is 65 cents and the strike is 63 cents. In the event that the trade is in-the-money at maturity, it will be exercised but the amount owed to Cautious could be limitless (see Chapter 5 'Derivatives, structures and hybrids'). It would be absurd for the counterparty risk control department to apply an infinite credit exposure on this trade, so it makes some estimate of the likely future price of the France Telecom shares and uses that to determine the exposure. As time goes on, this estimate will change and the exposure will change with it.

Note that the seller of an option has no counterparty risk except for delivery of the premium.

Potential Future Exposure (PFE)

Above we described how to calculate credit exposure. A more sophisticated approach, where exact credit exposure cannot be determined, is by using potential future exposure. PFE offers an alternative to the traditional credit exposure measures of mark-to-market and collateral management. It is measured by calculating an upper bound on the confidence interval for future credit exposures and so takes into account future as well as current positions.

Future credit risk predictions are more useful as relative rather than absolute values of risk. They can highlight books or portfolios that are particularly exposed to counterparty risk when compared to the total positions of the firm.

There is no easy means of reducing potential future counterparty exposure, even when it has been highlighted by calculation. Most firms still use collateral management as the best means of containing the risk.

A further means in preparing for counterparty risk is to reserve against it. What key factors affect the future mark-to-market value? At what time in the life of the deal does potential future exposure reach a maximum?

If a trade has price volatility of say 10% per annum, then as time goes on there is a possibility that prices will move further and further away from their current value and increase counterparty risk. However, because the remaining life of the trade is shortening, the risk of default is declining. These opposing effects will put an upper limit on the likely drift of counterparty risk.

Netting

Counterparty A is owed money by B arising from one trade. Because of a separate trade, A owes money to B. One might think that the expected flows could be netted (ie taking one from the other) in order to reduce the overall counterparty exposure. But credit risk departments are averse to such netting, when the two trades are independent: A will still owe money to B from the second trade, irrespective of B defaulting on the first trade.

If the cashflows are bound together in the same trade (such as a swap), then only the net effect will contribute to the exposure.

When netting is not allowed and the company owes money to its counterparties, trades are given a zero credit exposure (but not a negative exposure).

Back-to-back

One exception to the netting rule is a back-to-back trade. Here an equal and opposite trade is executed with the same counterparty to offset part or all of the obligations of the first trade. There are many reasons why a new back-to-back trade may be transacted, rather than just simply agreeing to cancel the first trade:

- The back-to-back reduces but does not remove all the exposures.
- The first trade was done on an exchange prohibiting cancellations.
- The legal risk of cancellation is too great.
- The operational processes do not handle cancellation.

When a back-to-back trade is executed, it is linked to the original trade. The counterparty risk control department may agree to net the positive and negative counterparty exposures to produce a reduced or zero exposure. It is important to be sure that the back-to-back trade is exactly the same as the original trade in all its trade details. Even a small deviation might cause residual counterparty exposure.

12.5 IMPOSING LIMITS

In order to control counterparty risk, the counterparty risk control department imposes a maximum limit for each counterparty and each time bucket with whom the company trades or is likely to trade. This will be based around the estimates of default probability and recovery rate. The smaller the chance of default, the higher the limit.

Then the current trading portfolio is analysed to see how much credit exposure exists with each counterparty in each time bucket.

A trader wanting to transact a new trade with a counterparty will first need to check that the new trade does not cause the credit limit to be breached.

TABLE 12.2 Exposures

Time period	A	B
Under 3 months	3	20.7
3–6 months	2.76	30.4
6–12 months	4.3	29.9
12 months–5 years	5.5	17.6
Over 5 years	0	10.4

For example, Cautious Bank has trading counterparties A and B. Table 12.2 shows the current exposures (in millions of EUR).

If the 6–12 months limit were 4.5 for A and 50 for B, a new trade causing exposure greater than EUR 0.2 million would be in breach for A, but the bank could trade up to EUR 20.1 million with B in the same time bucket.

12.6 WHO IS THE COUNTERPARTY?

Very often one legal entity has many trading companies. When considering default risk, it is important that exposures to the same legal entity are aggregated together, even if the trades causing those exposures were transacted with different companies. This is because, in the event of default, all money owed by that legal entity would be under threat of non-settlement.

Apart from trading in different countries under different names, the legal entity may own several other companies under a complex business structure. Counterparty risk control departments have to know the structure of all trading counterparties and whether the default of one has any legal consequences on any of the others. This knowledge is complex and subject to changes of which the counterparty risk department must keep abreast.

12.7 COLLATERAL

Many markets and financial entities insist on the posting of collateral in order to facilitate trading and give more confidence in a counterparty's ability to settle its obligations. Collateral is the deposit of assets by the party owing money for the period when money is owed. Collateral usually takes the form of a percentage payment of outstanding debt and can be adjusted up or down on a regular basis, depending on whether the amount of outstanding debt rises or falls. This collateral is often known as margin. We are familiar with this concept on credit cards. At the end of every month the cardholder is invited to pay off all, or a percentage of, the debt and have the rest rolled over to the next month.

Example of a collateral agreement

A common form of collateral management between professional counterparties (e.g. banks) is the following:

1. Both parties agree the list of trade types to be covered (e.g. interest rate products, equity derivatives, etc.).
2. The parties agree a valuation methodology for each asset type.
3. Each day the trades are marked-to-market and the net value of all positions is compared to yesterday's value and the change in value is paid by one party to the other.

The aim of the above process is that, if the posting of collateral takes place at the valuation time, then there is no counterparty risk at that point. As deals evolve and move further in (or out) of the money the counterparty risk is eliminated by this posting (payment) of collateral. Of course to be effective this requires a netting arrangement between the counterparties over these trades. However the posting of collateral does not eliminate counterparty risk – spotting that a counterparty is failing typically takes several days to establish so a PFE over that period can give an indication of the residual risk.

Advantages of collateral

In general, these are the advantages of using collateral:

1. Sign of intent

   The counterparty is expressing his intention to settle the debt. He is also made more aware of the size of his debt when he has to make a contribution towards it. He is less susceptible to the debt growing without his knowledge when he has to post regular margin payments that will increase if his debt increases.
2. Reduces exposure

   The actual collateral reduces the credit exposure and allows a greater amount of trading with that counterparty.
3. Early warning device

   Should the counterparty be experiencing repayment problems, the regular margin payments will be an early warning. If the counterparty cannot pay the percentage collateral, he will certainly not be able to repay the full debt. The company trading with the distressed counterparty has time to investigate the problem and take steps to reduce its effect when given such a warning.

12.8 ACTIVITIES OF THE COUNTERPARTY RISK CONTROL DEPARTMENT

The following are some of the activities in which a counterparty risk control department of a medium to large firm might be engaged.

Set policies for estimating exposure

A calculation methodology will be agreed for each trade type, usually based on the expected flow of assets as described above.

Where the exact asset flows cannot be determined (as in the examples above for swaps and options) the counterparty risk control department will need to have calculation policies and look into the actual market data to set boundaries.

For complicated structures it may have to calculate credit risk on a trade-by-trade basis and will therefore have to expend time understanding each trade.

Assign limits based on credit worthiness

One of the key activities is to research the credit worthiness of each counterparty and assign a trading limit. This limit will then be divided amongst all the trading departments of the institution. This could be on a fixed basis (equity gets 60%, structured trading 10% etc.) or on a first come, first served basis or by some other means agreed by all the trading managers.

When a trader wants to deal with a new counterparty, the counterparty risk department will need to arrive at a sensible limit. This is often smaller than would otherwise be the case until the counterparty has become more trusted through trading over time. The counterparty risk department may also be involved in the due diligence process, which is a regulatory requirement of trading with new counterparties. Some of this research may be shared or fully undertaken by researchers in the credit trading area of the institution.

Measure exposure

Having formulated a methodology and rules for its implementation, the counterparty risk department will then measure credit exposure and report it on a regular basis (daily). It will monitor trading with each counterparty and alert traders and managers when limits are being approached. Ideally, the traders will be able to view the utilisation of counterparty limits so that they do not miss trading opportunities. For example, if a trader knows that only 25% of the limit is being used, he can more readily trade than if the utilisation is approaching 100%.

One graphical method of representing this is shown in Figure 12.1.

The grey bars show the exposure limit over time with counterparty Adventure Finance. The black line is a plot of actual utilisation. In this example the trader is within the limit for every time bucket although he is very close to the limit for the 3–6 months period.

Deal with breaches

Accidental breaches may be due to human error or reporting issues, such as the trader not being aware of the exact utilisation before he trades (perhaps because another trade had just been executed, which was not yet accounted for in the credit exposure).

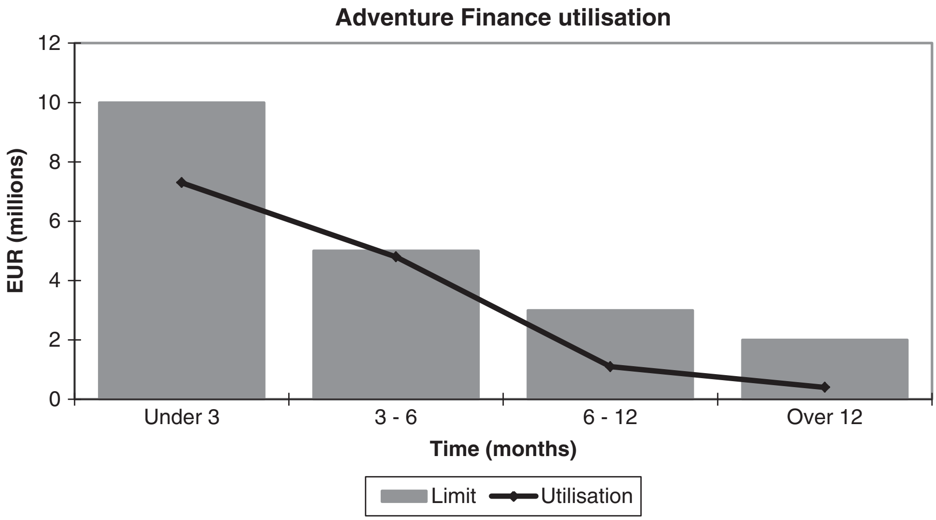

FIGURE 12.1 Counterparty limit and utilisation

These might involve a warning to the people concerned. Deliberate trading over the counterparty limit might be a disciplinary offence as it puts the institution at risk.

Policies for new trade types

Counterparty risk control must accommodate new business by formulating and testing credit exposure calculation on new trade types. This again requires a full understanding of the asset flows and their probability of occurrence.

Maintain legal data

As discussed, the legal structure of all the counterparties is very important. This has to be established and maintained by the counterparty risk control department.

Manage margin payments and receipts

Formulating collateral agreements is another task of the counterparty risk control department. This may involve careful negotiation with credit officers of the counterparty concerned. As trading is a fundamental activity of the financial entity and the main means of generating profits, anything that can promote trading while protecting the institution's assets is a boon.

The processes for paying and receiving collateral margin are usually operated by the middle office, but counterparty risk control has to oversee them and investigate when problems arise.

Interface with management

Although limits are set to minimise the effects of counterparty non-settlement, the counterparty risk control department may advise management on how to deal with tolerated credit exposures. The setting of the limit itself is a balancing act between allowing trade and protecting assets, and therefore needs to take into account the institution's appetite for credit risk.

12.9 WHAT ARE THE RISKS INVOLVED IN ANALYSING CREDIT RISK?

Assuming a company has correctly gathered its counterparty data and understands the links between the various parent and child companies, there is still a hidden risk that once one counterparty fails, it will pull down others with it. For example, a hedge fund might require the support of a major investment bank for its funding. The counterparty risk department will have to weigh up the benefits of investigating the funding of its counterparties against the extra research work involved and the cost of not knowing the information.

Added complication of credit risk

Counterparty risk is often a separate operation from the department trading credit products. In reality, the trade on a credit product has dual credit risk – firstly, to that to which the trade refers; and secondly to the counterparty of the trade. To get a true picture of counterparty risk, knowledge should be shared between the two departments.

Insufficient consideration of counterparty risk

Even if the counterparty risk control department is functioning correctly and setting sensible limits, its success at containing risk is contingent on the attitude and support of management. The managers are under pressure to deliver profits by promoting trading, so until a company has suffered a major reverse, they may not strictly enforce its reports and recommendations, seeing the counterparty risk function as being overly cautious or anti-trade.

Sudden counterparty changes

If a limit has been set according to current counterparty rating information or by any other means and that limit becomes fully or nearly fully utilised, there is very little room for manoeuvre should the counterparty suffer a reverse and the limit needs to be revised downwards. New trading with that counterparty can be restricted, but closing down existing trades might be expensive. If there is a credit trading desk in the organisation, sometimes it will be asked to cover the exposure by buying credit protection on the counterparty.

There are occasions when a counterparty fails suddenly and spectacularly, such as Lehman Brothers in 2008. The whole market was caught by surprise, but a good counterparty risk department should be able to identify the outstanding exposures and perform a damage limitation exercise.

12.10 PAYMENT SYSTEMS[2]

A payment system is a set of mechanisms for the transfer of money between economic agents. These agents may be the counterparties to a trade or intermediaries for payment or delivery of funds (ie money) or financial assets.

Many payment systems have been established between banks and are known as interbank systems. These include CHIPS in the United States, RIX in Sweden and CHAPS in the United Kingdom.

A payment system consists of

- institutions providing payment services
- various forms of money
- means of transferring them
- message instructions and communication channels
- contractual links between parties.

The banks themselves could act as intermediaries or counterparties.

Benefits of payment systems

Having a safe, secure and electronic means of transferring money brings many advantages to all participants in financial (and other forms of) trading. The sheer volume and value of payment system transactions justifies their use over any sort of manual system which would not be able to cope.

Risks associated with payment systems

A typical payment involves a payment leg (which is the monetary payment itself) and a delivery leg (transfer of ownership of a financial asset). Sometimes the delivery leg

[2]Material in this section was taken from 'The nature and management of payment system risks: An Internation Perspective' by Borio and Van den Bergh, published by the Bank for Internal Settlements.

can also be a monetary payment as in a foreign exchange transaction. In the case of a loan, there will be two payments in the same currency but at different times.

In any expected payment there are two clear risks – credit risk and timing tisk. Credit risk is the risk of loss on outstanding claims on participants in a transaction which includes the counterparties themselves and any payment or delivery intermediaries. The nature of credit (or counterparty risk) has already been discussed earlier in this chapter.

Timing risk is the risk of unavailability of funds or items for exchange at the due time. When the item not available is the settlement medium itself the risk is known as liquidity risk.

Whereas credit risk involves the possibility of a loss, timing risk involves a possible cashflow shortfall. The timing risk is usually due to technical problems with either the payment system itself or the way the payment has been entered into the system. It can be very costly, involving expensive borrowing to cover the shortfall and it can be totally unexpected.

Example

Here we present an example payment through a payment system and describe the risks that could arise (see Figure 12.2).

Suppose a hedge fund bought GBP 5 million of shares in Air France from an asset manager. The hedge fund banks at Barclays and the asset manager with HSBC.

We have the following *credit risks*:

- Hedge fund on asset manager in case funds are transferred before receipt of shares.

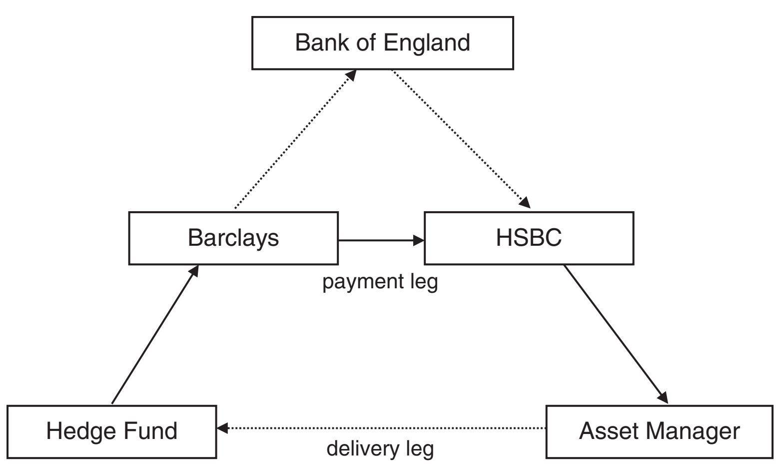

FIGURE 12.2 Intermediate payments and their risks

- Asset manager on hedge fund in case shares are transferred before receipt of funds.
- Barclays on hedge fund in case the payment leg (to HSBC) is made without the fund having sufficient funds.
- HSBC on Barclays in case funds are transferred to the asset manager without funds in Barclays account or before receipt of final funds from the hedge fund in the Bank of England account.
- Bank of England on Barclays in case it transfers funds to HSBC without sufficient funds in Barclays account.

And we have the following *liquidity risks*:

- Barclays on the hedge fund in case the funds are not available at the expected time.
- HSBC on Barclays in case the funds are not available at the expected time.
- Asset manager on HSBC in case the funds are not available at the expected time.

12.11 SUMMARY

Any trading entity has a chance of default. If default occurs it will not honour its debts leaving its counterparties with potential losses. The management of counterparty risk enables a firm to see where it has counterparty exposures and to keep them in line with the chances of default helping to control an important trading risk. The counterparty risk control department is charged with measuring and controlling this risk. Here we have explored some of the methods by which they may achieve this and looked into a common method of settlement known as payment systems.

CHAPTER 13
Accounting

As in any other business, the finance department of an investment bank, hedge fund or other company involved in trading needs to keep fair and accurate books and records. The finance department will use standard accountancy practices. It is beyond the scope of this book to explain such practices; we will discuss how trades manifest themselves in the accounts during and after their lifetime.

Our discussion will cover the balance sheet, profit and loss statement and other financial reports.

13.1 BALANCE SHEET

The purpose of the balance sheet is to provide the management, current investors, potential investors and regulatory authorities with a 'snapshot' of the company's assets and liabilities at a particular point in time. The items on the balance sheet relate to a given date typically stated on the balance sheet.

The balance sheet is divided into fixed assets, investments, cash and debtor categories. From the sum of these values plus the original capital value of the company, the profit and loss can be deduced. An example is shown in Table 13.1.

We shall now discuss each of the items on the balance sheet.

Fixed assets

This would include any property owned by the company, fixtures and fittings, hardware, intangibles such as software and other fixed items that are not subject to variation except for depreciation over time.

Investments

All live trades would feature in this item. Investments need to be marked to market for each financial accounting report. This gives a snapshot of their value for accounting purposes.

TABLE 13.1 Example balance sheet

Item	Current Value (millions, EUR)
Investments	150
Cash	70
Debtors	30
Fixed assets	50
Total	300
Capital	240
Profit and Loss	60
Total	300

Cash

All currency holdings by the company would be converted into the equivalent in the reporting currency using the foreign exchange rate at the time of the report and aggregated to be shown as a single total cash figure. The Bank of England treats gold as a currency for these purposes. Hence an example for a company reporting in euros might be illustrated in Table 13.2.

So the total value of EUR 70 million would show on the balance sheet item cash. As foreign exchange rates fluctuate, the cash value will change and this will affect the overall profit and loss.

Debtors

The mark-to-market value of a trade is the present value of the trade derived by using current market prices. Receivables that are not subject to mark-to-market fluctuations but which represent amounts owed by the company are represented in this item.

TABLE 13.2 EUR reporting

Currency	Local Amount (millions)	FX rate (1 EUR is)	EUR equivalent (millions)
EUR	46.35	1	46.35
GBP	6	0.8797	6.82
USD	14	1.4226	9.84123
ZAR	3	11.2066	0.2677
Gold	10,000 oz	USD 959 per oz	6.7223
Total			70

Creditors

Similarly, if the company owes money to another party it will be shown in the creditor entry.

Capital

This represents the original capital contributed to the company as adjusted by any profit or loss of prior periods.

Profit and loss

Profit and loss is generally expressed as revenue less expenses. In trading terms it can be thought of as the total net worth of the assets minus the capital value of the company.

Events that affect balance sheet items

Many activities of the company will impact the balance sheet. We will confine ourselves to explaining how trade lifecycle events affect the balance sheet. For this example we will assume the trade involves a purchase so that money is paid out initially and is paid back after maturity.

1. Funding for a trade

   If the trader does not have sufficient funds to transact a trade he will have to arrange funding by way of an internal loan from the treasury department or from external sources. Suppose the loan was for EUR 1 million. Then the accounting for the funding of the trade would see the *cash* item increase by 1m and the *creditor* item increase by 1m.
2. Trade executed

   Once the trade has been executed, it will make a contribution to the investments item of the balance sheet. The initial value of the trade would be the trade cost (net of commissions). If the trade cost EUR 1 million then *cash* would decrease by 1m and *investments* would increase by 1m.
3. During life of trade

   The trade will be marked to market at regular intervals. If the trade is worth, say, 1.1m then the *investments* item will increase by 0.1m. This will lead to a *profit and loss increase* of 0.1m.
4. Maturity of trade

   At maturity the trade will no longer be subject to mark-to-market variations. The amount of the final settlement will be known and this will be debt the counterparty owes. Suppose the trade is worth 2.3m on maturity. The *investments* item will decrease by 2.3m and the *debtor* item will increase by 2.3m. There will be no impact on profit and loss as the profit and loss impact will have been accounted for previously throughout the life of the trade.

5. Final settlement

Upon final settlement, the counterparty should pay the full cost and so the *debtor* item will decrease by 2.3m and the *cash* will increase by 2.3m. Once again, there will be no impact on profit and loss as the profit and loss will have been accounted for previously throughout the life of the trade.

6. Effect of loan

The loan will have to be repaid with interest. This is typically a known amount and will usually be deducted from profit and loss as an expense each day, if using accrual accounting to calculate a daily profit and loss figure.

Suppose the 1m loan was extant for 100 days with an interest rate of 3% per year. Then the total interest owing is $100/365 \times 0.03 \times 1{,}000{,}000 = 8219$ euros per day.

So the total accrual per day is EUR 18,219 which will be shown as a decrease in the *cash* item. The *creditor* entry will increase daily over the life of the trade until it is settled from cash.

7. Illiquid trade

If the trade is illiquid it may not be possible to mark it to market. Until recently this situation was rare but due to adverse market conditions some products that used to be traded regularly became illiquid.

One technique to deal with illiquid trades or prices is by using a proxy. Suppose one grade of oil is liquid and a derivative grade is illiquid. Trades on the illiquid grade could be valued by adjusting the price according to price fluctuations on the liquid grade.

When it is impossible to derive an independent valuation, the middle office may allow the trader to revalue himself. There may well be conditions attached to this valuation such as the trader being required to obtain three external bids.

13.2 PROFIT AND LOSS ACCOUNT

Profit and loss (usually abbreviated to P&L) is the amount of money made or lost by the company. Every trade will make a contribution to P&L. In addition, aggregated P&L reports will be required at various levels within the organisation such as

- Trading desk
- Trading division
- Entire company.

With respect to trades, P&L consists of different types depending upon how it was derived and whether it is real or virtual, as explained below.

Realised

Realised P&L is actual P&L no longer subject to uncertainty. For example a trade bought at 500 and sold at 600 has made a realised P&L of 100.

Unrealised

Unrealised P&L is a potential P&L. It is derived from the actual value of a trade were it to be exchanged today even though there is no intention for such an exchange.

Accrued

Accrued P&L arises as a result of a known income or expenditure that is shared out over the period of time for which it applies rather than being accounted all in one go on one particular day. For many events, accrual is a fairer way of dividing the P&L.

If, for example, a bond coupon period falls between two tax years, it is fairer to account part of the coupon in one tax year and the rest in the other than having to pay the full tax in either year.

Examples of accrued P&L are:

- interest accrued for the period of the loan
- bond coupons accrued from one coupon payment date to the next
- transaction fees that are accrued from start date to maturity of the trade.

Incidental

Incidental P&L might arise from fees, taxes or tax rebates and other costs associated with trading not accounted in the categories above.

Worked example

Now let us take a look at a trade and see how it affects P&L throughout its lifecycle.

Suppose 20 equity call options are purchased each for a premium of EUR 8000 with a maturity of five years. (All monetary amounts are in euros.)

The cost of purchase is 160,000 plus a broker's fee of 5000.

Trade date The options are worth the same as the price paid. The broker's fee has zero accrual:

Unrealised P&L: 0

Realised P&L: 0

Accrued P&L: 0

Total: 0

After one year The mark-to-market price of each option is 9000.

Unrealised: 20,000 (1000 for each of the twenty options)

Realised: 0

Accrued: −1000 (one fifth of the broker's fee)

Total: 19,000

After two years Fifteen of the twenty options are sold for 10,000. The rest have a mark-to-market of 8500.

Unrealised: 2500 (500 for each of the remaining five options)

Realised: 30,000 (2000 for each of the fifteen sold)

Accrued: −2000 (two-fifths of the broker's fee has accrued)

Total: 30,500

Maturity The remaining options were exercised and netted a total profit of 17,000.

Unrealised: 0

Realised: 47,000 (17,000 plus the already realised 30,000)

Accrued: −5000 (the full broker's fee)

Total: 42,000

Individual trades

The true P&L of a single trade will be comprised of

- the difference between price sold and price bought
- less the cost of funding
- less taxes and fees associated with the transaction
- plus any income generated while holding the trade such as equity dividends or bond coupons.

This will be of interest when the trade is distinct due to its size, complexity or usefulness to the person trading it. In low volume trading desks every trade can be monitored individually; with higher volumes this becomes impractical. For example a collateralised debt obligation (CDO) is traded infrequently and reported individually whereas a desk might do tens of foreign exchange trades per day and is only interested in their net effect.

Of particular interest to managers is a single trade showing a particularly high loss, which could trigger alarm bells within the organisation.

Compliance officers and auditors may also be interested in individual trades with high profits or sudden changes in P&L. An unusually high profit might be caused by the counterparty agreeing to take a loss on the trade due to money laundering. A sudden change in P&L might indicate a change in calculation methodology or very different market data inputs either of which could be because of a defective monitoring process.

Even when trades are aggregated for P&L reporting, they may need to be broken down and reported at the individual level for audit or compliance purposes.

Who is responsible for producing P&L?

The P&L report is one of primary concern to most stakeholders in any financial entity. Traders are directly measured by their ability to generate P&L. Not only are they tracked individually but also as part of the desk and division to which they belong. Trading managers need to justify their existence by producing profitable trading desks. Senior management need to convince investors and shareholders of their competence by returning trading profits.

The middle office is responsible for compiling daily P&L. In order to do this they need to take accurate mark-to-market valuations of the trades. This is not always possible – there may be conflicting sources of price data or missing price data. It is the traders who are closest to the market and who might feel they can obtain the best market prices but the middle office must be wary; traders have an obvious motivation in using prices that present the P&L in the most favourable light. There is often a clear conflict of interests and there is a risk that middle office will be unduly influenced by the people who generate the revenue that pays their salary and bonus.

Traders will have their own idea of P&L and will argue their case if the official P&L produced by middle office is very different.

The finance department will aggregate P&L figures given by middle office for the more general P&L accounts and other reports that they produce on a longer period basis such as every month and every year.

Risks associated with reporting P&L

Here we illustrate the risks that are carried in P&L calculation and reporting.

Inaccurate reporting There are two potential risks here. One is simply that the number being reported as the P&L is inaccurate. This could be due to poor input data or calculation errors. Assumptions may have been made which are ignored or forgotten when the P&L is reported giving the value more credence than it deserves.

A second issue arises when the P&L cannot be accurately determined. If the trade under consideration is not currently traded in the market and the market data used in its valuation is illiquid then it is hard to derive a current fair value. Various assumptions will have to be made and their validity is open to interpretation.

Over reliance on P&L Important though it is, P&L should not be taken in isolation. A large proportion of current P&L will come from unrealised positions each one of which carries market risk. If market conditions change, a huge potential profit could be wiped out. The P&L figures should always be read with the size of market risk in mind to arrive at a more realistic interpretation of the true state of affairs.

Short-term P&L Imagine a company selling billions of pounds of insurance and receiving premium payments. After some time there may have been a lot of money generated and very little paid out so the P&L appears very healthy. It's time to reward the staff – the company pays them out of its big profits. Then the next day disaster strikes and the insurance needs to be paid. This is very similar to what happened in the credit crunch. Too little attention was paid to trades which had made money but carried residual risk. When rewarding traders on a yearly basis there is always the danger that they will over represent the short-term profitability of their trades and ignore their overall longer-term value. P&L must assess and account for all facets of the trade right up to its maturity.

Over reliance on the market Deriving fair value by marking to market is only good if the market gets it right. Recent events have shown that markets are imperfect and can make big mistakes. Although there are few alternatives to mark-to-market for determining unrealised P&L, the people using P&L figures to make business decisions should always take market imperfection into consideration.

Rogue trading In theory the daily production of trade reports should make it very hard for unexpectedly large positions to develop. In practice we have seen several instances of rogue trading. Sometimes this is a malicious attempt to defraud, other times it is over-enthusiastic trading without proper supervision. Again undue emphasis on P&L to the neglect of other reported figures such as positions and exposures can lead to undesired consequences. Also there is no point reporting trade positions and values if no process is in place to act upon them. The surveillance camera is only effective if someone is monitoring it.

13.3 FINANCIAL REPORTS FOR HEDGE FUNDS AND ASSET MANAGERS

Here we present some of the additional financial reports required by specialist finance companies such as hedge funds and pension and other asset managers.

Overview

Hedge funds and asset managers attract investors who are prepared to deposit money with the hope and expectation that it will be well managed and make a return on investment in the future. The asset manager must keep careful account of how much has been invested, when and by whom.

Fees

To pay their costs and make profit for their shareholders and partners, hedge funds and asset managers charge fees to investors. They can be any or all of the following.

Management fees A global macro fund might charge 1.5% per annum management fees. This means any investor pays this fee regardless of the performance of the fund.

Performance fees If the fund makes profit, the hedge fund or asset manager may take a share in the form of performance fees. This could be something like 10%. If the fund loses money there is obviously no fee payable. The performance fee provides an incentive to the fund manager.

Entry and exit fees There may be a cost for an investor to join or leave the fund. This may be due to an additional administration overhead or to promote stability of investment within the fund.

Reports

In order to manage these investments, hedge funds and asset managers are required to produce extra reports.

Subscription and redemption This documents all investments added and withdrawn from the fund.

Assets under management This is a report of the current assets in the fund.

Performance The fund manager must produce regular performance reports for investors. This is usually once a month but interim reports are sometimes required on demand or in special economic circumstances to give actual and potential investors due warning.

The performance report has to be externally audited to ensure that investors are being given a fair representation of the state of the fund.

13.4 SUMMARY

Accurate accounting is essential to ensure the bank reflects its financial position to a range of interested parties such as shareholders, investors and regulators. Various accounting methods are used including balance sheet, profit and loss and specialised financial reports.

CHAPTER 14

P&L Attribution

As discussed earlier, reporting the daily P&L is an important activity of the trade lifecycle. In addition to knowing today's P&L however, many participants would like to know how the gain or loss in P&L actually happened. A special report known as P&L attribution or P&L explained can provide this information.

Once the P&L has been calculated and compared with the previous period's calculation, it is instructive to piece together the factors that caused the changes in P&L.

14.1 BENEFITS

Reporting the P&L attribution has at least three benefits. For simplicity, we will assume the P&L is calculated daily and the P&L attribution reports between two consecutive trading days.

Catching mistakes

The P&L attribution puts the trade's P&L in context with other trades and with the same trade done the previous day.

In context with other trades Various mistakes in booking will be detected by putting a trade in context with its peers. For example, if a new trade was erroneously entered with 10 times more notional, then it will have an expectedly large P&L compared to similar trades.

In context with previous day Suppose a piece of market data was incorrectly used in the P&L calculation today. Then the P&L between today and yesterday would show a much higher or lower jump than expected, alerting the reader to a possible problem.

Reconciliation

P&L is the headline measure of how an individual trader, desk or division is doing, but the trader's personal calculation of P&L may be different from the 'official' P&L calculated by middle office and used in many other parts of the organisation.

Much time can be spent each morning with traders, managers, middle office and control functions arguing over differences in P&L. The P&L attribution can drastically reduce this time by pinpointing from exactly where the P&L was derived, leading to all parties understanding the process and the trade and market inputs that lead to it.

One investment bank had three members of staff spending an average of three hours per day on investigating P&L differences. An attribution report would therefore have saved 15 expensive man hours per week!

Better understanding of the trades and the market

Aside from identifying problems in the trade booking and valuation process, P&L attribution is a very useful tool for traders and management to see where they are making and losing money. A trading strategy often evolves from a view on the direction one or many pieces of market data are going to take. P&L attribution quantifies profit broken down by market data groups, allowing strategies to be tested and revised.

At higher levels within the organisation too, the P&L attribution identifies which market forces are making the greatest impact on P&L. This is useful for identifying risks and capitalising on prevailing market conditions.

14.2 THE PROCESS

P&L attribution can work at any level in the P&L process, namely for individual trades, trading books, desks, divisions or company-wide. The process works by calculating a series of values at the required level of aggregation and reporting each one separately as it goes. The P&L attribution is always run between two reporting dates such as yesterday and the day before, last Friday and the Friday before, last month end and the month end before.

A typical set of reported values might be:

- difference in present value
- contribution by new trades
- contribution by amended trades
- contribution by deleted trades
- contribution by trades maturing between the two dates
- cash entering or leaving
- market movements
- theta.

Market movements

This consists of considering all the market data that the trade or aggregation of trades is dependent upon. Each one is then taken in isolation and the changes in that market data between the two dates are applied to the trade or aggregation of trades to see its effect on present value. Examples of market movements might be interest rates, foreign exchange (FX), bonds and equities.

The analysis of market movement and other impacts is non-unique. For example suppose yesterday to today's P&L change is broken down as follows:

1. date change with yesterday's market data
2. change in market data (say interest rates move, then FX, then equity, ...).

This will give different answers from changing market rates first, then changing the date. Neither is correct nor incorrect – and the difference is often not large – consistency in approach is more important.

Theta

Even if market data remained exactly the same between the two reporting dates, the trade will change value due to the effect of time. This time effect is known by the Greek letter, theta.

Unexplained

The difference in present value between the two dates should be explained by the sum of all these stages. Any differences are called 'unexplained'. Some unexplained is always likely because the underlying calculations will use assumptions that will cause differences when valuations occur on two different dates. High unexplained is often a symptom of trade booking or market data errors. It is therefore useful to examine trades or aggregations of trades with high unexplained and try to deduce where the problem has occurred.

14.3 EXAMPLE

Here we present the P&L attribution in two stages, although it would most likely be displayed in the same spreadsheet with the two tables combined into one running from left to right across the page.

Suppose we drill down to look at all the trades in one book and calculate attribution between two business dates (25 and 26 March 2009).

First, we have the trades and the P&L values for both dates plus the change in P&L, as seen in Table 14.1. We are able to see the contribution to the change in P&L

TABLE 14.1 P&L attribution

trade id	P&L 25-Mar-09	P&L 26-Mar-09	P&L Change	A New	B Deleted	C Amend	D Cash	E Unexplained	F Mkt Movement
bn6226	23,534	22,556	978	0	0	0	0	298	680
bn450f	−2,206	−2,115	−92	0	0	0	0	−28	−64
bn521rr	−0	34	34	−0	0	0	34	0	0
Crt	−11,742	−11,742	0	0	0	0	0	−0	0
fwc13	−720	0	−720	−720	0	0	0	0	0
fwc1146	876	0	876	876	0	0	0	0	0
fwc147	434	0	380	380	0	0	0	0	0
fwd342	434	0	434	434	0	0	0	0	0
cds_a4d	664	726	−62	0	0	0	0	−1	−61
cds_b33	0	393	−413	0	−393	0	−20	0	0
cds_c222	0	1,178	−1,178	0	−1,178	0	0	0	0
cds_d2	1,098	1,201	−103	0	0	0	0	−1	−102
Iuy	−107	−106	−1	0	0	−1	0	−0	0
is_33	−661	−543	−118	0	0	0	0	−0	−118
repo3343	−17,210	−17,206	−4	0	0	−4	0	0	−0

(Figures in thousands of euros)

TABLE 14.2 Market movements

trade id	Mkt Movement	Bond Basis Deltas	CDS Deltas	FX	IR Deltas	IR Vegas	Recovery Deltas	Theta
bn6226	680	332	260	0	79	0	0	8
bn450f	−64	−31	−24	0	−7	0	0	−1
bn521rr	0	0	0	0	0	0	0	0
Crt	0	0	0	0	0	0	0	0
fwc13	0	0	0	0	0	0	0	0
fwc1146	0	0	0	0	0	0	0	0
fwc147	0	0	0	0	0	0	0	0
fwd342	0	0	0	0	0	0	0	0
cds_a4d	−61	0	−62	0	2	0	0	−1
cds_b33	0	0	0	0	0	0	0	0
cds_c222	0	0	0	0	0	0	0	0
cds_d2	−102	0	−102	0	2	0	0	−1
Iuy	0	0	0	0	0	0	0	0
is_33	−118	0	0	0	−117	0	0	−1
repo3343	−0	0	0	0	−0	0	0	−0

of new, deleted and amended trades together with cash transfers on the right side of the table.

Then we have the unexplained P&L and the change caused by movements in market prices.

The sum of A, B, C, D, E and F equals the change in P&L.

Now we break down the market movement into its constituent factors and show the total market movement for cross-reference back to the first table in Table 14.2.

This particular group of trades is subject to market movements in:

- **Bond basis deltas.** This can be explained by taking an example of five-year bonds in Vodafone trading at 180 basis points spread to the underlying interest rate but the five-year credit default swap in the same company trading at 200 basis point spread. The basis (difference) is therefore 20 basis points. Someone who holds bonds and CDSs is paying 20 basis points. Now the impact on P&L caused by a change in the basis is defined as the bond basis delta.
- **Credit default swap (CDS) deltas.** This is the change in P&L caused by a change in the credit default swap rate.
- **Foreign exchange.** The change in P&L due to a change in foreign exchange rates.
- **Interest rate deltas.** The change in P&L caused by a change in interest rates.
- **Interest rate vegas.** The change is P&L caused by a change in interest rate volatility.

- **Recovery rate deltas.** The change in P&L caused by a change in recovery rates.
- **Theta.** This is explained above.

14.4 SUMMARY

P&L attribution is a very useful technique for understanding P&L and catching errors in booking and valuation procedures.

CHAPTER 15
People

Business functions and the people within them are essential to any discussion of the trade lifecycle.

A financial entity has many business activities relating to the trade lifecycle. Note that not all institutions employ all the business functions: the range and size of the organisation will dictate when specialists are required and when the same people carry out more than one function. For example, a small hedge fund might have the same person looking at market and credit risk control, manage without independent model validation and have one of the partners acting as the compliance officer.

We can divide the business functions into three broad sets:

- revenue generation
- activities that support revenue generation
- control.

We shall now discuss the various business functions.

15.1 REVENUE GENERATION

The first set of business functions encompasses people who make money.

Traders

The simplest form of trading is to start the day with a given amount of money and no other assets, transact trades throughout the day and finish in the evening with (hopefully) more money and no other assets. This would mean the business having no overnight risk to manage and the traders could be assessed by how much profit they brought in. Although this form of trading might exist for some very limited products, generally traders have to deal with a variety of products and assets and manage the risks associated with them.

Trading varies between the high volume and instant decision-making spot trades, to complex structures requiring weeks of preparation and scrutiny. The type of person who trades will vary according to what is being traded – different skills will be required for different markets. Some trading is very mathematical, some relies on economics and business, but all of it requires the courage and clarity to make firm decisions.

Traders bear heavy responsibility because somebody is trusting them to make return on the capital they are being given without subjecting that capital to undue risk. They are constantly involved in the present, while trying to predict the future.

Traders need to know their products and their market place; they must look out for economic and market indicators. They need to analyse a lot of information and form a view as to the direction of prices. Having formulated or been given a trading strategy, they must decide how best to implement it, while at the same time taking advantage of sudden opportunities. Conversely, they must be able to deal with reverses and trade out of risky positions, without leaving them overexposed to changes.

Broadly speaking, traders will require:

- sufficient systems and staff on hand to service their requirements
- few bureaucratic constraints imposed upon them
- as little time as possible on clerical activities, such as entering data into systems
- fast and accurate calculations
- the ability to manipulate input data and parameters to assess their effect on trades
- warning of events and price movements of interest to them
- knowledge of when they are approaching some limit on their trading activities
- timely and accurate reporting of their profit and loss (P&L)
- easy access to market data.

Trading assistants

In order to maximise the time a trader can devote to his trading activities, many firms employ trading assistants. These assistants have full front office access to trading systems and sit side by side with traders on the desk. Assistants can be used in different ways:

- administrative – running processes, booking details, liaising with other departments
- analysis – gathering data and running reports, testing theories and back testing potential or real trades
- programmatic – developing trading tools in a rapid application development (RAD) environment. The trader specifies what he requires, the programmer puts together a quick spreadsheet or primitive system and then it is refined and improved or simply discarded
- advisory – some trading desks have more senior and experienced staff on hand to advise or approve trades. These people are a second pair of eyes to catch errors and make suggestions; they may not be actively trading themselves.

Structurers

The job of the structurer is to put together structured and hybrid deals which are among the most complex in the financial industry (see Chapter 5 on derivatives). The structurer may trade himself or leave the execution of the structure and its components to the trading desks.

The structurer may require sophisticated valuation techniques and may have his own call on quantitative analysts and programmers. He will need access to market data for indicative and historical prices across various asset classes. He will need good communication with the sales force and the trading desks across all products and assets because his job may encompass many of the traded products in the organisation and some that are not yet traded.

He will also need the services of legal counsel to check his potential trades which might be very specific and unique. One of the key features of his work is to explain the complicated structures to clients, managers and risk control. He may need to work with them to thoroughly test and approve his ideas.

Typically, the structures take longer to be put together than simpler trades and many may be discarded without ever being transacted. It could be that the structurer only needs to put on two new structures a year to make his quota of profit, but for that he might have to try 20 structures – each one taking two weeks to construct and test.

Sales

The sales desk brings business into the firm. Salespeople inform clients of trading possibilities and encourage them to order trades, which will be executed by the traders. They put traders in touch with potential clients and advertise the products on offer. Salespeople need a good understanding of the trades and how they might benefit their clients. To attract new business, they need to know who to approach and in which organisations. To maintain existing business, they need to develop good relationships with their clients.

15.2 ACTIVITIES THAT SUPPORT REVENUE GENERATION

The second set are the people who support those that are making the money.

Researchers

Financial entities employ researchers to provide more information to the traders and sales force. The research might be general background information or be more specific. It may be produced periodically or at the request of a particular trading department. Some research papers are kept private within the organisation, while others are published. The reason for publishing is to enhance the company name and reputation – a good individual piece of research or a reliable researcher whom people read for advice, will bring in clients and enhance the appeal of both the product being researched and the institution. When a new product is being marketed, it is in the interests of the institution promoting it to encourage others to participate in order to create a viable and liquid market. Research is a tool for advertisement and creating product awareness without compromising competitive business advantage; it therefore has both external and internal faces.

Middle office (product control)

Middle office, as the name suggests, sits in the middle between the traders and other business functions. It has both support and control functions. The aim of middle office is to ensure that the trade is correctly booked and all its requirements, such as an appropriate and reliable source of market data, are available so that the trade can begin its journey through the processes of the lifecycle. Middle office is sometimes referred to as product control, emphasising the control aspect of the function. The elements of middle office responsibilities can be broken down as follows.

Trade A trade protocol will have been agreed between management, legal counsel, salespeople, traders and various control functions. Middle office will be the first to catch any new trades not adhering to the protocol. Middle office also checks that sufficient trade details have been supplied to allow successful booking of such new trades. It must also ensure that existing trades are being adequately monitored.

Data Product control must ensure it has a complete and accurate supply of static and market data every time a valuation is required. The most usual time for valuation is overnight and so data must be present every evening. The price data used should be a fair indication of prevailing market conditions and may well be from a different source to that used by the traders, hence arriving at a different valuation. The valuation derived by product control is the official one and will be used in the books and records of the financial entity. In the event that price data is missing, erroneous or stale, product control must decide how to proceed. There are various data discovery and data engineering methods described in Chapter 24.

Implementing trade changes The changes that might occur on a trade are described in section 8.7.

The middle office is responsible for implementing these changes. Some require regular daily activities such as fixings. Others are irregular depending on the trade, the underlying asset or the market.

Reporting Once executed, the trade becomes both an asset and a risk to the organisation. Middle office must report the trade both in isolation and in aggregation with other trades to all business functions which need to know. The number and range of reports will vary according to the particular organisation concerned. The preparation, compilation and distribution of the reports are the responsibility of the middle office. Most organisations require daily, monthly and yearly reporting.

Valuation One component of the suite of reports is the valuation. This is often done with particular mathematical models. Although middle office need not understand all of the intricacies of these models, it does need to know the input requirements, the running parameters and have some sense of how to interpret the results.

Responsibility We do not live in a perfect world. Many organisations have to 'make do' with incomplete systems which have problems or require workarounds in certain circumstances. It is essential that product control is well aware of these flaws, is able to justify the outputs in relation to inputs and knows how to act when problems arise. It bears a huge responsibility for the accuracy of the official records and is acting to preserve the integrity of the institution externally to investors, auditors and regulators and internally to management and the finance department.

Liaison Middle office is the supplier of reports and information to many business functions. As such it must interact with people at all levels of the business. As well as regular reporting of current activities, it needs to respond and inform when errors or irregularities occur. It must also help to plan and design processes and reports for new business activities by defining the business requirements.

Processes Due to their widespread responsibilities, middle office is required to operate a range of processes. Many of them will be performed by computer systems. Thus middle office is usually a major customer of the information technology (IT) department. Middle office needs to understand its requirements and communicate them to IT, test systems thoroughly and then operate them correctly. A key feature of computer systems is their need to be enhanced. New versions of existing systems must be thoroughly tested before their release to ensure that they continue to work as before, the only difference being the enhanced functionality. Middle office must approve any new versions before release.

Security Middle office provides security to the financial entity by monitoring trading activities. It is therefore usual for middle office staff to be present at all times when trading might occur.

End of day A consolidation of all the day's activities occurs towards the end of the working day. This involves the middle office checking that all trades are fully booked and that the data for overnight valuation and reporting has arrived. As in any retail bank, shop or hotel, the end of day is the time for cashing up. The principle is that the earlier a mistake is noticed, the lower the cost of fixing it.

The end of day P&L is reported by middle office but there is usually a daily discussion with the traders to allow them to comment or complain about anything they feel is unfair in the way the P&L has been derived. However, middle office has the final say in what constitutes the official P&L.

End of month It is common in investment banks and hedge funds for middle office to prepare extra reports at the end of each month. These often require external checking of trades and data to ensure the fair valuation of trades for shareholders, investors and regulators. Middle office has to represent the interests of the financial entity in this process.

For some data such as volatility surfaces, it is too time consuming to gather realistic market data every day, so data suppliers such as Totem, conduct a thorough price study once a month for end of month reporting. This involves them asking, say, 20 market makers for their prices, disregarding the top two and bottom two and taking an average of the middle 16 to arrive at a representative set of market data.

For end of day, the middle office will have used data supplied by the traders. But at end of month, this is corrected to the independent value. If the traders have (deliberately or otherwise) used skewed values, these will be corrected by means of a provision.

For example:

A trader's P&L comes out as EUR 1 million using his implied volatility data.

At end of month, using the independent market data it is revised to EUR 700,000.

So a figure of negative EUR 300,000 is added to his accounts as a provision to correct the P&L.

He now carries that provision for the coming month until the next time the independent market data is used.

It generally takes somewhere in the region of three to four working days each month to derive and verify the end of month valuations and to report them to the relevant audience.

Summary Having such a broad range of tasks to perform, middle office requires many different types of people including accountants, operators and administrative personnel. They need a good understanding of the products, together with careful application of the operating procedures. They need to spot when something looks amiss and pay careful attention to detail to ensure the numbers add up correctly. Apart from running reports, they should have an intuitive feel for expected results and be able to investigate problems to identify and fix them. Additionally, they require interpersonal skills to communicate with many internal and external people.

Back office (operations)

The back office is sometimes known as operations or 'ops'. Where traders agree and execute deals, it is the back office which does all the real exchange of assets, documentation and money. It is responsible for processes involving confirmation and settlement of the trade. These tasks require interaction with counterparties and custodians and sometimes with members of the exchange upon which a trade was executed. These activities are explained in Chapter 8.

Before any money is allowed out of the company, back office staff must be entirely satisfied that all payment details are correct. They must diligently process and check payment and reception instructions. As the people that sign the company cheques, they must be highly trustworthy and their activities must be clear, transparent and above suspicion.

Apart from paying counterparties, the back office department may have to pay commission to brokers and intermediaries, taxes to government agencies and fees to bodies such as exchanges.

Where custodians are not used, back office staff must account for all money received into and paid from nostro accounts. They must register holdings in bonds and sharers and take possession of documentation and physical assets. Where custodians are employed, they must be supervised and accuracy checked to ensure the company's interests are being properly managed.

Confirmation, as discussed in section 8.3, involves close liaison with the counterparty and possibly with traders and middle office to ensure trade details are correctly recorded.

Quantitative analyst

The quantitative analyst (quant) is responsible for developing mathematical models for the valuation and risk management of trades. These could involve an ad hoc spreadsheet taking a few hours to put together, or a fully documented library comprising several man-years of effort. Quants very often have several roles.

Short-term pricing A potential new trade may present itself to the trading desk. Before executing, the trader may want the quant to provide a rough and ready valuation of the price and sensitivities to market data movements (risks). This involves making sufficient assumptions to enable a speedy calculation, but not assuming so much that the validity of the results is compromised. Traders like to play around with different scenarios, so rather than provide one simple set of valuation results, the quant is likely to deliver a mechanism where the trade can be priced with a variety of different input data and parameters, usually by means of a spreadsheet.

Long-term model development When a sufficient number or size of a particulate type of trade is being transacted or the exposures caused by trades reach a certain volume, a reliable and comprehensive model is required to measure and protect the company from trade risk. The model will be customised or expressly written for each asset class and each type of trade within that asset class. Common features across asset classes or trade types may share core components of the same model.

For example, there may be an equity pricer for basic equity trades and a gold pricer for basic gold trades. But options on equities may share the same model as options on gold with variations to cater for the individual properties of equities and gold.

Outputs from models should be homogenous, so that trades valued under different models can have their results aggregated or compared.

Major new models require careful analysis of the requirements, efficient implementation, thorough testing and complete documentation. Quants often build their own testing tools, which are kept separate from the system incorporating the model.

Quants need to be aware of the operating constraints of the model they are developing, answering questions such as:

- Will there be a sufficient supply of liquid market data to run the model?
- Will the model run within an acceptable time period?
- Can an existing model be adapted to serve a new trade type or does a new model have to be developed from scratch?

Tools of the trade for quants include:

1. **1.** Spreadsheets
   Spreadsheets are universally popular with quants and traders because of their complete flexibility and uniformity. It is rare to find a quant who is not able to build and maintain a spreadsheet.
2. Algorithms
   Some quants are required only to develop algorithms for the models. Programmers then incorporate the algorithms into systems. Even with pure algorithms, the quant would be expected to provide thorough testing and assist in the system integration of his models.
3. Programming
   Quants have varying levels of programming skills. Depending on the organisation and the distribution of quants and programmers, quants may be required to write full or partial systems for their models using a programming language.
4. Libraries
   A common and effective division between the work of quants and that of programmers is to have the quants write libraries for their models. These libraries are self-contained pieces of functionality which have published interfaces for required inputs and expected outputs. The programmers then integrate these libraries into the valuation systems, without having to know what goes on inside the model

(the 'black box'). Advantages of this approach are the clear separation of responsibilities, the ability to plug a testing tool into the library and the parallel development of the library and the system – as long as the interface is agreed and known, both sides can develop independently.

Although we have listed quants as a support to the revenue generators, they can sometimes produce revenue themselves, such as when the valuation libraries are sold commercially. Generally, however, firms do not want their models known externally because they give away a competitive advantage.

Quants have three major clients for their work within the financial entity:

1. Traders
   We have already described the activities that traders require of quants. Many mathematical trades come to fruition only as a result of a close partnership between traders and quants coupled with on-going risk management.
2. Market and counterparty risk control
   The risk control staff may work with or directly employ quants to develop models for accurate assessment of the risk due to market forces or exposure to counterparty debt. As they require heavy processing with lots of input data, they may also need mathematical techniques to improve efficiency.
3. Official valuation
   Quants will develop pricing and sensitivity models, as described above, to be used for the official trade valuations in order to ascertain profit and loss and to identify the risks to which a financial entity is exposed. Middle office is generally tasked with running these processes, but the reports generated are used by management, finance, market and counterparty risk control departments and external groups, such as regulators and investors. The models used for official valuation are very often identical to those used by the traders. However, the process and its required input data and parameters are not controlled by the traders.

The nature of quant work is often very academic. Quants need to take a standard mathematical approach and adapt it to suit the requirements of the trade under consideration. This requires the quant to arrive at a balance between the academic and commercial worlds. For instance, precision is a very important mathematical discipline, but in a commercial environment, compromises may have to be made due to the imperfect nature of the 'real' world in which trading exists. Also there is usually a time delay between the use of commercial models and their incorporation into published academic papers.

Information technology

Information technology (IT) is a vital part of any modern financial entity. The people who design, build, operate and service these systems constitute a large and important group in the organisation because of the reliance on computer systems to perform a large number of trading processes. We shall break the IT function down into front line support, infrastructure, architects, project managers, programmers, operators and testers and explain the human side here.

Front line support These people are the financial paramedics. When a process fails, their job is to diagnose the problem quickly and accurately. They usually sit close to the users of the systems they are supporting. The diagnosis may be:

- user error – trying to use the system in an inappropriate way
- hardware problem – the machine itself has a problem
- data error – bad or missing input data
- system error – the system is not performing the way it should.

Front line support will advise the user where he has made a mistake, attempt to fix a hardware problem and point out why data may be invalid. In the case of a system error, they may fix it or implement a workaround to keep it operational while the problem is handed over to the people who wrote the system.

This team needs to be thoroughly acquainted with the operational requirements of the system, both the hardware and data. They must know how the system is used and, to speed diagnosis, know where to look for errors.

Having a front line support capability benefits both the IT department and the users. More efficient use can be made of programming skills and time; programmers will not need to waste time solving user problems which may often be nothing to do with the system itself. The immediacy and availability of the front line support instils a sense of security for the users – knowing that help is at hand when required.

If the system is third party – supplied by an external vendor – front line support will have to develop a relationship with the vendor. They will need to learn the system, communicate problems to the vendor, track progress with fixes and help in deployment of new versions.

Infrastructure IT infrastructure staff are responsible for the computers and operating systems which support the operations running the trade processes, but not the trade processes themselves. These would include networks, cables, hardware provided by exchanges for electronic trading, personal computers and servers. They are the computer mechanics and they need a good knowledge of the machine requirements of their users and the software they are running.

IT infrastructure may also be responsible for implementing policies to preserve the integrity of the users' machines. This involves monitoring and controlling the software downloaded to machines and eliminating potential threats from viruses or hackers. They may also keep machines standardised, so that users can operate the same system in the same way from multiple locations and ensure everybody is running from the same operating system and using the same version of software.

Architects For larger developments an architect may be employed. This could be for the design of a process, a database or an entire system. The architect needs a good understanding of the current and future requirements of the system he is designing. He will ensure that the technical specification is properly implemented throughout the development stage, showing prototypes and interfaces to the users on the way to the finalised system. He will also have to keep pace with updates to the specification – these are common in the constantly changing world of finance. A well thought-through design, however, should cope with anticipated changes without major alteration to the system.

Programmers Programmers write in-house systems and processes for users throughout the financial entity. Programmers range from the very technical (who have little contact with their clients), to the very application-focused (who interact daily with users).

Project managers IT serves most other business functions and as such, sits in the middle of the organisation. Project managers sit in the middle of IT itself. They have to oversee all the computer systems used in the trade lifecycle.

Business knowledge In order to provide an IT solution, a project manager must understand the business and its requirements. Only then can he design and manage the processes that will be built to satisfy them. The project manager must speak in business language – he is the representative of IT to the user community, which has little technical knowledge. The project manager must be able to discern and define the requirements, even when he receives only a vague outline from the user. An analogous example from the domestic appliance industry might be a washing machine user who may state that he wants clothes cleaned at an affordable price – all the other requirements being left up to the manufacturer.

Knowledge of data flow The basic functionality of any IT system is to put data in, press a button and get data out. Understanding the flow of information throughout the firm is the basis of providing a good solution. This entails detailed knowledge of the data and the way the data is passed around.

Technical knowledge When a solution has been agreed, the project manager will have to budget for it in terms of resources, costs and time. Estimating the time a project will take is one of the hardest aspects of project management, as it often depends on external forces. Experience will improve the estimation, as will keeping firm control of the system requirements. Any increase in functionality expected (known as “scope creep”) will have a negative impact on delivery time.

Management The project manager must control the project or projects with which he is charged. This means estimating timescales, budgeting staff and costs, monitoring and updating on progress, managing developers, as well as cajoling and encouraging to ensure completion by the deadline. A project manager must also manage the expectations of the users. It has been said that users never appreciate a good system, but will quickly detect a bad one!

Communication The project manager is in a unique position in terms of the amount of interaction he has with other business functions and his own staff. Because it is necessary for him to cross several business functions, he will develop an overall view of the processes being used across the organisation. He will also see competing priorities and pressures on limited resources which must serve many masters. His task is not to judge between them but, by appreciating what is required and the business gain achieved by each process, he will be able to advise managers of the best way forward and may be able to arbitrate between different business functions to provide a common solution, eliminating duplication. The project manager will require good communication skills and a diplomatic manner to be successful in these tasks.

IT operators Operators may be required for individual processes or to control the overall trade system. Their job is to run and monitor everything and provide early warning of problems to the users affected and IT support.

Common tools employed for this task are:

1. Heartbeat
   The system might continually report its status in various categories. For example:
   - green – everything OK
   - yellow – warning (action may be required)
   - red – error (action is required).

   The operator can monitor the heartbeat and take appropriate action.
2. Diagnostics
   Log files, performance meters and outputs from systems are all types of diagnostic tools that inform the operator about the health of the system.
3. Statistics
   Over a period of time, performance statistics can be gathered which show areas that might require improvement in efficiency or accuracy.
4. Spot tests
   The operator might be required to make random, on-the-spot tests on any part of the system to ensure it is operating correctly.

Testers An IT system needs thorough testing to ensure it works correctly. Programmers are notoriously bad at testing, partly because testing requires a different mentality to programming and partly because they have no motivation to find faults in a system they have created.

Testing requires great attention to detail and a clear communication of any problems found, so that they can be reproduced and fixed. We will discuss this further in Chapter 23.

15.3 CONTROL

The third set of business functions control those making the money to ensure that risks are managed and that laws and regulations are adhered to.

Legal

The legal department represents the legal interests of the financial entity in many areas, but here we confine the discussion to those impinging on the trade processes. Firstly, the legal team must ensure that the trading process and the trades themselves conform to the laws of the jurisdiction in which they are transacted. They must examine the more unusual and complicated trades to ensure the full extent of the obligations entailed are known. This is of particular relevance to insurance type products such as credit default swaps – it is easy to sell insurance and receive regular premiums without being fully aware of the liabilities.

Lawyers may be required to arbitrate trading disputes between counterparties or between a financial entity and an exchange. An acceptable and speedy resolution to a dispute saves money, preserves the company's reputation and ensures that trading with the counterparty can be sustained.

The legal department must also act to remove or reduce the possibility of the firm being sued. In the event of any sort of litigation, the legal department would have to prepare a case and instruct barristers.

The legal department clearly needs a good understanding of trading practices and how they relate to the relevant legislation.

Model validation

Many larger investment banks have a team known as model validation. Its primary task is to check the models developed by the quants. This involves building a testing mechanism which is usually completely separate from the system which is used in the trade process to call the mathematical model for valuation or risk measurement. This test harness will attempt to stress the model to ensure it withstands a wide range of acceptable data inputs and rejects unacceptable inputs.

Model validation will also probe the theory behind the model, to make sure it is mathematically and commercially realistic.

Having researched the theory and tested it in practice, it may issue guidelines for use (such as limits on parameters or input data or warnings about the meaning or accuracy of results). It will check that the system in use for official valuation is producing the same results as their own test when given the same data inputs and parameters.

As well as acting as a second pair of eyes in one of the least accessible areas of the financial entity (due to the complicated nature of mathematical models), the model validation team will also impose a release control mechanism. This means that any time a new version of any pricing system is released into use, it must undergo a series of tests to ensure that the changes in it have not inadvertently altered any valuations. This is done by a combination of regression and spot testing (see Chapter 23 on testing).

Model valuation tries to give an assurance that the model being used does what is says on the tin. However, there is an equally important question: is what it says on the tin really what is required? A sound management structure should ensure that this question is being asked. Model validation staff are often the most qualified people to answer because they are a control function, distant from the trading pressures experienced by quants.

Market risk control department

The market risk control department is responsible for assessing the risk to market forces to which the financial entity is susceptible. The details of market risk calculation are described in Chapter 11. Market risk must understand trades and how the various market data affects them. It needs to check individual trades as they are transacted and potential new trades before they are transacted. In addition, it must assess overall market risk by aggregation of many trades. A lot of its work is very mathematical, but sometimes experience and instinct play their part in detecting where the firm is vulnerable.

Market risk managers carry huge responsibilities. Market forces can lead to severe losses and yet prediction and calculation of these losses is not an exact science. It depends on the availability of market data and the liquidity of the products being traded.

A successful organisation will ensure the voice and warnings of market risk managers are heard and acted upon. Market risk must therefore be as realistic with its input data, assumptions and calculations as possible.

Counterparty risk control department

The counterparty (or credit) risk control department analyses the firm's exposure to each of its counterparties should they default and fail to meet their obligations. The details of the activities undertaken by the department are in Chapter 12. Like market risk, the counterparty risk function is essential in understanding and controlling the risk which trading generates.

Counterparty risk control has to balance the legitimate concern of traders to be able to trade as widely as possible, while seeking to protect the company from unnecessary losses. The appetite for accepting counterparty risk depends on the risk profile of the company's management and the prevailing financial climate. After the collapse of Lehman Brothers, a state approaching panic swept through the financial services industry and credit risk limits were slashed. This precipitated the credit crunch – nobody wanting to extend credit to anyone else.

Finance

As in any company, the books and records of the trading activities must be accurately produced and reported. This is the responsibility of the finance department. It is interested in producing aggregated views of trading, rather than looking at individual trades. It is generally dependent on other departments, such as middle office, for valuing the trades and collecting the trade details.

In addition, the department must monitor the financial health of the company, together with its actual and anticipated assets and liabilities. At regular intervals they must prepare budgets for all departments' future spending. At times they may have to advise on expenditure cuts and therefore need to know the value as well as the cost of all the company's activities.

Internal audit

Internal audit is a monitoring function deliberately designed to be independent of other business functions. It reports directly to senior management. It is in some respects the internal police force, monitoring how well the processes being undertaken adhere to the company guidelines. It also investigates and thinks through current operating processes and advises on omissions, risks and improvements that could be made. The purpose of audit is to identify risks and provide some measure of the impact of ignoring risks.

Although other departments may view them with suspicion, the purpose of audit is to protect the company's assets and ensure smooth operation of its systems. It can be a useful external pair of eyes, providing an alternative perspective and ensuring that all sections of the company are acting in the best interests of the whole. Uniquely, it gets to see all systems and processes and can advise where there is duplication.

The department operates in two ways.

Routine checks These are carried out periodically or on predefined occasions, such as every time a new trade type is approved. The check will involve the testing of rules imposed by the company to make sure that breaches are being acted upon and do not go unnoticed. Examples of rules could be:

- no single trade imposing an obligation of more than a certain amount upon the company
- no one trader having exposures greater than a certain amount

- settlement always being carried out by at least two staff
- no trading being conducted on mobile phones
- all trades being booked within one hour of execution
- failure to produce P&L being reported to senior management on every occasion.

It is not generally the task of the audit department to take action itself – that is left for the appropriate member of staff in the business function concerned. Depending on the seriousness of the breach, audit will expect certain measures to be taken.

Thorough audit of one area Generally auditors will from time to time pick upon a particular business function or process and carry out an in-depth investigation. For example, they might examine the commodities settlements process, compare it with other settlements within the same organisation and in other organisations and come out with a series of recommendations for improvement. These are known as audit points. The audit points are divided by their seriousness and each one is given a deadline by which it must be addressed. Audit will often carry out a follow-up check to see how things have progressed in the interim.

Compliance

The role of compliance is to ensure that people and processes comply with the law. Two of the most relevant laws to the financial services industry are money laundering and insider training. It is the responsibility of compliance to devise procedures to ensure these laws are not being broken and to ensure adherence to them.

Due diligence The compliance officers must also ensure that trade with counterparties is conducted with due diligence. This means that the background of the counterparty is checked to make sure it is a bona fide institution and not a front for criminal activities. Suspicious counterparty requests, such as offering to take on trades at an obvious loss, must be reported to their relevant regulatory authority and the police.

External regulation Since financial services are vital to the national and international economy, governments have imposed a system of regulation on those undertaking such services. This is to enhance confidence, protect the honest and law-abiding majority from the illegal actions of the minority and to ensure a level of competence is maintained to protect investors and clients outside the industry.

This regulation is implemented by various bodies such as the Financial Services Authority and the Securities and Futures Authority. The compliance officer must liaise with regulators, who might request inspection of trading documents, investigate trading procedures and conduct spot checks.

Staff training Compliance must educate its staff in their legal responsibilities. It might conduct periodic training sessions or provide material, such as videos and interactive questionnaires, to keep staff abreast with the latest rules and regulations.

Trading manager

The trading manager is the trader's immediate supervisor. He must agree a trading strategy with each of the traders reporting to him. He will allocate them a limit on asset holding and indicate an expected profit to be made within a given timescale. There will also be discussion about how to control risks. For leveraged trades such as options, there will be a limit on exposure.

For example, a manager has a desk with six traders. Two are tasked with short-term and arbitrage-type trading, two do medium-term swaps and two do longer-term trading based on economic fundamentals. The expected returns and associated risks are spread across the desk and the manager can monitor the situation.

There will be an implicit understanding that should the trader lose more than a certain amount of the assets entrusted to him, he will be asked to leave. This might be something in the region of 40%, but will depend upon the volatility of the market and risk appetite of the institution for which he is trading.

The trading manager is the first point of control on the activities of the trader. He should monitor the type and size of trades and ensure that limits are being adhered to. Quite often the trading manager is himself trading, and so he has to combine the two disciplines.

Management

The management bears responsibility for the financial entity and is accountable to shareholders and investors. Managers must decide priorities, resolve conflicts and ensure the well-being of the institution, by understanding and controlling the risks. Generally, they will set trading limits to ensure that potential losses are contained.

Balance There is always a need to balance the pursuit of extra revenue through trading with controlling the risks that trading brings. The appetite for risk will determine where this line is drawn. Risk comes in many forms and once the general risk appetite is determined, an exploration of where to allow and where to prevent risk can be applied to define a management policy for the running of the institution.

Board of directors The board of directors is the highest decision-making body in the financial entity. The composition of the board can give an insight into the balance of power between revenue generation and control. If senior managers of control functions, such as counterparty and market risk, sit on the board alongside the trading management, it indicates control is considered of high importance. Most support functions, such as IT, will report to the trading management at sub-board level.

Human risks

Inevitably, a trading organisation relying on human beings is going to be subject to human risk. Here we list some of the common risks.

Too much knowledge in one person If an individual is particularly good at his job because of his greater knowledge, experience or application, it is often tempting to give him more responsibility and a greater share of the overall burden of work. Other people do not see the need to study his area of expertise, because they know he can be relied upon. This causes a knowledge risk, where an area of the trading lifecycle is left solely in the hands of one individual. If that individual should leave the firm or become ill, there will be nobody to replace him. Although it may seem like a waste of resources, it is always important that every area has sufficient back up. Too many organisations have failed to recognise their over reliance on one person until it is too late and he or she has departed.

Not enough knowledge This is one of the greatest risks to any organisation. Sometimes the management of a particular trading area becomes convinced that a type of trade or trading strategy is foolproof and certain to bring in risk-free profits. Trading commences but suddenly the lack of proper understanding is exposed to great cost. It may seem absurd that financial entities specialising in financial products with strict internal and external controls should be able to engage in trading that is misunderstood, but it happens surprisingly frequently. Even when controls and procedures are in place, if the fundamental behaviour of the product is not known, these will be of little benefit.

It is not just in trading that a lack of knowledge can be risky; the trade lifecycle is a chain of processes and is therefore only as strong as it is at its weakest point.

Although training is often provided, particularly to junior staff, there is a tendency to consider a new product as a modification of existing products or to borrow techniques from one asset class into another. These assumptions can lead to incorrect processing and added risk. All new trades and structures should be thoroughly understood and the information disseminated to *everybody* involved in the trade lifecycle.

The wrong people Each business function has its particular demands and responsibilities. Personality and outlook play a part in how well an individual suits his business function. Examples:

- Back office must be diligent, calm and responsible while dealing with large sums of money.

- Market risk must speak out and not be afraid to challenge the traders when they see potential problems.
- Trading managers (especially ex-traders) must sometimes suppress their entrepreneurial tendencies and take into account advice from control functions.

Since large amounts of money are at risk, a trading environment can be very stressful. It is essential that this is considered when selecting individuals to fill the business functions.

Not enough investment in people There is sometimes a tendency to believe that computers can solve all the problems and only minimal staffing levels are required in some business functions. If things are going fine, this may well be the case. But for the unusual, the unplanned or the unlikely, computers will not be able to step in and sort out the problem. Appropriate levels of staffing must be maintained. The balance between humans and machines is hard to gauge, but broadly speaking, computers should deal with the ordinary and expected and human beings the more specialist or unusual circumstances.

Whenever computers are running processes, it should never be assumed that they have performed the task correctly on every occasion – even if a process has run successfully 200 times in succession, there is always a chance of a problem on the next run.

Incentive People need to be compensated for the time and effort they spend doing their jobs. Extra incentives to perform well in the form of annual bonuses are a feature of the financial services industry. Bonuses do, however, lead to problems. They are meant to be performance related and foster greater individual and group attainment. In some areas such as sales and trading, contribution to the overall revenues can be assessed and divided reasonably fairly. This is much harder to achieve in support and control functions. Here the bonuses may not be allocated meritoriously because the contribution of staff cannot be compared. An unfair bonus distribution weakens morale, enhances stress and leads to decisions being made with an eye to the effect on bonus, rather than for the overall good of the firm.

One major investment bank has recently put up base salaries for control and support staff to be equal to comparative jobs in other industries, while decreasing the bonus pool. It remains to be seen whether this has a positive or negative effect on productivity, but certainly many staff would prefer a stable salary to a variable bonus.

Short-term thinking Allocating bonuses, fixing budgets and deciding strategies have traditionally been annual events in the financial sector. This leads to all tasks being driven around a yearly cycle. At the end of the year, the balls are thrown up in the air and everything starts again. Many activities require longer-term planning and execution, especially IT projects.

The pressure on management strategies to think no more than one year ahead trickles down through all levels and all business functions. Although a longer-term position may be more appropriate, such considerations are sacrificed for short-term gain.

There are obvious risks in working to short-term timescales. Trades are often designed to post profit quickly, while long-term negative effects are overlooked.

Longer-term trading could be safer and more profitable, but does not receive sufficient consideration because nobody will be around to draw bonuses from it.

Conflicts and tensions In any commercial environment there are bound to be tensions and the stress of investment banking can accentuate them. However, some tensions arise from the very nature of the business functions and these are important to ensure trading is conducted with an appropriate level of control. When one or other side gains too much power, there could be risk to the business.

Trading versus control functions The most obvious tension is between traders and the control functions. Counterparty and market risk control departments are responsible for reducing risks. If they refused all trading, there would be no risk, but of course then there would be no business and no one to pay their salaries. Since traders are the revenue generators for everybody, there may be a tendency to allow traders more freedom than would be the case if the control functions were financially supported from elsewhere. Similarly, a member of product control, objecting to the trader's view of the current market price, may be afraid to raise an objection, knowing that his career and bonus depend on keeping the traders happy.

Recently it was disclosed that a senior member of market risk sitting on the board of a major investment bank had raised objections to the risky nature of the trading activities and very soon afterwards was removed from his post. After the credit crunch it became clear his warnings were correct and major damage would have been avoided had they been heeded.

Conversely, in a cautious environment, genuine trading under reasonable controls can be thwarted by over zealous control functions. The senior management must allow healthy debate between all sides and monitor the situation continuously to ensure a fair balance is maintained.

Trading versus trading Support staff are present to create and enhance the traders' ability to generate revenue. The better the level of support, the greater the chances of the trader making money.

However competition between trading desks can lead to duplication of resources. Traders often want their own support services and systems. They want staff at hand who know their business and can adapt to their requirements quickly. If resources, such as IT developers, have to be shared between trading desks, the traders may worry they will lose control. In order to increase their power and importance, some traders insist on having their own highly focused systems even when a wider scope may be more advantageous to the institution as a whole.

The support staff themselves may prefer working for one business area; serving two masters may not be ideal and requires strong management to ensure priorities and resources are fairly distributed.

Trust Finance is a complicated industry. Some business functions perform very specialised jobs and their skills and knowledge are not shared by other business functions. This means that there must be trust between the various departments in order for systems and processes to be designed and run effectively.

Traders invest a great deal of trust in quants to provide suitable models. The trader may have some knowledge of the underlying model, but he will not have the time to understand all the details and nor should he. His time is better spent on trading, leaving the quant to work on the models.

Another example is the business managers trusting the IT project managers and staff to build reliable systems. IT is very often seen from the outside as a mysterious and expensive operation. A manager of a business function requiring a new process to be written will have to agree a budget and scope for the project and then entrust the rest to the IT department.

Investing too much trust in any department or person might give them too much scope to make errors before they are caught and dealt with from outside. Too little trust will stifle productivity, cause resentment and waste time. The best way is for a balance to be struck where the specialist is trusted sufficiently to do his job without undue interference, but there are enough checks and balances to deal with problems as they arise and before it is too late.

Communication We have discussed a very wide range of business functions all acting upon some part of the trade lifecycle. In order for all the pieces to work together there must be communication. This communication must operate at all levels:

- peer to peer within the same business function
- employee to manager within the same business function
- peer to peer across different business functions
- manager to manager across different business functions
- peer to peer between trading counterparties
- to external regulators and investors from within the organisation.

Mistakes are very common where communication is missing or inadequate. Also, the wrong media for communication might cause the message to be lost. For example:

- Sending an email to a trader warning that he is approaching his trading limit might be ineffective when he receives over a thousand emails a day.

- Leaving a phone message for back office to investigate a missing settlement might not get delivered and the settlement never be received.
- Too many interdepartmental meetings might lead to key staff not attending because they are wasting too much time and thereby important discussions and communications might be missed.

A modern financial entity employs people from all around the world. Language may be an issue. Even where everybody is expected to speak a common language, nuances and expressions often communicate beyond words and these can be misinterpreted by non-native speakers of the language. Clear written documentation is sometimes less ambiguous, but this too relies on people reading it and it can be time consuming to produce.

Real life conflict example 1 In order to understand some of the conflicts of interest that can arise in a real world scenario, let us consider two examples.

The first involves a trader, a trading manager and a market risk controller.

The trader, Thomas, is coming to the end of his first year as a full trader. He has had some good ideas and made a profit, but is short of the target agreed with his manager. Thomas believes he has cultivated a reputation as a successful but responsible trader within the firm.

One day Thomas comes into work with a fantastic idea for a trade and believes he has tested it thoroughly in his potential trade spreadsheets. If it comes off, he will surpass his target and achieve a good bonus (some of which he has already spent on a new car). According to most market data scenarios, it will make a lot of money. The scenarios in which it would lose money are very unlikely given the current economic climate.

Thomas believes that the market risk controller, Claire, is overly cautious – she doesn't seem to realise that her salary is paid from the money he and his fellow traders make and she has no understanding of the real market.

Miriam is the trading manager with responsibility for all trades on the desk. The serious losses of the last year have been plugged, but the desk has not generated enough profit to satisfy the senior managers.

Miriam recruited Thomas who, she believes, has great potential. After being modestly successful so far this year, he has come out with his first big trade idea which he thinks could make a lot of money. She is aware of Claire's concerns about the possible downside but Claire does have a reputation for being a little too cautious even in post-credit crunch times.

Claire has worked in market risk control for ten years and been with her current bank for nine months. Since joining she has really tightened up the market risk department. Her strategy has been to strictly control all risky trades and to reverse the huge losses the bank suffered last year on bad trades. So far her approach has been warmly supported by managers keen to restore confidence in the bank.

Claire knows the young trader Thomas and his reputation for being a little brash and arrogant. She has performed scenario analysis on his new trade idea and is sceptical because, if things go wrong, it could undo all her good work and return the bank to its risky trading culture prevalent before the credit crunch.

In order to try to resolve the conflict Miriam calls a meeting for the three of them. Thomas outlines his strategy for the new trade and how he has risk tested it in various scenarios. Claire describes her objections, highlighting the potential high loss if things go wrong. It is left to Miriam to make the judgement on whether to proceed with the trade. She has a natural conflict between wanting to take advantage of a serious profit-making opportunity while at the same time accepting the advice of the risk controller.

The resolution will depend upon a number of factors including the risk appetite of the manager herself, that of the department and of the bank as a whole. Typically she would seek a compromise – perhaps limiting the size of the trade and its duration or imposing stops so that the trader gets out of the trade if it starts losing more than a certain amount.

Real life conflict example 2 The second example features a salesman, customer, trader and trading manager. Sam has been working as a salesman for Bank of Island for five years and has many loyal customers who like dealing with him and the bank for all their financial services. One of his best customers, Carrie, has phoned Sam asking him to quote to sell her a six-month copper future. On receiving the call Sam phones the copper futures trader, Tina. Things have not been good on the copper desk and Tina knows that this quote is for Carrie. Although the bank could make a profit at 31, she decides to take advantage of customer loyalty and quote 32. Sam relates the price back to Carrie and can detect a change of tone in the conversation. She knows this is high and feels the bank is taking advantage of her. Should she go to other banks for quotes and then have to go through the whole process of due diligence and start a whole new relationship? Her loyalty to Sam makes her reluctant. She decides to confront Sam with her concerns. He wants to preserve a profitable relationship, but he has to tread carefully with the trader who works for the same organisation as himself. He takes the problem to the trading manager, Millie.

Millie is an ex-trader and knows the trading game. However her new position of responsibility forces her to look at the wider picture – is it worth jeopardising a client for some extra profit in one trade? Now that the client is aware of the attempt to over price she will be more cautious. Millie calls a meeting with Sam and Tina. Sam calls Carrie and has her at the end of the phone during the discussion, which is mainly an exercise in damage limitation. By the end of the call Carrie feels reassured that she is being looked after; she sees the trader and salesperson working together and most importantly the price is reduced to a satisfactory level. Tina is not so happy – she knows she has to be more careful next time.

It is human nature to take advantage of weakness, and customer loyalty may be perceived as a weakness, but in the financial world there is generally keen competition and loyalty cannot be tested too far.

15.4 SUMMARY

The processing of the trade lifecycle requires a wide range of people to work harmoniously together. Human beings are a major cause of problems in the lifecycle and so an analysis of the part they play and how they fit together can lead to a better understanding of the risks and create a more successful operation.

CHAPTER 16
Regulation

The greatest change that has occurred to trading in recent years has been the increase in regulation. The list of regulations such as EMIR, Dodd-Frank, UCITs, AIFMD and Basel III grows in depth and breadth to cover all aspects of trading and trade processes.

The subject of regulation is too vast to be covered in any one volume. Here we present a taste of how regulation affects modern investment banking, referring the reader to specific articles and books for more detailed explanations.[1]

There are regulatory controls and initiatives across the globe, but overall there still remains less pressure in the Asia Pacific region and more in the Americas and Europe, the Middle East and Africa.

16.1 PURPOSE OF REGULATION

Sovereign governments and international organisations recognise that financial institutions have a large influence on local and global economies. To provide control and protection, regulators have been established. The aims of financial regulation include:

1. To increase market confidence; to allow all interested parties to have confidence in the financial system.
2. To ensure financial stability; to reduce the chances of another credit crunch or other financial disaster.

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3. To protect clients; to ensure that all consumers of financial services are treated fairly and protected from unwanted practices.
4. To reduce financial crime.

Major regulatory authorities

Apart from central banks such as the Federal Reserve and the Bank of England who have their own supervisory responsibilities, many other regulatory authorities exist such as:

- SEC (US Securities and Exchange Commission)
- FDIS (US Federal Deposit Insurance Corporation)
- CFPB (US Consumer Financial Protection Bureau)
- BaFin (Federal Financial Supervisory Authority)
- FCA (UK Financial Conduct Authority)
- FSA (Japan, Financial Services Agency)
- AMF (France, Autorité des Marchés Financiers)
- FINMA (Switzerland, Financial Market Supervisory Authority)
- CSRC (China, China Securities Regulatory Commission).

16.2 WHAT REGULATORS REQUIRE

Regulatory pressure on banks has been in the areas of liquidity, systemic risk, remuneration and market infrastructure. However new initiatives broaden the pressure to include capital, supervision, governance and culture and conduct.

Liquidity

Banks must keep a certain quantity of high-quality liquid assets to cover a period of stressed cashflows over a defined time period (Basel III stipulates 30 days). This is to ensure they can weather financial storms that tend to stress the organisations that have poor liquidity, even if they hold good longer-term assets and a healthy balance sheet. Although this seems like a simple rule to enforce, in practice it leads to many complications such as what is considered a liquid asset.

Systemic risk and market infrastructure

Banks must put in place safeguards relating to capital and liquidity to prevent systemic risk or contagion. This occurs when one shock to the financial system exposes risks in other places. This can be compared to a hurricane hitting a skyscraper – although the building might survive the hurricane, there could be secondary or tertiary effects that cause its collapse. The structure of the wholesale market in the EU is also undergoing significant changes. The European Markets Infrastructure Regulation (EMIR) is essentially directed at reducing systemic risk through the centralised clearing of derivatives. It also covers trade reporting, trade repositories and the performance and activities of central counterparties (CCP). EMIR came into force in August 2012 and brought many detailed regulations and the implementation of technical standards.

Remuneration, culture and conduct

It is widely acknowledged that cultural changes have to be made within banks in order to prevent a repeat of the problems that led to the credit crunch. Previously, banks demonstrated a disproportionate focus on making profit and rewarding employees at the expense of helping their clients and good market practice. They are being challenged to implement measures such as:

- top-down commitments by senior management to change working practices
- codes of conduct
- redefining behaviour patterns amongst employees
- changes to the way staff are rewarded to stop unwanted behaviour being reinforced. For example, bonuses are now spread over many years and a certain proportion paid as equity, increasing the employee's longer-term commitment to the organisation.
- change of appetite for risk. This affects such things as the composition of the board of directors and the setting of trading limits.

Structural reform

There has been a widespread ban in proprietary ('prop') trading which is loosely defined as trading whose sole purpose is to make profit without consideration of current or anticipated future client activity.

Also regulators have encouraged a separation of power to prevent a core credit institution (such as one taking deposits and lending) from trading. This leads to a division between the retail and investment arms of a bank.

The localisation of finance imposes greater control by making foreign banks operate in a host country as a subsidiary rather than as a branch. This means they have to meet local standards on capital liquidity, stress testing and other restrictions.

All these have had the desired effect of making banks concentrate on core activities and move further away from riskier enterprises.

Recovery and resolution

Banks are required to develop a recovery plan in the event of financial crisis and provide all relevant information to regulatory authorities.

They need to support, by means of cash donation, a deposit guarantee scheme to protect individuals in the event of a major default.

The cost of meeting losses of a failing bank (such as Lehman Brothers) will now be passed to the creditors (typically other banks) by converting claims to equity. So if a bank has a claim on a bank that is failing, it will no longer be paid out in cash relating to the size of the debt, but be given equity in the failing bank. However it will obviously suffer a loss as the equity will now be worth less.

Supervision and governance

Regulators have started insisting that the board's policies and practice in the area of risk management are subject to more reporting and scrutiny. This has included bringing in outside expertise on such matters where necessary and the undertaking of independent assessments. Individual responsibilities now have greater clarity and the role of chief risk officer has been given more independence, stature and authority. Supervisors now engage more frequently and intensively with the board of directors and senior management.

The whole area of risk is brought to the forefront of the activities of a bank so that mistakes and bad practice are prevented or caught earlier, contained and eradicated.

16.3 THE PROBLEMS

Banks are struggling to meet their current and upcoming regulatory requirements. They are being forced to restructure and divide themselves into regional hubs with more client-focused activity. These hubs, being more attuned to local culture and people, have greater autonomy and less direct influence from their foreign ownership. All this presents a massive cultural revolution.

In addition there are data management challenges. Banks need to:

- hold and use the right data
- satisfy an exponential rise in regulator demands for reporting and disclosure
- convince regulators they can understand, aggregate and disaggregate, manage risks by correct use of data, systems and IT architecture
- deal with regulatory pressure to improve their internal aggregation and reporting of risk data
- enhance business pressures to make better use of their data and to improve the efficiency of their data handling.

This is creating massive costs for banks and forcing tough decisions about the prioritisation of competing IT projects. Some banks run the risk of building a castle made of sand given the absence of existing robust systems. Meanwhile, banks also need to address the new and unforeseeable risks in data privacy and cybercrime, conflicting national laws and the impact of retrospective investigations, in an environment where vast amounts of data are indefinitely available.

A more far-reaching problem is that the cost of regulation may have exceeded its benefits and if the banks are cutting back on their total offering this can negatively impact economic growth.

16.4 RISK-WEIGHTED ASSETS

The idea of risk-weighted assets is to adjust risk based on the riskiness of a bank's assets. For example, loans that are secured by a letter of credit would be weighted riskier than a mortgage loan that is secured with collateral.

Basel III allowed an internal model approach to credit, market and operational risk. Regulators started reducing this flexibility because:

- Banks have been too aggressive in using their own models to reduce weightings.
- Banks are using general cleaning up of data and other housekeeping to show risk-weighting optimisation.
- Models are too complex and opaque.
- Recent low interest rates have enabled borrowers to avoid default and therefore reduce default estimates.
- Each bank has been left too much to their own devices.

Steps taken to compensate:

1. Benchmarks for risk parameters and setting constraints on model inputs.
2. Forcing stressing scenarios to adopt higher base values.
3. Bringing bank and supervisory practices closer together.
4. Greater disclosure by banks of how risk-weighted exposures are calculated and used.

The overall effect should be to reduce benefits of internal models and increase banks' costs. Also, by increasing the capital required, banks will be driven to reassess pricing and whether it is worth continuing to offer certain products.

In October 2013, the Basel Committee published a paper proposing:

- a move from the standard Value at Risk (VaR) calculation to that of Expected Shortfall. This will increase capital charges
- simpler boundary between the trading and banking book
- extending time horizons for liquidation of exposures in stressed market conditions
- a tougher approach to allowing benefits of hedging.

Effect of regulation in practice

Naturally the actual business of trading is impacted by the weight of regulation. The on-boarding of new clients and the range and sophistication of systems required to trade are two examples of many.

An Australian bank with a London office that wants to trade with an American counterparty will need to be concerned with regulation in three different jurisdictions. Many of these regulations will overlap but some will apply in only one of the jurisdictions. The usual rule is that the bank will have to apply the strictest of all the regulations. So if the capital retention requirements are 8%, 8.5% and 10% in the three jurisdictions, trades done with this counterparty will have to allow for 10% (the highest of the three levels).

Multiple forms will need to be completed to ensure that the bank has undertaken due diligence regarding the new counterparty and that it has established processes for measuring credit risk, posting of collateral, netting and related issues. The cost of on-boarding including the background checks and sign offs may be prohibitively expensive unless there is sufficient profit-making potential with the new counterparty. This will lead to a reduction in the number of counterparties and level of overall trading in the market place.

Working practices and IT systems must ensure that the regulatory requirements are being satisfied for the range of products being traded with the counterparty. In addition to old reporting requirements, they must produce the necessary reports for:

- Assessment of risk for internal use in many different scenarios on individual and aggregated levels
- Valuation for use in collateral management and to agree with the counterparty
- Reporting for an external readership such as regulators, exchanges and central counterparties (CCP).

Many systems operate on a matrix of countries and trade types. So the rules for trading swaps in Belgium are different from swaps in Brazil, and these are in turn, different from options in either location.

In the United States one of the most significant regulatory measures taken was to pass an Act known as the Dodd-Frank Act. Included in the Act are:

- Supervision of financial institutions
- New resolution procedure for large financial companies
- Creation of a new agency to implement and enforce financial laws
- Introduction of more stringent capital requirements
- Strengthening of control of over-the-counter derivatives
- Reforming regulation of credit rating agencies
- Implementation of changes to corporate governance and executive compensation practices

- Requiring registration of advisers to private funds
- Changes to the securitisation market.

It also incorporates a new rule called the Volcker Rule, which is a federal regulation that prohibits banks from conducting certain investment activities with their own accounts, and limits their ownership of and relationship with hedge and private equity funds. The Volcker Rule's purpose is to prevent banks from making certain types of speculative investments that contributed to the 2008 financial crisis.

Example: rule for LCH Canadian trades

Trade reporting rules implemented by the Canadian securities agencies require that trades involving 'local counterparties' and which are cleared must be reported to the relevant local securities agency.

LCH.Clearnet Limited (the 'Clearing House') has requested that all Clearing Members (including FCM Clearing Members) inform the Clearing House where they have established an account with the Clearing House for a Clearing Client or an FCM Client that is a Canadian 'local counterparty'. Clearing Members must also provide the Clearing House with the entity's current Legal Entity Identifier (LEI). LCH.Clearnet will report based on the LEI information received from Clearing Members. Where an LEI does not exist for a Canadian Clearing Client or FCM Client, Clearing Members must inform the Clearing House of the province where the 'local counterparty' is established.

For the purposes of the Canadian trade reporting rules, the following constitute a 'local counterparty':

1. A person or company organized under the laws of, or having its head office or principal place of business in the province.
2. An affiliate of (a) if responsible for its liabilities.
3. Parties required to register under provincial securities law as derivatives dealers.

Where a Clearing Member fails to provide the Clearing House with the foregoing information with respect to a Clearing Client or an FCM Client, it shall be deemed to represent to the Clearing House that the Clearing Client or FCM Client is not a Canadian 'local counterparty' and the relevant transaction will not be reported by the Clearing House.

16.5 CREDIT VALUATION ADJUSTMENT (CVA)

Two-thirds of counterparty credit losses in the financial crisis were suffered not as a result of actual defaults of the counterparty, but because credit market volatility negatively impacted bank earnings.[2] This means that actual counterparty default was less harmful than the change in valuation and the loss in liquidity of trades caused by higher credit charges and fewer players in the market wanting to carry such risk.

Before the financial crisis, insufficient attention was paid to the effects of credit losses. This is now being addressed by techniques such as credit valuation adjustment, which has been incorporated into the Basel III Framework.

What is CVA?

In the old days, a trade was valued using a discount curve which took into account the time value of money and was often based on risk-neutral pricing. Risk-neutral pricing is a financial term for measuring the sum of the expected values of all future cashflows on a trade without taking into account the real world price of that trade. (An expected cashflow is the actual cashflow multiplied by the probability it will be received.)

However, when a trade is executed with a counterparty there is an element of credit risk. Credit risk is the risk that the counterparty will not pay all or some of its debts. The size of credit risk depends principally on the credit worthiness of the counterparty and the time period of the debt – the longer the debt is into the future, the more chance the counterparty will default.

Nowadays banks are required to value the trade with the credit risk component priced in. This means an end to risk-neutral pricing. Regulation is forcing them to value using real world pricing which involves measuring the size of credit risk.

For all trades that are traded ‘over-the-counter’ (OTC) there is at least some credit risk which means the value of the trade is less than it would have been using risk-neutral pricing. This has the effect of lowering the profit and loss (P&L) for the trader and applying a credit surcharge to the trade. This charge can be reclaimed by the trader over the lifetime of the trade because, other factors being equal, the credit risk will decrease over time.

CVA is a measure of this adjustment to the value of a trade caused by credit risk.

How is it measured?

The actual method of calculating CVA is beyond the scope of this book but, in principle, CVA is calculated by adjusting the discount curve by the size and shape of the credit risk. To take a very crude example to illustrate this: if money in one year’s time is worth 95% of its value today (according to the LIBOR curve) and there is a 1% chance that the counterparty with whom the trade is being transacted will default within one year, the discount curve at the one-year point is set at 94% (instead of 95%) making all one-year cashflows worth less.

[2]Basel III Framework: The Credit Valuation Adjustment (CVA) Charge for OTC Derivative Trades (Shearman & Sterling, 2013).

How is credit risk measured?

In order to compute CVA, one needs to know the value of credit risk. This can be inferred from market prices and one of the most common instruments is the five-year credit default swap (CDS). (To understand the CDS, imagine paying an annual insurance premium on a house against accident or damage occurring in the next five years. Instead of a house, the CDS provides cover on a named corporate or sovereign entity and accident or damage means a default or similar credit event.)

Using this CDS price and some other factors, one can compute the implied default probability for that counterparty over a given period of time.

If there is no liquid five-year CDS for the counterparty, a bank would use a proxy instrument approximating to the same credit risk. This might be a CDS on the same counterparty for a different time period or a five-year CDS on a different entity with a similar risk profile to the counterparty, perhaps with an adjusted spread on top. For example, if there were no liquid CDS contracts on Banque Palatine in France, the counterparty risk department might accept the five-year CDS spread on BNP Paribas plus 30 basis points, because it considers Palatine more risky than Paribas.

DVA

The converse of credit valuation adjustment is debt valuation adjustment (DVA). Here we take into consideration CVA from the counterparty's perspective. Hence if one party incurs a CVA loss, the other party incurs a corresponding DVA gain. DVA is the amount added back into the value of a trade to account for the institution's own default. Although a trader or manager might see it as advantageous to use any tool to raise P&L, DVA is controversial because institutions record gains when their credit quality deteriorates creating perverse incentives and any gains can only be realised by actual default.

FVA

Funding valuation adjustment (FVA) is a reduction in the valuation of a trade caused by the cost of funding. Whenever a trader needs to pay out money, for example to fund collateral or hedge a position, he needs to raise funds. He can do this from the internal treasury desk or from the external money markets. Nobody (not even his own colleagues) will give him such cash without reward. The cost of such funding (which is the interest charge on the cash borrowed) will depend on the credit worthiness of the institution the trader works for and will vary over time.

Adjusting for cost of funding means that two counterparties to a trade may arrive at different valuations because one may be able to borrow money more cheaply than the other. This could cause problems, such as when the amount of collateral to be posted or received depends on them arriving at a common trade valuation.

CVA mitigation

High volatility in CVA – that is sharp changes in the adjusted valuation over short periods of time – is undesirable to banks and other financial institutions. To mitigate this volatility and at the same time hedge default risk, many buy CDS on their counterparties as part of the trading portfolio, so that the overall CVA on the portfolio is reduced. Therefore, were the counterparty to default, the banks would lose money due in trades with that counterparty but would offset some or all of the losses by repayments on their CDS. This policy makes trading more expensive because of the cost of buying CDS protection.

CCP

Regulators allow banks to discount some of the money they have to allocate for credit risk if they make use of Central Counterparty Clearing or CCP. CCP is equivalent to an exchange but for over-the-counter trades (OTCs).

CCPs are financial market infrastructures that can reduce and ‘mutualise’ – that is, share between their members – counterparty credit risk in the markets in which they operate. Their origins as clearing houses can be traced back to the late 19th century, when they were primarily used to net payments in commodities futures markets. Clearing via CCPs initially grew through exchange-traded products including bonds, equities, futures and options contracts. During the first decade of this century, clearing became important for OTC products as well as those traded on exchanges.

The use of CCP tightens up the trading of OTCs and reduces systemic risk:

- CCP takes over counterparty risk
- CCP enforces strict risk control and collateral
- Use of netting reduces overall exposure.

Also there is greater transparency as there is independent valuation and awareness of risk concentration.

Taken together, this gives banks increased capital efficiency by reduction of their balance sheet exposure and efficient use of trade management and collateral.

Parties to the CCP trade with the CCP and not with each other. The CCP matches every trade so if A wants to trade an interest rate swap with B, A trades with the CCP and the CCP trades the exact opposite of the trade with B. The CCP guarantees the obligations of the contract but has no market risk. It does however carry the risk that one of the counterparties defaults. This risk is managed in many ways, including by taking margin (or collateral) from each of its counterparties. Clearing trades centrally means that CCPs themselves become crucial nodes in the financial network. It is estimated, for example, that almost half of all outstanding interest rate swap transactions are centrally cleared. The systemic importance of CCPs is expected to increase further as the central clearing of standardised OTC derivatives becomes mandatory, in line with commitments made by G20 leaders following the crisis. This makes it essential for CCPs to manage properly the risks they face.

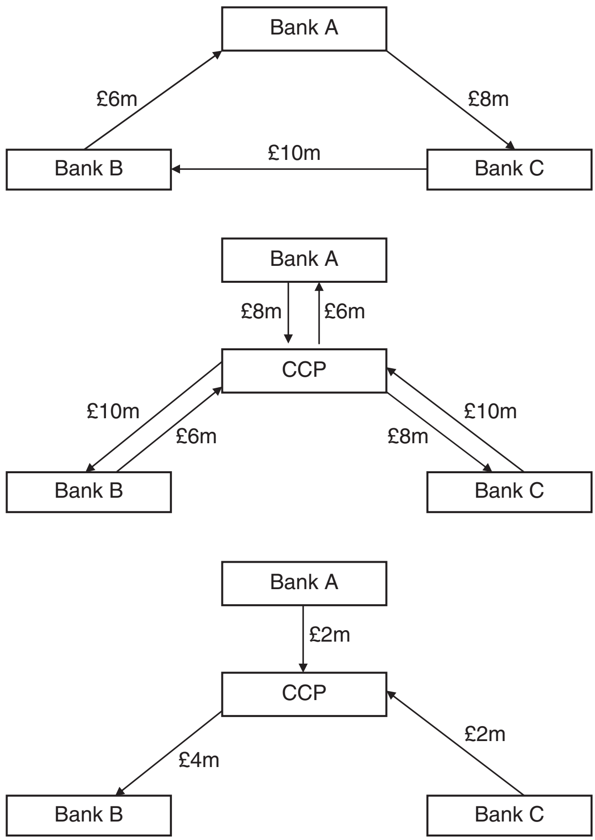

FIGURE 16.1 Netting efficiencies of central clearing

Multilateral netting[3]

CCPs can reduce counterparty credit risk by netting exposures across their members: that is, offsetting an amount due from a member on one transaction against an amount owed to that member on another, to reach a single, smaller net exposure. When trades are centrally cleared, the original counterparties' contracts with one another are replaced or 'novated' – with a pair of equal and opposite contracts with a CCP. Hence the CCP becomes the buyer to the original seller, and the seller to the original buyer.

Figure 16.1 provides a simplified example of this. Bank A enters into a contract that requires it to pay £8 million to Bank C; Bank C has a contract requiring a payment of £10 million to Bank B; and Bank B has a contract with Bank A where it must pay Bank A £6 million. The arrows in the top panel represent the gross exposures on these bilateral trades when these are not cleared centrally. Following novation of trades, the

[3]Material in this subsection based on 'Central counterparties: what are they, why do they matter and how does the Bank supervise them?' Amandeep Rehlon, Market Infrastructure Division and Dan Nixon, Media and Publications Division.

CCP sits between the buyer and seller of each bilateral transaction (middle panel). This allows gross exposures to be 'netted' (bottom panel), reducing exposures in the event of default. For example, Bank B is exposed to potential losses of £10 million if trades are not cleared, but clearing means it has a single net exposure of £4 million to the CCP. The CCP also holds collateral, known as 'initial margin', to mitigate against the risk of default.

Counterparties who trade outside of CCP often post margin to each other in order to reduce the burden imposed upon them by regulators to cover for credit risk. Each day the counterparties jointly agree the sum total of any future payments on the trade. The party with the obligation to pay will post a percentage of that payment as collateral in the form of bonds or cash.

For example on Day 30 of an interest rate swap trade, the valuation against market rates indicates that A would owe B one million euros. If the collateral were 10%, A would post 100,000 euros to B.

On Day 31, the valuation might indicate A only owes 750,000 euros. Now B would refund 25,000 euros to A leaving a posted collateral of 75,000 euros.

As the valuation of the trade varies, the collateral posted will change.

Netting rules and jurisdiction

Above we described the principle of multilateral netting. Netting is useful for reducing overall exposure to counterparty risk, but netting outside CCP requires a netting agreement between the two counterparties. This is defined for an agreed set of derivative trades.

Netting agreements are subject to legal jurisdiction and so trading with Credit Suisse in the United States may not be covered by an arrangement with Credit Suisse in Europe. This places a burden on banks to ensure that they have systems that can inform and guide traders and middle office staff as to when and where netting can be used. Generally, collateral will follow hand in hand with netting, so two counterparties with a netting agreement in place will add up the total outstanding amount due by one to the other and post one collateral figure in an agreed currency per business day.

Rehypothication

Rehypothication means using collateral pledged from one party as collateral with a third party. For example, A pledges capital of $50 million sovereign bonds to B, and B uses it as collateral with C. Counterparties who allow their collateral to be rehypothicated may be compensated by a lower cost of borrowing or a reduction in fees.

Hedge funds typically make use of prime brokers to execute trades on their behalf. The prime broker takes collateral from the hedge fund to secure the transactions and then rehypothicates this collateral when it does its own trades. Although this used to be common practice, hedge funds became much more wary of it after the collapse of Lehman Brothers and the ensuing credit crunch.

The legal status of rehypothication varies between jurisdictions. For example in the United States, the SEC puts a limit of 140% of the loan amount to a client under rule 15c3-3, but in continental Europe there is no restriction.

Portfolio-based CVA

Regulatory authorities tend to take CVA on a portfolio basis rather than on an individual trade. However the grouping of trades into a portfolio is somewhat arbitrary; portfolios may be determined by the trader enacting them, the type of transaction, the underlying currency or any other common factor. Therefore banks can optimise their use of CVA by switching trades between portfolios and many have devised complicated algorithms to this effect.

16.6 SUMMARY

Regulation is making a growing impact on financial trading. Banks must adhere to regulations that apply in their location and carry out due diligence in all their trading activities. Regulation brings its own set of problems and inevitably reduces the amount of capital available for revenue generating activities.

PART Three

What Really Happens

CHAPTER 17

Insights into the Real World of Capital Markets – Here be Dragons!

In order to fully describe the real world experience of working in capital markets, this chapter offers personal insights experienced by the author as he entered a hitherto unknown world.

Ancient cartographers would designate unexplored lands on their maps with the phrase ‘here be dragons’. We leave it to the reader to decide if this is an appropriate description here.

17.1 HOW IT USED TO BE

Let us go back to the mid 1990s – a time with little financial regulation, no euro to merge many of the largest world currencies into one, and before the notion of political correctness had been adopted. The City of London was awash with money-making opportunities; a busy currency desk could make a million dollars in one day.

Figure 17.1 depicts the floor plan, with the trading desks in the middle and the support and control functions around the periphery. The building was oval in shape, with the centre at the lowest level and the floor getting progressively higher towards the edges of the room, rather like a Roman amphitheatre.

The challenges for a quantitative programmer in his first week in capital markets were numerous. First there was the noise of battle. The traders screaming into telephones and at each other were the loudest, but there was a steady buzz of hundreds of staff on the floor having conversations with raised voices in order to be heard above the noise. After a few days it became easier to screen out the background noise and concentrate on one’s own thoughts and conversations.

IT departments in most organisations are tranquil; when staff leave they serve a notice period of a few weeks, which allows time for a handover. Not so on this trading floor – some of the high emotions and strong egos seemed to have penetrated into the desk IT team, so much so that within hours of my arrival, one member was

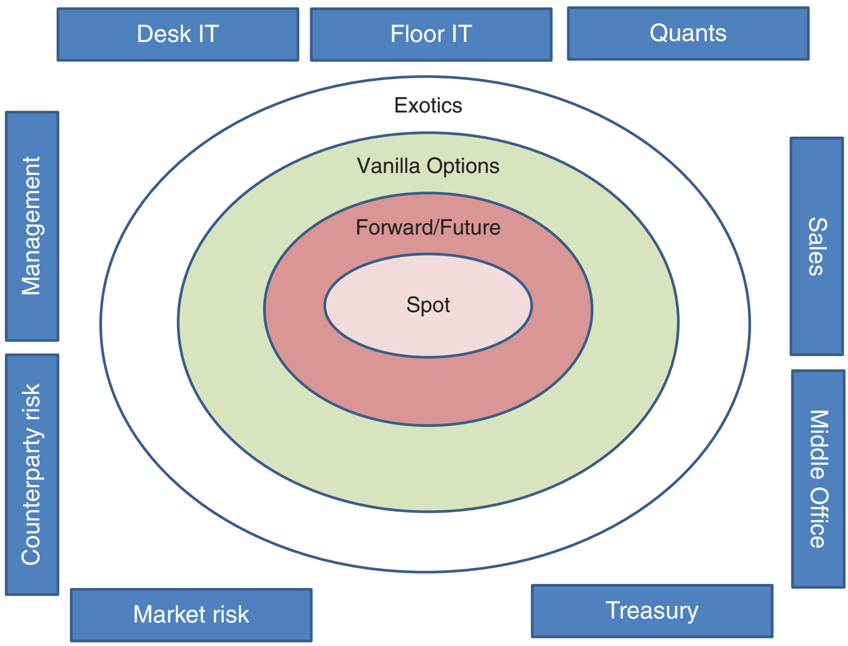

FIGURE 17.1 Floor plan

asked to leave, accompanied by a burly security man to ensure he took his personal possessions and departed immediately.

There were other casualties of war. People would be there one day and gone the next – nobody quite sure if they walked or were pushed. Once a whole team in another business function disappeared and were not seen or heard of again.

Telephones were not only for communication but were handy for expressing pent up frustrations. One rather loud head of a trading desk rammed his telephone down so hard that it smashed into pieces. A few minutes later a technician arrived with a replacement handset and a cleaner swept up the mess. Next day the manager was overheard asking his team if everything was calm and all the telephones were still in one piece!

The amphitheatre had a seating plan that was either random or very strange. I worked in an exotic currency IT team of 12. I was placed between a vanilla currency saleswoman and a middle office exotics man. None of my colleagues was within speaking distance. The middle office worker was friendly and helpful especially at the beginning. The saleswoman did not say one word to me for six months until she announced she was leaving and added that she was sure I was pleased about that.

The exotics traders worked unusually long hours even compared to other traders. There was no equivalent exotics desk in the United States and so they worked a full British day and then five hours extra to cover the American markets. In addition, it was not unheard of for them to put in extra hours in the night trading on the Australian exchanges. It was mandatory that at least one middle office representative was present when trading was in progress, so this meant long hours for members of another team who had no say in the matter if a trader decided he wanted to make a little more money.

17.2 CLASH OF CULTURES

The City of London was replete with cases of two completely different organisations being forced together by merger or takeover. One example was Barclays Capital – a very old British bank subjected to a very American-style management takeover that brought sweeping cultural changes to the whole organisation.

The old organisation was genteel, English, formal, rewarding loyalty, cautious by nature and slow to change. In a very short space of time it was transformed: competitive, worldwide, informal, rapid hire and fire, opportunist and fast changing.

This is not uncommon. Banks are always looking for ways to penetrate new markets by acquiring interests in other parts of the world. It makes business sense for them to join with something different from themselves – the resulting clash of cultures is likely if not inevitable.

17.3 THE EQUALITY OF MONEY

The early American pioneers subscribed to a common dream that every person, no matter their background, had the potential to achieve financial success. That attitude has pervaded many investment banks and financial markets throughout the world. A chief executive of a large investment bank observed that banks cannot distinguish themselves by producing better quality money.

So everybody has an equal opportunity to make (or lose) money. In many ways it is refreshingly open and fair. Appointment of trading positions is based around money-making potential rather than class, culture, race or where you went to school. A person can climb to the top purely by being good at generating profits and his rise will usually be quicker and less impeded by prejudice than in other industries and walks of life.

One of the first things that struck me working in London investment banks was the number of different nationalities and languages all working together for a common purpose.

Also, there was a general level of subordination to the revenue generators. The traders in particular called the shots. They were the masters of the financial universe and everybody else danced to their tune. Sales people had an ambiguous position – somewhere between outright generators of revenue and support staff for their trading colleagues. The third main group of revenue generators, structurers, were also well regarded and given huge resources, but their activities were less well known and they never quite hit the heights of popularity enjoyed by traders.

The revenue generators were the clients and masters of the support staff such as operations and IT. Middle office – with both a control and support function – were supposed to confront anything they saw as irregular or suspicious. In some organisations they did, but in most they were too afraid to really impose their will unless the issue was large enough to catch the attention of management. There was an aura surrounding traders created by the combination of their personalities and the fact they made the kill and all other employees shared the spoils.

17.4 THE POLITICS OF MONEY

Nobody can pretend that the investment bank is an example of the perfect organisation. There is an inevitable degree of politics. In my view this is exacerbated by envy, greed and the enhanced levels of stress and pressure caused by the size of potential profits and losses.

Firstly, successful traders were often promoted to become managers without any training or experience. As trading and management require very different skillsets and aptitudes, a good trader rarely makes a good manager. The single-minded determination, quick decision making and ability to take risks are characteristics of traders. Managers need to take advice, consider carefully and enable people to work rather than necessarily doing things themselves. As a result, many desks and departments were run poorly with too much focus on trading strategies and very little on the whole organisation and infrastructure needed to control and support trading.

The power and respect given to traders and other revenue generators often went to their heads. This engendered delusions of grandeur and arrogance because they were never told when they were wrong. Small mistakes went unpunished leading to much larger ones. They were often reported too late; nobody believed that a trader who made millions the previous year could be losing money this year. The maximum penalty for a trader was losing his job; the maximum loss for the organisation could be its closure, as with Barings in 1995.

Investment banking brought with it a level of snobbery, precluding outsiders from entering the industry unless they had experience or knew the right people. This was not only morally wrong but also bad business because banks often ignored large pools of talented people from other industries. There is nothing intrinsically difficult or special about investment banking. Clever, hard-working people should be able to gain access and make a positive contribution.

Perhaps the greatest source of politics was the bonus. Most banks paid a bonus annually and it was often a substantial part of the employee's income. Although it was often stressed that the bonus was just that – something extra on top of the regular salary and not to be relied upon – for many people it was the defining moment of the year. Their whole year and sometimes their whole life depended on that bonus figure.

In most cases it was not about the money, it was more a measure of their professional success or failure.

Although it was forbidden for employees to discuss bonus figures with each other, it did not take more than a few hours to see who had won and who had lost. Generally the happy group would go out for drinks at lunchtime on bonus day. The unhappy group were divided into those who got less than they expected and those who got nothing. The former would spend the morning in discussions with managers at all levels and, after ensuring they had made sufficient representation, would join their colleagues in the pub. The latter would be left calling recruitment consultancies to start the business of finding alternative employment. Nothing is quite as humiliating as being paid zero when your colleagues are enjoying substantial rewards for their year of dedication to the bank.

In some departments, such as trading and sales, the calculation of the bonus was directly related to money earned for the bank. However in other business functions, the bonus was very subjective depending on the whims of managers and how much they liked and wanted to keep their staff. I was party to a bonus discussion amongst a team of five managers who had a total of 30 staff between them. It was almost impossible to assess how a person in one team had performed relative to his colleague in another team. Although the bank spent much time and effort on all the latest comparison techniques and human resource initiatives, I came to the conclusion that the whole process was entirely arbitrary.

One method of calculation that always seemed to irritate staff was the way many organisations based the amount of money in the bonus pool on the level of the worst performers that year. For example, if equity derivatives had enjoyed a rise in profits of 10% but equities as a whole had lost money, the bonus pool was based on equities even for the people in derivatives.

The exact method of calculation of the bonus pool was never explained and changed from year to year. The people who were seen to have done well were generally rewarded, but in my experience most people were left disappointed. Even if they took home a good bonus in actual terms, if it was less than they expected it did not achieve its purpose of reward and encouragement.

Another detrimental effect of the bonus was the concentration on short-term gain at the expense of longer-term investment. There was little point in having a project lasting more than one year; the effort would go unrewarded if it was not delivered before the bonus assessment. Such short-term thinking has been partially cured by the recent introduction of bonus payments spread over several years. An employee now has to stay at the bank and continue to make it successful to enjoy the full bonus payment.

The old adage that power corrupts could have been written for investment banking. People in high positions controlled vast sums of money and, collectively with their peers in other banks, had great influence on the whole of a country's economy, as we saw to our cost in the banking crisis in the late 2000s. This power pervades the organisation and leads to some very questionable behaviour when there is a chance to make money or to prevent the loss of money. Both successes and failures are magnified and become far more important than in other industries.

A final observation in this section is that many investment banks are owned by retail banks. The management of retail banks often has little experience of investment banking and is unsure how to balance trust with control. Too little trust means the bank is overly cautious, wasting opportunities to make profit and under-utilising skills and resources. Too much trust, however, leads to a lack of control and understanding about what is happening. This can give the investment wing more power than is desirable and often this power lies too far down the organisation structure which is dangerous. The two activities of retail and investment are very different and nowadays there is a greater recognition and desire on the part of governments and regulators to separate them.

17.5 THE GOOD

Here are some reasons why someone would want to work in an investment bank: the environment is stimulating and challenging; intelligence and endeavour are rewarded; in many cases there is a meritocracy; there is an ability to develop one's skills and further one's career; the remuneration is often good or very good.

17.6 THE BAD

A large part of being successful in investment banking depends on perception. This perception does not always match reality. It is generally necessary to have 'face time' – being seen early in the morning, late at night or at weekends, even when the work does not require this extra time.

There was (and perhaps still is) a culture of being 'one of the boys'. Joining after-work drinking sessions and going on adventure weekends is often a hidden requirement for success. This penalises people with families and those who would rather separate their work and private lives.

Stress is a feature of investment banking. Even people away from the trading desk are often caught up in the heightened levels of tension when things are not going well. Although pressure can be stimulating, responsibility for events beyond one's control over a long period of time has many harmful physical and psychological effects.

A large part of the working lives of employees is determined by their line managers. They can influence or dictate the type of work one does, the hours, the pay and the all-important bonus. Many of them are unsupervised by senior managers and therefore the line manager wields a high level of control, making the lives of some people miserable.

Another unpleasant feature of investment banking was the way people lower down the pecking order were treated. For example, a trading desk had four active traders dealing vast sums of money and a lowly gopher, paid a fraction of their salary to carry out administrative tasks on their behalf. At lunchtime it was the gopher who was sent out to buy lunch for the team. As they were well paid they bought expensive meals, and the gopher was expected to pay out of his own pocket and be reimbursed later. Once he told me they owed him for three weeks of lunches – a total of 60 meals and he was shy and embarrassed to admit to them how much he needed the money.

17.7 THE UGLY

Some things were bad but others were really quite ugly, including physical threats. As all telephone conversations were recorded, if a trader was in dispute with a counterparty or middle office over the details of an executed trade, he might listen back to the tape to hear the exact words used. In one particular incident I witnessed a very successful and intelligent options trader leave his desk with a baseball bat in his hand. He came back 20 minutes later to say he had resolved a problem with the wording on the tape of his trade and that the middle office person had not said anything abusive clearly implying that the trader had. The use of a baseball bat to intimidate a colleague went unpunished and was considered part of a trader's behaviour.

There was also a level of psychological abuse. Middle office staff were often afraid to confront traders because it was made very clear to them who paid their salaries and who controlled their bonus. There was a lot of banter on the trading floor, most of it good natured, but sometimes it crossed the line into verbal abuse, particularly when the perpetrators had been drinking or the markets had turned against them.

There was also the totally ruthless and selfish nature of the trading floor. I am not sure whether it attracted people with such a character or whether the environment promoted it, but it can be particularly unpleasant working with a group of people whose only mantra is me, myself and I. They also managed to spread their attitude beyond investment banking when they moved into other fields, such as hedge funds and even software companies.

However many people managed to withstand the stress and tension and were genuinely good and helpful colleagues.

17.8 WHERE ARE WE HEADING?

Of course the recent financial crisis, and several incidents of improper conduct by banks or individuals working within them, has caused governments to seek to restrain what are seen as their excesses. There is far more regulation: EMIR, Dodd-Frank, UCITs, AIFMD, Basel III are just some of the ways banks are being monitored and controlled. Regulation is everywhere and banks are spending millions to keep up with responsibilities recently imposed upon them.

Apart from external control by governments and financial regulators, there has been a growth in internal regulation. Risk control departments have been expanded; shareholders and other stakeholders are demanding to know more about the type and size of risks to which their money is being subjected.

It is fair to say that much of the capital that used to be expended on revenue generating activities has been diverted to risk control and regulation. Risk control requires the following elements, all of which are expensive:

- quantitative analysts
- high-powered IT systems
- more mature and reliable methods to measure risk
- smarter mathematics
- more and more processing power.

Many staff, particularly in the back office and IT, have been moved away from the old financial centres, such as London and New York. Some remain in the same country as their revenue generating base, others are relocated abroad or their functions have been outsourced to third-party service providers.

There has been a greater recognition of the importance of credit-related factors when pricing and risk managing trades. Examples are:

- credit affecting sales credits
- counterparty value-adjusted (CVA) techniques
- growth of overnight indexed swaps (OIS).

Although structured credit as a set of trading products has been decimated by the credit crunch, the techniques and methodologies used to price structured credit products have a part to play in modern credit control.

17.9 SUMMARY

The real world of trading is exciting and has many positive and negative aspects. It is changing rapidly and a new era of control and regulation is starting to take hold.

CHAPTER 18
Case Studies

The aim of this chapter is to give the reader an insight into how real life IT projects happen in investment banks. Each case study is a true account based on the actual experiences of the author. These particular examples have been selected to highlight cases from different banks, asset classes and areas within banks and to provide as great a range of problems and solutions as possible.

18.1 CASE STUDY 1 – BONDS

This case study is taken from a project to build a fixed income (bond) platform for the middle office in the UK division of a large Dutch bank called Rabobank. The project became known as RABOND.

Rabobank background

Founded in the 19th century, with the full name Coöperatieve Centrale Raiffeisen-Boerenleenbank BA, Rabobank is a Dutch multinational banking and financial services company. Global Finance currently ranks Rabobank in the top ten of the world's safest banks. Its headquarters are in Utrecht in central Netherlands. The bank was founded as a cooperative movement of credit unions and rooted in agriculture. Its ties with agriculture remain strong and the bank has leveraged its substantial retail bank presence in the Netherlands with international investment banking subsidiaries, one of the more prominent of which is based in London.

Like most banks, Rabobank held a large portfolio of bonds and was active in hedging using credit default swaps (CDS). The fixed income desk was a very important component of the London-based Capital Markets division. The desk comprised traders, structurers, salespeople, middle and back office and a dedicated quantitative team of financial engineers drawing resources from a global pool of IT staff.

Project background

This case study features a problem that existed in the bank in the mid-2000s. Bonds were being booked into multiple systems depending on their type. It was very hard to identify them for reporting and management information and for any consolidated view of the entire portfolio. Additionally, the process of making fixings for floating rate bonds was very manual and labour intensive.

Management could not see the bank's overall exposures – this increased risk, made regulators nervous and created additional costs by way of over-hedging or failing to take advantage of economies of scale.

Also, at that time the bank was beginning to wake up to the dangers of credit risk, especially with structured credit products, and there was no easy way for them to track this type of risk.

Associated issues

Before attempting a solution, a study was made of associated issues that would need to be taken into account. These included data feeds, traders, sales, back office, back office systems, report generation and report distribution. However the primary client was the middle office.

Data feeds Before investing in a bond portfolio system, it was necessary to investigate the supply of market data which would become the raw material for the new system. The provision of market data by way of third party vendors such as Bloomberg and Reuters was expensive. Aside from cost, there was the issue of reliability and management of the data.

The data would need to be read into RABOND in a timely and accurate manner. All data would need a timestamp to verify its origin.

One of the important features of data feeds is that they operate at different levels. There is a constant or near constant supply of live market data (sometimes known as tickers). Then there are end of day, end of month and end of year marks for more accurate and official reporting. Market data providers also supply corrected data when the original data was inaccurate, corrupted or missing.

RABOND would need to select the most competitive supplier of market data and be able to integrate all such levels of data into the system.

The principal sources of market data required were bond data, interest rates, foreign exchange and credit data such as CDS, prices and rating agency ratings. In this case, RABOND could interrogate internal bank systems for interest rates and foreign exchange prices so the search was confined to bonds and credit data.

Traders The traders involved in the RABOND project did not regard such a system as bringing a big benefit to them and this lessened their interest in it. Traders in general have short attention spans for anything not connected directly with trading itself and so they had little time to participate in project discussions.

There were also reasons why they perceived RABOND as being negative from a trading perspective.

They were concerned that having a system to accurately measure credit and bond exposures might focus attention on this area and negatively impact their trading limits. They needed the financial engineering team (who were primarily behind RABOND) for other projects. Historically traders had never had much communication with the IT department.

Taken together, this meant that the project manager for RABOND had to steer a path away from the traders, only involving them where absolutely necessary. This is not unusual in IT projects – not every business area will benefit from every project and there is always some level of politics to try to minimise the negative effects and ensure the overall success of a project.

Sales The sales team foresaw an advantage in RABOND as they would be able to go straight to middle office for approval to buy or sell bonds cutting out the time and expense of dealing with traders.

The present systems were so poor that any new system was almost certainly going to be an improvement from their perspective.

However, the issue of risk control on direct selling by sales staff mean that liaison with traders was still required.

Back office The back office – also known as operations – were responsible for all payments and receipts. They had to deal with bond coupons and so an earlier and greater knowledge of anticipated coupons was a major benefit which ensured the full backing of this department in the project.

Better reporting of bond positions was essential – the current system was becoming too difficult to use.

Back office systems At the time, Rabobank had a legacy bond coupon system. This could cope with standard bonds, but a huge array of manual processes had to be done for the more complicated bonds. The system had no clear interface, making it more error prone.

In order to make RABOND a manageable project with a defined and achievable scope, it was decided to limit its functionality to deliver full back office reporting but build a different system to improve the back office systems. Again this is typical of financial IT projects – to avoid doing everything in one system which would make it unwieldy, hard to manage and increasing the risk of failure to deliver.

Report generation Rabobank had an existing and acceptable third-party reporting suite. Therefore there was no need for RABOND to build a new one, it simply had to produce new interfaces to connect to the suite.

The reporting requirements were to have some fixed reports which had standard, corporate presentation style and content. Then there had to be user-configurable reports where the user could choose their columns, sorting order and filter the data according to their individual needs.

Although the reporting suite produced the reports, the data was sourced from RABOND. It was therefore important to ensure speedy delivery of data, for example by using database table indexing.

Also, greater flexibility offered to the user meant less control over the data, so a careful balance had to be struck between the two.

One of the particular technical details was that, due to the vast array of possible bond types, the database tables only held columns for standard bond definitions. If a bond had data beyond those columns, use was made of a data blob which was an xml representation of several fields in one large column. RABOND reporting had to ensure that both standard and xml data types could be accommodated and shown side by side.

Report distribution As you might expect, a major bond reporting system had a wide audience. The primary but not exclusive recipients were:

- Middle office
- Management
- Sales
- Traders
- Back office
- Finance.

Each user group had their own requirements. They wanted reports at different levels of detail, at different times of the day and to include the ability to focus on a particular grouping of bonds.

RABOND adopted the approach of gathering the data at the lowest possible level and aggregating it to higher levels where required.

A configuration tool meant that users could be trained how to produce their own reports from an underlying set of data without having to draw on IT resources every time a new variation of report was required. This gave the users more flexibility and independence and reduced the cost of maintenance.

Security was another major issue for RABOND reports. The data was sensitive so reports could not fall into the wrong hands. A recipient list had to be maintained for newcomers, people changing jobs and people leaving the bank.

A report is only useful if it is clear when it applies. Therefore all reports need a timestamp. This is more complicated than it might seem. For example suppose:

- IBM Bond Price on 14 March was 109.11 (as given by market data on 15 March)
- IBM Bond Price on 14 March was 108.98 (as given by corrected market data on 31 March).

Now, if one was reporting in March, the bond price for 14 March would be different from a report run in April or later. So the timestamp had to say both when the report was run and to what date or date range it applied.

Additionally the source of data must be defined because different sources may have varying market data prices. The report may be a mix of raw and calculated results. Where calculations are used, the methodology should be quoted, as again, different methodologies will produce different results even for the same input data. Any assumptions should also be very clear to the reader.

Care had to be taken with any reports sent to an external audience. These could have legal implications, affect the bank's reputation, notify competitors of matters the bank would rather they did not know or mislead potential clients.

Other teams

An important consideration in most financial IT projects is the involvement of other teams outside the IT development team. At different stages of the project, the help and participation of these teams will be required. Careful co-ordination and planning will ensure that they are available and prevent delays.

Issues related to the involvement of other teams included the following:

- It is always harder to influence people working outside the direct line of command for a project.
- The other teams have their own priorities.
- They need more warning and are less flexible than the actual project team.
- They need more support and guidance as they are less involved in the project details.
- There is a higher probability that they will cause major project delays especially if the tasks need to be executed in serial order rather than in parallel with other tasks.

RABOND used the following techniques to overcome or minimise these issues. Management of the other teams was included early so that they could ensure cooperation when required. Planning of resources was very detailed and a timeline with plenty of contingency was set down. Communication with the other team members and their managers happened regularly before and during their involvement in the project. Incentives such as team drinks and dinners were offered to other teams who successfully completed their work for RABOND.

The following teams were involved in the RABOND project:

- Procurement
- Legal
- Data services

- Infrastructure
- Floor support
- Desktop support
- Database administration
- Overnight administration.

Procurement were involved in purchasing Bloomberg licences for dedicated middle office users of RABOND. They also had to buy credit rating information and extra capacity on the bank server for a new bond database.

The legal department negotiated the terms of the Bloomberg licences to allow bond data to be used in RABOND as the project required.

The data services team integrated the new incoming data with existing data sources. They also dealt with exceptions and corruptions in the data. They had to ensure compatibility with existing bank systems and standards for market data.

Infrastructure had to make the new database hardware operational. They also ensured that RABOND software conformed to the bank's desktop policies and that the integrity of the bank's data as a whole was preserved. Furthermore they monitored access to the system and its security.

Floor support had to be aware of changes to RABOND in advance. They had to be given acceptable documentation prior to go-live on any major release or sub release. A weekend had to be booked for installation of the system. They were required for on-going support of extra applications related to RABOND and doing backups. A particularly trying time was during the performance of parallel run, where the new system was road tested while the old system was still live and operational – this gave them the burden of effectively supporting two systems. Finally they had to ensure recovery to the old system and database if the parallel run was aborted, or a switch to live if it was successful.

Desktop support were the help desk for the application and hence the first line of support. They had to be acquainted with the new system and be given full training and documentation. Part of this process was to list likely help calls and how to deal with them. Two of the important features of their job were to deal with new users and to identify genuine problems with the system. They needed to know when and how to contact second line support for more detailed questions. They had to be informed of the most critical days and times when RABOND would require higher levels of support. Also there had to be a prediction of call volumes during the day and night in order to allocate sufficient support resource.

Database administration, as the name suggests, had to maintain all aspects of the RABOND database, which was one of its core features. They were concerned with performance, robustness – that is the ability to cope with events such as power outages – checking and maintaining database logs, performing backups, providing contingency in the event that the main database was out of action for any length of time and scheduling necessary tasks that had to be performed on the database.

Many of the calculation and reporting elements of RABOND were performed overnight to maximise quiet operational time and provide users with results first thing in the morning, so the overnight administration team were key players in the project. They had to ensure that the RABOND processes operated smoothly and in the correct order and fitted in with other overnight processes. For example the calculation engine of RABOND required discount factors (see Chapter 4). These were generated from another system that could only run after the official end of day interest rate prices had been collected. When errors occurred, the overnight administration team needed to know whether they should rerun a process or call in specialist help. They also had to compile overnight reports on how and when the processes had run.

The solution

The actual RABOND project took into account all of these issues and the need to work with the associated teams described above. The solution was built around a central bond database. This was a standard relational database but had an interesting feature to cope with a business problem concerning bonds.

Most bonds have standard descriptive fields. However a few bonds have a wide variety of specialist fields. Although the database only contained 20 common fields, analysis revealed that a possible 85 would be required to cope with any bond available at the time, not to mention the possibility of new bond types in the future. So a special extra field was added, known technically as a data blob. This field contained an xml representation of one or more of the specialist fields. An extra piece of technology was developed to be able to quickly search in the blob where necessary and to combine queries on both standard and blob fields without impacting the performance of the database. This was a very satisfactory compromise that served RABOND well.

With the database as the foundation, RABOND provided the ability to book new bonds and search for existing bonds. An intuitive graphical user interface (GUI) was developed so the user could see part or all of the details of an individual bond or combine bonds to see aggregated holdings.

RABOND also calculated anticipated cashflows in the bond's native currency or converted to any other currency.

One major benefit of the system was the ability to anticipate fixings. Fixings apply to any floating rate bond coupon. This anticipation meant that fixings could be put in the diaries of the middle office team. They could come into work any morning and easily see a list of all bonds whose coupons they would need to fix that day. This saved a lot of time and error where fixings were late or completely missed. RABOND also had an easy process to actually make the bond fixing, to recall previous fixings and look for likely errors where different bonds using the same underlying reference were fixed with different values.

Apart from fixings, RABOND allowed far better monitoring of credit watch events. Major credit ratings companies such as Standard & Poor's (S&P) assign a credit band (or rating) to sovereign countries and corporations. These ratings reflect their credit worthiness and by implication how likely they are to honour their debts, including repayment of outstanding bond coupons and final redemptions. Before a country or company is likely to be upgraded or downgraded a full band, the ratings company usually issues a watch event. For example, S&P's RatingsDirect publication on 'Use of CreditWatch and Outlooks' lists three sets of circumstances leading to a CreditWatch:

1. When, in its view, an event or deviation from an expected trend has occurred or is expected and when additional information is necessary to take a rating action.
2. When it believes there has been a material change in the performance of an issue or issuer, but the magnitude of the rating impact has not been fully determined, and Standard & Poor's believes that a rating change is likely in the short term.
3. A change in criteria has been adopted that necessitates a review of an entire sector or multiple transactions and Standard & Poor's believes that rating changes are likely in the short term.

RABOND accepted CreditWatch events as part of its market data inputs and was able to warn managers, traders and the middle office early and accurately so that they could take preventative action.

As described above, an expansive set of reports was produced by RABOND on demand and at regular intervals.

Finally RABOND kept a full audit trail of user activity. This enhanced the security and integrity of the system. It also allowed for error correction if a user made a mistake and enabled performance to be improved on areas of the system and database under most use. The audit trail also eliminated disputes as to whether 'he did this' or 'she did that' by confirming exactly what occurred. Such disputes are surprisingly common between different business functions in investment banks as many staff are under pressure in busy periods and can make mistakes.

Testing the solution

Perhaps it is surprising that the one area of IT projects which is commonly under resourced is testing. Testing is often the poor relation of project implementation with banks reluctant to hire dedicated testing staff. This was true of RABOND and meant that testing fell into the lap of programmers and users.

Programmers make bad testers – they have no incentive or desire to find fault with their own work. Programmers tend to be creative, whilst testing requires a different approach and type of personality.

Users are very good at testing what concerns them, but will not look at areas of the system beyond their daily lives and are not always good at testing the unlikely scenarios that account for many system failures.

RABOND suffered an unnecessary long testing period due to the lack of dedicated testers and the reliance on users to complete full testing.

What actually happened?

Middle office in particular had rarely had such a large project built for their benefit. While the focus was on RABOND and the resources were readily available they did their best to ensure they extracted as much functionality as possible. Although some of this was certainly of benefit to them and the bank as a whole, it caused a great deal of ‘scope creep’ (when more is put into a project than was originally planned). This caused delay and frustration especially on the part of other business areas like sales who wanted to go live with less functionality. This is a fairly typical experience – a set of users do not know when they will next have access to IT resources so they make the most of the circus being in town before it moves on.

In the case of RABOND, too much dependence was placed on one user. She was the only one who knew both the existing system and the new RABOND system well enough to adjudicate on when RABOND was ready. This put an unreasonable level of responsibility for the project on her shoulders.

The signoff process was left to an informal middle office and IT arrangement. Although such informality can foster a less stressful, less political and more honest relationship, it has the downside of allowing one party (in this case middle office) to drag its feet. However, once RABOND went live, the middle office in particular and the rest of the bank in general did not look back.

As it happened, at the time of RABOND going live, the IT management were pre-occupied with an abundance of other projects and so their attention was diverted. Also, IT resources were moved on and off the project at the wrong times causing delays. The steering committee that set up the project lost interest before the end as many of its members left for new roles in Rabobank or other banks and the newcomers did not have the same level of interest and ownership of the project. In summary, particularly towards the end, there was insufficient focus on RABOND to drive it to a speedy conclusion.

From a technical perspective, the fixed column combined with xml blob approach worked very well. The integration of RABOND report generation into Rabobank’s existing reporting suite was seamless. The system was very extendable and this meant it was quicker, cheaper and easier to produce subsequent versions of the software.

Towards the end of the project, a data licence issue with Bloomberg came to light and required the intervention of the legal and procurement departments. This was due to a misunderstanding of how the RABOND bond data was going to be stored.

Floor support was very strict. The application did not conform to guidelines the floor support team themselves had changed after the project started. Some swift political intervention was required to overcome this obstacle. The credit event feeder system was canned due to unreliability so the project was diverted to taking this data from Bloomberg.

The financial engineering team who wrote the calculation engine and a few other mathematical tools used by RABOND finished long before the IT team. This meant that by the time the system was ready for full testing, the financial engineers were on other projects and had to re-acquaint themselves with code they had forgotten in order to provide specialist help or fix bugs.

There were a series of credit events just after the project went live. The system coped well with these and provided information of tremendous benefit which would not have been possible without it. This more than justified the system's existence.

Overall RABOND was considered a success.

Integration with other areas

The data feeds integration suffered a Bloomberg licensing issue and the termination of the separate ratings feed.

As predicted, the system was used far more by sales than by traders. The sales team were very happy with it; the traders remained agnostic towards it.

Back office agreed that it made coupon receipt and anticipation much easier.

The report distribution was generally satisfactory although there were some issues with reports reaching too wide an audience. Everybody liked the professional and standard format of the reports to the extent that other systems adopted the RABOND reporting style.

Other teams were generally very cooperative. The duration of the parallel run did however cause tension.

Project timeline

The first phase overran by four months but delivered more functionality, including a greater range of bond types than had been envisaged at the outset.

The parallel run took too long, placing too much strain on the middle office and had to be aborted.

There was little scrutiny of delivery schedules and no after-project review.

IT work

The IT work lacked resource consistency as staff moved in and out of the project. There was too little documentation produced, so project handover was slow. Technical support was very good.

Testing was under resourced, so programmers had to spend more time fixing problems which were detected later than they should have been.

Users

On the whole it was felt the users were too fussy, the relationship with IT too informal and they received too much IT and financial engineering resources. As mentioned, the users were very happy with the outcome which enhanced their accuracy, reduced risk and made their working lives easier.

What happened next?

Phase 2 of the project focussed on improving speed. This is common with IT projects: first they are made to work and then to work faster once the slower areas are identified in normal and high-stress situations.

Two years later RABOND was integrated with the back office system. Most of RABOND functionality and all of its screen displays were preserved. Technology used in RABOND was brought across to other asset classes such as fixed income.

18.2 CASE STUDY 2 – FRONT OFFICE FOREIGN EXCHANGE

This case study is taken from a project to build an exotic currency options pricing and risk management system for the front office of NatWest Markets in the mid-1990s. The project became known as EcoRisk.

Background

NatWest Markets was the investment banking division of National Westminster Bank, the largest retail and commercial bank in the United Kingdom. Since 2000 it has been part of The Royal Bank of Scotland and is ranked in the world's top ten banks by size of assets.

As a major British bank with a large retail client base, there was a huge turnover for the foreign exchange division which generated massive profits on vanilla options and for its sister desk, exotic options. There was also a large treasury desk.

To illustrate how much money was being made, in 1995 the head of the vanilla desk (who retired at the age of 34) offered an incentive to his traders that if they were to make one million pounds profit on any one day, he would take them to any city in the world and buy them lunch. Within five months, the team were enjoying Icelandic delicacies in a restaurant in Reykjavik.

The exotics desk sat next to people from treasury, vanilla options, forwards/futures and the spot traders in a large circular arrangement akin to the Roman amphitheatres, with the centre area being lowest and the floor getting progressively higher towards the edges of the room.

Perched on the top layer around the outside were the exotics IT team who had a perfect view of the proceedings alongside and below them.

Figure 18.1 shows this arrangement, with the spot desk in the centre being at the lowest level and the floor rising further and further as you move outwards.

The desks highlighted in Figure 18.1 were those covered by the exotic options IT team.

The exotic options desk had five traders consisting of one manager, three active traders and one trading assistant. Sales had three members, middle office six and

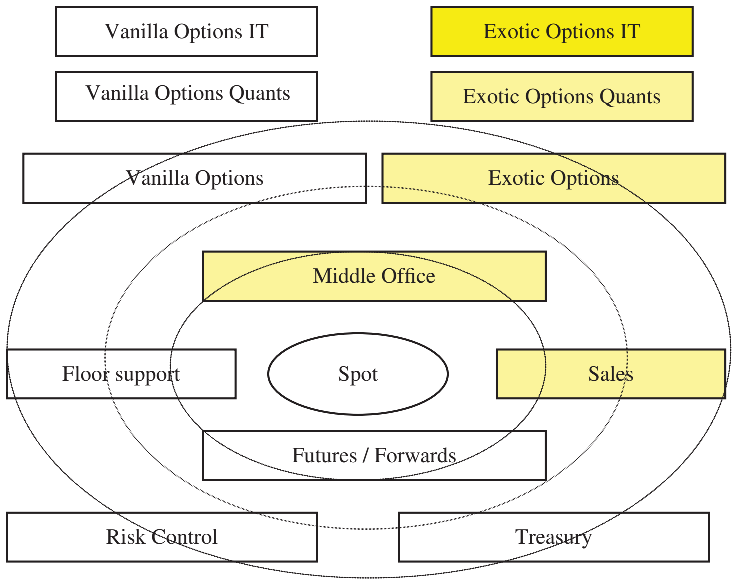

FIGURE 18.1 Currency floor plan

quantitative analysts (quants) had four. The exotic IT team consisted of ten dedicated full-time staff who built and maintained three systems: EcoTrade for middle office, NMos for sales and EcoRisk for traders. This IT team worked together with the quants and the full IT department which serviced the whole of foreign exchange.

The business challenge

The EcoRisk team was charged with building a brand new front office pricing and risk management system. This had to provide an intuitive user interface and full access to a library of analytics built by the desk quants. Furthermore, EcoRisk had to extend the underlying valuation interface taking in new products such as currency option baskets. There was a requirement to keep the existing system – a set of spreadsheets interfacing to the quant library – while EcoRisk was being built.

The human challenge

Dealing with traders is always difficult for a variety of reasons. When the traders are extra busy dealing with vast sums of money, their time, concentration and patience are in short supply.

EcoRisk was being developed in the mid-1990s before the concepts of political correctness and dignity at work had been accepted. This meant frequent and loud verbal abuse if a trader was under stress and somebody of lesser importance did something they did not like.

For historical reasons, there was no co-ordinated management between the quant and exotic IT desks. The team used to be run by a man respected for both his mathematical knowledge and programming skill. When he left, the two natural replacements (one from each side) could not agree who should take over and, since neither commanded the respect of both groups, it was easier to split the team into two. This meant there was unnecessary competition between two teams who should have been able to work in harmony.

Project parameters

An exotic option foreign exchange trader (like many traders around the world) had four screens on his desk. These were full of constantly changing market data, risk management scenarios, financial news and the latest portfolio valuations. His minute-by-minute job was to assess this data, watch for critical or important changes and make short and long-term decisions; buying, selling and hedging.

When I asked a few traders how they coped with such a daunting volume of data they answered that they just got used to it over time.

EcoRisk had to reproduce a lot of the data on these screens and there was little or no time for meetings with traders to discuss their specific requirements.

EcoRisk also had to work with the quants to fully integrate their analytical libraries.

Everything in trading was short term so the deadlines for the project were very aggressive. The products and risk management techniques were continually changing so the project had to cope with moving goalposts.

Another major obstacle was that User Acceptance Testing (UAT) was to be done by users with no patience or appetite for testing (ie the traders). They expected the new system to come fully functional on day one or it would not be used.

Major considerations

Having analysed the project requirements and the parameters within which it was operating, the project management decided that the three biggest considerations were:

- a powerful Graphical User Interface (GUI) – this means the screens and dialogues by which the user interacts with the system underneath
- a balance between flexibility and control
- connecting to the mathematical library to perform calculations in the optimal manner – speed and accuracy were going to be essential to the success of EcoRisk.

GUI In order to design the best GUI given the operating constraints, the traders were observed in their daily work. Here are some of the issues that affected the design:

1. It was quickly apparent that the traders had to spend a lot of time scrolling horizontally to read through pages of data. It was therefore decided to put all the main functionality on the first screen.

2. The state of market data was very important – traders wanted to:
   - watch live feeds and have calculated results change as the input data changed
   - snap the market data at a certain point and do all calculations based on that time
   - invent market data and see how that affected the calculations.
3. Traders were working simultaneously with both the actual and the potential:
   - Trades. The trader wanted to see his current portfolio of trades and superimpose possible future trades to gauge their effect.
   - Portfolios. The trader had real portfolios in which he traded and dummy portfolios for purposes of comparison and as a 'play area' to test ideas and plans.
   - Events. The trader wanted to ask questions of his portfolio such as what if this barrier were breached in a barrier option?

Flexibility versus control An Excel spreadsheet gives the user almost unlimited flexibility, but is very hard to control. A system in which user operations and incoming data are managed gives more control but reduced flexibility. The trick for EcoRisk was to get the right balance between flexibility and control.

Traders tended to want greater flexibility but did accept that some level of control was required.

Connection to mathematical library The purpose of EcoRisk was pricing and risk management. This depended on the underlying mathematical library.

This library was a black box to the EcoRisk developers –its workings could not be seen; all that was visible were the input data and the output results.

The mathematical library was written in the programming language C. For various reasons EcoRisk was written in C++ so an interface between the two had to be agreed and then each library function was wrapped, tested and integrated separately.

The solution

The solution followed the three core activities of prototyping, heavy testing and user involvement at every stage.

Prototyping A prototype is an early sample, model release of a product built to show how it might look or work and possibly to act as the starting point for the product itself.

A picture says a thousand words – everybody can look at the prototype and have a much better idea of what is being proposed than by reading a long functional or technical document.

A prototype allows views to be expressed early in the development process. Users and others may not be able to articulate what they want but they are certainly able to see something and decide it is not what they want!

In the case of EcoRisk, time was invested building a prototype consisting mainly of mock-ups of how screens would look and interact with each other. After a series of 'show and tell' with the users, this prototype became the foundation for the system itself. Over time the prototype evolved into the working application. This meant that at any time the users and management could view progress and see how much of the project work remained.

Prototyping was the best and perhaps the only option for building EcoRisk, given the nature of working with traders. In general a prototype has the advantages of:

- providing an early warning of divergence from expected behaviour
- demonstrating real progress
- aiding communication.

However the disadvantages are:

- A prototype is not good for showing core functionality such as when an engine is being developed with few user screens.
- It takes extra development time.
- It can be misleading as it shows progress in a GUI that may not be reflected in the rest of the system.
- It is biased in favour of showing GUI functionality – the rest of the work may be underestimated.

Heavy testing Due to the importance of the calculation engine, a lot of time was spent testing every product in stand-alone spreadsheets and comparing with the results from EcoRisk. Many scenarios were tested, including extremes of market data and unlikely events to fully stress the system.

The GUI testing was designed to try to make the system crash, test performance under the weight of heavy use and test various data exceptions such as missing data, stale data, the wrong format of data and the user putting in the wrong unit of data (such as millions instead of thousands).

User involvement Even the exotic traders did have quiet moments and sometimes could be persuaded to do some testing as a bit of relief from the stress and responsibility of trading. So picking the right time, they would test until they found a problem, got bored or something more important came up.

Their testing was not rigorous but was good for hit testing and testing real life cases. It certainly was not text book but was iterative and reasonably effective.

Involving the traders in all stages of the project lifecycle gave them an appreciation of how EcoRisk could benefit their daily work. Traders were accustomed to an imperfect world and so having a glossy, well-polished application was not important to them. Also, they had an intuitive feel for what was right and so gave invaluable hints throughout development. Ironically their lack of concern about the high turnover of new releases made them an easier user community than some other business areas.

However, traders had a tendency to be moody and petulant. Their reaction to the state of the system was heavily dependent on the current state of their P&L. Therefore they could easily damage morale and confidence among the project team even when it was unjustified. Furthermore, they tended to do testing sporadically, often late in the evening and were not concerned about noting down their results. This, coupled with their having the attention span of a goldfish, meant that taking away something meaningful from their involvement was not always possible.

Management

The original need for the EcoRisk system was agreed by the trading, quant and IT managers. They then formulated a rough timetable and decided the project would be paid for as part of on-going IT resource allocation and not from a separate budget. After that there was very little direct management involvement.

There was informal tracking of progress and functionality. The development team was small and was left to make its own judgement on the balance between new development on EcoRisk and supporting the existing trader systems.

The major foundation and architecture for the system was agreed early on with the relevant managers and remained unchanged throughout development. However, the detailed requirements were left to the traders and so changed on a regular basis.

Meetings

EcoRisk was unusual for the total absence of formal project meetings. The development team was small enough to have two or three-way conversations rather than a meeting. Exchanges with the quants were on a one-to-one basis as that was the most effective means of communication and because of the political reasons described above. The team leader of EcoRisk did meet the team leaders of EcoTrade and NMos in order to discuss shared resources, common code and functionality and to agree support rotas across all three projects.

There were occasional meetings with the head of trading (usually while he was taking a smoking break) but there were no formal meetings with traders.

Documentation

Another feature of EcoRisk, which might surprise or confound people more used to formal project development, was the lack of documentation. There were no formal functional or technical specification documents. Traders' requirements which came piecemeal were written down, entered into a logbook, developed, tested and checked off the list.

However an audit trail was maintained for tracking back and to prevent the scope of the system being extended too far.

No manuals were written because the users (the traders) would never have read them. There were on-screen tooltips and a user guide based on the common convention of hitting F1 on an area of the system to retrieve notes relevant to that area.

The other tried and tested means of traders getting help was for them to just shout and someone would always rush to their assistance. As it was compulsory for at least one developer to be on call whenever traders were operating there was always help on hand.

How to integrate a black box

In order to make EcoRisk successful, the team had to overcome the challenge of integrating a fully-functional mathematical library into a complete application. As mentioned previously, the mathematical library was developed and maintained by a different team – the quants – with whom there were a few long-standing political tensions. It was vital to diffuse this tension and make both sides understand the importance of cooperation and how the traders would benefit from an integrated package. This situation is not uncommon in investment banking where teams often survive by their independence and their ability to show managers their contribution and worth without being negatively tarnished by the real or perceived mistakes of others.

The core functionality of EcoRisk was the mathematical library which enabled pricing and risk management but, as is typical of such libraries, it accounted for only about 20% of the total code used in the application.

The quant library was known in computer terminology as a 'black box'. This is a term borrowed from electronics and denotes the integration of something whose actual operation cannot be directly observed. To obviate this problem, it was necessary for at least one of the EcoRisk developers to understand the inputs and outputs of the more than 50 separate functions contained inside the black box. He had to gain an intuitive feel for the size and direction of results with respect to the size of inputs. Products were broken down into constituent parts and their data structures were analysed. This was not done in a vacuum – a good working relationship with the quant team was forged and the developers spent time explaining how their library should be used.

One of the key factors in the integration was the testing of results to determine if an erroneous result was caused by the library itself or by the way the library was being used. This meant that support could be offered by the appropriate team – a genuine mathematical problem by the quants and anything else by the EcoRisk developers. As the library was well established and had been used for a long time before EcoRisk was built, most of the errors were not as a result of the library itself.

Support

Originally the trading team demanded support 24 hours a day from Monday to Friday. Eventually, by negotiation, this was reduced to 07:30 to 22:00. This may seem a long trading day, especially as the traders did not work shifts and each one covered the full working day, but it was common for them to work such hours. In fact, on more than one occasion the head trader worked through the night trading foreign exchange products on the Australian exchanges. Special occasions, such as the night of a general election in the UK or the American presidential election, also resulted in all-night trading.

As in most support departments, bugs (faults in the application) were tracked and prioritised against:

- other bugs in EcoRisk
- other development in EcoRisk
- bugs in the exotic currency options IT team's other projects.

As the entire IT team supported EcoRisk and the other two products (EcoTrade and NMos described above), the other members who had not been involved in the development had to be taught how to support it.

The mathematical problems were left for the specialist developers who analysed them and decided if they needed to be passed on to the quants. But most problems were of a general application nature and could be investigated by all competent developers.

As is true for most computer projects, the level of support is highest just after the first release and subsequent additional releases, but as the application is used, more of the common problems are detected and fixed and so only the more unusual cases tend to come up.

Debugging valuation problems

As EcoRisk was a pricing and risk management tool, many of the problems reported were regarding valuation. So here is how valuation problems were debugged (ie investigated using computer tools):

- First of all it was important to understand what the user was expecting and what was actually happening. Sometimes it was possible to directly compare the outputs in EcoRisk with those produced in an equivalent spreadsheet.
- If the user was doing multi-layered calculations, these had to be broken down to find the actual computation with the error.
- It was found that 80% of calculation problems were caused by dates. This could be because the user had expected a parameter to be one date and it was another, or because the system was adjusting weekends or holidays when it should not have or vice versa, and a variety of other similar issues. This meant that carefully checking dates could alleviate many problems without the need to delve into more complicated mathematical algorithms.
- Market data was another cause of problems. In particular when the market data was an extreme value or was stale (the same as yesterday because the provider had mistakenly not updated it).
- It was important to check all the user's parameters and input assumptions, as the principle of 'garbage in, garbage out' always holds true.

- Another common problem was the size of inputs – for example the user thought he should input a percentage when the system required basis points (1/100th of a percentage point).
- As EcoRisk was dealing with currencies, the direction of the currency pair being reversed caused a fair percentage of the total errors. For example, the user input the USD/EUR exchange rate as 1.1761 interpreting this as 1 EUR = 1.1761 USD whereas the system reversed it to be 1 USD = 1.1761 EUR.

Not seeking perfection

When building an application for a rapidly changing front office environment, it was important to keep in mind that we were not seeking perfection. Something that was usable and ready quickly was of greater benefit to the business than something of greater quality that was delayed.

Figure 18.2 gives a rough idea of the speed at which functionality is typically added into a system; it is slow at first while the foundations are being laid, quicker during the middle and then slows towards the end as the developers try to cope with every scenario and possibility.

There is always a balance between reducing time to completion and adding more functionality – EcoRisk inclined towards faster delivery. This was because of a rapidly changing landscape – what was useful today was obsolete tomorrow and there was a

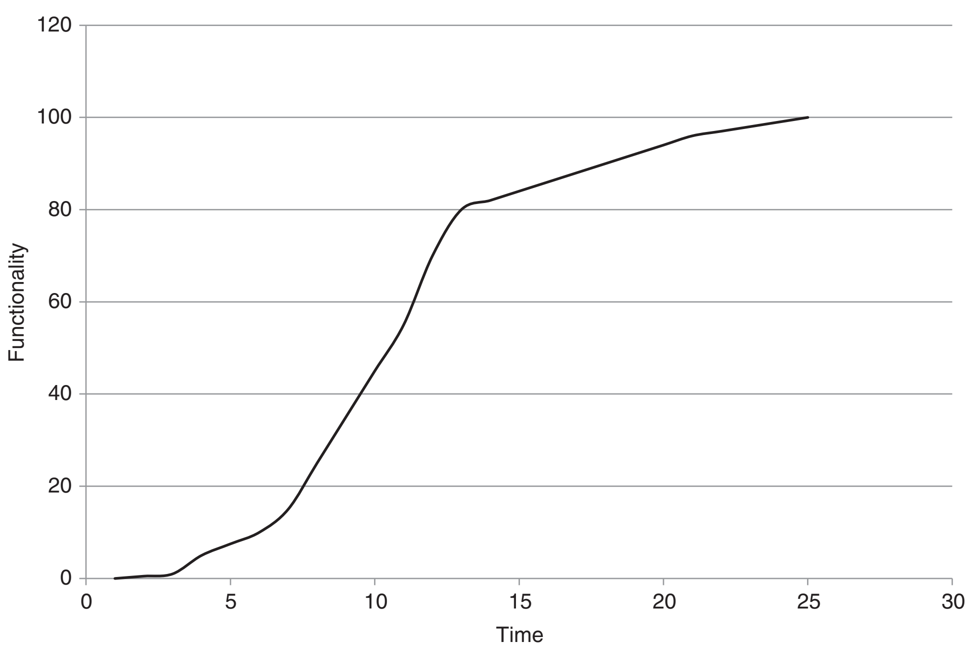

FIGURE 18.2 Functionality vs. time

constant pressure to help the business make money by replacing its existing system of spreadsheets which were not able to cope with the volume and complexity of work.

Another important design decision in most applications is the balance between generic and procedural. Generic design and development means that components are built with a view to their reuse. Procedural development means solving the particular task at hand in the best way without regard to any similar future tasks. This can be compared to building a car that will get you from A to B that is specifically designed for A–B terrain (procedural) or building a car that will go from A to B, C and D etc. taking into account all possible terrains (generic).

There are advantages and disadvantages to both and the decision often comes down to the particular preference of the architect or team leader. A generic approach is often slower and has more compromises to cover various scenarios, whereas the procedural method is quicker for the job in hand but can result in many similar parts being built separately time and time again.

Setting priorities

To keep a project moving and best utilise limited resources, the project manager has to set priorities that will lead to individual decisions about the order in which work is undertaken. In EcoRisk the guiding principles were:

- Trader problems came first (not a difficult decision to make!)
- Development was sometimes more important than support (projects aiming for greater quality will often do support before development).
- Overall perception of the application was the key to its success so a lot of effort was invested in getting the approval of the users (the traders).
- The environment was not robust so short term always prevailed over long term (technical managers and architects might be wringing their hands at reading this but a project will only succeed if it operates within its constraints and not according to a textbook vision of what is correct).

Handling pressure

Apart from the business of developing a fully functional and robust application, front office IT staff also needed the personality to withstand a highly pressurised trading environment. Sitting close to the traders, they inevitably felt the tension and stress when things were not going well and money was being lost. The nature of the environment meant that traders were quick to blame anything and anyone in sight when they saw profits slipping out of their hands. But they were equally quick to forgive and forget when the tide turned.

A programmer had to have the confidence to express an opinion, being careful to pick a time when the trader was not preoccupied with a tough decision or too morose from a negative trading position. He had to be strong and able to justify his views but not to the extent of annoying or contradicting a trader who knew his business better than any outsider.

The programmer also had to keep a sense of perspective; he was not trading vast sums of money and could not afford to be overwhelmed by the prevailing mood. He had to remain detached and calm and avoid the temptation to be overly reactive and emotional.

Multi-tasking

Being a programmer on a busy trading floor in the mid-1990s meant having to juggle several tasks all being demanded at the same time. Here are some examples:

- fixing a bug in the original trading system
- developing a new feature in the new EcoRisk system
- grabbing five minutes of quiet trading to demonstrate something to a trader and gauge his reaction
- understanding how a particular exotic option product works in the mathematical library
- co-ordinating development with the sister system EcoTrade
- dealing with a trader screaming that he has a general IT problem and, as the person nearest, having to go and help.

What actually happened?

Having described the problem being resolved and the environment in which the solution was being developed we now describe what actually took place during this project.

Rapid development EcoRisk benefitted from rapid development. There were a series of releases each one quick and delivering something useful and new to appeal to the traders' appetite.

An agile approach (before the days when agile was widely adopted) facilitated this user–developer interaction and short turnaround time between an idea being proposed, developed and integrated into the application.

The foundation of the application had:

- clear data structures
- a well-defined application programming interface (API) with the maths library
- a solid graphical user interface (GUI) layer.

Mixed quality Users wanted rich functionality and rapid development. In return they were prepared to accept reduced quality.

There was however no compromise on the accuracy of results, as it was essential these were correct and reliable.

The project could best be described as more than rapid application development, but less than robust architecture.

It is important to appreciate that the pragmatic compromises were necessary, driven by the front office environment and requirements.

Testing The lack of dedicated testing resource meant that testing was split between developers performing unit testing, quants doing mathematical testing and traders performing user acceptance testing. This left several areas of the code base under tested and prone to bugs, which led to many bugs being reported after deployment. Although not an ideal situation, it was accepted by the traders.

New technology The system was originally built in C++ and Visual Basic linked by the common object model (COM). This model made installation difficult, time consuming and error prone. At some point during the development, the technology was upgraded, which meant some of the front-end, graphical user interface had to be rewritten. Fortunately, as the application was well-layered this did not affect the business logic and so the time wasted was not as great as it might have been.

The mathematical library was originally built and remained in the C programming language.

Extra products As anticipated, extra financial products in the form of exotic currency options were required during development. This meant new input screens being added. However the screens displaying results were already designed from the beginning to cope with new products and so did not require further change.

Project manager hijack The main difficulty encountered came from a totally unexpected source. The application was near to completion but the project did not have a formal project manager. The management was shared between the head of the IT team and the team leader for EcoRisk, himself a developer. One of the project managers on a sister project, NMos, saw that EcoRisk was going to be a great success and decided that it would do his career no harm to be a part of it. He therefore put the case that EcoRisk needed a dedicated project manager and that he was the best person for the new vacancy. He secured the role and then deliberately slowed the project by having lots of meetings with traders and managers and insisting on changes. This was mostly to draw attention to his involvement so that he could take credit when the project was delivered.

Such behaviour is not uncommon in capital markets. As bonuses are generally set once a year, often around December, many politically-minded employees suddenly come alive for about three months to show how deserving they are of a generous bonus and then disappear for the rest of the year when there is no financial incentive to be noticed.

EcoRisk suffered from such behaviour; it did get delivered and was successful but could have done without this needless extra delay.

Helpdesk created As EcoRisk became the third major system built by the exotic currency options IT team, the burden of support became quite onerous. Specialist developers were spending too much time on common user errors. It was therefore decided to create a helpdesk. Its functions were to:

- handle all first line calls
- identify the problem and write full reproduction steps
- solve non-specialist problems themselves
- pass on specialist problems to the dedicated IT team concerned.

The types of problems encountered when EcoRisk went live were:

- general IT queries (e.g. Excel not working)
- problems with EcoRisk installation
- how to perform tasks in EcoRisk
- problems with market data
- problems with results
- system crashes
- specific queries on how a product is priced or risk managed in the system.

With the helpdesk in place, the solutions were divided into those provided by the helpdesk and those by the specialist EcoRisk developers. The former included all non-specialist tasks and formulating easy workarounds. The latter were involved in more difficult workarounds, immediate fixes in a patch release, referring calculation problems to the quant desk, drill-down heavy debugging of source code and putting together fixes for the next release.

18.3 CASE STUDY 3 – EQUITY CONFIRMATIONS PROJECT

This case study is taken from a project to build a confirmations system for the operations department of equity derivatives within the investment bank SBC Warburg (now part of UBS).

Background

SBC Warburg was the product of a major Swiss bank (Swiss Bank Corporation) acquiring a boutique British investment bank (S G Warburg & Co.). Prior to this acquisition, Swiss Bank had purchased O'Connor & Associates, a Chicago-based trading firm with expertise in financial derivatives. Although Swiss Bank had acquired O'Connor, much of the culture and style of the American firm permeated the more traditional Swiss bank leading to a very casual dress code, first class self-learning programmes for staff and flexible reporting lines empowering people lower in the organisation with greater responsibility than in similar banks.

The later acquisition of Warburg did not however lead to such a homogeneous organisation. Based in different physical locations in the City of London, the ten minute shuttle ride between the sites was like travelling between two different ages of banking. Where SBC was liberal, modern and international, Warburgs was stuffy, traditional and quintessentially English. In large oak-panelled meeting rooms, coffee in the morning and tea in the afternoon was served by waiters in full uniform who looked disdainfully at senior managers from SBC dressed in open-necked shirts and jeans.

SBC Warburg (SBCW) did however manage to produce a first class investment bank with a great deal of focus on equities and option trading.

The equity confirmation project was known as OTTC. OTC is a standard abbreviation for over-the-counter deals as opposed to exchange traded deals. Nobody was sure why the project gained the extra T in its name.

The main users of the OTTC system were traders for deal capture, middle office who validated and enriched the basic deal capture and operations for matching, confirmation and settlement. Straight through processing (STP) was already in use for the exchange traded deals but there was no system for handling the OTCs.

The operations department of SBCW, like its counterparts across the financial sector, was responsible for confirmation of trades, settlement of monies, dealing with custodians of shares and other assets and monitoring corporate actions.

OTTC functionality

The main functionality in OTTC was:

- trade capture
- trade matching
- generation of confirmations
- distribution of confirmations
- management of confirmations
- reporting.

Trade capture OTTC was required to provide a fast and accurate way to capture a trade. It was decided to maintain the current system, where traders recorded their trades on a paper 'blotter' and the middle office would enter the details into OTTC. This meant that traders could continue to do what was quick and easy – namely a few handwritten notes on a pro forma sheet of paper and a further pair of middle office eyes would check the details and resolve any faults or ambiguities before they entered the system.

OTTC was designed to be clear and intuitive. For most fields, the user could start typing and was offered suggestions before he had to type the whole text. The system made use of key characters so 5M meant five million and 6m translated to six months from now.

Trade matching The first stage of the confirmation process is to match our version of the trade with that of the counterparty. This resolves conflicts and detects missing trades. Once the trade is matched, the rest of the process can begin.

How OTTC did matching A list of trades was imported for each counterparty with whom SBCW dealt. A filter of all the trades in OTTC was made for the counterparty in question. Then the list was matched against the filter producing a report of:

- successful matches with the SBCW reference number and that of the counterparty
- trades found in both but with conflicting details
- trade in OTCC but not in the counterparty list
- trade in counterparty list but not in OTTC.

At this point, the trade details within OTTC could be corrected or the counterparty informed and asked to send an amended list. This process was repeated until the two sides matched.

Confirmation A confirmation is a formal statement of the terms of the transaction. It is sent by both counterparties to each other within an agreed time from when the trade was executed.

Generation of confirmations The system began with a confirmation template document relating to the type of trade. For example, a vanilla option had a different template to that of a barrier option. The relevant trade details were then completed in the document. Before distribution (ie sending to the counterparty) the user had to check and approve the confirmation.

Distribution At the time there were two methods of distribution: email and fax. The confirmation document produced by OTTC entered a queue from which a separate distribution system sent the document to the counterparty by whichever method was applicable; some clients used email, some fax and for some it depended on the type of trade as to how it was distributed.

OTTC had a system of traffic lights to monitor:

- whether the email connection was working correctly
- if the fax machine was operational
- success in sending out the confirmations.

Confirmation management In order to manage confirmations, OTTC had to track all incoming and outgoing emails and faxes. Then it had to keep track of the confirmation status of every trade throughout the process. The possible statuses were:

- Not matched
- Matched
- Our confirmation sent
- Their confirmation received
- Fully confirmed.

Reporting Several different types of reports were required in OTTC.

a. Ad hoc

The user needed the ability to query for such things as a particular fault, type of trade, counterparty, underlying share on which a trade was based and a whole array of other queries. An intuitive report designer within OTTC allowed the user great flexibility but was simple to use and also allowed for reports to be stored for future use and shared between different users. There were also common 'pre-packed' reports available from the beginning.

b. Fault reports

As OTTC was used in live interaction with counterparties throughout the business day, it needed to report faults to the relevant operators as soon as they occurred. The fault reports were an extension of the traffic lights described above.

c. Management information

Summary, high-level reports were produced for managers to inspect the performance of the department which was a direct reflection of the type and quantity of confirmations being produced.

d. Statistical reports

OTTC was also required to produce statistical information over longer periods of time. Questions such as 'How many confirmations were successfully matched first time?' and 'How many confirmations failed per day?' led to improvements in processes and better training of staff.

What actually happened?

The project required a framework known as a technical architecture. It also had a database for the capture and retrieval of trades and other data.

Architecture The system was built according to the common three-tier architecture with one unusual modification. The graphical user interface and business logic used standard technologies but the database was object oriented rather than relational.

This was a benefit for the developers as they could learn something new but, as the object-oriented database was untested in a major commercial environment, it was somewhat risky.

The database The database design was acceptable but was very tied to particular trade types being traded at that time. This meant it was not easily extendable in the future when new trades were on the market and extensions were costly in development and testing time.

The object-oriented database tied in well with the OTTC business logic and screens and facilitated quicker development. But it was slower on filtering and sorting and, with the benefit of hindsight, it would have been better to have chosen a relational database.

Trade capture The trade capture facility was the basis of the success of OTTC. It was easy to use, very popular with users and set the standard for future GUIs within the IT department. With a few clicks and the minimum of typing, any of 17 equity derivative trade types could be captured in the system.

Matching Each counterparty had their own data format for supplying trades to be matched. Time spent having to deal with each of these formats was underestimated in the project plan. Additional analysis, implementation and testing were required every time a new counterparty was added. There was a frustration on the trading desk and within management that this caused a delay in being able to trade with new counterparties, restricting growth and limiting potential profit.

Confirmations The generation of confirmations worked well. Distribution by fax also operated to an acceptable standard. However distribution by email created problems due to the bank's firewall and security protocol. This caused the extra involvement of the bank's security department and delays in getting clearance to adopt new methods to allow the email distribution to work.

Reporting OTTC had a rich suite of reports. The functionality was flexible, it was easy to produce new reports and so the reporting was well regarded. However, getting access to the system proved to be a source of contention as there was an on-going political fight for control over sensitive counterparty data. This is a common consequence of more widespread reporting tools – they allow too many people to see too much about what is really going on within the bank!

System testing Unlike the front and middle office projects described in the previous two case studies, OTTC benefitted from a good allocation of dedicated testing resources. The testing was planned and executed well which led to a reduced level of defects and problems in the final delivery. Also, the early detection of defects meant that developers who had worked on the project were still around to fix them before moving on to other projects.

User acceptance testing Just after the system testing was completed, the user acceptance testing began. As the name suggests, this was carried out by the users themselves to ensure that the system worked the way they expected and needed.

There was a cooperative and friendly relationship between the users, developers and project management. There was a little too much focus on testing the user interface to the detriment of the processing of confirmations themselves. This meant that some confirmations were not handled correctly, but this only came to light after the system went live. However, it only affected a small subset of the total number of confirmations being processed and was deemed acceptable in the context of the project as a whole.

Overall, the users were very happy with the system. It worked reliably, reduced costs and risks and allowed greater volumes of trading.

Project management This was a well-managed project. It had a knowledgeable and involved steering committee and the full commitment of all the relevant department managers. There was a defined scope, an agreed timescale and a clear project progression from inception to delivery.

Costs The project review, conducted a month after the project went live, concluded that too much time had been spent on screens for trade capture. However all the required functionality was included in the delivery. The project was three weeks late in being delivered and went 25% over the projected budget.

On-going Part of the service provided by an IT department includes the post-live support and development. In the case of OTTC there was a responsive and high quality level of support and within a few months, the system had been enhanced for more traded products. Later it was extended to cover other asset classes such as foreign exchange and interest rate products.

18.4 SUMMARY

Building IT projects in investment banks brings its own set of problems. To be successful, one must understand the financial sector and how it differs from other industries, the pressures experienced by the user community and the underlying reasons why IT projects are commissioned and built.

CHAPTER 19

The IT Divide

In this chapter we will explore a phenomenon that is common in many investment banks, but in our experience is seldom recognised or discussed. We will refer to it as the 'IT divide' and it manifests itself as a cultural, business and communication gap between the people working in information technology and all the other departments within the bank. We will use the term 'business' to donate the non-IT community.

We will give examples of good and bad projects and attempt to answer the following questions:

- What is the IT divide?
- What problems does it cause?
- How can it be bridged?

19.1 WHAT IS THE IT DIVIDE?

The first factor to consider is a lack of understanding of IT by the business. Most business managers are aware that they spend a lot of money on IT, but have no clear knowledge of where the money is going or why it costs so much. An analogy might be to having builders in your home. They might be necessary but they cost money and you are never exactly sure what they are doing.

In addition, people in other business functions regard IT professionals as a different species. IT uses a strange language full of technical terms and three letter acronyms. They dress differently, spend their spare time in unusual ways (taking apart computers, attending folk music festivals, addicted to Star Trek etc.) and find it hard to talk to 'normal' people.

Due to these and other issues, the business fails to engage in sufficient detail with IT. The business head might talk to the head of IT, individual users might talk to developers or testers and there may be a steering committee liaising with IT project managers, but real, detailed communication is missing. The business expects IT to understand its jobs and the problems it encounters and come up with solutions, but often its demands are unrealistic or insufficiently well described to enable IT to carry out its function.

The reverse problem also exists: IT staff have poor business knowledge. Many IT functions are fungible – that is, they can be transferred from one organisation to another. Although this has some advantages, it often means a programmer or tester will arrive in one bank using the same technology as his previous bank and expect his job to be very similar. Too often there is a tendency for him to immerse himself in the technological side of his work, which he might find more interesting and more likely to progress his career – it may be just too steep a learning curve to try to understand the business around him.

Many banks employ business analysts to try to fill the gap between business and technical knowledge and this does work up to a point. However the most effective designer, developer or tester will need to understand the environment in which he is operating, the people he is working with and the real problem he is there to solve.

Business knowledge is often complicated and specific. The IT professional roaming from bank to bank may pick up detailed knowledge of a small area of one business, but is then working on a completely different project with a different business function or asset class and a new range of products. A general, comprehensive guide is hard to come by and there are not sufficient training materials or time for him to really learn a new business area.

In addition, the access to the business afforded an IT professional can be remote and sporadic. IT is often physically situated on a different floor, different building or even a different country from the professional community it serves. The improvement in communication media mitigates the physical distance, but nevertheless the psychological gap when two people who should be working together are not able to see each other remains, all the more so if they have never even met each other. As the number of people working in IT is typically greater than in other departments and they do less client-facing work, they are often situated in the cheaper offices – out of sight and out of mind. This leads to a perception of being second-class citizens and accentuates the isolation mentality of IT.

The final and perhaps most important factor is that the business and IT speak different languages. Obviously this is not to be taken literally (although outsourcing to foreign countries might indeed present language problems). The different language here is a difference in goals, outlook, background and the meaning of terms used in business and IT. Not only is there a difference in definitions between business and IT, there is often a difference in how a particular trade, process or term is used between one bank and another, further increasing the confusion. Clarifying exactly what a business functional specification or user requirement means is the first task in trying to solve the underlying problem. But this is not always done properly and can lead to misunderstandings that linger throughout the project lifecycle.

Misunderstanding causes confusion and frustration between the two sides. This leads to lack of confidence in the ability of IT, increases costs and reduces morale. As an IT project will involve lots of IT professionals throughout the lifecycle, it is important that all of them have a good understanding of all the terms and requirements of the project. Furthermore, the results of all communication between IT and the business must be passed along as the project progresses.

19.2 WHAT PROBLEMS DOES IT CAUSE?

Perhaps the most serious problem is that IT projects cost more than they should. The solution is designed, developed and tested according to a specification based on what IT understands of the business problem. If this is incorrect, errors which cause delays and add to costs can be expected at every stage in the project lifecycle. Furthermore, IT professionals are reluctant or unable to talk to their business counterparts when they encounter a problem or require clarification. This leads to the problem manifesting itself later when it is harder to fix.

As most IT projects are delivered late, missing deadlines has almost become standard practice. As in the example of the builders above, the homeowner has an expectation of when the work will be complete, but is not told the deadline has been missed until it is passed. The builder will provide some 'technical' reasons for the delay which he knows full well will mean nothing to the homeowner. As frustration grows, each side loses trust in the other. What little communication there was before, all but disappears and the homeowner is just glad when the work is finally complete and he no longer has to deal with the builder.

Most IT projects are developed to solve a business problem. The business is well aware of its problem and has a strong desire that once the project is complete, the problem will have been solved, leaving it with much improved business practice. Unfortunately, as IT does not completely understand the problem and because the business has failed to articulate it properly, the solution provided does not meet the original expectation. This gap between hope and reality leaves business staff feeling short changed. Not only have they invested money for which they have not received sufficient return, but they have also lost the opportunity of utilising precious IT resources which have come their way and may not return until other departments have had their chance.

The outcome of all these problems is a deep mistrust of IT by the business. We have seen many cases where a business manager would rather call in third-party consultants or software vendors than deal with his own IT department.

19.3 IT IN THE MIDDLE

Figure 19.1 shows an accurate depiction of the relationship between business functions in several investment banks. There are two noticeable features:

- IT has a relationship with all other business functions
- The other business functions do not tend to communicate with one other.

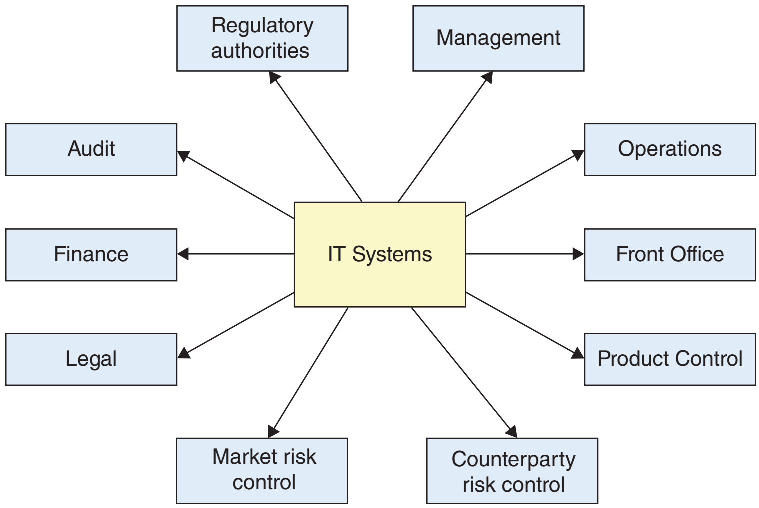

FIGURE 19.1 IT in the middle

This puts IT in a unique position carrying high responsibility. The burden of investigating and improving workflows and business processes often falls to IT. This can even be when there is no need for a new IT system to solve the problem. We know of several cases where IT has improved the business simply by alerting one business function to a process already in existence in another or by getting two business functions to streamline their processes to take notice of each other rather than acting independently.

Taking an overall view of current practices can lead to rationalisation and optimisation, and very often the only people who see this are those working in IT. Empowering IT to act on its findings or at least to make others aware of them can lead to significant business improvements. If however, there is an IT divide, the useful knowledge gleaned by IT may be lost.

19.4 IMPROPER USE OF IT

It seems obvious that a complete understanding of the required processes should precede IT development. In many organisations this is not the case – IT jumps, or is encouraged by the business to jump, straight into development before the problem being solved is fully articulated. Already built IT systems may be shoehorned into new areas under the principle that what worked over there should be fine over here.

As described elsewhere, most investment banks are divided into desks trading different asset classes such as interest rates, foreign exchange, fixed income and equities. Each trading desk requires a front office, middle office, operations and other business functions and services. It is common for the heads of these desks to take a silo approach to IT. Instead of pooling IT systems, resources and knowledge, they take their own dedicated IT teams and build systems for their own area. This is wasteful because many processes and systems could be shared across desks. For example, a lot of the IT work behind foreign exchange is the same as for interest rates and more complex equity trades are hedged using both interest rate and foreign exchange trades.

Knowledge is power and IT is a very good provider of knowledge. Therefore it suits desk heads to maintain a silo approach even though it may be detrimental to the bank as a whole. One major investment bank had five trading desks sitting next to each other on a massive trading floor in Canary Wharf, London. Each desk had its own third-party trading system, data sources and IT team. There was little or no communication between these teams – they could have been working for different banks.

The silo approach also means that the inherent opportunity of IT to tackle several problems at once is not utilised. IT can provide an opportunity to make comprehensive improvements across business functions, asset classes or other departments of the bank, but often a business will hide and protect its IT resources or systems so it does not have to share them with other groups, because that would lead to a dilution of its control over IT and a reduction in the availability of resources.

It is also common for short-term business gains to be given prominence over longer-term investment in IT. Trading involves making lots of instant, short-term decisions based on current market conditions; IT involves planning and assessment of situations well into the future. As many business managers are ex-traders they tend to favour the short term over the long term. The problem is compounded by the annual bonus structure and the high turnover of staff – employees are not concerned about a future that does not involve them.

19.5 ORGANISATIONAL BLOCKERS

The poor use of IT is also down to the way firms are organised. No incentive is given to share IT resources and systems.

IT managers tend to be rewarded by the number of people working for them. This encourages them to hire more staff and go for bigger projects which are more costly and risky to the bank.

Furthermore, a large project may become too big to fail, because so many people have staked their reputation on its success. If the project gets into trouble these people would rather continue with it, even though it may make better business sense to abandon it before more money is wasted. The threat to their reputation impedes their ability to make the best decisions. The corollary is that small, successful projects go unrewarded.

It should also be mentioned that a rapidly changing business environment is not conducive to long-term IT projects. By the time the project is complete, the business has changed too much for it to be useful. However, with careful thought and design, it should be possible to build a solution that is adaptable for areas that are likely to change. It should not be considered a failure if part of a system is continually evolving, as long as it is built on a firm foundation that does not need to change.

19.6 IT BLOCKERS

There are several factors inherent in IT that limit or block its use in the financial sector. The first is that IT tries to bring general techniques to a very idiosyncratic industry. Many IT practices and components are borrowed from outside finance, but when someone tries to apply them to banking they fail to understand the differences. The whole approach required in finance is quite different. It also varies between different areas of the bank. One needs to deal with the focus on quick rather than perfect for the front office, whereas back office requires something stable but multifaceted to cope with a range of products and circumstances.

Trading is the biggest source of revenue, so a lot of IT projects are dedicated to traders. IT professionals fail to appreciate why traders behave the way they do. Traders can be impatient, un-responsive, demanding and aggressive but this is more an outcome of their daily activities rather than a reflection of their view of IT. Project managers, developers and testers are often frightened to engage with traders. There is also the danger that IT perceives the lack of engagement as a lack of interest. Usually this is not true, traders and others are only too glad to be given systems to improve their working lives but do not always have the time to attend formal project meetings; they are much more worried about how their profit and loss will look in five minutes than they are about suggestions for a project six months from delivery.

Moreover, IT staff, having seen the adverse impacts of the short-term approach favoured in the past, tend to regard this approach as impure and not part of how IT ‘should be done’. This is a serious mistake – IT is there to serve its business not to make everybody conform to its way of thinking, and should look at modern approaches to IT iterative development, often referred to as ‘Agile’, to deliver in a responsive but pure way.

Alongside this problem, IT professionals are often loath to make compromises to achieve delivery. Programmers in particular are far more like artists than scientists – they want elegance and completion. They do not always have the mentality required to see the bigger picture; that sometimes the business client would rather 80% of the functionality ready now than 100% in three months. In fact, many see the application they are building as their own pet creation rather than a tool to help business users reduce costs or produce greater revenues. Personal pride in one’s work is important, but it can be taken too far to the detriment of the wider community.

IT staff often know how a solution might improve the business and feel that the current business practice is sub-optimal, but they have to tread a thin line between advising on benefits and dictating to people how they should do their job.

19.7 HOW TO BRIDGE THE GAP

Here are some techniques for bridging the gap between IT and business.

First and foremost is to engender trust between the two sides. An IT manager once remarked that his whole job entailed spending large amounts of money. His sponsors – the business managers – could not and did not know anything about how he spent the money: the whole relationship depended on trust. They trusted him to spend the money wisely on their behalf. As in any human relationship, trust does not develop instantly. It has to be slowly nurtured by a series of successful outcomes to demonstrate that IT knows what it is doing and fully understands what the business wants. Of course just as trust can grow, so it can fall apart. One bad, late or overly expensive project can destroy years of carefully built up trust.

Communication is another key means to reduce the IT divide. Communication should exist at every level – between directors, managers and workers. It should be between the business and IT, between different sets of IT workers and between different areas of the business. It should involve all media: telephone, email and instant messaging. However, it is known that only 7% of human communication is by words spoken, so the best method is by face-to-face discussion.

Once communication has been established, keep communicating. A lot of business and IT interaction involves using difficult terminology and the transfer of exact and complicated processing, so it is better to over communicate to ensure that both parties have fully understood the topic under discussion. When something is first conveyed verbally, it is often a good idea to replay it in writing to preserve a record and prevent misunderstanding.

Despite the common desk division between asset classes and products, it is often better for IT staff to take a more comprehensive view of the business. If they are commissioned by one area of the business to investigate a problem, it may be prudent to look into other areas and see if a more wide-ranging solution can be offered. There may be political or organisational impediments, but IT has a duty to act in the interests of the whole bank.

Another technique which has proved very useful is to provide regular interim deliverables in a project, rather than one big delivery at the end. This gives encouragement to the business as they see progress being made and allows them to catch anything incorrect before it is too late to change. If one stage happens to be late, this will cause less alarm because the business can see that a lot has already been achieved. Interim delivery builds trust, reduces risk and generally provides a better end product. It also means development is more of a collaborative exercise between the business and IT.

IT professionals should be encouraged to know all their customers. There is a wide audience for most IT projects – sponsors, managers, testers, users – and even somebody in a different department who receives a new or different report because of a new system or process, should be involved, consulted and considered. Not only is it polite but it makes the process of building trust and delivering good systems much easier if everybody is aware of them. People are wary of change and are sometimes suspicious that a new system might put their job at risk. But if they are educated and informed they will be able to see the benefits and, for example, go the extra mile to test it thoroughly, so that they get something that helps them do their job better, reduces stress or eliminates menial and boring work.

Quality control is an area which, in our experience, is often missing from IT projects in investment banks. Improved quality comes at a cost, but so does delivering software with many defects. So improving the nature and range of testing can enhance the reputation of IT and reduce the overall project costs.

Finally, IT should try to avoid scope creep. There is a natural tendency for clients to ask for extra features as projects develop, but every additional piece of functionality adds to the cost and delays the delivery. The best response is to record all such requests, estimate their time and cost and present them to the business manager or sponsor for agreement before undertaking the work. Privately agreed favours done for business users by IT developers can go untracked and so create an unfair impression that IT delivery is always late.

19.8 KEEPING UP WITH CHANGE

One of the particular difficulties experienced by the IT department in the financial sector more acutely than in other industries is keeping up with the constantly changing nature of finance. Many banks have adopted a three-fold IT solution to this problem.

1. Rapid Application Development (RAD)
2. desk-based IT professionals
3. integrated systems.

RAD

This method involves one person or a small team of developers working very closely with a trader or other front office revenue generator. They develop very quick solutions often in the form of spreadsheets which can test ideas and potential trading strategies. They might be discarded quickly if unsuccessful or, even if they are adopted, they are intended to be replaced with more durable systems, so they act as a stopgap solution.

RAD does lend itself to a trading environment, but there is always a danger that a working RAD application is left in place because ‘if it ain’t broke don’t fix it’ or because there are not sufficient IT resources to work on the longer-term solution. RAD solutions tend to be built for one purpose, often lack proper testing and are less robust.

Desk-based IT professionals

It is common for a trading or structuring desk to have its own IT team dedicated to supporting it. This means it is readily available and fully committed to the needs of the desk. The IT team gain business experience tailored to that desk, making them more proficient and useful to the desk. They might convert a successful RAD solution into something more durable or build applications from scratch to support the desk. Although this approach has many advantages, it does lead to systems being duplicated across many desks, because each team is unaware of general IT development in the bank or there may be politics involved in sharing other resources.

Integrated systems

The most comprehensive form of development is when a system is integrated across many desks, asset classes or business functions. This will involve the use of general IT resources which are more remote and therefore have less specialist business knowledge.

A successful organisation will utilise combinations of all three approaches and be able to cope with change.

19.9 WHAT DOES THE BUSINESS WANT FROM IT?

As in any relationship each side should try to understand the other. IT professionals should take into account the following requirements from the business community,

Engagement from idea to delivery (and beyond)

Many IT systems start life as an idea in the head of somebody in the business. That idea needs to be articulated, discussed, formulated, agreed and then a system designed, built, tested and managed. The business is looking for engagement from all of the IT staff involved at every stage in the process. They want client-focussed, sensible solutions that provide value for money. They do not expect IT to use the opportunity to try out new technology for the sake of new technology, to enhance their marketability or to do what they find enjoyable or interesting unless it is in the best interests of the business. They also want to know what is happening in non-technical language throughout the development lifecycle.

Even after a system has been delivered the business requires the engagement of IT for support, training and enhancements.

Understanding of particular financial requirements

The business will take it for granted that a programmer can program and a tester can test. They want value-added IT staff who take the time and trouble to understand the financial business. Reading technical magazines is all well and good, but a grasp of products, cashflows and what a business function really does is equally important.

Ownership

Too often IT projects stagnate or fail because nobody takes proper ownership. The business expects IT to follow through a project from start to finish. Ownership means assignment of responsibility. Once that is accomplished, responsibility must be undertaken and followed through to the completion of the project. Proper management should ensure that problems come to light early and are resolved. Communication is essential to ensure all of this occurs.

Investigation to uncover real problems

An IT system is generally built to solve a business problem or facilitate a business process. IT has a responsibility to uncover the real problem it is trying to solve before embarking on development. Sometimes it is discovered that a solution to a similar problem already exists or that re-using existing IT components is sufficient without the need for new work; IT is often the only department with such knowledge. The business expects IT not to squander time and money unnecessarily.

Predictable outcome

The business expects IT to be able to estimate the cost and delivery date of a project based on the functionality it should contain.

No last minute surprise

One of the worst scenarios from the business perspective is getting to the end of a project and, without any interim warning, discovering the project has cost more than expected, is not yet ready or does not contain the functionality required. This should not be allowed to happen. Projects do sometimes overrun on cost or time, but this does not occur suddenly. As soon as it is known, the business should be told. Nobody likes to be the bearer of bad news, but it is far less damaging if the business can plan for the delay or extra cost earlier rather than later.

Project plus

The business would like full testing of any system. In addition, training at appropriate levels and in the correct medium should be provided. This could be by classroom instruction, on-site teaching, online manuals, written documentation, context sensitive help or someone available at the end of a telephone to answer questions.

Support of a system – reacting to and fixing defects – is also very important. There should be resources available for enhancements which are often required once the business sees what a new system can and cannot do.

Satisfied end users

The real success of an IT project depends on the people using it being satisfied. The business manager signs off and pays for the project, but he wants his employees at the coal face to benefit from it.

Solve the actual problem

The business wants IT to solve the actual problem it is experiencing and not what IT perceives to be the problem. This might sound obvious, but it is amazing how many IT systems fail in this, their foremost objective.

Do's Here are some tips for IT staff to keep their business clients happy:

- Keep in touch.
- Deliver something early.
- Test.
- Think through deployment.
- Minimise parallel run time.
- Listen to everyone involved.
- Learn from mistakes.

Don'ts And here are some things to avoid:

- Don't invent problems to solve.
- Don't solve unnecessary problems.
- Don't be overly creative.
- Don't hesitate to make suggestions.
- Don't assume IT knows best.
- Don't be late without warnings and reasons.

19.10 WHAT IT WANTS FROM THE BUSINESS

Now let us look at how the business can help IT to do its job.

Clearly articulated requirements (or statement of the problem)

Clients rarely understand exactly what they require from IT. This however does not prevent them working with IT through one or a series of discussions to formulate their problem and agree the best solution or to devise their requirements for a new process or system. It is unrealistic to expect even the most experienced IT professional to fully understand the working processes of the business. Therefore time and effort should be expended in articulating clear requirements.

Availability of business staff throughout lifecycle

Building a system for a business unit is a continuous process. IT would benefit from having representatives of the business available for discussions, demonstrations and making agreements on issues as they arise. A successful development cycle is related to close cooperation and high levels of communication between the service provider (IT) and the client (the business).

Keeping to agreements of functionality (no scope creep)

Asking for extra functionality after the contents of the system have been agreed is known as scope creep. It is almost certain to involve delays to delivery. If the business genuinely decides it needs something more than originally intended, IT should be given the budget in time and money to satisfy the extra requirements.

User acceptance testing not done by IT

Before a major system or application is delivered and signed off, it needs to go through a process known as 'user acceptance testing'. IT staff can test to make sure a system does not break, runs efficiently and correctly and contains all of the agreed functionality, but they are not generally able to test it the way a real user would. It is often assumed that once IT passes a system to the business, it is completely ready; the business does not allocate sufficient time or resources to this final and essential part of testing. Lack of user acceptance testing is also a big source of frustration between the business and IT, with each side blaming the other for the failures it causes.

19.11 PARTICULAR CHALLENGES OF THE FINANCIAL SECTOR

We end this chapter by examining the particular challenges of the financial sector which make the IT divide more pronounced.

Historical processes

Some trading dates back hundreds of years. It uses strange terminology, odd units of commodities such as 1/48th, and has idiosyncratic rules and regulations. They might seem archaic, but they are a reality that IT has to overcome.

Also, many banks are using legacy systems built many years ago. Due to their size or complexity, they are expensive to replace. The millennium bug arose because large systems built in COBOL abbreviated the year to two digits (74 instead of 1974) to save computer memory space. Nobody considered the system would still be in use in the year 2000 when two digits would no longer be enough.

Finding programmers who can maintain such legacy systems is increasingly difficult as those technologies become more obsolete.

Must understand all processes before systems are designed

When designing a new system it is best to take everything into consideration. Although not everything may be built at that time (or in the future), a good design must take into account all existing and potential processes. As financial processes are complicated, this makes the art of design more challenging than in other industries.

Competing needs

As we have described above, an investment bank is full of internal competition for IT resources. This can be between desks, asset classes, product sets and business units. Proper governance and management (sadly lacking in many banks) is the only way to devise proper priorities and prevent IT being pulled in too many directions at the same time.

Rapid changes

The business changes rapidly. What is today considered exotic, tomorrow becomes vanilla. Coping with the pace of change is one of the hardest challenges for IT in the financial business.

19.12 EXAMPLE OF A GOOD PROJECT

An example of a good project was one undertaken for Barclays Capital. It consisted of credit utilisation measuring and reporting. There was a small, dedicated team of IT programmers and testers with a project manager and business analyst. Regular meetings were held with representatives from the business community including counterparty risk control, traders and quants. An early prototype was developed to capture the essential look and feel. This evolved incrementally into the final product. At each stage, key users were able to see how the project was developing and catch any errors early. There was a continuous monitoring of resource allocation. Targets were clearly defined and understood. The project was developed on time and within budget and achieved its goals.

19.13 EXAMPLE OF A BAD PROJECT

A project which did not follow the guidelines outlined above was a global derivatives initiative for a European bank. The objectives were unclear from the outset. The person in charge of the technology came from an architecture design background and wanted to stamp his authority on the IT department in the bank. He embarked on an expensive platform of infrastructure with no client delivery goals or achievements. There was little or no discussion with clients before or during the project. The trust invested in this person allowed him to continue unchallenged as the management and steering committee assumed he knew where he was going and that something radical had to be done within IT to catch up with the bank's competitors. Use of the latest technology was put before delivering functionality. The project was abandoned after two years having cost millions of pounds and the person in charge left the bank soon afterwards.

19.14 SUMMARY

IT is very different from other business functions. In order to build successful IT solutions, it is necessary that IT and the business community come together, understand each other's requirements, communicate well and work harmoniously. Too many projects fail because the IT divide is not bridged.

CHAPTER 20

The Role of the Quantitative Analyst

Quantitative analysts are better known as quants. They perform a vital role in most capital market organisations but are often regarded as quite different by virtue of their personalities and interactions with other business functions. Their work is little understood by the wider world, but here we try to unveil some of the mystery that surrounds the quants.

20.1 WHAT IS A QUANT?

A quant is generally someone with a high level of mathematical knowledge and aptitude. He or she uses his or her skills to develop mathematical calculations. Here are some common individual tasks that a quant might do in the course of a regular working day:

- Answering questions such as 'What's the yield on this instrument?'
- Pricing a single trade
- Calculating risk measures
- Developing methodology to analyse a type of product
- Implementing methodology (writing code)
- Analysing a competitor's product – how does it work and how is it hedged?
- Getting product approval for a new product range
- Ensuring that another quant's model is accurate and compliant.

20.2 WHERE DO QUANTS WORK?

Figure 20.1 shows the points in the trade lifecycle where a quant may be involved (the circled text).

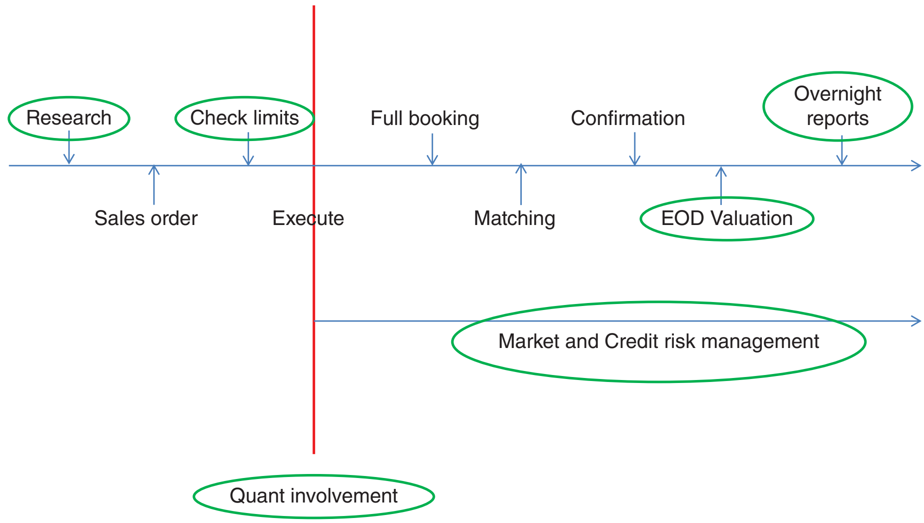

FIGURE 20.1 Position of quants in trade lifecycle

Not every quant will be involved in every function. As in all professions, quants tend to specialise in one or two areas, so a bank will employ quants in:

1. Supporting a trading desk
   This may involve long-term model development for pricing a new or exotic type of trade, or more immediate work such as testing how a potential trade may perform according to various market scenarios. The management of risk is also very important to traders and, due to its complexity, the trader may call upon the help of quants.
2. Market risk control
   In many ways this is similar to the pricing and risk management for a trader except that the focus is on quantifying and controlling risk according to a wide range of likely and less likely market scenarios. There is a wide range of possible market data combinations which lead to vast numbers of calculations. Because of this, quants in market risk control often have to develop clever ways of performing numerical analysis in order to enable the control department to carry out a full analysis every night and sometimes ad hoc during the day.
3. Counterparty risk control
   Although in function the role of a quant in counterparty risk control is very similar to that of market risk control, the techniques of counterparty risk are very different and often call upon a different mind-set and range of experience (see later).
4. Research
   Banks undertake a variety of research, both for internal and external publication. For the more mathematical aspects, a quant may be asked to formulate and document a mathematical model or process.

5. Client advisory

   A key service that banks provide is to advise their clients on financial matters. Many of their clients are small to medium companies which do not have their own financial experts. Quants often talk to clients in order to understand their requirements and help them with financial planning. They might analyse a client's business to answer questions such as:
   - how many liquid funds/How much liquid funding they should keep available
   - how to balance short and long-term borrowing
   - in which currencies to hold their assets
   - investment advice.
6. Analysing the competition

   Suppose a competitor issued a bond backed by life insurance contracts that pays 100 units if at least 20 out of 100 named individuals survive ten years or more from the issue date. This involves particular mathematical skills to answer questions such as:
   - How much is the expected profit for the competitor?
   - What are all the risks associated with the product?
   - Can our organisation offer something similar and make money plus control the risk?
   - Is the product priced fairly?
   - And the big question – should we be getting into this type of market?
7. Quants in defence

   There are cases where quants could have saved their banks large amounts of money had they been brought in to examine valuation systems being supplied by third parties. One example is of a capital products group which issued a note for a corporate borrower at a spread over the price of gilts, which was priced by an external valuation system to determine the yield on the gilt. The external system made a big mistake, the note was issued at the wrong price and the bank had to make up the difference. Quants should be used to ask and answer valuation-related questions – blindly trusting software without being confident of the results leaves a bank open to capital loss and reputational damage.

20.3 TOOLS OF THE TRADE

So what does a quant use as tools for his or her trade? The obvious first tool is the brain. A lot of quant work is mathematical, involving deep and pure thought together with collaboration with other quants in the same bank and possibly with academics and others outside. Quants also make heavy use of published papers and articles which could come from pure or applied mathematics, economics, finance and other disciplines, such as engineering and quantum physics.

There is still widespread use of old-fashioned paper and pencil together with the more sophisticated spreadsheets and algorithm generator tools, such as Mathcad.

Nowadays most quants also do programming. Often they like the older, more functional programming languages such as C and Fortran, although the object-oriented C++ has become more commonly accepted. Quants want a language that allows them to write mathematics in programmatic code and that will run fast and be easy to debug if there are problems. They also want to be able to reuse common functions.

A collection of calculations may be grouped into a mathematical library. How to use the library is defined by an application programming interface (API). Once the library and API are made available, a non-quant programmer should be able to make calls on the library and receive calculation results without having to understand how the functions in the library work. This is known as calling a black box. The quants will be responsible for maintaining and extending the library.

20.4 PLACE IN ORGANISATION

The world of investment banking can be broadly divided into poachers (people trying to make profits) and gamekeepers (people ensuring the rules are not being broken). Quants perform tasks on both sides of the fence, as is depicted in Table 20.1.

Depending on where they work, quants may have direct interfaces to traders, market risk control, counterparty risk control, middle office (who carry out the official valuation), IT and management.

20.5 WHERE SHOULD QUANTS SIT?

One of the questions managers ask is where they should seat their quants. If we consider quants used to help traders, there is a good case for saying that they should be on the desk next to the traders, but there are also advantages to them sitting in the backroom.

Being near traders means that they are close to the action – they see and feel more keenly what the trader requires. They are more accessible to try out ideas and follow the latest market trends. Traders do not have time to leave the desk and so having quants nearer means making more use of their skills.

On the other hand, the backroom is more conducive to quiet contemplation, proper analysis and more thorough research and development. They can take a step

TABLE 20.1 Poachers vs. gamekeepers

Poachers	Gamekeepers
Developing models for trading	Model validation
Risk management for traders	Working for risk control functions
Applying regulations	Defining, policing regulations

back to get an overall perspective and have more opportunity to collaborate with their colleagues. Also a front office desk will cost more and allows less freedom for the quant to work for several departments in parallel or consecutively. So the backroom enjoys economies of scale in its use of quant resource.

The final decision will depend on the particular business requirements of the desk and the organisation as a whole. It comes down to:

- Who do you want them to influence?
- Who do you want them to be influenced by?
- What sort of development will they be involved in?
- Do the traders want them nearby?
- What are the business drivers?
- How can they best be managed?

20.6 THE BOUNDARIES OF QUANTLAND

Note: Quantland is an invented term to define where work undertaken by quants starts and stops.

Incorporating a mathematical box of tricks into a working computer system raises the question of how much work is done by the quants and how much by members of the regular IT department. The answer to the question involves far more than allocation of work – it will dictate the boundary of the two worlds and the level and position of interaction between them. It might seem strange to think of quants and IT as two separate teams, but the type of personalities involved often means management should think carefully about how best they can cooperate and when to allow each to work independently.

In Figure 20.2, the analytics are written by quants and then incorporated into the rest of the system by the IT department. Quants provide training and documentation on how to use their materials, but do not get more deeply involved. The boundaries are clearly defined and there can be no argument about individual responsibilities. The

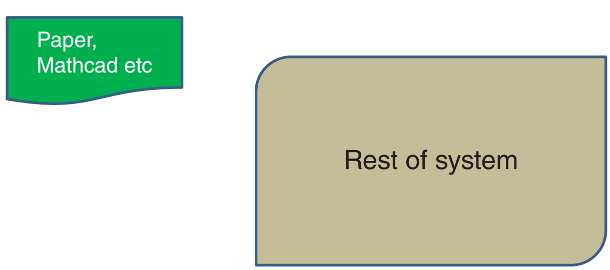

FIGURE 20.2 Analytics written by quants and incorporated by IT

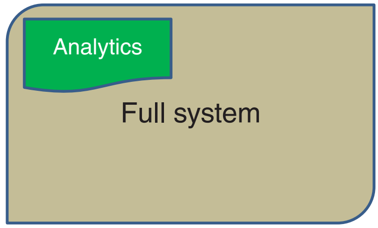

FIGURE 20.3 Analytics as separate module within full system

analytics could be developed before the rest of the system is even conceived. Each side can plan, design, build and test in isolation until the very end when the two are put together.

In Figure 20.3, the analytics are still a separate module but they live within the full system. Here the quants help with integration and maintenance. The boundaries are less clearly defined and a fault may need to be investigated by one side and passed on to the other. Also, there needs to be a greater degree of planning from the outset. Questions such as who checks input data, how errors are handled and who formats results into user-friendly format need to be resolved in collaboration.

Figure 20.4 is a fully integrated system of analytics and all other functionality. Quants are involved in everything and take on the role of developers. Some quants are well suited to this activity and so are suited to this scenario, but in our experience quants are best used as specialists in mathematical work, leaving the rest to IT professionals.

As mentioned above, the boundaries of Quantland will be determined to some extent on the basis of the human relationship between the quants and IT and whether quants:

- work with IT
- work despite IT
- work without IT
- can be used as rapid application developers
- can work alongside IT rapid application developers.

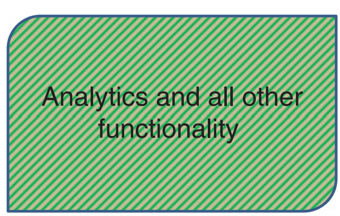

FIGURE 20.4 One fully integrated system

20.7 WHAT DOES IT THINK OF QUANTS?

There are far too many quants and IT professionals in the world to make sweeping generalisations about how they interact with one other. Here are some impressions gleaned over a career working with both groups:

- **Here be dragons.** Many IT professionals are afraid of quants. They feel overwhelmed by their superior intellect and are shy about asking questions for fear of seeming foolish.
- **Helpful SME or necessary evil.** Successful quant-IT partnerships usually involve mutual trust and cooperation. This can arise however from two opposite views. Sometimes quants are considered as helpful subject-matter experts willing to share their knowledge and guide IT in to how best to use their work. Others are thought of as a necessary evil, something one does not particularly enjoy but cannot live without.
- **Confident or arrogant.** Quants are seldom timid. They have formidable academic pedigrees and are employed as experts. Their confidence can sometimes cross the line into arrogance.
- **Not in the real world.** Their academic background may prevent quants from being fully integrated into the financial world. Their ideas sometimes suit the classroom better than the trading floor. Getting them to utilise their skills in real trading scenarios takes time and patience.
- **Different programming styles.** Most quants can and do program, but their style of programming often leads to conflicts with traditional IT practices and conventions. For example, they might have strange calling conventions and return codes. On one quant desk, the quants insisted on successful functions returning zero, whereas IT was used to them returning non-zero. This led to no end of confusion and heated argument until a compromise was reached where each side would do what it wanted and live with the other side doing the complete opposite!
- **At best 20% of the full system.** Quants and others often make the mistake of thinking that their work forms the majority of the system, because the essence of a risk system is the calculation engine. This is rarely the case. There are many layers between the user and the engine such as:
  - User interface
  - Checking user inputs
  - Converting inputs to a format used by the engine
  - Deciding which function or functions to call in the engine
  - Receiving the results
  - Converting results to user-friendly format
  - Displaying results to the user

- Handling errors
- Providing guide, hints and explanation to the users.

  This means the engine often accounts for no more than 20% of the overall work. Although the quant work is essential, it should not be assumed that once the quants have finished, the system is ready.

20.8 DIFFERENT TYPES OF QUANTS

There is no one generic set of quants. Quants come in all shapes and sizes and are suited to different types of financial products. To illustrate this, let us look at the difference between interest rate and credit quants. Remember that apart from pricing credit trades, the theory behind credit analysis is more commonly extended to the whole of counterparty risk. This means credit quants have a prominent role in capital markets – matching and perhaps surpassing those of other quant disciplines.

Interest rate quants deal with very well understood market forces. The mathematics is exact using closed-form solutions. The pricing is very precise; there are many published papers leading to a very mature set of models for financial products.

Credit quants have to cope with many unknowns. They need to make assumptions and use immature models. There is often a paucity of empirical evidence which leads to them taking a common sense approach to pricing and analysis of results from models.

A different attitude is required depending upon the type of product being modelled. A senior and very experienced credit quant described the approach used by interest rate quants to credit products as being 'precisely wrong'.

Figure 20.5 attempts to explain what he meant. Interest rate quants are not used to making assumptions, so they will try to pin down a trade valuation with the maximum precision. The point they miss is that credit involves such wide assumptions that this exercise is meaningless. The only way to deal with unknowns, such as the recovery rate, is to take a very broad, real world approach and look for a likely range of results. Then express the results with a confidence factor such as 'the spread has an 80% chance of being between 45 and 47 basis points'.

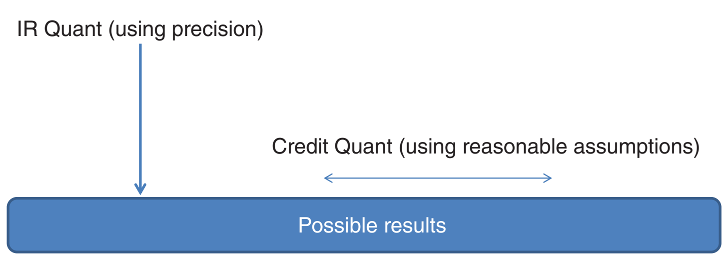

FIGURE 20.5 Precisely wrong

20.9 GETTING THE JOB DONE

Investment banking is a business; time is money and the banks require their employees to deliver results. However quants are mathematicians and mathematicians tend to seek elegance in their work. A simple, elegant solution is aesthetically far more pleasing than a long-winded one, even if the latter does the job and can be delivered more quickly. So managers of quant departments often have to cajole their staff away from their academic instincts and impress upon them the importance of delivery.

This integration into the real world can be aided by encouraging quants to look beyond themselves and see the whole environment in which they sit. They should be able to interface with other people, both in terms of communication and in ensuring their work can be adopted and understood by others. This comes down to being able to explain difficult mathematical concepts verbally and in writing as well as showing in non-mathematical terms how their solution solves the problem that has occurred.

Additionally, there is a balance between a pragmatic approach – solving the immediate problem at hand – or a full design, taking into account situations beyond the one immediately at hand. The first approach is direct and quicker, but the latter may be more cost effective if similar work will be required in the future.

20.10 SUMMARY

Quantitative analysts perform a varied and important role in investment banks. Their position in relation to IT staff depends on the type of interaction desired. The two groups can work independently, collaboratively or somewhere in between. Some quants aid the traders with pricing and risk management while others are involved in the control function helping to quantify market and counterparty risk exposures.

PART Four

Behind the Scenes

CHAPTER 21

Developing Processes for New Products (and Improving Processes for Existing Products)

Investment banking is an evolving business. Processes are continually required to solve new problems or improve existing practices. Sometimes changes come because of the desire to trade new products, other times regulators may impose new requirements or the need to catch up or overtake competitors forces banks to consider change. Here we consider processes. Note that the term 'process' is agnostic – it could be something carried out by computers or by human beings.

21.1 WHAT IS A PROCESS?

We consider a process to be an activity performed on a trade or related to the existence of a trade. Examples of processes are:

- book trade in a system
- calculate fair value of a trade
- settle a trade
- stress test a trade under different scenarios of market conditions.

Processes run the entire business of trading. These occur at all stages of the trade lifecycle. They can be automated by computers, operated by human hand or a mixture of both. Later in this chapter, we will discuss the building and running of a brand new process, but before that we will describe a common situation in many financial entities.

21.2 THE STATUS QUO

There is an old joke about a man who is asked how to get from Liverpool to Birmingham. He answers: 'if you want to go to Birmingham, don't start from

Liverpool!' Many organisations have a complete tangle of existing processes and anyone trying to rationalise them would be better off starting again from scratch. Let us try to understand why processes very often turn into a tangled and disorganised mess and in doing so, we will see how difficult it can be to build and maintain processes for a trade lifecycle.

21.3 HOW PROCESSES EVOLVE

Processes start in different ways. Here we follow a typical evolution for a process where the organization is reluctant to embrace too much change in one go.

Stage 1 – toe in the water

A typical foray into the trading of new products or trading in new markets begins with a trader and a spreadsheet, possibly with some client enquiries. The trader analyses the market and the products, working out where he can make money, either by trading for himself or through fees charged to the client. He puts together sample trades with sample market prices and starts a virtual book. He trials the book for a limited time and if successful, he seeks approval from his manager and the risk control functions. If they are happy, he begins transacting real trades under tight limits. Then some rudimentary processes are implemented, probably cloning those already in existence for similar products and 'tweaking' them to cope with any differences. If the trade is not covered by the existing processes, a new process is built quickly and bolted on top (see Figure 21.1).

Even though each new trade might require much more human work because it involves an entirely new process or adjustments to an existing process, the volumes are low enough for the institution to manage.

Stage 2 – ready to swim

There comes a point when the original trading concept has been tested and deemed worthy of more extensive trading. The limits are adjusted and greater volumes are

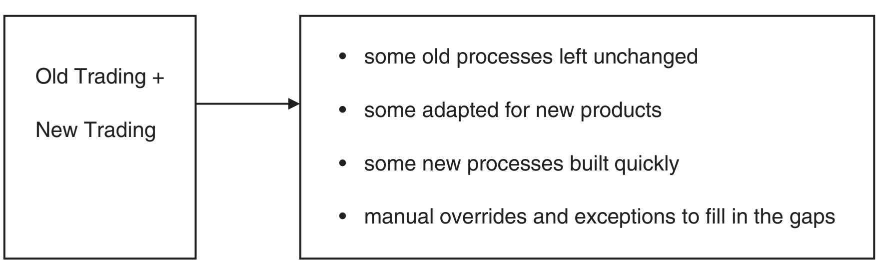

FIGURE 21.1 Evolution of processes

expected. Then the processes have to be upgraded. Sometimes it is a requirement to have working processes in place before the green light for further trading is given – then there is real business pressure to upgrade.

While a human being can be trained relatively easily to do something unusual or different from his previous experience, a computerised system requires programming and extensive testing. Some systems are easy to change because they have been designed to be flexible; others are more fixed and inflexible. Also, many processes feed systems outside the direct control of the financial entity and are therefore tied to the requirements of the external system.

There are different approaches to developing systems. These range from a rapid application development (RAD) designed for speedy implementation, but not meant to last long; through to a fully integrated, robust solution taking years to build, but lasting for decades. The RAD approach is more common in front office and risk control; the fuller system, for the back office and finance areas.

Now we are ready to swim, more robust systems are required and those responsible for processes have to make a decision – to extend the current processes or implement new ones. It may be impossible to extend what is there and too time consuming or costly to implement a full system, so again there may have to be a compromise.

Typically, front office and risk management will have a new process, while the back office and finance processes will be adapted to fit those already in existence.

Examples of solutions to unchangeable systems It is not uncommon to find a person in some business functions employed solely to work around the limitations of an automatic system. For example, there may be a back office settlement system designed for spots and futures. As the system cannot cope with options, someone has to book exercised options as futures after the exercise date, so that the system can process them.

Another example is a very popular data provider who developed a system based around the old DOS operating system. As greater functionality was added to the system, it became too costly to replace the original user interface with something more modern. It has now reached the point where they employ hundreds of people to train and help users work with the existing system, instead of rewriting it from scratch.

Stage 3 – training for the Olympics

Eventually the trading of the new product is entrenched in the organisation. There is a perception that the current processes are operationally risky or not robust enough to cope with the trading volumes. Then a decision is taken to build fully satisfactory processes and systems. This involves designing and building a proper platform and infrastructure. By now the needs of the particular products are fully understood, the weak processes have been exposed and all of the accumulated knowledge and experience can be harnessed into building processes that will last well into the future.

21.4 INVENTORY OF CURRENT SYSTEMS

With our introductory look at how processes evolve, we can see the type of processes that might arise. Depending on the individual organisation, any of the following issues could be encountered.

Redundancy

A process has been superseded by another process that may be cheaper or more efficient to run. The users of the original process are not aware of the new one and so the institution is incurring greater cost or more risk by operating two processes to fulfil the same function. Even if everybody has stopped using the old process, it may continue to be maintained, because nobody is sure that it is no longer used – this will add to cost and divert resources. (See Chapter 25 on reporting for an example.)

Partial duplication

Sometimes a new process almost does the work of an old process, but not quite. This means that both processes have to be maintained when a simple rationalisation might lead to more efficiency. The reasons for partial duplication are lack of awareness or nobody being in sufficient control of the whole operation to be able to make the decision to merge them.

Legacy systems

Many systems have run so successfully that there has been no incentive to change them. Even though the environment around them has moved on, they have been left alone with the maxim 'if it ain't broke, don't fix it'. The problem is that as time goes on, they become harder to maintain because fewer people possess the technical expertise that was used to build them. Sometimes new circumstances arise which were not envisaged at the time of implementation. This leads to a desperate search for a work-around or alternative solution.

A classic example is the old Cobol mainframe, which stored only two digits to designate the year, because storage space for data was at a premium. This was no problem in the 1970s and nobody thought the systems would still be in use 20 or 30 years later when the date changed to 2000. This created what became known as the millennium bug.

Planning

Take three cities:

- New York has a near perfect system of streets and avenues numbered logically, making orientation around the city very easy.

- Paris has 12 beautifully straight avenues converging at the Arc de Triomphe.
- London has a maze of streets with no logical order, frustrating natives and visitors – it takes taxi drivers up to four years to acquire sufficient knowledge to get a licence.

What is the reason for these differences? New York was planned from the outset; central Paris was demolished and rebuilt; London evolved without any planning.

Looking back, it's amazing to see how processes became so entangled and complicated. To plan effectively, one needs:

- thorough knowledge of what will be required in the future
- sufficient budget to execute the plan
- agreement of all involved to discontinue their existing processes and adopt the new ones when they are ready.

There can also be a tendency to over engineer a solution, either to give it more functionality than will ever be needed or to take into account every possible contingency 'just in case'. This can lead to a waste of resources or for the solution to take too long to be completed, hampering the advancement of the business.

Politics

Much investment is expended in certain systems and processes and, even when everybody knows they have failed, it is politically too costly to abandon or replace them. Many people spend much of their working lives using substandard systems to save someone higher up in the organisation losing face.

It worked elsewhere

Many processes are copied between business areas or from one financial entity to another. This may well be appropriate, but careful investigation should be made and each case treated according to its own circumstances. Even slight differences may cause greater operational risk or time wasting. The clever designer will combine past experience with local knowledge to build the most effective solution.

Consolidation

Sometimes the business takes the view that it is better to consolidate two existing processes into one, in order to save the cost of rebuilding. This can work if it is carefully managed and if the two processes are doing very similar tasks and working with the same or similar format of input and output data.

Consolidation can, however, be far from smooth because processes are made to do tasks for which they were not designed. Maintenance and enhancement is then hampered because, even though the original design may have been simple, it has now become entangled. Very often a consolidated process is unintuitive to the new or inexperienced user – this leads to a greater risk of mistaken use or failure.

21.5 COPING WITH CHANGE

All businesses change over time, none more so than in the financial sector. Processes designed for one time have to be adapted and modernised. This can be achieved by incremental enhancement or by rebuilding from scratch. The degree to which a process can be enhanced depends largely on its design. If, for example, a process was built for any asset class and happened to be used for interest rates, it may be easy to enhance it to incorporate foreign exchange. But a bespoke commodity system may be very hard to change for any other asset class.

The popular method – but not always the best one – for dealing with change is to use a spreadsheet to cope with an unusual trade. This will require another spreadsheet to feed from the original one and so on, until the one unusual trade has evolved an entire alternative system of spreadsheets. This involves far more human effort and much greater audit and other risks than those arising from trades booked through established processes.

Dependency on IT

For fixing actual problems in the computerised processes, one would expect to make a call to the IT department. However, sometimes regular processes become dependent on IT, even though they do not have faults. This is because the process involves accessing the database or some other media beyond the control of the users. Instead of building a user interface to control and run the process, the system has been left partially or fully operated by the IT department. This can be costly and inefficient. It also takes control away from the user, making him unnecessarily dependent on others, which will hamper his ability to perform his daily tasks.

21.6 IMPROVING THE SITUATION

Whether a process is run manually or automated by computer, careful planning is required to improve it. The status quo should not be assumed to be the only option available. It may well be possible to improve the current situation without resort to building new computerised systems, by reorganising or rationalising those that already exist. Here we look at how to go about improving processes in general.

We assume that an institution has a set of processes making up the trade lifecycle and activities relevant to it, and that someone has been tasked with improving the current situation. He may be a project manager, a business manager or some other co-ordinator, but here we shall refer to him as the auditor.

What would the ideal set of processes be?

In order to evaluate the strengths and weaknesses of the current set of processes, the auditor needs to take a fresh look at what is required, without being influenced by what is there now. This will clarify what the processes' objectives are and show how well the existing systems are satisfying those requirements.

This consideration should take into account:

- purpose – what are we trying to achieve?
- audience – who requires these processes?
- times – ideally when should processes start and by when should they finish?
- data – what data should be used (and what data does not need to be used)?
- systems – what systems do we have available for running these processes?
- human resources – which staff are available, what skills do they have, what are they good at, what are they not good at?

Understanding the current processes

Before any new processes can be considered, it is important to understand what is currently in existence. Questions which might arise from this investigation are:

- Where are the bottlenecks?

  A bottleneck occurs when a process takes so long to complete that it prevents other processes from running smoothly. The reason why it is finishing late could be either because it is taking a long time to run or because it is starting late.
- What are the time consuming processes?

  Even if a process is not a bottleneck, it could be taking longer than is necessary. This might place an unnecessary burden on human or other resources.
- Where are the dependencies?

  A thorough understanding of the dependencies of current processes is vital before any improvements can begin. Dependencies can be upon other processes, data or particular members of staff.
- Where is there duplication with other processes?

  Duplication could be within the same business area or in a completely different area. The person auditing the current processes needs a wide enough mandate to investigate all relevant processes if he is to spot duplications. Duplication could be partial or total. It should be possible to completely remove a totally duplicated process. Sometimes two processes may seem to do the same thing, but they may draw data from two different sources and therefore the removal of one of them might not be so simple.

- Where are the weak points?

  The weak points in a process – or chain of processes – may be obvious, but sometimes they require a subjective opinion from someone with experience of how processes should work. Some points to consider are:
  - too much reliance on one person
  - too many errors
  - too many failures to complete
  - too important to be run the current way – an important process may need better protection or more people knowing how to operate it.
- What is not needed?

  Sometimes an institution may be paying for resources that are not required, either because processes have evolved to the point where they are no longer needed or because they were purchased for a contingency that was never used. Examples are:
  - hardware – machines not being used
  - networks
  - software – systems or libraries
  - people – consultants or external contractors
  - data – third party supplied data
  - trading services – for example, barges to store crude oil that the company no longer deals in.
- What are the overall requirements?

  It is easy to get lost in the minutiae of processes and fail to see the wood for the trees. While it is important to look at each individual process, the aim of the exercise is to consider the overall purpose of all the processes.

  For example, it could be that a process has been run for a long period, even though it actually achieves nothing – the original reason for having it has long since been lost. The process may seem perfectly reasonable at a micro level, but viewed from a higher perspective, it is obviously completely useless.

  In order to put the processes in context, the overall picture must be understood. Then the underlying requirements for people, data and systems can be mapped. Also, the overall purpose can be re-appraised to ensure that it still remains valid. In other words, do the current set of processes really do the job for which they are intended?

Methods of understanding The above may seem like a reasonable approach in theory, but actually conducting a process audit can be very difficult in practice. Here are some suggestions.

- **Survey the staff.** Question the people responsible for tasks in the lifecycle and find out who does what and when.
- **Follow the data.** Data enters the processes, is processed and then leaves in the form of reports. By tracking the data from source to sink, one can build a view of all the processes operating on it.

TABLE 21.1 Recommendations

Recommendation	Benefits	Cost of new process
Combine all commodity trade booking into one process	Reduce mistakes Save 3 man-days per week	Training and testing time – no new systems to develop
Automate confirmation generation for swaps	Confirmations will complete $^1/_2$ day quicker than at present	3 months for development and delivery of new system

- **Flow diagram.** Processes are essentially workflows: joining the dots between workflows and building up a flow diagram gives a good visual indication of the current situation and reveals gaps where undiscovered processes may be operating.
- **Constraints.** Knowing the full extent of the constraints under which the current processes are being operated will further enhance the audit.
- **Documentation.** When all else fails, read the manual! Documentation of current processes may exist and be helpful. There is, however, the possibility that the document is out of date, in which case it can provide an incomplete or inaccurate picture.

Recommendations Having looked at how things should work in an ideal world and how things are operating in practice, the auditor can assess the shortfall (also known as a gap analysis) and come up with suggestions or recommendations. The purpose is to facilitate decision making. Therefore, as much relevant information should be gathered as possible and then condensed into the most pertinent points for the decision-makers. An example report is shown in Table 21.1.

The report can refer to appendices for the full background to each recommendation.

21.7 INERTIA

One of the biggest obstacles to changing existing processes is inertia. Staff grow used to their current modus operandi and know how to work around any idiosyncrasies and problems, however inefficient they may be. They are suspicious that new processes may bring new and unknown dangers, make their working day longer or more complicated or make their jobs redundant.

There is also the cost of change, which involves staff having to learn the new process, test it thoroughly and deploy it within the organisation. Usually these steps have to be undertaken while still preserving and running the old process (which cannot be switched off until the new process is fully functional). This inevitably leads to more work and to the complication of having to run two processes simultaneously.

It often helps when implementing a new process to explain to the people concerned what the benefits are – easier operation, fewer mistakes, less stress, being able to leave work earlier in the evening etc. Since the staff concerned are going to be the ones switching off the old process and starting the new, it is much easier if they understand why the processes are being changed.

Another method of overcoming inertia is the involvement of management at a sufficiently high level. Once convinced of the benefits of a new process or processes, the management can enforce a smooth transition.

When to change

Timing plays a big part in the progression to new processes. Often processes change when new leadership of a business area takes over or when people used to the old methods leave. Sometimes a substantial loss to the business caused by a failure of the current processes leads to a sudden demand for radical overhaul. In other cases, change happens gradually – one process here and another one there – until eventually everything that needs changing has been replaced.

21.8 SUMMARY

However good or bad the current set of processes are, there is always going to be some level of operational risk associated with them. The more accurate the information about the current processes, the easier it is to assess the risks and know how to contain and reduce them.

As well as running a business that is seeking to optimise revenues and profit, the business management must understand their costs and how, if necessary, to reduce them. They must also know, as far as possible, the risks of taking on more of the same business or expanding into new business areas.

CHAPTER 22
New Products

Trading is continually evolving in the financial industry. An organisation must be able to keep up and in order to do so must have procedures for transacting new products. By new products we mean new trading types or new asset classes; not transacting more of existing trade types.

22.1 ORIGIN OF NEW PRODUCTS

The desire to transact new products might come about for a variety of reasons.

Opportunities

Traders and structurers are always seeking ways of making money. Sometimes they or someone else in a financial entity may spot a new opportunity. This could be through a modification to an existing trade or a completely new type of trade.

As the world of commerce evolves, so does the financial industry serving it. For example the new breed of weather derivatives has arisen recently to fulfil a need to insure against adverse weather.

As trading matures in any existing area, the market becomes well understood and well populated leading to a reduction in profit-making opportunities. This sometimes has the effect of pushing businesses to look for greener pastures.

People joining the organisation

It may seem a cliché but the biggest asset of a financial entity is its staff. Being a service industry with very little physical infrastructure such as plants and machinery, a finance house distinguishes itself from its peers by the skills and application of its employees.

To grow a new business area staff with specialist skills are often deliberately targeted from outside. This could be traders, salespeople, structurers, quantitative analysts or anyone else who can provide a revenue generating advantage. Together with the revenue generators, support and control staff may be recruited if those currently within the organisation do not have sufficient expertise to handle the new products and cannot be taught to do so in sufficient time.

Clients

A client expects a bank to service its requirements. If this entails something new then the bank may have to embrace it in order to satisfy the client and maintain its reputation.

A complicated structure put together for a client may not directly lead to new trading but, if there is a sufficient quantity of such structures being requested or a common component can be extracted from the structure and traded as a stand-alone instrument, this can lead to the birth of a new trade.

Keeping up with the Joneses

Being a very competitive industry, it is essential for a financial entity to keep an eye on the activities of its peers. Stakeholders in a bank or asset manager will ask questions of managers who are not embarking on business that can return them profits.

Due to high turnover of staff and much interaction between the front office of different financial entities, it is difficult for new business ideas to remain secret. Also, in many cases it is to the advantage of a company promoting new business to build a market place for the new product. It can still retain its competitive advantage by understanding the product better than its rivals or by bringing in more business through a greater connection to clients wanting it to trade the product on their behalf.

22.2 TRIAL BASIS

A product is often traded on a trial basis to ascertain whether it is viable.

Why trial?

It is rare for an organisation to be fully ready to embrace a new trading type. Trading a new type of trade therefore incurs additional risks and costs. The benefits of the new trade may still be uncertain and so the organisation is reluctant to commit itself until more is known.

The risks arise from having less knowledge of the product and how it might behave. Models for validation may have to make more assumptions to cover for this lack of knowledge and the product is likely to be relatively illiquid in the early days of trading. Market risk control will have to assign more risk to the trade to cover the greater uncertainty.

Operational risks are higher because processes have not yet been designed for this trade. More processes will have to be run manually and a work-around to existing processes designed to fill any gaps between what is available and what is required. This is likely to be more expensive in terms of labour and introduce a greater susceptibility to errors.

To contain the risks and limit the costs, permission might be granted for a new trade to be transacted on a trial basis for a short period of time such as one month. If successful the trial might be extended or trading on the new product fully adopted.

Features of the trial

Here are some of the possible features of a trial period for a new trade:

1. Limited quantity of trades

   The trader is only allowed to trade up to a certain number of trades during the trial.
2. Limited size of trades

   The notional size of any one trade or the trades in aggregation may be limited.
3. Limited risk

   The amount of money at risk from the new products will be limited.
4. Limited counterparties

   The organisation may be reluctant to jeopardise or restrict current trading lines with good counterparties and so may opt for new trading with selected counterparties only. In addition it does not want to deal with counterparties who are not able to transact and settle the new products.
5. Limited direction and scope of trading

   Examples are:
   - the organisation may insist that only purchases are allowed on the new trade
   - for options they may allow calls but not puts
   - for credit derivatives they may only be permitted on investment grade names.

Advantages of the trial

Having decided to trial a new product, the organisation will be looking for some benefits in order to proceed into full trading. Here we look at the advantages of conducting a trial.

Controlled environment for testing In the same way that an engine manufacturer tests a new design first by computer simulation and then by building a working model, so the management of a financial entity may want a controlled test of a new product before committing resources and risking the firm's capital to full trading. The trial period gives them an opportunity to evaluate the product and if it loses money, the downside will be limited.

Opportunity for improvements While the trial is running, mistakes can be rectified and experience gained in how to trade and manage the new products. Also, it is much easier for designers and implementers of new processes and systems to learn from a working example than from abstract ideas.

Due diligence It may be necessary for due diligence imposed by the external regulators or internal procedures that the trial be conducted before full trading is allowed.

More data to be available As more participants enter the market, prices become liquid. Having a trial increases the chances of the product being liquid when full trading commences. Liquid products are generally seen as being advantageous for a variety of reasons explained elsewhere. See Chapter 24 for an overview.

In addition, the presence of an independent data source for market prices is very helpful for middle office in particular and reporting in general. As products become more liquid, independent data providers can include them in their daily or intra-day publications.

Wait for exchanges and systems to catch up Exchange traded products are generally regarded as less risky and many institutions prefer dealing on exchanges rather than OTC. They may therefore wait for a product to become available on the exchange before trading it.

In addition, an institution relying on a third-party vendor for its systems may need to give the vendor time to catch up with developments in the market place before a system incorporating the new products will be ready.

22.3 NEW TRADE CHECKLIST

Whether or not a new trade is transacted on a trial basis initially, there are various stages that have to be completed for trading to start.

Management approval

Firstly, there must be a sound business case for the new trade. A manager with sufficient authority in the organisation will need to grant approval on a trial or full basis to the new trading activity. He will have to be satisfied that there is sufficient understanding of the product that it can be traded successfully and the risks associated with it can be managed. There must also be sufficient control and support for the product available within the organisation.

Legal and regulatory approval

Lawyers retained or employed by the institution will have to check that the new trading activity is legal and that the institution fulfils any legal responsibilities arising from the trading. In particular they will have to agree documentation with every intended counterparty for the new trade.

If the new trading activity falls outside the current regulatory registration, the regulator will have to be informed and grant permission.

Trading limits

The trading management will set trading and risk limits as for any other product. They will generally be more cautious with new products especially if there is no trial period.

Risk control limits

Market and counterparty risk control will need to study the new product and ensure they have sufficient expertise to set limits and test to ensure they are not being breached on a regular basis.

Models

Where the new trade is reliant on a mathematical model for present value or sensitivity analysis, this will need to be available and have been checked by model validation. It is often the case that the quantitative analysts are the first to become familiar with a new product and they must convey their understanding to other business functions such as managers, risk control departments and middle office.

Trade lifecycle processes

In order to transact the new trade all key stages of the trade lifecycle must be supported. This could start on a rudimentary basis with the expectation of more comprehensive integration later. Staff processing the new trade must be educated to ensure they can deal with it correctly. Very often spreadsheets are used for the new trade and they are signed off as exceptions until proper systems are developed. Such spreadsheets carry their own risks.

Middle office can book and mark the products

Middle office must be satisfied that they can properly represent the new products in the booking system and that they can obtain mark-to-market prices for them. They must be capable of showing the new products in overnight and periodic reporting.

22.4 NEW PRODUCT EVOLUTION

There is a story that in the 1950s a professor of mathematics at the University of Oxford was asked if it was true that he was one of only three people in the world who understood Einstein's general theory of relativity to which he replied – 'Who is the third?' Whether there were two or three people who knew it then, there are thousands who know it now. Knowledge in mathematics and many other disciplines starts with the discovery or invention by a few and is understood over time by the many.

The same is true in the commercial world for new trading which might involve these stages:

1. A single quantitative analyst or a small group of traders develop a product.
2. It is tested and refined.
3. Counterparties are sought to build a market place. Bid/offer spreads start wide.
4. Gradually spreads tighten as larger volumes are traded.
5. Research papers are published to stimulate greater market participation.
6. Pricing and risk management models become more standard and less esoteric.
7. Existing systems are modified and enhanced to obviate the need for exceptional spreadsheets and processes.
8. Legal documentation is standardised.
9. Risk controllers lose some of their natural caution to the new product and reduce the risks allocated to those approximating the true risk.
10. Eventually the regulators catch up and include the product in their controls and procedures.
11. The product becomes standard and derivatives upon it start being developed.

So, as a new product evolves, first the lighter and easier and then the heavier and more established processes are adapted to work with it until it becomes another standard product.

22.5 RISKS

As mentioned above, new products carry additional risks because of being relatively untested. There are fewer people with knowledge and experience and so a heightened human risk. Processes may treat the new risk type as an exception, excluding it from some of the standard operational risk controls and causing a greater possibility of processing risk.

Early participants in the new trade may misunderstand how to trade it and lose money. The trade may be too illiquid to get out of positions causing losses when market conditions reverse. Assumptions underlying the initial trade development may turn out to be unfounded or wrong.

A costly infrastructure may be developed for the new trade that is wasted if the trade fails to reach its projected market volumes.

22.6 SUMMARY

There are several advantages to entering into new areas of trading but the risks must be considered. The new trade must be well understood and the right level of support and control applied to it. Long-term planning for its eventual integration into the mainstream may well be required.

CHAPTER 23
Testing

Testing is a key stage in the development and running of any process in the trade lifecycle. Although testing does not add anything tangible to the lifecycle, it serves to reduce the number of mistakes and improve reliability.

23.1 WHAT IS TESTING?

Testing is the activity that is undertaken to ensure that a process does what it is supposed to do. A process is designed to fulfil a business need; testing should ensure that need is fully satisfied by the process.

Testing applies to processes whether or not they are run by computers. A manual process may, however, require a different style and scale of testing because humans are better than machines at adapting to changes in operating conditions. The majority of our discussion in this chapter is related to system testing, but the ideas can be extended to manual process testing.

It is not always necessary or desirable that a process be perfect. The time spent making a process perfect might be wasted when a less than perfect system would be satisfactory for the given business process. Deciding on the appropriate level of quality is a matter of negotiation between the management, the development team and the users. It also depends upon the environment in which the process was developed and is being used.

For example, a third-party vendor supplying a confirmation system might be expected to provide a higher level of quality than an in-house developed system. This is because:

1. the vendor is more remote than the in-house developers and so the time to fix problems will be greater
2. the vendor will probably be supplying several clients and hence has economies of scale, enabling better testing

3. the client is paying directly for the vendor product and so has a greater expectation of quality
4. the users and the in-house developers may be used to working in an iterative manner before arriving at the final product.

The overall acceptance of a process will be based upon whether it reaches the required level of quality. Individual testers might discover many faults with the system and log them. Then quality criteria will be applied to determine which must be fixed to make the system acceptable. This might involve the project manager, the tester and the users working together (see the subsection below on fault logging).

23.2 WHY IS TESTING IMPORTANT?

Testing is often the poor relation of the development process because it is expensive in terms of time and resources, and to do it properly requires a particular attitude and skill set.

Testing is important because it creates safer and more robust processes, reducing the cost of fixing, replacing or working around faults. Testing in a timely fashion removes uncertainty and ensures that the problems can be fixed while the system developers are still available and can remember how they built the process.

The extent of testing depends upon the importance of the process and the risks if it fails. NASA might spend several years testing their lunar spacecraft, while a simple spreadsheet may only undergo a quick rudimentary check.

The management of a particular process should balance the cost of testing against the risks of not testing, to arrive at an appropriate testing level.

Testing is often a matter of cultural background. There is a story of a Japanese company supplying a component for an American car manufacturer. It was asked to ensure the component had no more than 15 faulty parts in every thousand. After some weeks, the Japanese company supplied two consignments: one containing a thousand good components and the other containing ‘the 15 faulty ones as per specification’!

Many financial entities do not allocate any proper testing time, leaving it to a combination of developers and users to ‘come out with something that works’. The fast changing landscape and constant demand for new and refined processes eats into the development time. So companies are often guilty of considering testing a luxury rather than a necessity. They are then left wondering why their processes are not working properly, leading to more processing errors and longer working hours for staff to deal with the problems.

23.3 WHO DOES TESTING?

In the general commercial world, it is the responsibility of a supplier to ensure the goods he supplies conform to an acceptable standard. Systems developed for financial entities are different because they are tailored to the specific needs of the business users. So the development of such systems is, in essence, a partnership between in-house IT or external software vendors on the one hand, and the business users on the other. They have a joint responsibility and interest in ensuring the system performs the task required.

Testing can be done by staff in the IT division (internal or external) supplying the process, or by those in the business function who are going to be using it. Either side might employ specialist testing personnel or rely on their regular staff to carry out testing.

To see the different sides of testing, let us consider an analogy of a meal cooked by a team of chefs and served to customers at a restaurant. The cooks will test the meal by tasting it and the head chef might give his view on the overall presentation. The diner will conduct similar tests, although he may be more discerning and objective.

In the same way, an informal set of tests might be performed by IT developers and the project manager and perhaps a more discerning test by the users. But in reality this will leave several gaps in the overall testing required. Like chefs, developers are creative people with a vested interest in their product being successful. Unless they are very self-critical, they will find it hard to test sufficiently rigorously to uncover faults. They are also under time pressure to deliver quickly.

The users also have limited testing time and inclination. Time spent testing detracts from their daily tasks. There is a temptation to check the obvious and routine operations and sort out any other problems as and when they are discovered. On the other hand, some users are overly officious in their testing duties and are unnecessarily critical of a new process, delaying its release while changes are made and re-tested.

A very common pattern in the development process is for systems to be used before they are fully tested. Faults are discovered randomly as different sections of functionality are subject to real life processing. They are then fixed and the system is re-released. This process iterates, sometimes over months or years, until a stable system has evolved.

23.4 WHEN SHOULD TESTING BE DONE?

Every time a process is used it is being tested. A fault might not be detected until a particular circumstance or combination of circumstances arises. Therefore, a process can never be said to be fully tested.

Testing usually occurs at several different points in the development and release of a process:

- during development
- after one section of development is complete
- after the whole process is complete
- when the system is given to users

- when the system is about to go live
- once the system is in use
- after any changes or additions have been made.

Ideally, testing of any stage of development should be carried out as quickly as possible after the development. The advantages being:

- less chance of faults spreading through to other parts of the system
- easier to identify where the fault lies and who introduced it
- less chance the developer has forgotten how the part was developed
- fewer errors when the system is shown to users
- more time available for fixing problems
- easier to plan the project.

Whenever a fault is discovered, there is the risk that all results produced by the system hitherto were subject to the same fault. This reduces confidence in the system and can lead to major work tracing the effects caused by erroneous results.

23.5 WHAT ARE THE TYPES OF TESTING?

There are several distinct types of testing at different stages in the development and release cycle. We start by describing the main stages of testing and go on to look at some particular types. It is beyond the scope of this book to cover all possible testing techniques.

Stages of testing

Testing is conducted at various points of the system lifecycle as described here.

Unit testing As the name implies, unit testing is the testing of a single component in the system. This testing is conducted in isolation from the rest of the system. Often unit testing is done by the person writing the unit, although it may be retested by an independent tester.

Integration testing When units are assembled they are tested in groups and this is known as integration testing. This tests whether the units can work together.

System testing System testing is conducted on a complete, integrated system to evaluate the system's compliance with its specified requirements. It goes a stage further than integration testing by making sure the software and hardware work in their designated operating environment.

Acceptance testing (or user acceptance testing – UAT) This is generally performed by the user. Its purpose is to ensure that the system conforms to the user's requirements. After successful acceptance testing, the user is said to have 'signed off' the system. The system is then deployed and used.

Parallel testing This can be part of acceptance testing and involves the user running his existing system in parallel with the new system under test. The purpose is to ensure that every activity that can be done under the old system is present and correct in the new system. One major problem of parallel testing is that it requires maintenance of two complete operating environments together with full working data for as long as the test is being run. This can be a major strain on resources. Another drawback is that the test might only ensure the new system matches the old, without testing new functionality or functionality that should have been improved.

Generally parallel testing is good for short periods of time when a new system is meant to replace the old system without significant changes or enhancements.

Testing types

Many and various are the possible types of testing available. Organisations can choose to employ some or all of the following.

Smoke testing This is a quick, superficial test to ensure that one unit or a part of the system appears to be working. It is usually conducted when something is first produced or when it has been changed. If something fails during smoke testing there is no point continuing with more thorough tests until it is fixed.

Black box testing A unit of the system is tested as a black box, meaning that input data is fed in and output results are checked without knowledge of how the unit works.

White box testing The tester has knowledge of the internal unit under test and attempts to test most or all possible paths through the underlying programming code.

Spot testing This is random testing of the system. Although it is not structured, it allows the tester to be imaginative and gives an overall confidence in the underlying system before more structured testing is performed.

Extreme testing The tester designs extreme cases and tests how the system performs. This might comprise tests on hardware, such as removing and replacing the power cord, or on software, such as particularly large volumes of data, or using corrupted data files.

Data testing Data testing checks how the system copes with all manner of input data. This might include particularly large or small numbers, missing data, data set negative when it is usually positive or data arriving in an unusual format.

International testing Many systems are developed in one location for use internationally. The tester must simulate conditions in other locations, such as changing time zone and language to see if the system can operate correctly.

Machine testing A system might be designed for all manner of hardware. The tester needs to check that it can run on all required platforms such as Blackberry, laptop, desktop and server.

Depth testing Depth testing checks that all the possible routes of functionality have been tested. For example, some screens might be four or five clicks away from the start screen. Anything released as part of the system, however inaccessible or unlikely to be used, should be part of a thorough test regime.

Stress testing This determines the stability of the system by testing beyond normal operational use, often up to breaking point to observe where the limit lies.

Regression testing Once a set of tests have been designed and carried out, it is often desirable to be able to repeat them for subsequent releases of the system. Having a predefined set of tests, and comparing the results with those expected, is a quick and useful means of spotting problems that were not previously present. This is known as regression testing and can very often be automated.

23.6 FAULT LOGGING

A major part of testing is to record faults. Here we outline some of the salient features of fault logging. The tester will usually attempt to complete most of these, but they may be subject to changes by people such as project managers – the setting of priority being one example.

Types of fault

Faults can be categorized based on the nature and severity of the problem they cause.

Critical A critical fault will probably be communicated immediately to the support or development staff, but might also be logged for auditing and review purposes.

Crash If a fault causes a system to crash it is, if nothing else, very annoying. It could also pull down other processes running on the same machine and cause loss or corruption of data. Crashes are generally regarded as unacceptable, even when there are workarounds available, and so fixing them is given a higher priority.

Incorrect functionality Here the system fails to do something it is supposed to do. This is a very wide-ranging type of fault; it could be innocuous or it could have very negative effects.

Cosmetic Although cosmetic changes might be given lower priority, they do detract from the usability of the product and are generally easy to fix.

Request A request for new or changed functionality is not a fault, but very often the tester is in an ideal situation to make recommendations. It is helpful if there is some way for him to record them alongside the faults. This makes it easier for the development team to offer a concerted solution. The work involved in satisfying a request is usually very similar to that in fixing a fault, providing the request is for a small scale change or addition. Requests for major pieces of work should not feature in fault logs.

Workaround

Upon discovering a fault, the tester might, with or without the aid of the user, design a workaround to cope with the problem until it is fixed. It is helpful if some description of the workaround is provided so that priority can be assessed. Some workarounds are easy to live with; some are difficult and may cause other problems.

Priority

Priority can be assigned in multiple layers but broadly, faults have high, medium or low priority. Together with priority, the presence or absence of a workaround should be taken into account; an easy workaround might reduce the priority.

Faults are not always fixed in order of priority. Sometimes it makes sense for a developer working in one section of the system to fix all the faults in that area before moving on to another section. Also, the fixing of faults depends upon the availability of staff and how long the fault might take to fix. It might make sense to fix easy, lower priority faults, while waiting for a more experienced developer to become free for the higher priority but harder ones.

The number of high, medium and low faults gives an indication of the current quality of the system and its readiness for use. Of course it should be remembered that the absence of faults could indicate a robust system or, more worryingly, insufficient testing.

Area

A system might comprise several screens, areas of functionality or output reports. These might have been developed by different teams at different times, so it is important for the fault log to state exactly where the problem arose.

Fault description

If a fault is described comprehensively it is easier for the support or development team to locate the problem and fix it. The first thing someone investigating a fault will want to do is to recreate the problem, so it is good practice for the tester to state all of the steps leading up to the fault. 'I pressed the Generate button and it hung' is less useful than 'I entered a bond trade with the following characteristics [stated in the fault report] and when I pressed the Generate button the system stopped for at least five minutes whereupon I closed the application'.

The context of the fault should also be reported: did it happen on the first attempt, after 10 successful attempts etc? Sometimes one fault might be comprised of two or many faults; a good tester will think through what is happening in the system and try to identify all the individual faults.

Faults are sometimes caused by correct functionality being incorrectly documented. The tester should have a good feel for the system and its documentation to discern where the fault really lies. An incorrect document is misleading and impairs the successful operation of the system.

23.7 RISKS

Here we summarise the business and operational risks related to testing.

Too little testing

Processes may not run correctly, leading to extra costs for the business. Misleading results may have undesirable consequences. The investment in developing or purchasing software is being wasted if the software fails to perform correctly.

Too much testing

Resources are wasted carrying out superfluous testing and improving software beyond what is necessary.

Poor testing

There may be a false sense of security about the system if it is assumed testing has been carried out, but in reality it has either not been done at all or not been done effectively. This might lead to unexpected delays, faults or the assumption that results are accurate when they may actually be false.

Over reliance on testing

A well-tested system improves its quality and robustness, but does not make it more efficient. Underlying flaws in design or implementation may mean it is harder to extend the system in the future or it does not perform as well as it could. A well-tested system is not necessarily a good system.

Poor communication

As we have found, testing is a collaborative activity involving managers, developers, users and specialist testers. For testing to be effective, the results must be communicated to all interested parties. Developers must know and understand the faults, users must be aware of any shortcomings and managers need to build testing and fault fixing into their planning. Overall confidence in the system is highly dependent on good, effective testing.

23.8 SUMMARY

An organisation which devotes time to testing will enhance performance and reduce operational risks. There are various types and means of testing; each company will need to tailor their testing to suit the scale and complexity of their operations.

CHAPTER 24

Data

Data, deriving from the Latin *dare* meaning to give, is used to refer to information. This definition is too wide for our purposes and so in this book, the word data will be taken to mean information required in the trade lifecycle and associated processes that originate from outside the trade itself. It may be helpful to think of the trade as the recipe and data as the ingredients – the success of the dish is very much dependent on the quality of its ingredients.

(Note: Data is technically a plural word but the singular datum is rarely used in the financial industry.)

24.1 COMMON CHARACTERISTICS

The range and type of data required to process a trade can be vast. There are, however, a few factors which are common to most if not all data.

Identification

The data needs some unique identifier to distinguish it and show the user to what it refers.

Time of validity

The data provided is relevant for a given period of time. Data can be relevant for an instant and then be invalid seconds after it has been published or it could stay meaningful for many years.

Reference time

The data may refer to a given date or time or may be completely independent of time.

Value

The data has a value. This could be one item, a vector, a matrix or several dimensions of information. It could be textual, numeric or both.

Source

The data comes from a source. This could be a file, a person, an exchange or some publication.

24.2 DATABASE

A database is a mechanism for storing data. Some organisations use one database to hold all their data, while others have many. The key requirements of a database are:

- Storage
  It can actually store all the data required of it in a safe and secure manner. The data must retain its integrity – whatever is stored must be an acceptable representation of the original.
- Retrieval
  The retrieval must be efficient and accurate. It is useful and sometimes essential that data can be combined, filtered and sorted in the retrieval process.
- Robust
  The database should be available whenever it is required.

Database design is very important to the success of any process using data. The design must take into account the data to be stored and the likely retrieval queries required.

24.3 DATA

Data is an everyday term but what does it actually mean in the financial sector?

Types of data

In considering the types of data used for the trade lifecycle, we divide them into three loosely-defined groups based on the frequency of change.

Market data This changes regularly. As the name implies, market data originates from the market. It is usually derived from recent market prices – a price being the agreed purchase cost of a trade or the price at which a trader would be prepared to enter into a trade. Examples of market data are:

- a 12-month future contract in cocoa traded in tonnes on the NYBOT commodities exchange
- current exchange rate of GBP/USD
- price of J Sainsbury ordinary shares on the London Stock Exchange.

Static data Static data changes very infrequently. Examples of static data are:

- industrial sector classification of Lloyds Banking Group
- business day convention of Spanish government bonds
- address of the Chicago Mercantile Exchange.

Semi-static data This third group is hardest to define. It falls somewhere between market and static data and implies data which may change but not at regular intervals.

Examples include:

- Moodys credit rating for Bulgaria
- the recovery rate for British Airways bonds
- the name of the chief executive of JJB Sports.

Why does type of data matter?

It is useful to split data into these categories in order to apply efficient processes for collecting and managing them.

Input Market data will need to be input at frequent intervals, static data can be input once and semi-static data need only be input upon a change.

Storage Most institutions will not delete old data, because it is useful in a variety of ways. So there needs to be room to store each bit of market data, while it is in the system.

Although nowadays storing data is relatively cheap, access times will increase as the data grows and this needs to be taken into account when processes come to retrieve market data.

Expectation Processes receiving data need to know what data to expect, when it will arrive and how much of it there will be. Market data input processes might expect data for each member of the set, even if it remains unchanged from the previous day. Static data would not be expected at all: if there were a change it might require some manual intervention, as it may not be worth writing a process to cope with something so unexpected. Semi-static data would not usually be expected, but if it were present, processes would need to know what to do with it.

24.4 BID/OFFER SPREAD

A market maker facilitates trading by providing a market for the asset in question. To do this, he must be prepared to buy and sell the asset. He is not going to do that without some financial incentive to compensate him for his effort and the risk he is taking. The incentive is the bid/offer spread. For any given asset he will quote two prices: the lower is the one at which he is prepared to buy; the higher, the one at which he will sell. Hence if orders or traders come to him, some wanting to buy and some to sell, he will make a profit in this spread.

The risk to the market maker is that there will be more sellers than buyers or vice versa. This will mean he will have to raise or lower his prices to regulate the market. He needs to make a careful judgement when fixing his bid and offer prices using his professional skill. The greater the difference (or spread) between bid and offer prices, the greater his profit. However, he has to compete with other market makers and therefore his spread needs to be realistic.

It could be argued that in collecting market data, one need only calculate the mid price (the average of bid and offer) and record that as the price for that asset. However, there are at least two reasons why one might wish to store bid and offer prices.

The size of the bid/offer spread can be a good reflection of the liquidity of the market. A larger spread means that the market maker is not expecting high volumes of trade and needs to insure against a one-way traffic in the trade. Also he needs to make more money on each transaction as trading is sparse. The converse is true when markets are very liquid. In addition, at times of uncertainty in market prices, the spread will widen. For example, the single biggest economic indicator published periodically is the non-farm payroll released by the US Bureau of Labor Statistics on the first Friday of each month. Just before the announcement at 08:30 Eastern standard or daylight time (13:30 in UK, 14:30 in Europe), spreads in assets directly affected by the figure will widen considerably.

The second reason for storing bid and offer prices is that these show the actual price required to trade the asset. The mid price is theoretical but cannot actually be traded. For instance a bank holding 100 million Ford Motor company bonds and wanting to sell them in the market will need to know the best offer price available, rather than the mid price.

24.5 CURVES AND SURFACES

Here we discuss how data is combined to create a series. As we are generally looking at market values against time it is helpful to consider such series as geometric shapes – curves for two dimensions and surfaces for three dimensions.

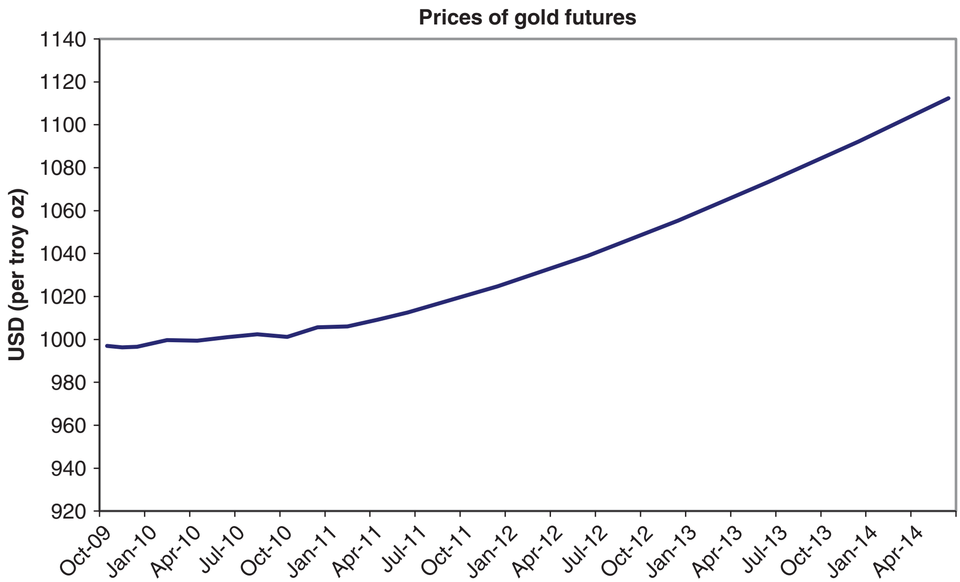

FIGURE 24.1 Comex gold futures

Curves

When market data is expressed as a figure for a given unit of time (or tenor), it is often helpful to aggregate the data for all its tenors to form a curve. To the system, the curve is simply a vector of numbers, one for each period of time; to the human being operating or using the data, it is a line drawn on a graph with the price on the Y axis and time on the X axis, as shown in Figure 24.1. From curves we can infer the market's predictions for the future direction of assets. The points on the curve comprise quotes for future or forward instruments.

Table 24.1 shows the gold future prices as of September 2009[1] while Figure 24.1 shows the corresponding futures curve.

Now let us consider one of the most fundamental curves – interest rates. There are many institutions prepared to lend money for a variety of terms ranging from overnight to at least 30 years. The interest rate applied is a function of the credit worthiness of the borrower – the lender's expectation of receiving full repayment of his loan. Even if the borrower were 100% guaranteed to repay on time, however, the lender would still charge to cover the loss in value of money over time. This market value is the fundamental interest rate and is used to price money over time using discount factors.

[1]Published by Comex Gold.

TABLE 24.1 Gold future prices as of September 2009

Future contract date	Price (USD per troy oz)
Oct 2009	997.0
Nov 2009	996.3
Dec 2009	996.5
Feb 2010	999.7
Apr 2010	999.4
Jun 2010	1001.1
Aug 2010	1002.4
Oct 2010	1001.2
Dec 2010	1005.6
Feb 2011	1006.1
Apr 2011	1009.2
Jun 2011	1012.6
Dec 2011	1024.7
Jun 2012	1039.0
Dec 2012	1055.4
Jun 2013	1073.4
Dec 2013	1092.2
Jun 2014	1112.4

To determine this curve, we need to find where the market quotes interest rates for lending money, without credit risk of non-payment. There are two such markets – the inter-bank market and the bond market for a very secure government bond.

The inter-bank market is where large banks lend to each other with the assumption of repayment. Similarly, US Treasury bonds are considered fully guaranteed by the security of the United States government.

An inter-bank market such as LIBOR (London interbank offer rate) has three types of market instrument.

Money market These are short-term loans from overnight to nine or 12 months in duration.

Futures These are standard contracts for forward exchanges of money, where the rates are fixed today. They range from about three months to two years.

Swaps These are quoted for longer periods extending up to 30 years or beyond.

By combining prices for these three sets of instruments, we can derive a yield curve which indicates the yield (or interest rate) against time (see Figure 24.2).

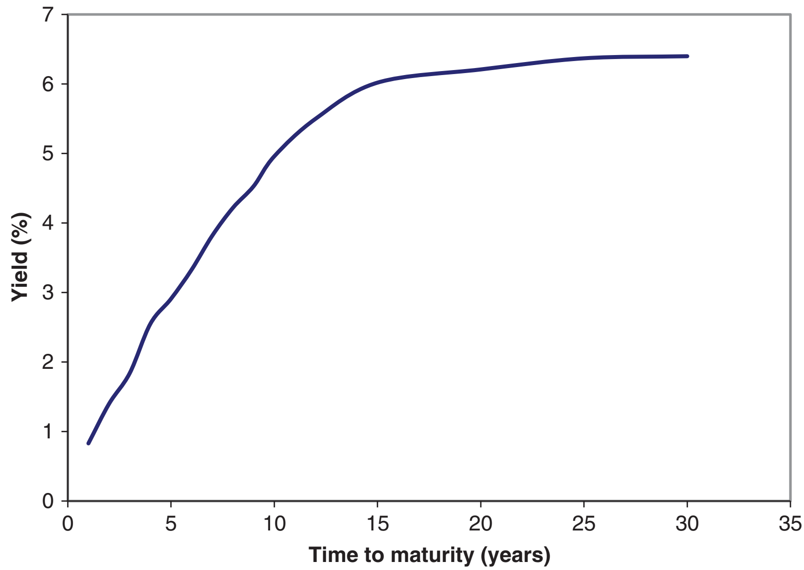

FIGURE 24.2 Yield curve

Surfaces

Some instruments have three dimensions – two dimensions of data for any time period. In order to look at the shape of market data over time, we need to use a three-dimensional object, usually referred to as a surface. A typical example is implied volatility. Although volatility is generally regarded as a reflection of the way prices move, it can also be a source of market data. This is because premium prices of an option infer the volatility (known as the implied volatility). The typical behaviour of options is that they are have greater implied volatility when deeply in or out-of-the-money. In or out-of-the-money is a function of price. So in order to model the market data we need three dimensions – value, price and time. By observing market data for implied volatility across different prices and times, we can construct an implied volatility surface.

It is important to recognise that future curves and surfaces generated from current market data are only a market-implied snapshot of how asset prices will move. They change as market prices change and therefore implied future prices have volatility. They are, in essence, current market data for spot and future instruments – they are not actual future prices.

24.6 MARKET DATA

Let us consider the universe of market data required to handle all of a financial entity's trade processes and calculations.

Sets of market data

Different sets of market data can be applied depending on the business function and the type of operation being performed. Here we discuss some of these types.

Current (live) As the name implies, current market data is what is available in the market place right now. It is by definition the latest possible set of real market prices.

Official A financial entity will usually designate a set of market data to be official and use it in order to perform its reporting and valuation. The official market data may be from a specific source or one present at a certain time, or both. For example a credit hedge fund might designate official data as:

- credit default swap prices provided daily by CMA at 17:00
- interest and foreign exchange rates provided by Bloomberg at 16:40 and
- credit ratings supplied by S&P at 18:00.

Dealt Any market data agreed by the counterparties at the time of execution will form part of the trade details.

This may be the current data at time of execution, some average of recent market data or it could be any agreed value.

Historic Certain business functions require the use of historical data. This could consist of the official data stored in the database daily over a considerable length of time or historical data purchased from a data supplier or a combination of both.

Indicative Sometimes an approximation to market data is required without precise numbers. This is known as indicative market data.

Random Many processes are concerned with simulating possible market data. One means of achieving this is to use random data. Although truly random numbers are very hard to generate, computers have randomising functions which can produce pseudo-random data.

Predicted Mathematical techniques can be applied to a selection of random data to predict averages, likely ranges and extreme values.

User selected There are occasions when data is missing, of poor quality, incomplete or unlikely. The user will then want to input his own values. Alternatively, he may want to test out different scenarios using his own choice of market data.

TABLE 24.2 Usage of data types by business function

	Indicative	Current	User	Official	Historic	Predicted	Random
Sales	Mainly	possible					
Traders	Yes	yes	yes	yes		yes	yes
Middle office			yes	yes			
Back office		likely		possible			
Market risk		yes		yes	yes	yes	yes
Credit risk		yes				yes	
Legal	yes				yes		
Audit	yes	yes	yes	yes	yes	yes	yes
Finance				yes			
Management		yes		yes			

Business usage of market data sets

Having listed the possible types of market data sets in Table 24.2, we see how different business functions will use them.

Sales The sales force is attempting to attract clients to the institution. It needs to demonstrate trades and their likely effects over time. Example data is generally sufficient for these purposes and so indicative data can be used. Where salespeople are concluding trades with clients, current data may be required.

Trading Traders are constantly looking for opportunities and seeking to maximise their profits while keeping their exposure to risk under control. They need as many different sources of data as possible in order to perform these activities. A trader will frequently want to see live, official and future data at the same time – future data being comprised of random, predicted or his own estimations.

Presenting data to a trader is a problem in itself. Most traders have their own way of working and will have many screens to accommodate their needs. The trader will want to switch rapidly between his sources. He may want to keep his live source and have real time updates on his positions or freeze it while he tests other scenarios. It is important that at all times the trader is aware of the source and time of any data he is viewing.

Sudden changes in live data are of particular interest as they may represent trading opportunities or require action to reduce risks.

Although traders develop an ability to view and process vast amounts of information, systems which help them can enhance profitability and reduce errors. In designing such processes it is essential to know and understand how the trader operates. Then the machine can mimic the way the trader uses data.

Middle office The middle office is charged with ensuring trading processes run correctly. This encompasses the trades themselves and the market data feeding them. The middle office has to choose the most appropriate data source which is then, by definition, the official source. Middle office has to have operational procedures for dealing with bad data in the official source – this could include manual overrides, hence their use of user data.

Traders often have the best access to market data, as they are dealing with it continually. Middle office has to be wary before accepting data from traders for official use for the following reasons:

- Traders will naturally want to show their trades in a good light using data that maximises P&L.
- Traders want to show they dealt trades at competitive prices. The trader will not want the embarrassment of official data contradicting his view of the market or showing his trade to be unnecessarily risky.

Back office Confirmations and settlements usually require small amounts of market data, but they must be very accurate and agreed with the counterparty. Often the data used is that quoted on a particular exchange at a particular time.

Market risk control Market risk control departments rely on market data. The approach they take to quantifying market risk will determine what type of market data they use. For analysis using historical data, they need to look back as far as possible. They will also need to deal with situations where current trades or markets did not exist historically and 'invent' data using one of the techniques described below.

If they employ a stochastic model, they will use predicted data garnered from a small range of current and historical data; for simulations such as Monte Carlo they require random data.

As well as looking at the past, market risk needs a thorough understanding of current exposures and will generally use official data or possibly live data for this purpose.

Credit risk control Credit risk control staff are interested in measuring exposure to counterparties' default on payment. They are concerned with current and predicted market positions and will use data accordingly.

Finance The finance department prepares and maintains the official books and records. It would normally use data approved by middle office.

Legal The legal department is generally more concerned with the context and definition of data than the content. Staff there are more likely to use static data for definitions rather than market data. Some legal trading documents will use indicative or example data for illustration.

Audit Audit departments need to consider all use of data in the institution. They will be interested in seeing how the different types of data are used and what steps are taken to ensure the data is authentic.

General management Managers want to supervise the activities of all business functions. In order to be able to form strategy, deal with problems and report accurately, they will need official data. Live data might also be used for immediate issues.

24.7 BACK TESTING

This is a technique employed by several business functions to determine how a current real or potential trade would have performed with historical market data. This gives the tester some 'feel' for the trade and allows the processes to be thought through to ensure that valuation, reporting, risk control and other activities would have enough data available to manage the trade. Back testing is instructive, but relies on the assumption that future data will be similar to past data, which may not be realistic.

24.8 HOW CAN DATA GO WRONG?

As trading processes are so reliant on data it is important to understand how data can go wrong. Here we present some of the common symptoms of bad data and some techniques for dealing with them.

Missing

Any process that relies on a complete set of market data is going to fail when any data is missing. Missing data may not be due to any fault in the data supplier: genuinely missing data is an occupational hazard for the data user and arises because not all market data is published with the same frequency.

Extreme values

Due to errors in data compilation or publication, sometimes data appears far too large or too small or negative when it should be positive or vice versa. It could also be a reasonable value, but not in the context of data on either side of it or in comparison with data the day before or day after from the same source. Detecting extremes can be very easy when the range of likely values is known and consistent. But on the other hand, it could require great experience and diligence. It is possible for machines to check for extremes if a test can be devised using logic.

Stale

If data arrives today exactly like yesterday's at one or many points this can cause problems. The lack of change could be genuine – the source not having altered – or it could be the symptom of a problem.

Incomplete

Another data problem occurs when a source provides most data correctly, but some of the file or feed is missing from the start, middle or end. Although this manifests itself in the same way as missing data described above, it is usually for a completely different reason. In the case of incompleteness, the problem is nearly always due to an error on the side of the data provider and not because of inherent problems in the data itself.

Invalid

Examples of invalid data are numbers that appear as text, columns in the wrong order, extra lines or characters appearing where they are not expected. If the format of data is different from what is expected, the reader process will either fail or use incorrect values.

Techniques for dealing with bad data

Not all data received is correct. An organisation must be prepared to deal with bad data and can employ some or all of the following techniques.

Reject The process requiring data can be instructed to reject the data when it is bad. This would involve informing the user and probably also telling the data supplier. All subsequent processes would also have to be suspended if they were relying on outputs from this process. Of all the causes of bad data, the most likely to involve outright rejection would be invalid or incomplete data. If all data were stale that would also indicate a data supplier problem.

Prompt user If one or a number of data points were missing, stale or extreme the user could be alerted and prompted to input more reasonable data or accept that the data present is correct. This would involve the process waiting for the user response. If there were many problems it might be too time consuming or labour intensive for the user to fix them and a more systematic approach would be required.

Warn user Another technique is for the processor of data to continue to work with bad data where possible and list all the errors and suspected errors as it goes, reporting

TABLE 24.3 Futures data for EUR interest rates

Data	Values
6m	98.7675
9m	98.6175
15m	98.0125
18m	97.6775

the list to the user at the end. The user can then investigate the problems and decide what action to take. He could:

- disregard the results, fix the problems and re-run the process
- proceed without fixing
- fix the errors, but use the initial results in the interim until a run with the fixes has been completed.

Interpolate across missing or bad point A point is one data item usually existing in a set of data. Mathematical techniques can be used to estimate a point. This is most commonly used when data is missing, but can also be applied to extreme or stale data. Suppose we have data for futures data for EUR interest rates, as shown in Table 24.3.

If the machine or user has detected that the 12m point is missing, we could apply some sort of interpolation (linear, cubic spline etc.). This interpolation could use the other future instruments shown in Table 24.3 or an extrapolation from values of previous days for the missing instrument (12m).

Data engineering When interpolation is not appropriate, a wider means of correcting bad data is to look at the context of the existing good data and use trends to predict for the bad or missing points. Suppose we are missing an entire day's credit curve for HSBC which is in the UK banking sector. If we looked at the last month of credit data and found that five-year credit spreads for HSBC were an average of 8% lower than that of the UK banking sector, we could apply an 8% reduction in today's UK banking sector values and use it for the missing five-year spread. Similarly for the one-year, two-year, three-year spreads etc. Alternatively, we could take the whole UK corporate credit market as our control set of data or we could take the international or European banking sector. The decision as to which control set is to be used is a subjective one, depending on experience of the market and the use to which the data it to be put.

Data discovery Sometimes a financial entity is confronted with the problem of pricing a trade in a new business area or in an existing one where price data is or has been hard to come by. It might have to research new data sources to complement the existing ones or to make use of a one-off snapshot of data. An example might be when trading with a new, small counterparty and having to investigate its credit worthiness.

Using alternative sources of data can be expensive and requires a proper process of vetting to ensure the new source meets the required standard of validity and authenticity.

Data cleaning Data cleaning is a process automatically applied to data in anticipation of errors, rather than a reaction to errors once they are known. The cleaning is a two-stage process:

- detecting bad data – this could be bad in any of the ways described above
- correcting bad data – again using one of the techniques above.

Time series analysis Periodic trends are commonplace in market data. Oil prices might be higher in November than in July; share prices fall just after ex-dividend date; and bid/offer spreads might be wider on the Friday afternoon before a public holiday. Mathematical models can analyse data for such trends and separate them from changes caused by market forces. This is particularly useful in fixing bad or missing data.

Some instruments have long-term trends that can be detected and measured if enough market data is present or if the fundamentals behind the instrument price are well known. For example, the 30-year price of crude oil is mean-reverting so, irrespective of current ups and downs, the long-term price tends to converge on a fairly stable value.

When to fix bad data

Designing and building systems to fix bad data can be expensive and sometimes it is unnecessary. If the process using supplied data is of low importance or the data quality is generally very good, it may not be worth investing time in fixing bad data.

A judgement needs to be made taking into account the likelihood of bad data and the damage it may cause.

24.9 TYPICAL DATA SOURCES

There are many suppliers of data. Here are some of the more common.

Exchanges

Trading exchanges publish market prices to the members of the exchange and sometimes to the public. These are generally very accurate and up-to-date.

Vendor data

There are many companies selling market data. They provide a range of services including live price tickers, on-demand queries and periodic data files. Most will also supply historical data. The data they quote consists of broker prices, bid and offer quotes and recent transaction prices. The daily price file might comprise an average set of prices throughout the day, through the last trading hour or the very last traded prices.

Many vendors apply data cleaning and engineering processes to the raw data. It is important for users of the data to be aware of exactly how the supplied data was derived. In making comparisons between different data suppliers or using multiple suppliers, the user might need to make adjustments to compensate for these differences.

Vendors often supply user interfaces or entire systems along with their data. Some incorporate trade booking and calculation functions. Many small institutions might be able to use the system for all their trade lifecycle processes. In such a case, care should be taken to understand the risks of complete dependency on a third party vendor.

Often the challenge in accepting exchange or vendor data is incorporating the format into the finance house's existing processes and systems. Time and money should be budgeted for such conversion, which might also involve data transformation.

Internal data

A large organisation that has been trading for some time will have built up a considerable store of data. It is obviously in the firm's interests to use that data before paying for an external supply. Sometimes, however, there is a need for an independent source to check the integrity of the data already being held.

24.10 HOW TO COPE WITH CORRECTIONS TO DATA

It is useful and sometimes essential to record the source and exact time that data was received. If the source is a process, the username of the person running the process or the machine from which it is run could be recorded to ensure a full audit trail of data.

It is possible that daily reports were run using a set of data that was later corrected in time for a monthly report. So the monthly report is not going to give the same results as the daily reports from which it is comprised. Here we present two methods of indicating which data was used in a data process:

1. Record all the input data and log it against the process details so that at a later date, all of the data used in the process can be retrieved.
2. Record the timestamp from which the process drew its input data. Later data can be retrieved by searching for data that would have been present at that timestamp. Table 24.4 shows an illustration of how data might have changed and how the timestamp could be used.

TABLE 24.4 Commodity X

Ref Date	Price	User	Timestamp	Reason
15 Jan 09	88.7	Amelia	15 Jan 17:06	Source
15 Jan 09	88.27	Billy	15 Jan 17:33	Correction
15 Jan 09	88.09	Charlie	21 Jan 12:03	Correction

Now, for the overnight process on 15 January the price used would be 88.27 (the last entered value on that day). However the end of month report for January would use 88.09 (as entered by Charlie later in the month).

An historical process running in July would return to using 88.27 in order to recreate the actual data run on that day.

When correcting data, some people like to maintain a record of the original value and add notes explaining how the corrected value was derived.

If data is not recorded carefully, it can be lost during the calculation process and deriving it from results is usually impossible. This means that the user can never repeat the original process and get the same results. When queries are raised about the results by management, auditors, shareholders or any other interested party, it will be hard to know if the cause was poor data or some other factor.

Exceptions and errors

A distinction can be made between when a process has failed because the data source is missing and when the data itself has errors. An exception is the term given by IT to when the process has not run properly, an error is when the process has run successfully but the data itself has faults.

Categories of error are described above. Exceptions could be caused by:

- power failure during process
- supplier not providing the data
- being out of storage space
- expected input file misnamed or in the wrong place
- version of software not compatible with version of data.

To diagnose and fix problems it is helpful to make this distinction. The user will then know where to look for the cause of the problem.

24.11 DATA INTEGRITY

Data must be consistent and used in the correct manner. The recipient of data must be aware of its origin and type.

Data sources

In order to be able to manage data effectively, it is helpful to maintain its integrity. This means making a distinction between the various stages input data goes through. It should be clear where all data comes from.

Raw Raw data is that which is received directly from the data provider, warts and all. It is fed into the system and stored. It may be that more than one set of raw data is gathered each day, or that if one source fails another is used. Knowing the actual source of raw data then becomes more relevant.

Processed Raw data may suffer from some of the deficiencies described above, such as missing or unlikely values. Techniques to overcome these problems, also described above, will result in a modified set of input data which we can call processed input data.

Implied Many valuation and reporting processes require more than input data (be it raw or processed). For example, a CDO pricing function may require a hazard rate which is not a directly quoted instrument in the market place. The hazard rate can, however, be implied from the credit default swap instrument for which prices are available.

Therefore an intermediate process would be required to take the raw or processed data and convert it to an implied hazard rate curve. Although implied data can be recreated from source data, it is sometimes beneficial to store it:

- so that it can only be implied once and then can be reused many times saving processing time
- to allow more thorough checking and understanding of the process. By breaking it down and storing the implied data, the user can see how implied is affected by raw and then how the final result is affected by the implied.

Sometimes implied data can be at a much simpler level. A mid price is the average of quoted bid and offer prices. It does not always exist in the market place in which case it would be implied data.

Although there is often a temptation to apply logic to raw input data and to store a modified value in the database, an assessment should be undertaken to balance the efficiency gained against the loss of integrity.

Importance of data integrity

Integrity is important when a query arises on a reported value. The report will be at the very final stage in the process, so the user will have to trace through all the input and intermediate processes to find if it was caused by incorrect data, incorrect

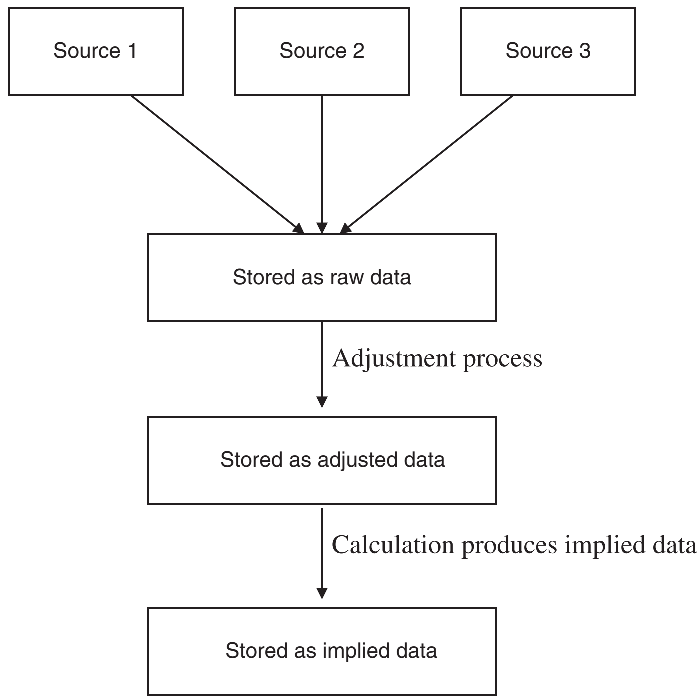

FIGURE 24.3 How data changes

processing or is indeed a valid result. If data has been automatically changed by the input process it makes this investigation harder. Proving the error was caused by the data provider is also more difficult if the client does not have the actual data supplied in his systems. Just as the police seek to secure and preserve a crime scene, so any auditor or investigator will want data to remain exactly as it was supplied.

Another advantage of preserving integrity is that historical data processes will always be working with the same data, even if adjustment processes have changed (see Figure 24.3).

24.12 THE BUSINESS RISKS OF DATA

Misuse of data carries its own risks which are described here.

Putting too much faith in data

Everybody involved in the trade lifecycle is using and working with the effects of input data. Key management strategies, day-to-day tasks and split-second trading decisions are all based on input data – directly or through reports and calculations. It is easy to assume that data is correct – we have been receiving it for many years, the supplier is authentic and other people use the same data.

Due diligence would surely require the question to be raised of what happens if the data is wrong and perhaps more worryingly, what if it's wrong sometimes but not always? The success of the cake depends on the ingredients.

Not reacting to data

The other extreme is too little notice taken of input data. If the data is an accurate reflection of the state of the market, warning signs, such as larger than usual changes should be detected quickly and reported to the people who can make decisions. It is of little use if a junior clerk in the back office spots an irregular pattern and by the time the news filters through to the management it is too late to react.

Coping when data not there

A good test of the resilience of an organisation is to switch off its market data supply for one day and see how it copes. Are there back up procedures in place, can data be obtained or inferred from other sources? As data is so important, these scenarios should be taken into consideration.

Ensuring authentic data

Obviously data must be authentic to be a trusted source. This may be easy to verify in the case of a daily feed from a vendor's FTP[2] site or by a secure delivery mechanism, but other types of data can be potentially insecure. Live data arriving at users' machines or directly entering the database can be hazardous and difficult to monitor. The recipient of this data needs to balance the benefit of such data being available so easily with the security risk involved.

24.13 SUMMARY

The trade lifecycle is heavily dependent on the correct use of accurate data. Understanding data is a key part in building and running successful processes in trading organisations. Financial data is used by all business functions and therefore every member of staff should be fully aware of its origin, use and composition as well as what to do when the data is missing or incorrect.

[2]File Transfer Protocol (FTP) is a standard network protocol used to exchange and manipulate files over a network, such as the Internet.

CHAPTER 25

Reports

A report is a mechanism for conveying information. A process works on data and produces results. These results are reported to interested parties. Examples of reports featured in the trade lifecycle are:

- opinion of the legal department on a proposed trade and issues requiring clarification
- report on all new trades transacted today
- current P&L per trader
- combined asset holdings across all trading divisions
- budget for forthcoming year
- management explanation of sudden large losses
- list of bonds paying coupon in the next seven days
- research paper on the state of the lead mining industry.

Reporting is a fundamental part of the processing of a trade. In order for all business functions to perform their daily tasks, they need recent, relevant and accurate information about the trade. This information flows by way of reports.

Reports are generated from input data, other reports or both, as illustrated in Figure 25.1.

They can consist of text, tables, graphs, pictures or any other media for conveying information.

25.1 WHAT MAKES A GOOD REPORT?

A good report is precise, concise, timely and relevant to its readership. It gives the appropriate level of detail and it communicates the information in a clear manner. Problems, errors and exceptions are clearly marked, as are differences from the norm. We shall now discuss factors influencing how a report should be planned and produced.

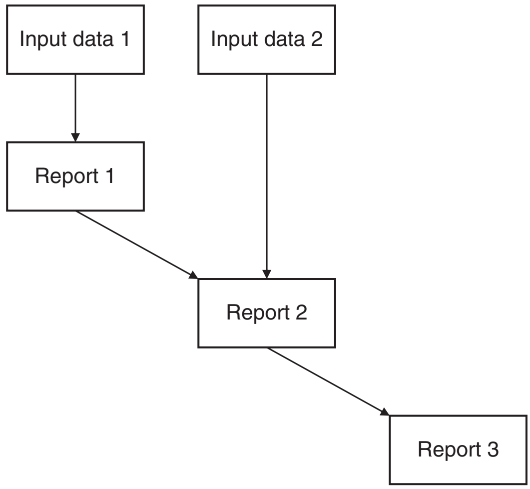

FIGURE 25.1 Inputs to reports

25.2 REPORTING REQUIREMENTS

When designing reports one should take into consideration the following.

Readership

The content and presentation of the report will depend upon the readership.

- An external audience will require more formal language and style.
- Management prefer brevity with information being summarised.
- Control functions may want a top-down approach – where totals are on page one with details on subsequent pages should they want to drill down into the information.

When there is a mixed readership, combining the requirements of both may mean the information is not delivered in the best way. In this case it may be best to split the report in two.

Content

Exactly what information is required? Is there additional information that, although not being absolutely necessary, will enhance the report? Too much information will overload the reader and he may miss something important; too little information and the report will fail to achieve its purpose. Is the content clear and unambiguous?

Are abbreviations going to be understood? Where graphs and tables are not fully explained, will the reader know what they mean?

Presentation

The style and format of the report are as important as its contents. The human eye will be drawn to the unusual and the reader is more likely to take notice of something which is easy to read and understand – he does not want to plough through 10 pages of text to find the one number he needs from the report.

Careful use of colours can enhance a report, but will not show up on black and white hard copies. Font size can be used to distinguish between the essential, the useful and the nice to have. Similarly bold text and italics can convey extra meaning.

The old adage that a picture says a thousand words is applicable to reporting. A graph summarises a table of data and a table summarises a list of figures.

External readership

Producing any report sent outside the organisation may require a higher level of information such as legal disclaimers, copyright notices or regulatory wording. A written report may burden an institution with unwanted obligations and errors could be very costly, so external reports require a greater level of checking. People who may be required to check external reports include:

- legal counsel
- compliance
- press officers
- management
- staff responsible for corporate image.

Habit

Readers get accustomed to the layout of reports. If the layout is changed even slightly, it can cause confusion and frustration. When changes do have to be made the readership should at least be informed or, better still, consulted.

Distribution

Nowadays there are several means of distributing reports available:

- paper copies being transmitted by post or fax
- soft copy by manual email
- soft copy by automated email
- an application or system for report manipulation
- web-based dynamic reporting.

The means of distribution must suit the reporting requirements and are constrained by the reporting budget. Although more powerful than the alternatives, web-based reporting is not always the most cost-effective solution. Automated emails are very good in principle, but if the report requires checking before distribution they can be dangerous. Where reports require a physical signature, paper hardcopy is the only viable medium of distribution. An application allowing the user to choose his own reports can be very useful but it may be expensive and too much for the user to cope with.

Timing

There are several constraints affecting the timing of reports.

- input data must be present and correct
- any dependency reports must have been run
- machines must be available to run the report
- the distribution mechanism must be ready to transmit the report – a report is not complete until it has reached its readers.

When scheduling reports, the generator must consider when they start and stop being useful to their readers. Some reports are for background information, while others form the basis of decisions and other processes. The timing of some reports is crucial – if they do not arrive on time, they might as well not arrive at all.

If constraints mean a report is not ready when it would be most useful to its readers, extra investment might be considered to bring forward its publication. Reporting priorities should be determined at the outset and then periodically reviewed as business needs change over time.

Accuracy

An appropriate level of accuracy should be applied to the report. Making it more accurate may be time consuming and unnecessary for certain reports – the user may prefer a faster, less accurate report than a slower, more accurate one. An example of this would be the P&L report which might be run to three different levels of accuracy as shown in Table 25.1.

TABLE 25.1 Types of report

Name	Time Run	Duration	Accuracy
Flash	Evening	10 minutes	Approximate
Internal	Overnight	Several hours	Accurate but possibility of data errors etc.
External	End of month	Several hours	Accurate and errors removed

The risk of running a less than accurate report is that a reader may not realise the level of accuracy and make inappropriate decisions based upon it. This is particularly so if the report is read by people for whom it is not primarily intended. There is a human tendency to believe what one sees written down – to mitigate this risk the level of accuracy can be clearly printed on the report – for instance, ‘For guidance only’.

Raw reporting

A report communicates information from the producer to the reader. As such, the needs of the reader should be taken into account. Very often the report is produced in a style and format dictated by the method of production. It may sometimes be appropriate to write an extra process that converts the raw report into something more readable. This is also useful when one report is going to be read by several different users. In general, production of the raw report takes more time than enhancing it, so several report enhancers could be written, all based upon the same raw report.

Configuration

Even if the user cannot change the actual report he receives dynamically, it may be very useful for him to be able to specify his own requirements and for the report to be produced with these in mind. This would not just be for the initial set up but, for on-going changes as well.

If the data comprising the report is sufficiently granular then a layer of configuration can be applied to it to produce the required specification.

Table 25.2 shows an example of the full report.

What may the recipient of such reports want to do?

1. The user might want to select his own fields: today he only wants lead, copper and total.
2. He may want to filter the report and only see items with P&L greater than USD 30 million or less than USD −30 million
3. He may want to sort the traders by profitability, starting with the most profitable.

Selection of fields, filtering data and sorting are the most common examples of user configuration.

Configuration depends upon all the underlying data being available – a means by which the user can specify what he requires and a process that can take the user options and apply them to the data to produce the finished report.

Configuration is a very powerful way of delivering an exact report to the reader – it can take one generated set of results and produce countless different reports.

Web-based reporting is a dynamic means by which the user can send his requirements to a remote machine controlled by the report supplier and quickly see the outputted report.

TABLE 25.2 Precious metals P&L (USD millions) as of 6 Jan 2015 by trader

Alice

	Tin	Steel	Lead	Aluminium	Copper	Total
Spot	45.63		99.40	74.50	−10.09	**209.44**
Future	−33.50					**−33.50**
Options						**0.00**
Total	**12.13**	**0.00**	**99.40**	**74.50**	**−10.09**	**175.94**

Barbara

	Tin	Steel	Lead	Aluminium	Copper	Total
Spot		−30.00			4.44	**−25.56**
Future		−28.77		5.00	7.12	**−16.65**
Options		−303.33				**−303.33**
Total	**0.00**	**−362.10**	**0.00**	**5.00**	**11.56**	**−345.54**

Carmelle

	Tin	Steel	Lead	Aluminium	Copper	Total
Spot						**0.00**
Future						**0.00**
Options	44.33	101.22	99.22	20.03	38.99	**303.79**
Total	**44.33**	**101.22**	**99.22**	**20.03**	**38.99**	**303.79**

Total

	Tin	Steel	Lead	Aluminium	Copper	Total
Spot	45.63	−30.00	99.40	74.50	−5.65	**183.88**
Future	−33.50	−28.77	0.00	5.00	7.12	**−50.15**
Options	44.33	−202.11	99.22	20.03	38.99	**0.46**
Total	**56.46**	**−260.88**	**198.62**	**99.53**	**40.46**	**134.19**

Dynamic

A dynamic report is one that allows the user to change it on the spot. He may add headings, change column widths, put in summary totals or change the content by adding filters and sorting criteria as described in the section above.

Advantages:

- Dynamic reports reduce the need for a dialogue between the report producer and the user.

- Sophisticated reports can be produced tailor-made to user requirements with no extra work for the producer.

Disadvantages:

- Some users do not have the time or the desire to learn how to produce dynamic reports.
- Very often documentation and guidance need to be provided.
- There may be the potential for a dynamically produced report to convey the wrong information or message. Dynamic reporting should allow changes in format but never changes in content.

Frame of reference

In general reports should state the date and time of their production. Thus if the user receives two similar reports he can immediately distinguish them. Auditors or others who are tracking historical reports will know the information available when the report was produced.

The report should also convey its terms of reference such as:

- timeframe of report – next six months, yesterday, past five years etc.
- data sources
- assumptions
- input parameters
- types of trade reported on – deleted, amended, open, matured, new etc.
- a confidence interval should be applied to any statistical predictions, e.g. there is 95% probability that the total risk will not exceed X dollars.

The problem of multiple dimensions

Most reports are constrained by only having two dimensions available to the reader. (Some graphs can be three dimensional, as can computer-simulated graphics.) When results occur in multiple dimensions, the producer must decide how best to convey the information. He could break everything down into an array of two-dimensional outputs, he could let the user configure his own results (see the configuration section above) or data could be combined to reduce it to two dimensions. This solution will depend upon the level of detail or brevity of report required.

25.3 WHEN THINGS GO WRONG

There are three main areas in which a report can go wrong:

- results are wrong
- results are correct but incomplete
- the report is not generated at all.

Depending upon the importance of the material, it may be worth having a report testing process (human or systematic), which can look for any of these problems and take action if it finds one.

Other useful additions to the reporting process are:

- Putting a status on the report such as number of records processed or time taken to run. Then the user can see if the number or time is different from usual.
- The reporting process may generate warnings and errors as it goes – these could be reported to the user. (It may be the user is not interested in the specifics, but just needs to know the number and type of errors.)
- When no report is produced a blank report could be sent explaining the absence. This is often preferable to nothing being sent and the user just assuming it is late or that is was received but he mislaid it. People like to know as early as possible when a problem arises, even if it has not been resolved.
- Provide a mechanism for the user to report suspected problems. The readers of reports are often the best people to detect faults – if they can report them and know their report will be acted upon, everybody gains.
- Important reports can be sent in two or more stages. First to friendly users who can provide constructive feedback and then to more remote or demanding users, who expect a higher degree of quality. Blitzing the whole readership in one go can be dangerous for one-off or unusual reports that are not tried and tested.

25.4 REDUNDANCY

Over the course of time, there is a tendency for a report's distribution list to grow. Generally people are quick to ask for a report they need but less inclined to inform the distributor when they no longer need it. This can lead to problems:

- For sensitive information it may be important to know who is reading the report.
- When contemplating switching off a report, it is necessary to know who may still be reading it.
- The size of the readership may determine the resources invested in maintaining or enhancing a report – if this size is inaccurate, perhaps the resources are being misused.

Several years ago an investment bank discovered that an old mainframe system was producing 532 different reports for 212 users across the organisation with each receiving between one and 10 different reports. The system was going to be replaced and an audit was undertaken to decide which reports were still required. After a three-month process it was discovered that only five different reports were being used and that 80% of the mainframe readership had either left the company altogether or had moved to a job no longer requiring the reports.

Many reporting systems have an easy way of adding and deleting from the readership. They may also have built-in diagnostics to show if a user no longer exists or is no longer reading the report. Some report producers carry out regular surveys to ensure their distribution list is current and appropriate.

25.5 CONTROL

A key decision in the operation of any report is who is going to control the production and distribution. Sometimes the generation of the report is separate from the distribution mechanism. There are usually three choices:

- operator: a person independent from the readership
- automated: such as via a computer system
- user: a member of the readership produces the report for himself. He may also be responsible for distribution to other people.

25.6 ENHANCEMENT

The basis of a report is the production of results from a set of input data and parameters. Some reports take this basic level of results and enhance it by means of opinion, summaries, conclusions, trend lines or by any other narrative. It is often this 'value added' report that contains the real benefit to the readership. However it is a good idea to try to separate facts (or basic results) from opinion (or enhancements). Any enhancement should also state the author in case of query or the need for further information.

25.7 SECURITY

The transmission of any report requires an appropriate level of security to ensure it does not fall into the wrong hands. This might involve:

- secure transmission
- encoding
- password protection
- request-only distribution
- monitoring
- limited copies being produced.

25.8 RISKS

We have mentioned two reporting risks above: security lapses and the acceptance of inaccuracies because they are written in the report. But there are other risks associated with reports.

Even correctly produced reports are subject to misinterpretation, if the readership is not fully educated about their limitations and scope.

If a report is the basis for decision making there must be somebody receiving the report who is in a position to make the decisions. Moreover, if two or more people attempt to act upon a report, it is important they are acting in concert and not duplicating or contradicting each other.

Once a report has been distributed there is a risk if nobody can interpret the results or explain how they were derived. The production team might have gone home, it may be another time zone or the producers themselves are not able to answer the queries. An unexpected result might indicate a major problem requiring urgent action or it may be a false alarm. Either way prompt dialogue can avert many problems and requires people of sufficient knowledge being available.

Lack of co-ordination in report production or distribution might lead to mixed signals being transmitted, confusing or misleading the readership. Inaccurate translation can also carry risks in multiple language environments.

If a report requires retraction or correction, it is important to act fast. Generally, once something is in writing, it is hard to erase its effects whether they are benign or malign – and a written or electronic report always has the potential to be quoted or reused.

25.9 SUMMARY

Reports are an important means of communicating information to both an external and internal audience. They should be prepared in a timely and accurate manner. The format and content requires careful design and implementation.

CHAPTER 26

Calculation

Between the input data and the output reports sits the calculation process. The calculation could be anything from a 'back of an envelope' approximation taking milliseconds to a precise multi-factor mathematical model taking days to run.

The degree of expenditure in the calculation process depends upon many factors including:

- Are trusted mark-to-market valuations available in the market place?
- Is there an accepted calculation model?
- Are other valuation processes available and accessible?
- What is the required level of accuracy?
- How sophisticated are the products to be valued?
- Is scenario analysis desirable?
- What are the range and type of output reports required?
- What is the extent of risk calculations?

26.1 WHAT DOES THE CALCULATION PROCESS ACTUALLY DO?

Before looking at calculations we need to consider their purpose.

Example from outside the financial world

In order to illustrate how to calculate the value of a trade let us consider an example of a second-hand motor vehicle.

I own a five-year-old Ford Galaxy diesel, manual transmission car. If cars with the same specification are available in the second-hand car market, I can mark-to-market my car and gauge its current value. Let us suppose it is worth £8500.

Now my car has extras which are not part of the quoted market prices, so I need to make an estimate of their worth and add it to the price, as seen in Table 26.1.

TABLE 26.1 Extra value added above standard

Feature	Estimated additional worth (£)
Alloy wheels	400
Sports suspension	150
Rear bumper skirt	175
Colour: Green	0
Customised registration	65
Total extra value	790

Hence I might mark my car as £8500 + £790 = £9390

A similar example would be valuing a house. Unless identical houses are for sale in virtually the same location then it is necessary to obtain data on house prices in the area, their sizes, ages, plot areas, condition, frontage and other relevant factors and use this data to gauge the price of the particular house. Where sufficient data is available we may use an 'interpolation' model – some means of combining the known data and prices, and the known data about the particular house in order to calculate a price for the house.

In the following, 'value' means the net value of the trade taking into account the current market price of the underlying instrument. Where there is no market price (such as a structured product or an illiquid asset) instead of market price we use 'model price' – the model being a means of interpolation using known data – which in turn is calculated from known asset prices and a mark-to-market pricing model.

The calculation process values each live trade in the system. It may report results per trade or aggregate them and report in pre-defined combinations or do both.

The valuation of a trade generally involves the calculation of net present value and risks, as can be seen in Table 26.2.

Valuation of one trade

Now let us look in detail at the value of an individual trade.

TABLE 26.2 Calculation outputs

	NPV	Risk
Single trade	Single value	By each risk type
Multiple trades	Aggregation by any of: Product type Currency Asset class Maturity etc.	Aggregated by any of: Product type Risk type Currency Time bucket etc.

Net present value Net present value (NPV or simply PV) is the present value of the trade given the input market data and trade data at the time of valuation. It is the trade's predicted current worth. The NPV can be ascertained from a calculated value or from the mark-to-market value.

Calculated value This is the NPV derived from the calculation process.

Mark-to-market value This is the market's view of the current value of the trade. It is the price that one would be charged for purchasing the trade right now. To value a held trade using mark-to-market, the trade has to be relatively standard and liquid.

For simple trades using standard pricing algorithms the NPV and mark-to-market should be very similar. There will be some differences caused by:

- the market maker taking profit in providing the trade in the form of the bid/offer spread
- a special desire on the part of the buyers or sellers to make the trade which will distort the market price being offered
- liquidity and other factors affecting price.

Why not use mark-to-market? The reader should remember that 'valuation' may be performed (as discussed later in this chapter) to estimate a market price – as is often required by regulators of banks and other institutions. Alternatively 'valuation' may be performed in order to estimate the value of 'anticipated' receipts – what the investor thinks will actually happen during the life of the trade.

In many trades it is appropriate to use mark-to-market valuations but in the following situations it may not be desirable or possible.

Illiquid Some trades are illiquid meaning that prices are only quoted infrequently and therefore comparison with the market will usually not be valid. Alternatively there may be prices quoted every day, but they are unrealistic because they are based on very few actual trades transacted.

For example, if one thousand exchange-traded futures on 12-month USD were transacted in the last hour of the day, the quoted market price (some sort of average of the one thousand) will be a good reflection of market value. If only one or two futures on Bangladeshi Taka were transacted in the course of an entire day, the market price would not give a very good indication.

Another example is a call option on BT at a strike of 140p and maturing in three months and 20 days. Such options may trade regularly with a three and six-month maturity, but not the exact maturity of the trade. The basic product (call options on BT) is liquid, but the specific trade is not.

No prices available For complicated or illiquid trades there may be no equivalent trade available in the market place and so mark-to-market is impossible. To take the car example, if I owned a car which I customised in some way so that very few cars like it were available in the market place, I would not be able to get a direct valuation. I would have to estimate how much difference my modification had made to the price of the standard model and add that to the standard model price.

Market sentiment It is rare that one would not use market prices if they are available: to ignore such data is to say that we believe the market price is unreliable.

Common trades may undergo temporary market price changes because of current market sentiment. This sentiment might be applicable only for a short time and so to value the trade fairly and consistently day on day from before the sentiment took hold, through the current period and into the future it may be better to use an unsentimental mathematical model. Examples of factors affecting market sentiment are:

- panic caused by natural disasters, wars and terrorism
- proximity to major announcements
- uncertainty – lack of information or conflicting information.

It should be noted that this type of market sentiment is different from an overall market view on the direction of a particular security or instrument. For instance, the NPV of an option on gold is driven by the spot and futures prices of gold (among other things). If a war is possible and market sentiment sends the spot price of gold up but leaves futures relatively unchanged, there will be a mismatch between the mark-to-market and calculated value of the option. Should the threat of war disappear the spot price will come down. If the war actually starts, the futures prices will also rise – either way the mismatch between market and calculated value will reduce. Market sentiment may cause arbitrages to open up which makes valuation difficult – such times often being associated with wide bid/offer spreads – and it becomes unclear what 'market value' might mean in such circumstances.

Complicated trades When trades are complicated even if they are liquid, the trader may take the view that his model is better than the one being used by the market to derive the market prices. An example might be certain types of interest rate options where broker or market-maker quotes are readily available but vary according to source.

Of course there is no one entity called the market, each contributor to the market price will have his own models and so the market price is a sort of average of all the models.

This is of particular relevance when the decision for entering into the trade was based on the belief that the true value (as predicted by the calculation) was different from that being quoted in the market. To switch to a mark-to-market valuation would now be inconsistent.

Other reasons why having a calculation engine is useful Valuation is necessary where a reliable market price is not available. A trade value is required by banking institutions to mark their books to market every day. There are a variety of additional calculation engine uses as follows.

Risk For mature products the market data may provide some basic risk results, such as delta together with the spot prices. This may be sufficient for simple risk analysis but most traders and risk managers would like to have the ability to do more extensive calculations. For non-mature products there will not be any risk measures available from the market. (See Chapter 10 for full explanation of risk management.)

Scenario analysis In order to get a feel for how trades may change in value over time, many traders and risk control functions like to play with market data. Once a calculation engine has been built and tested, it is easy to apply any set of market data and get results. This lends itself to scenario analysis which, in essence, is a process of generating the market data you want to use, valuing with that market data and comparing the results. Some typical scenarios:

- Bump all market data up by 5%.
- Set all market data to be at its lowest value for the past month.
- Set volatility of spot prices to 15%.
- Assume all credit recovery rates fall to 5%.

Value at Risk (VaR) VaR is a type of worst-case valuation – over the next day (week, month, …) with an unchanged portfolio asking how bad could the valuation get? Typically this is done on a portfolio basis and requires, in addition to a valuation model, a model of the variability (volatility) of the driving variables (interest and exchange rates, equity prices, etc.) and their relationship (correlation). (See Chapter 11.)

Parameter variation Designers of washing machines put switches on the machine to allow the same basic washing process to be run in different ways according to the user's personal requirements, such as temperature, duration, economy and amount of spinning. This is analogous to the parameters on a mathematical model. Examples of model parameters are:

- ability to control speed versus accuracy
- tolerance to bad data
- acceptable levels of calculation error
- assumptions to be used or ignored.

Any model involving parameters may require these parameters to be varied according to the circumstances of the valuation.

Aggregation and reporting flexibility Although mark-to-market calculations can be aggregated after they are read, some forms of aggregation are quicker or more accurate when performed from within the calculation engine itself. This is because mathematical techniques can be applied to take known short cuts.

If one controls the calculation engine and knows the reporting requirements, the results can be generated with reporting in mind, making the process more seamless, accurate and efficient. This is often preferable to taking market-supplied results and bolting them onto a report-generation process.

Adaptability Relying on mark-to-market prices can be restrictive. The way a trader wants to trade may change to take advantage of new possibilities and he may be unduly handicapped if he has to rely solely on mark-to-market prices for his valuations.

Also, it is possible that market prices may be temporarily unavailable, for instance, due to an exchange losing its systems and not reporting prices or the market data supplier having a transmission problem. In such cases the organisation will not be able to see its current valuation unless it has a calculation engine to provide it.

Why not rely solely on calculation engines? The following discussion concerns trades for which mark-to-market valuations are available. As we have said there are many trades that are too complicated or non-standard for mark-to-market. Then, of course, there is no alternative to bespoke calculation of NPV. It should also be noted that for any realistic NPV calculation the engine must use input data which is related to the market prices. These prices are the mark-to-market prices of underlying instruments and so a calculation is always in some measure dependent on the market.

Aside from this, regulators, auditors and managers are wary of calculated values if they are very different from market prices. However reliable the model, the trading environment is in the market place and so reporting needs to take market prices into account. Should a trade need to be reversed, it is the market price that will determine how much the reversal will cost, not the predicted current worth coming from the model. Additionally it would take a very brave manager to be able to stand up in front of his investors or regulators and claim that because of the model he is using he need not take into account the mark-to-market.

NPV calculations are not exact measures of reality. For all but the simplest products they rely on a model of the world (see below) and hence, at best, they are likely predictions. It is therefore possible that the model is wrong: either at certain underlying prices or in certain market conditions it is not a true reflection of current value. Different models may provide different results. In many cases a calculation built around a model may be too complex and take more time to evaluate than is available. Therefore assumptions have to be introduced to speed the calculation – the assumptions could be unfounded in certain circumstances again making the results less than reliable.

Models of complex structures – and the traders trading them! – may not be completely trustworthy. It is common in such cases to over-ride the model value with offsetting reserves reducing the model profit and only allowing profit to emerge over the life of the trade or until such time that the model proves its validity.

Compromise Many financial entities have arrived at a compromise whereby results are reported based on mark-to-market valuations but calculated values are used for scenario analysis, risk predictions and trading strategies. In this way, the mathematical innovations of the model are balanced by the discipline of market forces.

The model A mathematical model is an attempt to mimic what happens in the real world. It is similar to the way a map is used to condense and represent the geography of a region.

Models may arise in many ways; here we illustrate a common progression which is loosely based on the case history of a real model.

1. Someone observing stock prices thought they behaved according to a special pattern in which the logarithm of the random jump in prices followed a process known as Brownian motion (or a Wiener process). (Brownian motion is the mathematical model for the apparently random movement of particles suspended in a fluid.)
2. A crude formula was developed to encapsulate this distribution.
3. The formula was tested and refined using empirical prices and found to be a good approximation to reality.
4. Trading processes could use the model to assess the value of the products. At first few people had implemented the model and those who had, produced very different results, so there was a wide discrepancy in prices being traded.
5. The market for the product developed and became more mature. The implementation of the model became more standard and was widely available.
6. Offshoots (or exotic derivatives) of the original product started to be traded which required adaptations of the basic model. Again, at first only a few trading houses had developed these and so held a market advantage. Later others caught up and the exotic derivatives became more standard.

26.2 THE CALCULATION ITSELF

The NPV of a trade is the sum of the current value of all future cashflows in the trade. If the cashflows are known we can add them and produce the NPV without resort to anything beyond interest rate models.

There are two basic components to most NPV calculations – discounting and conversion to reporting currency. We shall illustrate the principle of discounting by the following example.

Suppose we have an annual fixed coupon bond of 5% on a notional of 10 million dollars with one and half years left to maturity. There are two future cashflows:

In 6 months	5% of 10 million
In 18 months	5% of 10 million plus the 10 million redemption

TABLE 26.3 Discount factors

Date	Discount Factor
Today	1
1 week	0.99900
2 weeks	0.99823
1 month	0.99623
3 months	0.98976
6 months	0.97951
9 months	0.97023
12 months	0.96720
18 months	0.95983
24 months	0.95427

Now what are those cashflows worth today? Money now is preferable to money at a future date (a property known as 'the time value of money'). One dollar in six months will be worth less than one dollar today. We apply a principle known as discounting to calculate how much a future cash amount is worth today. Using an interest rate curve, we derive discount factors for any given future date (see the section on bootstrapping below).

Suppose Table 26.3 shows the discount factors for the next two years.

Then the sum of the future cashflows for the bond discounted to today is

$$0.97951^{1} \times 0.05 \times 10{,}000{,}000 + 0.95983^{2} \times 1.05 \times 10{,}000{,}000 = \text{USD } 10{,}567{,}970$$

Conversion to reporting currency

It is necessary to convert all the flows to the reporting currency for any trade that has cashflows in a currency other than the reporting currency or for trades involving an exchange of commodities. Typically, valuations are carried out in the local currency then converted at the current spot rate to the reporting currency. This is equivalent to converting cashflows using forward FX rates and then valuing using the reporting currency discount factors as will be shown.

Suppose in the example above our reporting currency was EUR and the trade is in USD. We need to calculate the two cashflows and convert them into EUR before adding them together. This is because the exchange rate will be different for each flow.

[1] The 6 months discount factor.
[2] The 18 months discount factor.

TABLE 26.4 Current and future FX values

Today	buy USD 125 for EUR 100	(FX is 0.8 EUR per USD)
In six months	USD 125 is worth USD 128.125	(2.5% interest in 6 months)
	EUR 100 is worth EUR 103.600	(3.6% interest in 6 months)
	Sell USD 128.125 for EUR 103.600	(Implied FX is 0.8086)

The exchange rate applied will be the forward exchange rate at the time of the flow. This can be derived in two ways:

1. Take the forward curve for the currency pair (in our case EUR/USD).
2. Use the forward (discounting curve) for EUR and USD and the spot rate for EUR/USD.

Because the spot and forward market for interest rates and foreign exchange is very efficient these two methods will be equivalent – otherwise an arbitrage would exist which the market would soon close out.

So the six-month FX rate is 0.8086 and let us suppose the 18-month FX rate is 0.7904 as in Table 26.4.

Then in our fixed bond we have the EUR cashflows as

$$0.97951 \times 0.05 \times 10{,}000{,}000 \times 0.8086 = 396{,}015.9 \text{ and}$$
$$0.95983 \times 1.05 \times 10{,}000{,}000 \times 0.7904 = 7{,}965{,}821$$

giving an NPV of EUR 8,361,837.

Unknown cashflows

In many cases cashflows are not known with certainty. An option is an example of a product that has an unknown cashflow. To value the option we have to use some sort of statistical model that predicts the likely price of the underlying instrument on the exercise date and from there we can calculate the value of the option.

Let's examine a simple case where the underlying price could only be one of a discrete set of possibilities.

Suppose Table 26.5 shows an option is struck at 0.9 and the probability of certain prices.

Then the future payoff (for a call) is estimated at $0.2 \times 100 + 0.1 \times 1100 + 0.2 \times 2100 = 340$.

We would discount the 340 using discount factors to arrive at the value of the option.

Notice that the mathematics does not care what the underlying asset actually is and so option modelling is applicable across asset classes.

TABLE 26.5 Option outcomes at different final prices

Price	Probability	Payoff at exercise
0.7	0.2	0
0.8	0.2	0
0.9	0.2	0
1.0	0.2	100
2.0	0.1	1100
3.0	0.1	2100

A more likely distribution of underlying prices is to assume that they are log normal. Then we can use the industry standard Black Scholes formula to calculate the option NPV.

Other dependencies

An exotics trade such as a knock out single barrier option pays a return conditional on two events:

- The underlying price did not reach the barrier at any point in the life of the trade.
- The option was exercised meaning the spot price was greater than the strike at maturity (for European style options).

To calculate the NPV the probability of both events must be calculated. Since both are dependent upon the underlying price, we could still use the log normal price distribution and a variant of the Black Scholes formula.

Monte Carlo

The Black Scholes option pricing formula is an example of a closed form solution – that is, the result can be expressed in some formulaic combination of the input parameters. Many trade pricing functions are closed form or semi-closed form and they work like a black box: input data is fed in, the parameters are set, the button is pushed and results come out. In some cases a 'closed form' solution may not be available and numerical techniques may have to be used. One such is Monte Carlo,[3] which uses random numbers and 'simulation' to generate the outcome. A large number of calculations are repeated to calculate the average value and thereby estimate the value of the trade. For option pricing it could work like this:

1. Generate a set of random numbers (many programming languages have a means of pseudo-random number generation in a uniform distribution between 0 and 1).

[3] See *Monte Carlo Methods in Finance* (2002) Peter Jäckel, Wiley Finance.

2. Using standard mathematical techniques convert these uniform distribution random numbers into a number with log normal distribution of required mean and standard deviation and call it X (could use forward price at maturity date for mean and volatility for standard distribution).
3. Calculate the payoff given price of X at maturity (or 0 if strike is greater than or equal to X) and call the result V.
4. Repeat steps 1–3 so that there is a total of one million runs.
5. Find the average of the one million Vs.

26.3 SENSITIVITY ANALYSIS

As mentioned, NPV is a snapshot based on the market data at time of calculation. It gives no indication of the likely direction of the NPV or what might happen if the market data changes. Traders and other people concerned with market risk (that is exposure to change caused by market forces) often like to measure the sensitivity of a trade to a change in market data.

The various risk measures are explained in the chapter on risk management. Here we will explain the means by which this exposure can be calculated.

If we want to examine the sensitivity of the NPV to one particular instrument used in the calculation of the NPV we perturb the price of that instrument and recalculate the NPV. The sensitivity is then the difference in NPV caused by that price change.

Suppose the NPV of an option on aluminium NPV was USD 15,600,722.

The overnight spot rate for USD was 0.8375%. To find the option sensitivity to this spot rate instrument we bump it by one basis point to be 0.8475% and revalue the option giving us a value of say USD 15,600,798. We then define the sensitivity to spot rate as 15,600,798 – 15,600,722 = USD 76.

We can calculate sensitivity to any instrument used in the trade calculation. Since the sensitivity comes out as a currency amount, we can aggregate sensitivities across many trades. If the trader had a portfolio of two barrier options, five vanilla options, four forwards and a spot trade we could calculate the sensitivities of each trade to one instrument and show the aggregated portfolio sensitivity to that instrument.

The sensitivity to the underlying spot instrument is known as delta.[4] If we want to know the sensitivity to a change in delta (known as gamma) we could employ a second order sensitivity calculation such as:

Calculate the basis NPV (call it V_0)
Bump the underlying spot up by one basis point and revalue (V_1)
Then delta is $V_1 - V_0$ and call it Δ_u
Bump the underlying spot down by one basis point and revalue (V_2)

[4]This is the interest rate delta. For this instrument there would also be an aluminium price delta.

Then delta is $V_2 - V_0$ and call it Δ_d
Gamma is then $\Delta_u - \Delta_d$

An equivalent method of calculating the sensitivity to a particular instrument can be used when the NPV can be expressed as a continuous function of that instrument. Then the delta sensitivity is the first order derivative to the instrument at the market price and gamma is the second order derivative.

It is often the case that calculation of sensitivities can be done at the same time as calculation of the NPV within the same run. This is faster than bumping the market data and re-running the calculation.

Note that the above sensitivity measures assume that the underlying variable (driving the market price) changes continuously over time. Such measures are often incorrectly applied to markets which do not have this property and where market prices undergo 'jumps' rather than smooth changes. Such behaviour makes hedging difficult and should in principle be analysed with different risk measures – for example sensitivity to a 20% change in the underlying driving variable.

Where the pricing model is implemented by Monte Carlo simulation the calculation of sensitivities can present problems. Differences between calculations generated by random numbers may reflect more of the randomness than the underlying change so special techniques have to be used, or simpler sensitivity analysis performed.

26.4 BOOTSTRAPPING

Above we alluded to the calculation of an interest rate curve using a process known as bootstrapping. This is a generic process and the name comes from pulling oneself up by one's own bootstraps. Here is a simple explanation.

Suppose we know that the interest rate for borrowing money for 12 months is 2.3% and for 24 months is 3.7%. This means that if I borrowed 100 units today I would pay back 102.3 in 12 months or 103.7 in 24 months. I would like to know what the 12-month interest rate will be in 12 months' time.

Borrowing for 24 months is the same as borrowing for 12 months and then taking out a new loan for another 12 months. Let's suppose this second loan which is a 12-month loan forward 12 months attracts r% interest.

Then we have two calculations which must be equivalent:

Borrow for 24 months = 103.7
Borrow for 12 months + Borrow again at 12 months forward 12 months

$$\begin{aligned} 103.7 &= 102.3 \times (100 + r)/100 \\ r &= (103.7/102.3) \times 100 - 100 \\ r &= 1.368524\% \end{aligned}$$

Thus I have used information I know to calculate a new instrument via bootstrapping.

Note that in practice such calculations are made more complicated by the presence of different means of calculation time periods – day-count conventions) (see below) and different ways of quoting interest rates (annual, semi-annual etc.).

26.5 CALCULATION OF DATES

A very important component of all cashflow calculations is the actual dates to be used. In our experience, problems with dates account for many pricing errors.

Accrual convention

For trades with regular cashflows such as bonds and swaps there are four properties of the trade that determine the dates to be used:

1. Frequency – how often does the cashflow occur?
2. Day-count convention – how to split an annually agreed rate across the cashflow dates
3. Business day convention – what to do when a payment is due on a non-business day
4. Holiday calendar – what constitutes non-business days.

It is possible that an OTC trade may have exact dates for payments recorded as part of the trade agreement and therefore no date calculations are required. But for all exchange traded and for most OTCs the four properties will be stipulated and then the dates will be derived by the calculation process.

To see how these factors are used let us consider a fixed bond trade paying an annual coupon of 400,000 quarterly and then the next four payments, the first being on 8 March 2007. Without any modifications the payments should be:

Thu 8 March 2007	100,000
Fri 8 June 2007	100,000
Sat 8 September 2007	100,000
Sat 8 December 2007	100,000.

Now suppose the holiday calendar tells us that non-trading days are Saturdays, Sundays and a list of holidays including Monday 10 December 2007.

Our day-count convention is 'Following' – this means take the first business day when the payment is due on a non-business day.

Our revised dates become:

Thu 8 March 2007
Fri 8 June 2007
Mon 10 September 2007
Tue 11 December 2007.

We now employ the day-count convention (sometimes known as the accrual convention) to calculate the size of the payments.

Some common conventions include the following.

Actual/Actual This means calculate the actual number of days between payments and divide it by the actual number of days in a year.

Actual/360 This means calculate the actual number of days between payments and divide it by 360 regardless of the length of the year.

Actual/365 This means calculate the actual number of days between payments and divide it by 365 regardless of the length of the year.

30/360 This is a little complicated but involves considering months as always being of 30 days and years being of 360 days. There are some variations such as 30E/360 and 30E+/360 which handle months of 31 days in different ways.

For our example let us take Actual/360.

Then to calculate our second payment amount we take the number of days between 8 March and 8 June and divide by 360. This is 92/360 and so the payment is

$$400{,}000 \times 92/360 = 102{,}222.22$$

assuming the payment date prior to the first date is Friday 8 December 2006.

Our full payment schedule is shown in Table 26.6.

TABLE 26.6 Full payment schedule

Raw date	Adjusted date	Days since last payment	Factor	Amount
8 Mar 07	8 Mar 07	90	0.25	100,000
8 Jun 07	8 Jun 07	92	0.25556	102,222.22
8 Sep 07	10 Sep 07	94	0.26111	104,444.44
8 Dec 07	11 Dec 07	91	0.25278	101,111.11

This market convention pays a total of 367 days assuming a year of 360 days. The setting of the coupon or swap rate will take this into account and be slightly lower than for the equivalent using, say, an actual/actual convention.

26.6 CALIBRATION TO MARKET

A scientist wishing to perform an experiment where local conditions affect the results will first calibrate his equipment. This means he will take readings locally and derive some simple calculations from them. Comparing these results to standard results from other places, he will see how much adjustment needs to be made to take into account those local conditions.

It is sometimes necessary for valuation algorithms to perform a similar process. This involves taking market data to produce curves which are then used later in the calculation. This is known as calibrating to market and a typical example is in the pricing of collateralised debt obligations. Here the default (or survival) curves are generated from the market credit default swap prices. These curves are then stored and used in future valuations.

26.7 TESTING

There are various tests required for valuations. The valuation is a precise mechanism, the results of which have serious consequences. So rigorous and thorough testing is very important. Chapter 23 discusses testing at greater length. Here we briefly note some of the tests relevant to calculations.

Sanity check

Do the results look reasonable? If they are very different from mark-to-market, can these differences be accounted for?

Regular testing

Does the model give the expected results when regular input data is applied to it?

Boundary testing

At the boundaries, model effects are often more pronounced, so testing here is essential. By boundaries we mean scenarios, such as just before and just after at-the-money conditions for a vanilla option or just before a barrier is reached for a barrier option.

Unusual values

This involves testing the valuation with especially high, low or otherwise unusual input values and calculation parameters.

26.8 INTEGRATING A MODEL WITHIN A FULL SYSTEM

The model rarely stands on its own. It is generally integrated into a whole pricing and risk management system. After the quant has tested the model in isolation, it must also be tested from within the full system to ensure the results remain unaltered.

26.9 RISKS ASSOCIATED WITH THE VALUATION PROCESS

Most of the risks connected to the valuation process arise through insufficient testing and documentation. By documentation we also mean communication of how and when to use the valuation.

In addition, the valuation must only be used within the parameters for which it was designed and built. There is often a temptation to take a model designed for one class of trades and apply it to other trades that appear similar. Insufficient appreciation of the subtlety and limitations of the model can lead to erroneous results in this situation. The model should really come with clear guidelines as to when it should and should not be used.

Model approval is usually only given to a model when used with a defined set of trades and a defined set or range of market conditions.

Another common practice is to start using a prototype model in real situations before it has been fully tested. This is due to the pressures of the fast-changing business environment, the length of time required for testing and the lack of alternatives.

All settings and input requirements to a model must meet the quality and completeness expected by the model otherwise inaccurate results may be produced.

26.10 SUMMARY

Successful trading depends on accurate and available valuation of trades and risks arising from changes in market prices. The calculation methodology lies at the heart of this process. Input parameters and the model to be used must be carefully selected. There are various techniques for coping with unknowns such as future market data values.

PART Five

Summary of Risks

The following appendices bring together all the risks described elsewhere in the book. For convenience they are grouped by general categories. Some risks not previously mentioned are included for completeness.

They consist of:

- Operational Risks
- Human Risks
- Control Risks
- Processing Risks
- Organisational Risks
- Unforeseen Risks

UNFORESEEN RISK

No stakeholders in a business – investors, managers, employees or customers – want unforeseen risk. Due to its sudden effect, the organisation is ill-equipped to deal with it and its consequences are unknown. One of the major causes of the recent credit crunch was the failure of many organisations to take into account a particular risk: that so many American sub prime mortgage borrowers would be unable to repay their debt. Unforeseen risk points to poor management and supervision and reduces confidence in the financial entity. If risk is present, it should be known about and then sensible decisions can be taken about how to manage it.

APPENDIX A
Operational Risks

The longer mistakes remain in the trade lifecycle, the more costly they are to correct. Here we list some of the common risks associated with the lifecycle.

CONFIRMATION

A poor confirmation causes delays in the processing and settlement of a trade. This increases the probability of settlement risk occurring. Moreover, since confirmation is a two-way process, other organisations will quickly see mistakes and sloppy practices, and these damage the reputation of the firm.

SETTLEMENT

Settlement is where money changes hands and so some important risks are associated with it.

Theft

A big risk in the settlement process is theft. This could occur where the settlement process is intercepted by criminals or where staff involved in the process (including those writing or operating a computerised settlement system) divert part or all of the money to their own bank accounts.

Cost of recovery

Even if there is no attempt to deliberately steal money, there may be a significant cost in recovering it, not to mention severe embarrassment, if the settlement process goes wrong and money is transferred to the wrong account; too much is transferred to the correct account; or the transfer is on the wrong day or at the wrong time.

Legal

Settlement is a legal obligation arising from execution of a trade. A counterparty risks being sued by the wronged party if it fails to settle the right amount at the right time and according to the given settlement instructions.

The legal process, even if settled out of court, will be expensive and time consuming.

Reputation

Any missed or erroneous settlement will cause damage to the reputation of the counterparty at fault. Trading works to a large extent on trust and poor settlement will quickly lead to trading lines being reduced or withdrawn. Trading is one of the main activities of investment banks and hedge funds, and settlement is the most visible face of the institution to its peers. So a failure to settle will arouse doubts as to the competence of the organisation concerned.

Unexpected charges

A party to a trade may be expecting a large receipt of money upon settlement. If the settlement is delayed for any reason, it will not have that money at its disposal. This could result in not being able to pay off a debt charged at a daily interest rate.

Other trades

A counterparty may have a trade with settlement expected on a given day. It may be planning to use that cash, financial instrument or commodity to execute a subsequent trade. A delay on the first settlement will affect other settlements that depend upon it.

Unsettled trades use up counterparty risk allocations and may prevent opportunities for more trading with the same counterparty.

Documentation

Where securities are owned, there exists documentation risk. In order to receive coupons or dividends, the holder must ensure they are correctly registered (in the case of registered securities) or that they initiate the claim for payment process in a timely fashion (for bearer securities). There is also a risk that documentation may be lost or stolen.

Breaks

A major part of back office time is spent tracing ‘breaks’, where a settlement has not been enacted. These breaks are very expensive in time and human resources.

Sometimes huge numbers of unpaid settlements are built up because operations do not have time to chase them.

PAYMENT SYSTEMS

Credit risk – risk that a counterparty has insufficient funds to settle its debt.

Liquidity (timing) risk – risk of unavailability of funds at the requisite time.

STRAIGHT THROUGH PROCESSING (STP)

There are risks associated with STP. A fully automated system means that mistakes are fully automated. The machine cannot respond to potential or actual errors unless it has been programmed to do so. Due to the varied nature of trade booking errors, the design of the system cannot be relied upon to catch them all and, even when they are caught, the process requires human beings taking appropriate action. Also, some business functions are required to *merely* check trades in the STP. Since checking is a passive activity, it is easy for mistakes to slip through.

PROVISIONAL TRADES

The extent to which a provisional trade carries a legal responsibility must be clear and transparent to anyone acting upon or using that trade. Falsely assuming a provisional trade to be completely abstract could cause loss and is therefore a risk.

A clear risk exists if the provisional trade automatically becomes live when a counterparty does not withdraw by a given date. There may be a tendency to apply less stringency with the writing and checking of a provisional trade ticket, as it is not real. This bears risk because, in the event the trade is executed, it might be simply transferred to a live trading book with the falsely applied assumption of accuracy.

Orders

Orders are instructions to trade but not trades themselves. A risk arises when orders are missed and clients or counterparties expect them to have been transacted. Another risk is caused by changes or deletions to orders not being reflected in the ensuing trades.

Exercise

There are risks, such as poor communication between traders and middle office, which lead to exercise being missed when it should have occurred, and being performed when it should not have occurred.

There is also a problem when market rates are very volatile and an option is at-the-money. A sudden swing could take the option into the money and make it worth exercising. Systems showing market data must be accurate and up-to-date – the timing of market data may be as crucial as its actual value.

Another issue arises from at-the-money options with volatile market data. When a trader expects an inflow of assets, he takes steps to hedge his position and reduce his risks. The problem of last minute decisions about option exercise is that the asset changes cannot be managed so effectively. This can result in greater hedging costs or greater exposure.

APPENDIX B

Human Risks

Inevitably a trading organisation relying on human beings is going to be subject to human risk. Here we list some of the common risks.

TOO MUCH KNOWLEDGE IN ONE PERSON

If an individual is particularly good at his job because of his greater knowledge, experience or application, it is often tempting to give him more responsibility and a greater share of the overall burden of work. Other people do not study his area of expertise, because they know he can be relied upon. This causes a knowledge risk, where an area of the trading lifecycle is left solely in the hands of one individual. If that individual should leave the firm or become ill, there will be nobody to replace him. Although it may seem like a waste of resources, it is always important that every area has sufficient back up. Too many organisations have failed to recognise their reliance on one person until it is too late and he has departed.

NOT ENOUGH KNOWLEDGE

This is one of the greatest risks to any organisation. Sometimes the management of a particular trading area becomes convinced that a type of trade or trading strategy is foolproof and certain to bring in risk-free profits. Trading commences and suddenly the lack of proper understanding is exposed to great cost. It may seem absurd that financial entities specialising in financial products with strict internal and external controls should be able to engage in trading that is misunderstood, but it happens surprisingly frequently. Even if controls and procedures are in place, they will be of little benefit if the fundamental behaviour of the product is not known.

It is not just in trading that a lack of knowledge can be risky; the trade lifecycle is a chain of processes and is therefore only as strong as its weakest point.

Although training is provided, particularly to junior staff, there is a tendency to consider a new product as a modification of existing products or to borrow techniques from one asset class to use in another – these assumptions can lead to incorrect processing and added risk.

WRONG PEOPLE

Each business function has its particular demands and responsibilities. Personality and outlook play a part in how well an individual suits his business function. Since large amounts of money are at risk, a trading environment can be very stressful. Stress leads to mistakes, increasing the risks to the firm.

NOT ENOUGH INVESTMENT IN PEOPLE

There is sometimes a tendency to believe that computers can solve all the problems and only minimal staffing levels are required in some business functions. If things are going well, this may well be the case. But for the unusual, the unplanned or the unlikely, computers will not be able to step in and sort out the problem. The balance between humans and machines is hard to gauge, but broadly speaking, computers should deal with the ordinary and expected; human beings the more specialist or unusual circumstances.

Whenever computers are running processes, it should never be assumed that they have performed the task correctly on every occasion. Even if a process has run successfully 200 times in succession, there is always a chance of a problem on the next run.

RELIANCE ON SHORT-TERM PLANNING

There are obvious risks in working to short-term timescales. Trades are often designed to post profit quickly, while long-term negative effects are overlooked.

Longer-term trading could be safer and more profitable, but it is often not considered because nobody will be around to draw bonuses from it.

CONFLICTS AND TENSIONS

In any commercial environment there are bound to be tensions and the stress of investment banking can accentuate them. However, some tensions arise from the very nature of the business functions and these are important to ensure trading is conducted with an appropriate level of control. When one or other side gains too much power, there could be risk to the business.

TRADING VERSUS CONTROL FUNCTIONS

The most obvious tension is between traders and the control functions. Counterparty and market risk control departments are responsible for reducing risks. If they refused all trading there would be no risk, but of course then there would be no business and no one to pay their salaries. Since traders are the revenue generators for everybody, there may be a tendency to allow traders more freedom than would be the case if the control functions were financially supported from elsewhere. Similarly if a member of product control objects to the trader's view of the current market price, he may be afraid to raise an objection because his career and bonus depend on keeping the traders happy.

On the other hand, in a cautious environment genuine trading under reasonable controls can be thwarted by over zealous control functions.

COMMUNICATION

Mistakes are very common where communication is missing or inadequate.

PANIC

Processes may be well designed, implemented and tested, but there may still exist a risk due to panic in the face of extreme conditions. Rehearsing emergency drills and making the emergency processes intuitive and user-friendly can mitigate this risk.

APPENDIX C
Control Risks

The two major areas of risk control – market and counterparty – carry their own set of risks.

MARKET RISK CONTROL

There is a risk associated with relying too much on the market risk control department to avert risk from market forces. Staff in this department do not prevent disasters from occurring: the expectation is that should something unusual happen, they will be able to provide the necessary data on the risk profile of the organisation at various macro and micro levels so that the extent of the damage can be assessed.

Also, they cannot measure every possible disaster. Nobody can determine how much or in what way the future replicates the past. Market risk control lives in the world of the unknown, but uses probability to give some feel for exposure to risk. Understanding the limitations of market risk controllers is very important in order to assess the credibility of their measurements.

Everything correlated

Market risk allocates risk on an asset-by-asset basis. Interest rate traders are given so much interest rate risk, commodity traders commodity risk and so on. Most of the measurements of risk (with the exception of scenario testing) also consider each risk type separately. This means there is an implicit assumption that one type of market risk is not connected to other types. This assumption is not always correct: we have observed several episodes in the recent and distant past that have caused markets to react in concert across the range of asset classes. This means that in times of crisis markets are ultimately correlated to each other.

The tails

When we reach an extreme case of market data performance – known mathematically as the tail of the graph – different factors come into play and cause the standard model to become less reliable. Predicting behaviour at the tails is very difficult and as a result enhances the size of market risk.

The human factor

Risk analysis is a mathematical exercise – valuations do not have emotions. However an important point to bear in mind is that the driver for the valuations is the various input data. This comes from prices set by human beings reacting emotionally as well as intellectually to events around them. Although the human factor in market risk cannot be precisely quantified, it should be taken into consideration and studies on past crises can reveal trends in human and hence market behaviour.

COUNTERPARTY RISK CONTROL

An entire business function is devoted to measuring and controlling the risk associated with a counterparty defaulting on payments. Here are some of the risks.

Correlation between counterparties

Even if a company has correctly gathered its counterparty data and understands the links between the various parent and child companies, there is still a hidden risk that once one counterparty fails, it will pull down others with it. For example, a hedge fund might require the support of a major investment bank for its funding. The counterparty risk department will have to decide how far to investigate the funding of its counterparties and decide if the cost of the extra research work outweighs the cost of not knowing the information.

Added complication of credit risk

Counterparty risk is often a separate operation from the department trading credit products. In reality, the trade on a credit product has dual credit risk: the risk the trade refers to and the risk to the counterparty. To get a true picture of counterparty risk, knowledge should be shared between the two departments.

Insufficient consideration of counterparty risk

Even if the counterparty risk control department is functioning correctly and setting sensible limits, its success at containing risk is contingent on the attitude and support of management. Managers are under pressure to deliver profits by promoting trading. Until there is a major reverse, they may not strictly enforce the reports and recommendations of the counterparty risk function, because they see them as being overly cautious or anti-trade.

Sudden counterparty changes

A limit may be set according to current counterparty rating information or by any other means. If that limit becomes fully or nearly fully utilised, there is very little room for manoeuvre should the counterparty suffer a reverse and the limit needs to be revised downwards. New trading with that counterparty can be restricted, but closing down existing trades might be expensive. If a credit-trading desk exists in the organisation, it will sometimes be asked to cover the exposure by buying credit protection on the counterparty.

There are occasions when a counterparty fails suddenly and spectacularly, such as Lehman Brothers in 2008. The whole market was caught by surprise, but a good counterparty risk department should be able to identify the outstanding exposures and perform a damage limitation exercise.

APPENDIX D

Processing Risks

The process of trading carries the following risks.

CASHFLOW RISKS

When trades, cashflows and asset holdings do not match up there are problems. Either the systems are not reporting what is going on or the processes are not being properly executed – both sources of major operational risk. Since these activities and measures are so intrinsic to the whole trading process, it is important that proper systems and controls are in place for managing them.

DATA RISKS

Data is the life blood of any financial organisation. Here are some risks associated with data.

Putting too much faith in data

Everybody involved in the trade lifecycle is using and working with the effects of input data. Key management strategies, day-to-day tasks and split-second trading decisions are all based on input data – either directly or through reports and calculations. It is easy to assume that data is correct – we have been receiving it for many years, the supplier is authentic and other people use the same data.

Due diligence would surely require the question to be raised as to what happens if the data is wrong and perhaps more worryingly, what if it is wrong sometimes, but not always.

Not reacting to data

The other extreme is too little notice taken of input data. If the data is an accurate reflection of the state of the market, warning signs, such as larger than usual changes, should be detected quickly and reported to the people who can make decisions. It is of little use if a junior clerk in the back office spots an irregular pattern but by the time the news filters through to the management, it is too late to react.

Coping when data is not there

A good test of the resilience of an organisation is to switch off its market data supply for one day and see how it copes. Are there back up procedures in place, can data be obtained or inferred from other sources? As data is so important these scenarios should be taken into consideration.

Ensuring authentic data

Obviously to be a trusted source, data must be authentic. This may be easy to verify in the case of a daily feed from a vendor's ftp site or by a secure delivery mechanism, but other types of data can be potentially insecure. Live data arriving at users' machines or directly entering the database can be hazardous and difficult to monitor. The recipient of such data needs to balance the benefit of this information being available so easily, with the security risk involved.

REPORTING RISKS

Reports are distributed to a wide internal and external audience.

Security

Sensitive information falling into the wrong hands is a risk associated with the generation and transmission of reports.

Inaccuracy

Decisions are often made based on information in reports. If these reports are inaccurate or incomplete, the firm could make the wrong decisions. Even correctly produced reports may be misinterpreted, if the readers are not fully educated about their limitations and scope.

Lack of support for readership

Once a report has been distributed, there is a risk if nobody can interpret the results or explain how they were derived. The production team might have gone home, it may be another time zone or the producers themselves may not be able to answer the queries. An unexpected result might indicate a major problem requiring urgent action or it may be a false alarm. Either way, prompt dialogue can avert many problems but it requires people of sufficient knowledge to be available.

Poor distribution

Lack of co-ordination in report production or distribution might lead to mixed signals being transmitted which confuse or mislead the readership. Inaccurate translation can also carry risks in multiple language environments.

If a report requires retraction or correction, it is important to act fast. Generally, once something is in writing, it is hard to erase its effects, whether they are benign or malign. A written or electronic report always has the potential to be quoted or reused.

New products

New products carry additional risks because they are relatively untested. Fewer people have knowledge and experience and so there is a heightened human risk. Processes may treat the new risk type as an exception, excluding it from some of the standard operational risk controls and increasing processing risk.

Early participants in the new trade may misunderstand how to trade it and lose money. The trade may be too illiquid to get out of positions, causing losses when market conditions reverse. Assumptions underlying the initial trade development may turn out to be unfounded or wrong.

A costly infrastructure may be developed for the new trade, but it is wasted if the trade fails to reach its projected market volumes.

Legal and regulatory risks

Every organisation trades under a set of relevant laws and regulations. Failure to fully abide by these carries many risks.

Closure

If a firm fails to fulfil its regulatory responsibilities, it could have part or all of its activities closed down.

Penalties and prosecution

Depending on the nature of the breach, companies or individuals who have broken the laws or regulations governing their conduct may be subject to significant fines, criminal prosecution or both.

Litigation

A company that breaches its legal and regulatory obligations may also be liable to civil litigation brought by any party that has suffered as a result. If the entity fails to perform its activities with sufficient care, it could be liable to a claim of negligence. The standard of care owed by the entity will depend on the sophistication of the particular investor – with professional institutions viewed as requiring less protection than members of the public. Courts will look to standards mandated by regulation and applied by other firms in determining whether the requisite standard has been met.

Costs

The resolution of proceedings initiated by a regulator, or the defence of a lawsuit, can be very costly. They will typically require significant management time in addition to legal costs.

Reputational risk

In any case of personal or corporate malpractice, the company may suffer reputational risk. Potential clients may steer clear of companies that have breached legal or regulatory requirements. Counterparties may also be wary of trading with a company that does not play by the rules.

Advisory risk

Legal risk does not rest solely on actual trading activities. There is also a considerable legal responsibility when advising clients on financial services. Thus advisory activities must be policed to the same degree as those of trading.

TESTING RISKS

Here we summarise the business and operational risks related to testing.

Too little testing

Processes may not run correctly leading to extra costs for the business. Misleading results may have several undesirable consequences. The investment in developing or purchasing software is wasted if the software fails to perform correctly.

Too much testing

Resources are wasted carrying out superfluous testing and improving software more than is necessary.

Poor testing

Staff may be lulled into a false sense of security if they assume a system has been tested, when in fact it has either not been tested at all or not been tested effectively. This might lead to unexpected delays, faults or false results being taken as accurate.

Over reliance on testing

Testing a system thoroughly improves its quality and robustness, but does not make it more efficient. Underlying flaws in design or implementation may cause it to be harder to extend in the future or hinder its performance. A well-tested system is not necessarily a good system.

Poor communication

Testing is a collaborative activity involving managers, developers, users and specialist testers. For testing to be effective, the results must be communicated to all interested parties. Developers must know and understand the faults, users must be aware of any shortcomings and managers need to build testing and fault fixing into their planning. Overall confidence in the system very much depends on good, effective testing.

APPENDIX E
Organisational Risks

Many risks affect the organisation as a whole.

BUSINESS CONTINUITY PLANNING (BCP) RISKS

An untested BCP plan can jeopardise the business by inducing a false sense of confidence.

Linked to this risk is the tendency of many people to undervalue the purpose of BCP. The BCP staff are dependent on IT and business professionals to tell them what is required – if the exercise is not taken seriously key components or activities might be missed.

Another risk is that the BCP is thorough, but cannot cope with a double or extensive disaster.

VALUATION AND MODEL APPROVAL RISKS

Most of the risks connected to the valuation process arise through insufficient testing and documentation. By documentation, we also mean communication of how and when to use the valuation.

In addition, the valuation must only be used in the scenarios for which it was built. There is often a temptation to take a model designed for one class of trades and apply it to other trades that appear similar. Insufficient appreciation of the subtlety and limitations of the model can lead to erroneous results in this situation.

A common risk associated with the process of approving valuation and risk management models is that the validation asserts the model does what it is supposed to do, but nobody checks that the model is appropriate for the business problem it attempts to solve. This can lead to the risk of valuation results being falsely relied upon.

MANAGEMENT RISKS

Management controls and directs an organisation. If there is too little or too much management the following risks may occur.

Decision making

A poor decision as well as lack of judgement, communication or information between management and staff increases the risk to an organisation.

Lack of empowerment

If staff see a potential risk or problem, but they do not have the authority to take action to avert it, the organisation will suffer.

Structural risk

A poorly designed organisational structure can lead to responsibility being given to the wrong people or not allocated to anyone. Whenever a manager lacks the ability to control a risk, the risk can grow.

DOCUMENTATION RISKS

Documentation is the means by which knowledge is transferred.

Insufficient or inaccurate documentation

Insufficient or inaccurate documentation might lead to false assumptions about the way a process, model or system is supposed to work or to it being operated incorrectly.

Unread documentation

There is no point producing a correct and thorough piece of documentation if the people who need to read it do not. Staff must be given the time to study documents that affect their work.

Out-of-date documentation

There is a risk if documentation is not kept up-to-date as the process, model or system changes it describes develop over time.

FRONT OFFICE RISKS

Apart from risks already mentioned, there are some that are specific to the front office trading and sales desks.

Sales

There is a risk in selling something that cannot be delivered. This can lead to legal costs or damage to reputation.

Trading

Taking on too much market risk, being over-leveraged or violating trading limits can endanger the entire firm. Working without support and control functions also hampers the ability to book and manage the trading process. A lack of understanding of the complexities of a product might cause severe trading losses.

Liquidity Liquidity risk is present whenever a lack of market activity prevents trading out of held positions.

Funding Committing to a trade where insufficient funding is available is a source of risk to the firm.

Research If not enough research was carried out to make proper decisions or the research was wrong, trading might be impaired or poor decisions taken.

IT and systems

We have already described data and reporting risks, but here we list some other risks associated with systems and IT.

Systems not working as expected and documented Most IT systems involve significant cost and time to complete. If they fail to fulfil their objectives then resources have been wasted and one or many business processes are left poorly implemented enhancing operational risk.

False reporting Either success is reported as failure or failure as success. This is always going to add some level of risk to the operation.

Project Projects overrunning can lead to trading opportunities being missed or an increase in operational risk. The same applies when projects do not deliver the functionality that was required.

System operation Whenever the operation of a system is wrong, a process may fail and operational risk is increased.

Diagnostic When an error has occurred but is not detected or reported, a risk is created. Conversely, if a benign situation is falsely reported as an error, this can lead to much time being wasted tracking down a problem that does not exist.

Effective control and support

As explained in Chapter 15, the financial entity has revenue generators together with people who support and control them. When these three divisions are not acting properly there may be risk.

Not enough support Revenue generation is impaired because the systems and resources required for making money are not available.

Not enough control Revenue generators, in particular traders, may take on too much risk or fail to think through the consequences of their trading positions.

Not enough revenue generation Restricting revenue generation by imposing too many controls will mean everyone in the firm loses their source of income. It is therefore essential that senior management set a strategy that gives each of the three divisions (revenue generation, support and control) the ability to carry out their business function with an appropriate balance to reflect the requirements of all stakeholders in the control of risk and generation of profit.

Recommended Reading

Frederick P. Brooks, Jr. (1995) *The mythical man-month: Essays on Software Engineering*, Addison Wesley.

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KPMG, Evolving Banking Regulation – annual review of bank regulation.

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