Risk-First

Software Development

Volume 1: The Menagerie

Rob Moffat

Risk-First: The Menagerie

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Credits

tbd

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Thanks to:

Books In The Series

- **Risk-First: The Menagerie:** Book one of the Risk-First series argues the case for viewing *all* of the activities on a software project through the lens of *managing risk*. It introduces the menagerie of different risks you're likely to meet on a software project, naming and classifying them so that we can try to understand them better.
- **Risk-First: Tools and Practices:** Book two of the Risk-First series explores the relationship between software project risks and the tools and practices we use to mitigate them. Due for publication in 2020.

Online

Material for the books is freely available to read, drawn from `risk-first.org`.

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Contents

Preface

Welcome to Risk-First!

Let's cover some of the big questions up-front: The why, what, who, how and where of *The Menagerie*.

Why

> "Scrum, Waterfall, Lean, Prince2: what do they all have in common?"

I've started this because, on my career journey, I've noticed that the way I do things doesn't seem to match up with the way the books *say* it should be done. And, I found this odd and wanted to explore it further. Hopefully, you, the reader, will find something of use in this.

I started with this observation: *Development Teams* put a lot of faith in methodology. Sometimes, this faith is often so strong it borders on religion. (Which in itself is a concern.) For some, this is Prince2. For others, it might be Lean or Agile.

Developers put a lot of faith in *particular tools* too. Some developers are pro-or-anti-Java, others are pro-or-anti-XML. All of them have their views coloured by their *experiences* (or lack of) with these tools. Was this because their past projects *succeeded* or *failed* because of them?

As time went by, I came to see that the choice of methodology, process or tool was contingent on the problem being solved, and the person solving the problem. We don't face a shortage of tools in IT, or a shortage of methodologies, or a shortage of practices. Essentially, that all the tools and methodologies that the industry had supplied were there to help *minimize the risk of my project failing*.

This book considers that perspective: that building software is all about *managing risk*, and that these methodologies are acknowledgements of this

fact, and they differ because they have *different ideas* about which are the most important *risks to manage*.

What This Is

Hopefully, after reading this, you'll come away with:

- An appreciation of how risk underpins everything we do as developers, whether we want it to or not.
- A framework for evaluating methodologies, tools and practices and choosing the right one for the task-at-hand.
- A recontextualization of the software process as being an exercise in mitigating different kinds of risk.
- The tools to help you decide when a methodology or tool is *letting you down*, and the vocabulary to argue for when it's a good idea to deviate from it.

This is not intended to be a rigorously scientific work: I don't believe it's possible to objectively analyze a field like software development in any meaningful, statistically significant way. (For one, things just change too fast.)

> "I have this Pattern"
>
> —Attributed to Ward Cunningham, *Have This Pattern, C2 Wiki*[1]

Does that diminish it? If you have visited the TVTropes[2] website, you'll know that it's a set of web-pages describing *common patterns* of narrative, production, character design etc. to do with fiction. For example:

> "Sometimes, at the end of a Dream Sequence or an All Just a Dream episode, after the character in question has woken up and demonstrated any [lesson] that the dream might have been communicating, there's some small hint that it wasn't a dream after all, even though it quite obviously was. . . right?."
>
> —Or Was It a Dream?, *TVTropes*[3]

[1] `http://c2.com/ppr/wiki/WikiPagesAboutWhatArePatterns/HaveThisPattern.html`

[2] `https://tvtropes.org`

[3] `https://tvtropes.org/pmwiki/pmwiki.php/Main/OrWasItADream`

Is it scientific? No. Is it correct? Almost certainly. TVTropes is a set of *empirical patterns* for how stories on TV and other media work. It's really useful, and a lot of fun. (Warning: it's also incredibly addictive).

In the same way, "Design Patterns: Elements of Reusable Object-Oriented Software[4]", is a book detailing patterns of *structure* within Object-Oriented programming, such as:

> "[The] Adapter [pattern] allows classes with incompatible interfaces to work together by wrapping its own interface around that of an already existing class. . . "
>
> —Design Patterns, *Wikipedia*[5]

Patterns For Practitioners

Design Patterns aimed to be a set of *useful* patterns which practitioners could use in their software to achieve certain goals. "I have this pattern" was a phrase used to describe how they had seen a certain set of constraints before, and how they had solved it in software.

This book was a set of experts handing down their battle-tested practices for other developers to use, and, whether you like patterns or not, knowing them is an important part of being a software developer, as you will see them used everywhere you go and probably use them yourself.

In the same way, Risk-First aims to be a set of *Patterns for Software Risk*. Hopefully after reading this book, you will see where risk hides in software projects, and have a name for it when you see it.

Towards a "Periodic Table"

In the latter chapters of "The Menagerie" we try to assemble these risk patterns into a cohesive whole. Projects fail because of risks, and risks arise from predictable sources.

What This is Not

This is not intended to be a rigorously scientific work: I don't believe it's possible to objectively analyze a field like software development in any meaningful, statistically significant way. (For one, things just change too fast.)

[4] http://amzn.eu/d/3cOwTkH

[5] https://en.wikipedia.org/wiki/Design_Patterns

Neither is this site isn't going to be an exhaustive guide of every possible software development practice and methodology. That would just be too long and tedious.

Neither is this really a practitioner's guide to using any particular methodology: If you've come here to learn the best way to do Retrospectives, then you're in the wrong place. There are plenty of places you can find that information already. Where possible, this site will link to or reference concepts on Wikipedia or the wider internet for further reading on each subject.

Who

This work is intended to be read by people who work on software projects, and especially those who are involved in managing software projects.

If you work collaboratively with other people in a software process, you should find Risk-First a useful lexicon of terms to help describe the risks you face.

But here's a warning: This is going to be a depressing book to read. It is book one of a two-book series, but in **Book One** you only get to meet the bad guy.

While **Book Two** is all about *how to succeed*, This book is all about how projects *fail*. In it, we're going to try and put together a framework for understanding the risk of failure, in order that we can reconstruct our understanding of our activities on a project based on avoiding it.

So, if you are interested in *avoiding your project failing*, this is probably going to be useful knowledge.

For Developers

Risk-First is a tool you can deploy to immediately improve your ability to plan your work.

Frequently, as developers we find software methodologies "done to us" from above. Risk-First is a toolkit to help *take apart* methodologies like Scrum, Lean and Prince2, and understand them. Methodologies are *bicycles*, rather than *religions*. Rather than simply *believing*, we can take them apart and see how they work.

For Project Managers and Team Leads

All too often, Project Managers don't have a full grasp of the technical details of their projects. And this is perfectly normal, as the specialization belongs

below them. However, projects fail because risks materialize, and risks materialize because the devil is in those details.

This seems like a lost cause, but there is hope: the ways in which risks materialize on technical projects is the same every time. With Risk-First we are attempting to name each of these types of risk, which allows for a dialog with developers about which risks they face, and the order they should be tackled.

Risk-First allows a project manager to pry open the black box of development and talk with developers about their work, and how it will affect the project. It is another tool in the (limited) arsenal of techniques a project manager can bring to bear on the task of delivering a successful project.

How

One of the original proponents of the Agile Manifesto, Kent Beck, begins his book Extreme Programming by stating:

> "It's all about risk"
>
> —Kent Beck, *Extreme Programming Explained*[6]

This is a promising start. From there, he introduces his methodology, Extreme Programming, and explains how you can adopt it in your team, the features to observe and the characteristics of success and failure. However, while *Risk* has clearly driven the conception of Extreme Programming, there is no clear model of software risk underpinning the work, and the relationship between the practices he espouses and the risks he is avoiding are hidden.

In this book, we are going to introduce a model of software project risk. This means that in **Book Two** (Risk-First: Tools and Practices), we can properly analyse Extreme Programming (and Scrum, Waterfall, Lean and all the others) and *understand* what drives them. Since they are designed to deliver successful software projects, they must be about mitigate risks, and we will uncover *exactly which risks are mitigated* and *how they do it*.

[6] http://amzn.eu/d/gUQjnbF

Where

All of the material for this book is available Open Source on github.com[7], and at the risk-first.org[8] website. Please visit, your feedback is appreciated.

There is no compulsion to buy a print or digital version of the book, but we'd really appreciate the support. So, if you've read this and enjoyed it, how about buying a copy for someone else to read?

A Note on References

Where possible, references are to the Wikipedia[9] website. Wikipedia is not perfect. There is a case for linking to the original articles and papers, but by using Wikipedia references are free and easy for everyone to access, and hopefully will exist for a long time into the future.

On to The Executive Summary

[7] https://github.com

[8] https://risk-first.org

[9] https://wikipedia.org

Executive Summary

1. There are Lots of Ways of Running Software Projects

There are lots of different ways to look at a project in-flight. For example, metrics such as "number of open tickets", "story points", "code coverage" or "release cadence" give us a numerical feel for how things are going and what needs to happen next. We also judge the health of projects by the practices used on them, such as Continuous Integration, Unit Testing or Pair Programming.

Software methodologies, then, are collections of tools and practices: "Agile", "Waterfall", "Lean" or "Phased Delivery" all prescribe different approaches to running a project, and are opinionated about the way they think projects should be done and the tools that should be used.

None of these is necessarily more "right" than another- they are suitable on different projects at different times.

A key question then is: **how do we select the right tools for the job?**

2. We can Look at Projects in Terms of Risks

One way to examine the project in-flight is by looking at the risks it faces.

Commonly, tools such as RAID logs and RAG status reporting are used. These techniques should be familiar to project managers and developers everywhere.

However, the Risk-First view is that we can go much further: that each item of work being done on the project is to manage a particular risk. Risk isn't something that just appears in a report, it actually drives *everything we do*.

For example:

- A story about improving the user login screen can be seen as reducing *the risk of users not signing up*.

- A task about improving the health indicators could be seen as mitigating *the risk of the application failing and no-one reacting to it*.
- Even a task as basic as implementing a new function in the application is mitigating *the risk that users are dissatisfied and go elsewhere*.

One assertion of Risk-First is that **every action you take on a project is to manage a risk.**

3. We Can Break Down Risks on a Project Methodically

Although risk is usually complicated and messy, other industries have found value in breaking down the types of risks that affect them and addressing them individually.

For example:

- In manufacturing, *tolerances* allow for calculating the likelihood of defects in production.
- In finance, projects and teams are structured around monitoring risks like *credit risk*, *market risk* and *liquidity risk*.
- *Insurance* is founded on identifying particular risks and providing financial safety-nets for when they occur, such as death, injury, accident and so on.

Software risks are difficult to quantify, and mostly, the effort involved in doing so *exactly* would outweigh the benefit. Nevertheless, there is value in spending time building *classifications of risk for software*. That's what Risk-First does: it describes a set of *risk patterns* we see every day on software projects.

With this in place, we can:

- Talk about the types of risks we face on our projects, using an appropriate language.
- Anticipate Hidden Risks that we hadn't considered before.
- Weigh the risks against each other, and decide which order to tackle them.

4. We can Analyse Tools and Techniques in Terms of how they Manage Risk

If we accept the assertion above that *all* the actions we take on a project are about mitigating risks, then it stands to reason that the tools and techniques available to us on a project are there for mitigating different types of risks.

For example:

- If we do a Code Review, we are partly trying to minimise the risks of bugs slipping through into production, and also manage the Key-Man Risk of knowledge not being widely-enough shared.
- If we write Unit Tests, we're addressing the risk of bugs going to production, but we're also mitigating against the risk of *regression*, and future changes breaking our existing functionality.
- If we enter into a contract with a supplier, we are mitigating the risk of the supplier vanishing and leaving us exposed. With the contract in place, we have legal recourse against this risk.

From the above examples, it's clear that **different tools are appropriate for managing different types of risks.**

5. Different Methodologies are for Different Risk Profiles

In the same way that our tools and techniques are appropriate to dealing with different risks, the same is true of the methodologies we use on our projects. We can use a Risk-First approach to examine the different methodologies, and see which risks they address.

For example:

- **Agile** methodologies prioritise the risk that requirements capture is complicated, error-prone and that requirements change easily.
- **Waterfall** takes the view that development effort is an expensive risk, and that we should build plans up-front to avoid re-work.
- **Lean** takes the view that risk lies in incomplete work and wasted work, and aims to minimise that.

Although many developers have a methodology-of-choice, the argument here is that there are tradeoffs with all of these choices.

"Methodologies are like *bicycles*, rather than *religions*. Rather than simply *believing*, we can take them apart and see how they work. "

6. We can Drive Development With a Risk-First Perspective

We have described a model of risk within software projects, looking something like this:

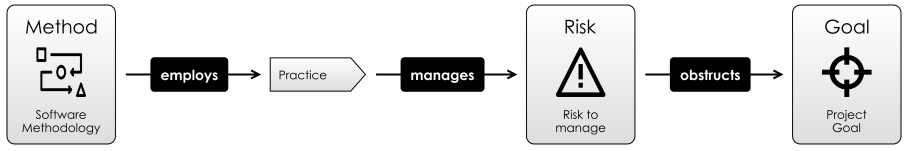


Figure 1: Methodologies, Risks, Practices

How do we take this further?

One idea explored is the *Risk Landscape*: Although the software team can't remove risk from their project, they can take actions that move them to a place in the Risk Landscape where the risks on the project are more favourable than where they started.

From there, we examine basic risk archetypes you will encounter on the software project, to build up a Taxonomy of Software Risk, and look at which specific tools you can use to mitigate each kind of risk.

Then, we look at different software practices, and how they manage various risks. Beyond this we examine the question: *how can a Risk-First approach inform the use of this practice?*

For example:

- If we are introducing a **Sign-Off** in our process, we have to balance the risks it *mitigates* (coordination of effort, quality control, information sharing) with the risks it *introduces* (delays and process bottlenecks).
- If we build in **Redundancy**, this mitigates the risk of a *single point of failure*, but introduces risks around *synchronizing data* and *communication* between the systems.

- If we introduce **Process**, this may make it easier to *coordinate as a team* and *measure performance* but may lead to bureaucracy, focusing on the wrong goals or over-rigid interfaces to those processes.

Risk-First aims to provide a framework in which we can *analyse these actions* and weigh up *accepting* versus *mitigating* risks.

Still interested? Then dive into reading the introduction.

Part I

Introduction

CHAPTER 1

A Simple Scenario

In this chapter, I'm going to introduce some terms for thinking about risk.

Lets for a moment forget about software completely, and think about *any endeavour at all* in life. It could be passing a test, mowing the lawn or going on holiday. Choose something now. I'll discuss from the point of view of "cooking a meal for some friends", but you can play along with your own example.

1.1 Goal In Mind

Now, in this endeavour, we want to be successful. That is to say, we have a **Goal In Mind**: we want our friends to go home satisfied after a decent meal, and not to feel hungry. As a bonus, we might also want to spend time talking with them before and during the meal. So, now to achieve our Goal In Mind we *probably* have to do some tasks.

Since our goal only exists *in our head*, we can say it is part of our **Internal Model** of the world. That is, the model we have of reality. This model extends to *predicting what will happen*.

If we do nothing, our friends will turn up and maybe there's nothing in the house for them to eat. Or maybe, the thing that you're going to cook is going to take hours and they'll have to sit around and wait for you to cook it and they'll leave before it's ready. Maybe you'll be some ingredients short, or maybe you're not confident of the steps to prepare the meal and you're worried about messing it all up.

1.2 Attendant Risk

These *nagging doubts* that are going through your head I'll call the Attendant Risks: they're the ones that will occur to you as you start to think about what will happen.

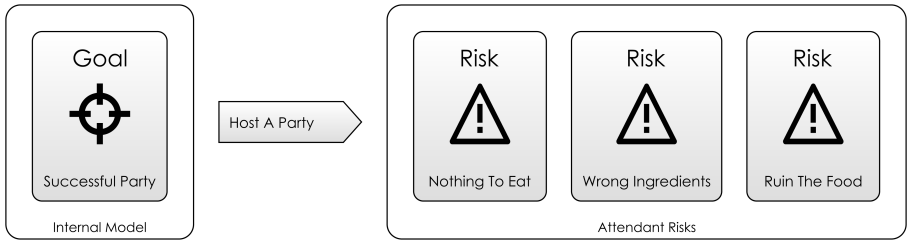


Figure 1.1: Goal In Mind, with the risks you know about

When we go about preparing this wonderful evening, we can choose to deal with these risks: shop for the ingredients in advance, prepare parts of the meal, maybe practice the cooking in advance. Or, we can wing it, and sometimes we'll get lucky.

How much effort we expend on these Attendant Risks depends on how big we think they are. For example, if you know there's a 24-hour shop, you'll probably not worry too much about getting the ingredients well in advance (although, the shop *could still be closed*).

1.3 Hidden Risks

There are also **Hidden Risks** that you *don't* know about: if you're poaching eggs for dinner, perhaps you don't know that fresh eggs poach best. The difference is, Attendant Risks are risks you are aware of, but can't be sure of the amount they will impact you. Hidden Risks are ones you are unaware of.

Donald Rumsfeld[1] famously called these "Unknown Unknowns".

Different people evaluate risks differently, and they'll also *know* about different risks. What is an Attendant Risk for one person is a Hidden Risk for another.

Which risks we know about depends on our **knowledge** and **experience**, then. And that varies from person to person (or team to team).

[1] `https://en.wikipedia.org/wiki/There_are_known_knowns`

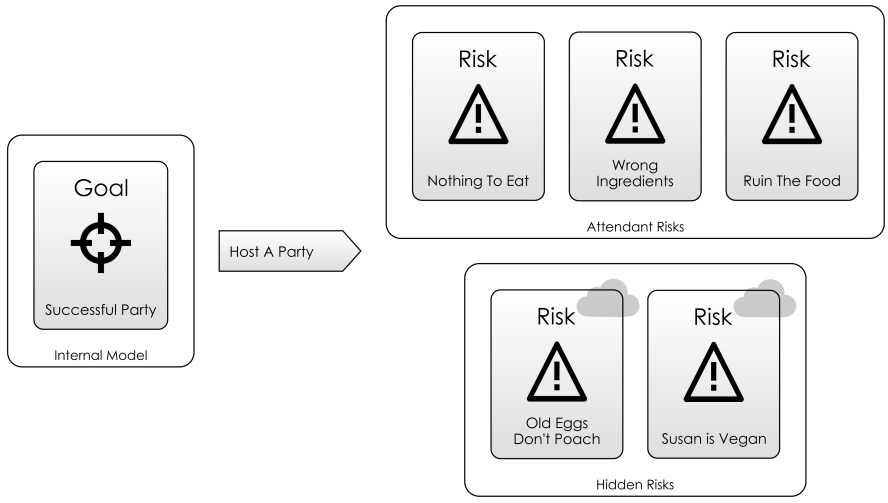


Figure 1.2: Goal In Mind, the risks you know about and the ones you don't

1.4 Meeting Reality

As the dinner party gets closer, we make our preparations, and the inadequacies of the Internal Model become apparent. We learn what we didn't know and the Hidden Risks reveal themselves. Other things we were worried about don't materialise. Things we thought would be minor risks turn out to be greater.

Our model is forced to Meet Reality, and the model changes, forcing us to deal with these risks, as shown in diagram ref{model_vs_reality.png} . Whenever we try to *do something* about a risk, it is called Taking Action. Taking Action *changes* reality, and with it your Internal Model of the risks you're facing. That's because it's only by interacting with the world that we add knowledge to our Internal Model about what works and what doesn't. Even something as passive as *checking the shop opening times* is an action, and it improves on our Internal Model of the world.

If we had a good Internal Model, and took the right actions, we should see positive outcomes. If we failed to manage the risks, or took inappropriate actions, we'll probably see negative outcomes.

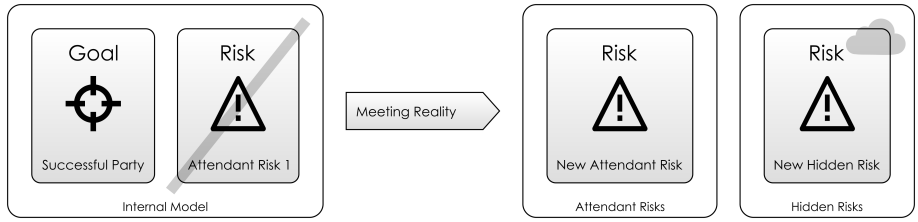


Figure 1.3: How Taking Action affects Reality, and also changes your Internal Model

1.5 On To Software

Here, we've introduced some new terms that we're going to use a lot: Meet Reality, Attendant Risk, Hidden Risk, Internal Model, Taking Action and Goal In Mind. And, we've applied them in a simple scenario.

But Risk-First is about understanding risk in software development, so let's examine the scenario of a new software project, and expand on the simple model being outlined above: instead of a single person, we are likely to have a team, and our model will not just exist in our heads, but in the code we write.

On to Development Process. . .

CHAPTER 2

Development Process

In the previous chapter we introduced some terms for talking about risk (such as Attendant Risk, Hidden Risk and Internal Model) via a simple scenario.

Now, let's look at the everyday process of developing *a new feature* on a software project, and see how our risk model informs it.

2.1 An Example Process

Let's ignore for now the specifics of what methodology is being used - we'll come to that later. Let's say your team have settled for a process something like the following:

1. **Specification**: A new feature is requested somehow, and a business analyst works to specify it.
2. **Code And Unit Test**: A developer writes some code, and some unit tests.
3. **Integration**: They integrate their code into the code base.
4. **UAT**: They put the code into a User Acceptance Test (UAT) environment, and user(s) test it.
5. . . . All being well, the code is **Released to Production**.

Now, the *methodology* being used might be Waterfall, it might be Agile. We're not going to commit to specifics at this stage. Also we don't need to consider whether this is particularly a *good* process: you could add code review, a pilot phase, integration testing, whatever. It's probably not perfect, but let's just assume that *it works for this project* and everyone is reasonably happy with it.

We're just doing some analysis of *what process gives us*.

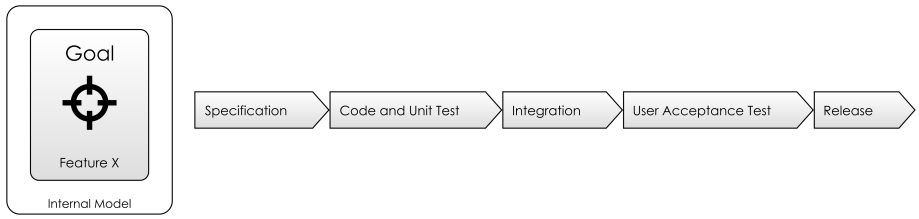


Figure 2.1: A Simple Development Process

2.2 Minimizing Risks - Overview

I am going to argue that this entire process is *informed by software risk*:

1. We have *a business analyst* who talks to users and fleshes out the details of the feature properly. This is to minimize the risk of **building the wrong thing**.
2. We *write unit tests* to minimize the risk that our code **isn't doing what we expected, and that it matches the specifications**.
3. We *integrate our code* to minimize the risk that it's **inconsistent with the other, existing code on the project**.
4. We have *acceptance testing* and quality gates generally to **minimize the risk of breaking production**, somehow.

We could skip all those steps above and just do this:

1. Developer gets wind of new idea from user, logs onto production and changes some code directly.

We can all see this would be a disaster, but why?

Two reasons:

1. You're Meeting Reality all-in-one-go: All of these risks materialize at the same time, and you have to deal with them all at once.
2. Because of this, at the point you put code into the hands of your users, your Internal Model is at its least-developed. All the Hidden Risks now need to be dealt with at the same time, in production.

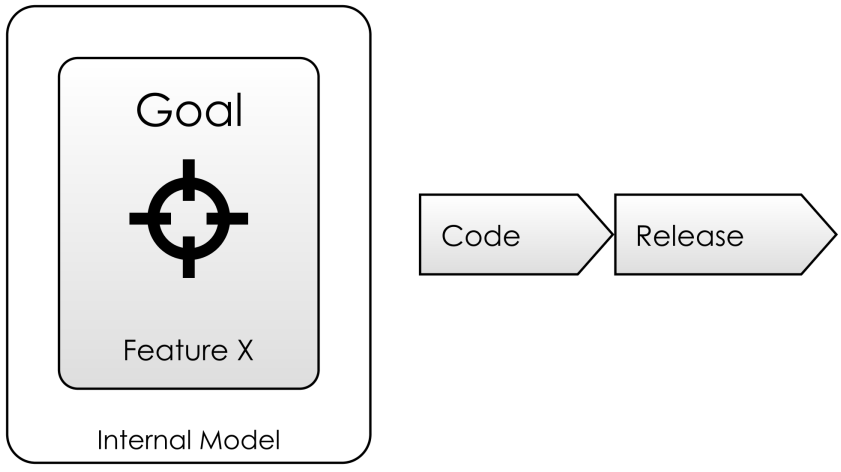


Figure 2.2: A Dangerous Development Process

2.3 Applying the Model

Let's look at how our process should act to prevent these risks materializing by considering an unhappy path, one where at the outset, we have lots of Hidden Risks. Let's say a particularly vocal user rings up someone in the office and asks for new **Feature X** to be added to the software. It's logged as a new feature request, but:

- Unfortunately, this feature once programmed will break an existing **Feature Y**.
- Implementing the feature will use some api in a library, which contains bugs and have to be coded around.
- It's going to get misunderstood by the developer too, who is new on the project and doesn't understand how the software is used.
- Actually, this functionality is mainly served by **Feature Z**. . .
- which is already there but hard to find.

The diagram below shows how this plays out.

This is a slightly contrived example, as you'll see. But let's follow our feature through the process and see how it meets reality slowly, and the Hidden Risks are discovered:

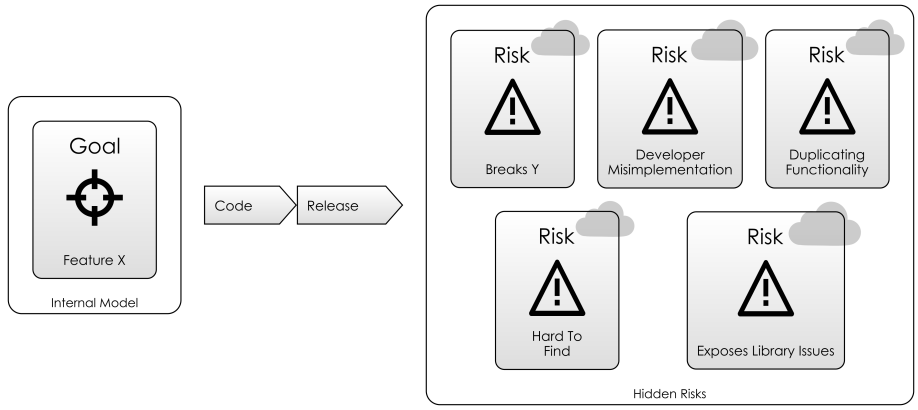


Figure 2.3: Development Process - Exposing Hidden Risks

Specification

The first stage of the journey for the feature is that it meets the Business Analyst (BA). The *purpose* of the BA is to examine new goals for the project and try to integrate them with *reality as they understands it*. A good BA might take a feature request and vet it against his Internal Model, saying something like:

- "This feature doesn't belong on the User screen, it belongs on the New Account screen"
- "90% of this functionality is already present in the Document Merge Process"
- "We need a control on the form that allows the user to select between Internal and External projects"

In the process of doing this, the BA is turning the simple feature request *idea* into a more consistent, well-explained *specification* or *requirement* which the developer can pick up. But why is this a useful step in our simple methodology? From the perspective of our Internal Model, we can say that the BA is responsible for:

- Trying to surface Hidden Risks
- Trying to evaluate Attendant Risks and make them clear to everyone on the project.

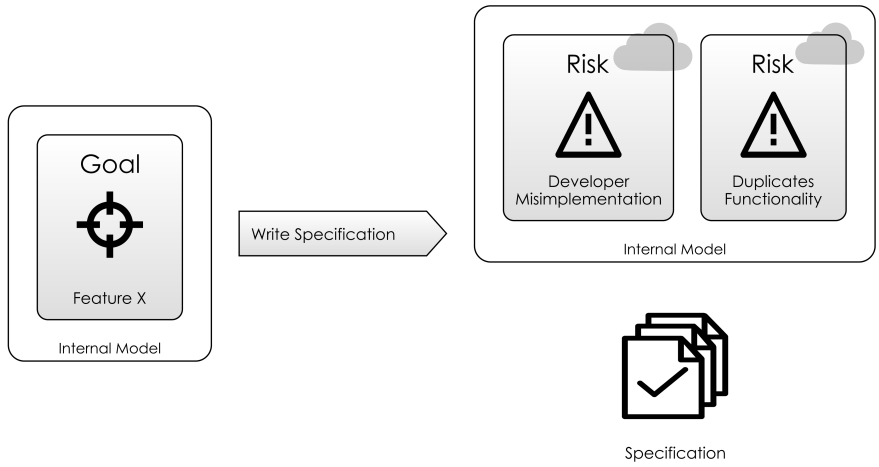


Figure 2.4: BA Specification: exposing Hidden Risks as soon as possible

In surfacing these risks, there is another outcome: while **Feature X** might be flawed as originally presented, the BA can "evolve" it into a specification, and tie it down sufficiently to reduce the risks. The BA does all this by simply *thinking about it*, *talking to people* and *writing stuff down*.

This process of evolving the feature request into a requirement is the BA's job. From our Risk-First perspective, it is *taking an idea and making it Meet Reality*. Not the *full reality* of production (yet), but something more limited.

Code And Unit Test

The next stage for our feature, **Feature X** is that it gets coded and some tests get written. Let's look at how our Goal In Mind meets a new reality: this time it's the reality of a pre-existing codebase, which has it's own internal logic.

As the developer begins coding the feature in the software, she will start with an Internal Model of the software, and how the code fits into it. But, in the process of implementing it, she is likely to learn about the codebase, and her Internal Model will develop.

At this point, let's stop and discuss the visual grammar of the Risk-First Diagrams we've been looking at. A Risk-First diagram shows what you

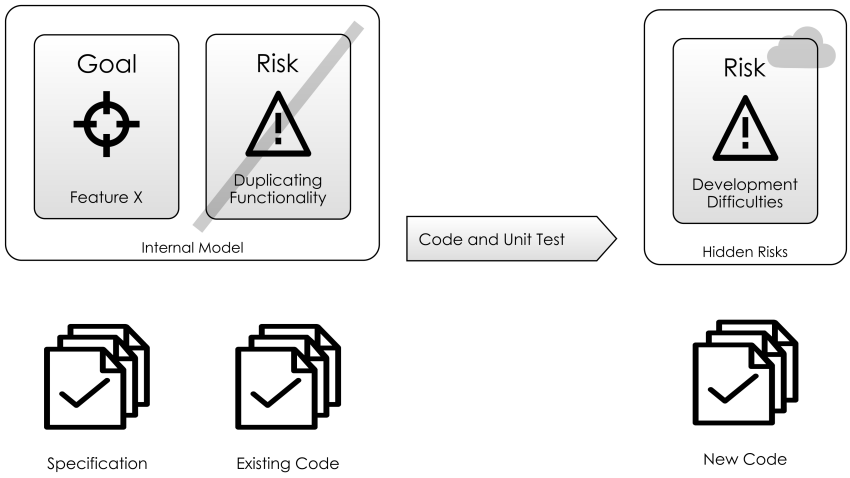


Figure 2.5: Coding Process: exposing more hidden risks as you code

expect to happen when you Take Action. The action itself is represented by the shaded, sign-post-shaped box in the middle. On the left, we have the current state of the world, on the right is the anticipated state *after* taking the action.

The round-cornered rectangles represent our Internal Model, and these contain our view of Risk, whether the risks we face right now, or the Attendant Risks expected after taking the action. In figure 2.5, taking the action of "coding and unit testing" is expected to mitigate the risks of "Developer Misimplementation" and "Duplicating Functionality".

Beneath the internal models, we are also showing real-world tangible artifacts. That is, the physical change we would expect to see as a result of taking action. In this diagram, the action will result in "New Code" being added to the project, needed for the next steps of the development process.

Integration

Integration is where we run *all* the tests on the project, and compile *all* the code in a clean environment, collecting together the work from the whole development team.

So, this stage is about meeting a new reality: the clean build.

At this stage, we might discover the Hidden Risk that we'd break **Feature Y**

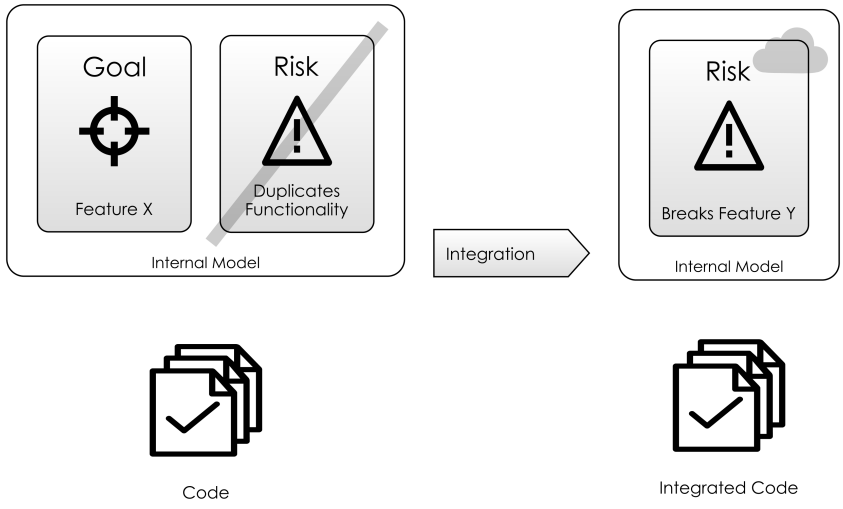


Figure 2.6: Integration testing exposes Hidden Risks before you get to production

User Acceptance Test

Next, User Acceptance Testing (UAT) is where our new feature meets another reality: *actual users*. I think you can see how the process works by now. We're just flushing out yet more Hidden Risks.

- Taking Action is the *only* way to create change in the world.
- It's also the only way we can *learn* about the world, adding to our Internal Model.
- In this case, we discover a Hidden Risk: the user's difficulty in finding the feature. (The cloud obscuring the risk shows that it is hidden).
- In return, we can *expect* the process of performing the UAT to delay our release (this is an attendant schedule risk).

2.4 Observations

First, the people setting up the development process *didn't know* about these *exact* risks, but they knew the *shape that the risks take*. The process builds "nets" for the different kinds of Hidden Risks without knowing exactly what they are.

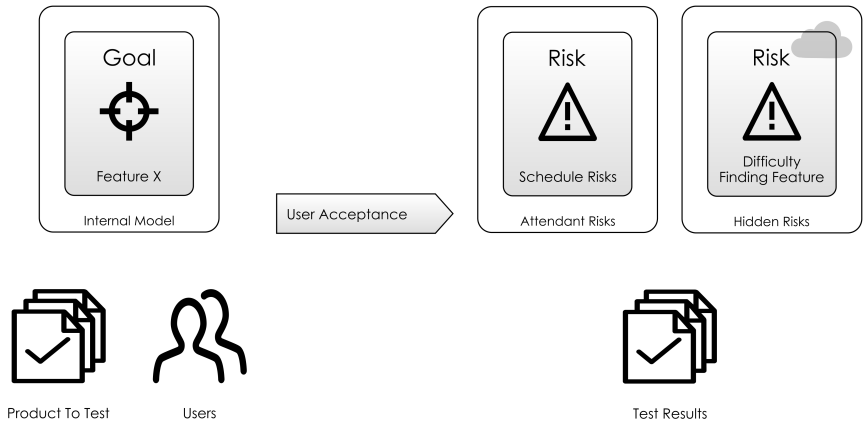


Figure 2.7: UAT - putting tame users in front of your software is better than real ones, where the risk is higher

Second, are these really risks, or are they *problems we just didn't know about*? I am using the terms interchangeably, to a certain extent. Even when you know you have a problem, it's still a risk to your deadline until it's solved. So, when does a risk become a problem? Is a problem still just a schedule-risk, or cost-risk? We'll come back to this question presently.

Third, the real take-away from this is that all these risks exist because we don't know 100% how reality is. We don't (and can't) have a perfect view of the universe and how it'll develop. Reality is reality, *the risks just exist in our head*.

Fourth, hopefully you can see from the above that really *all this work is risk management*, and *all work is testing ideas against reality*.

In the next chapter, we're going to look at the concept of Meeting Reality in a bit more depth.

CHAPTER 3

Meeting Reality

In this chapter, we will look at how exposing your Internal Model to reality is in itself a good risk management technique.

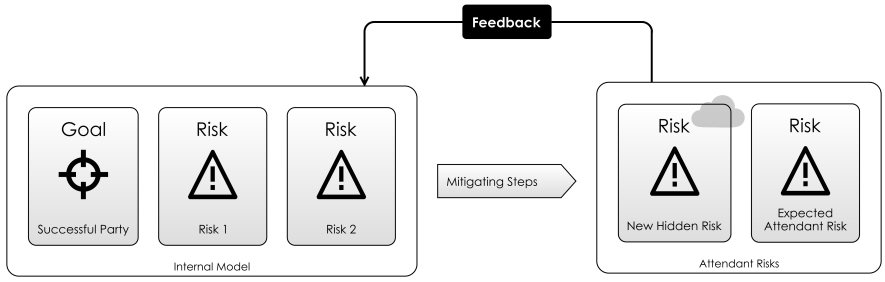
3.1 Revisiting the Model

In A Simple Scenario, we looked at a basic model for how **Reality** and our Internal Model interacted with each other: we take action based on out Internal Model, hoping to **change Reality** with some positive outcome.

And, in Development Process we looked at how we can meet with reality in *different forms*: Analysis, Testing, Integration and so on, and saw how the model could work in each stage of a project.

It should be no surprise to see that there is a *recursive* nature about this: The actions we take each day have consequences: they expose new hidden risks**, which inform our Internal Model, and at the same time, they change reality in some way. As a result, we then have to take *new actions* to deal with these new risks.

So, let's see how this kind of recursion looks on our model.



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3.2 "Navigating the Risk Landscape"

Figure 6.1 shows *just one possible action*, in reality, you'll have choices. We often have multiple ways of achieving a Goal In Mind.

What's the best way?

I would argue that the best way is the one which mitigates the most existing risk while accruing the least attendant risk to get it done.

Ideally, when you take an action, you are trading off a big risk for a smaller one. Take Unit Testing for example. Clearly, writing Unit Tests adds to the amount of development work, so on it's own, it adds Schedule Risk. However, if you write *just enough* of the right Unit Tests, you should be short-cutting the time spent finding issues in the User Acceptance Testing (UAT) stage, so you're hopefully trading off a larger Schedule Risk from UAT and adding a smaller Schedule Risk to Development. There are other benefits of Unit Testing too: once written, a suite of unit tests is almost cost-free to run repeatedly, whereas repeating a UAT is costly as it involves people's time.

You can think of Taking Action as moving your project on a "Risk Landscape": ideally, when you take an action, you move to some place with worse risk to somewhere more favourable.

Sometimes, you can end up somewhere *worse*: the actions you take to manage a risk will leave you with worse Attendant Risks afterwards. Almost certainly, this will have been a Hidden Risk when you embarked on the action, otherwise you'd not have chosen it.

An Example: Automation

For example, *automating processes* is very tempting: it *should* save time, and reduce the amount of boring, repetitive work on a project. But sometimes, it

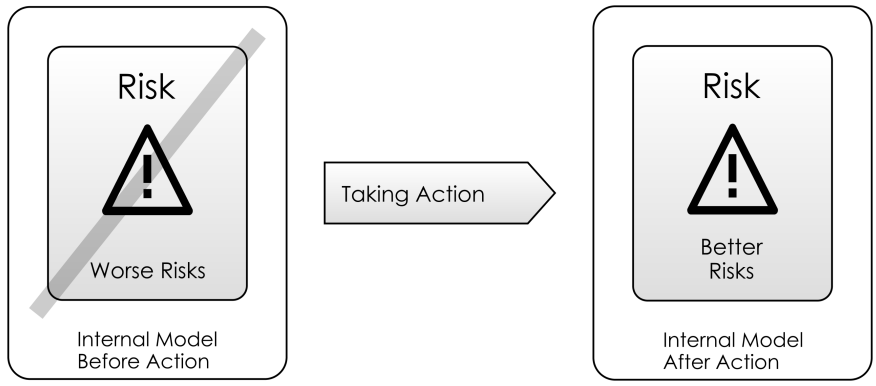


Figure 3.1: Navigating The Risk Landscape

turns into an industry in itself, and consumes more effort than it's worth.

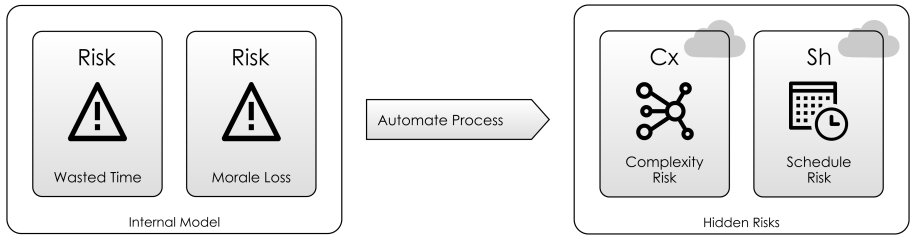


Figure 3.2: Hidden Risks of Automation

Another Example: MongoDB

On a recent project in a Bank, we had a requirement to store a modest amount of data and we needed to be able to retrieve it fast. The developer chose to use MongoDB[1] for this. At the time, others pointed out that other teams in the bank had had lots of difficulty deploying MongoDB internally, due to licensing issues and other factors internal to the bank.

Other options were available, but the developer chose MongoDB because of their *existing familiarity* with it: therefore, they felt that the Hidden Risks of MongoDB were *lower* than the other options, and disregarded the others' opinions.

[1] `https://www.mongodb.com`

This turned out to be a mistake: The internal bureacracy eventually proved too great, and MongoDB had to be abandoned after much investment of time.

This is not a criticism of MongoDB: it's simply a demonstration that sometimes, the cure is worse than the disease. Successful projects are *always* trying to *reduce* Attendant Risks.

3.3 Pay-Off

We can't know in advance how well any action we take will work out. Therefore, Taking Action is a lot like placing a bet.

Pay Off then is our judgement about whether we expect an action to be worthwhile: Are the risks we escape *worth* the attendant risks we will encounter? We should be able to *weigh these separate risks in our hands* and figure out whether the (Glossary#pay-off) makes a given Action worthwhile.

The fruits of this gambling are revealed when we meet reality, and we can see whether our bets were worthwhile.

3.4 The Cost Of Meeting Reality

Meeting reality *in full* is costly. For example, going to production can look like this:

- Releasing software
- Training users
- Getting users to use your system
- Gathering feedback

All of these steps take a lot of effort and time. But you don't have to meet the whole of reality in one go. But we can meet it in a limited way which is less expensive.

In all, to de-risk, you should try and meet reality:

- **Sooner**, so you have time to mitigate the hidden risks it uncovers
- **More Frequently**: so the hidden risks don't hit you all at once
- **In Smaller Chunks**: so you're not over-burdened by hidden risks all in one go.
- **With Feedback**: if you don't collect feedback from the experience of meeting reality, hidden risks *stay hidden*.

In Development Process, we performed a UAT in order to Meet Reality more cheaply and sooner. The *cost* of this is that we delayed the release to do it, adding risk to the schedule.

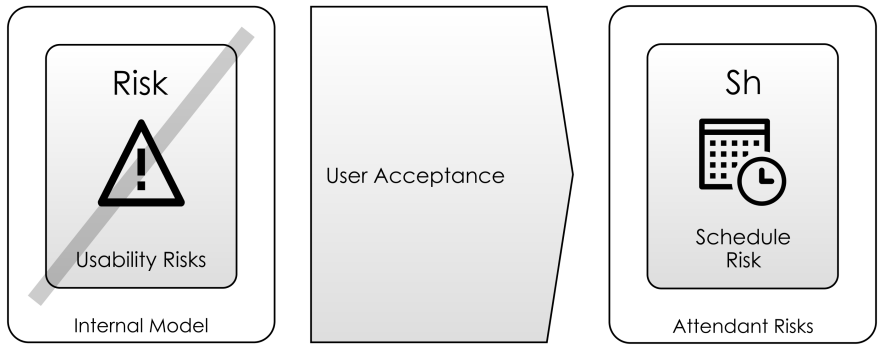


Figure 3.3: Testing flushes out Hidden Risk, but increases Schedule Risk

3.5 Practice 1: YAGNI

As a flavour of what's to come, let's look at YAGNI, an acronym for You Aren't Gonna Need It:

> YAGNI originally is an acronym that stands for "You Aren't Gonna Need It". It is a mantra from Extreme Programming that's often used generally in agile software teams. It's a statement that some capability we presume our software needs in the future should not be built now because "you aren't gonna need it". - YAGNI, *Martin Fowler*[2]

The idea makes sense: if you take on extra work that you don't need, *of course* you'll be accreting Attendant Risks.

But, there is always the opposite opinion: You *Are* Gonna Need It[3]. As a simple example, we often add log statements in our code as we write it (so we can trace what happened when things go wrong), though strictly following YAGNI strictly says we shouldn't.

[2] `https://www.martinfowler.com/bliki/Yagni.html`

[3] `http://wiki.c2.com/?YouAreGonnaNeedIt`

Which is right?

Now, we can say: do the work *if there is a worthwhile Pay-Off*.

- Logging statements are *good*, because otherwise, you're increasing the risk that in production, no one will be able to understand *how the software went wrong*.
- However, adding them takes time, which might introduce Schedule Risk.

So, it's a trade-off: continue adding logging statements so long as you feel that overall, the activity pays-off reducing overall risk.

3.6 Practice 2: Do The Simplest Thing That Could Possibly Work

Another mantra from Kent Beck (originator of the Extreme Programming[4] methodology), is "Do The Simplest Thing That Could Possibly Work", which is closely related to YAGNI and is an excellent razor for avoiding over-engineering. At the same time, by adding "Could Possibly", Kent is encouraging us to go beyond straightforward iteration, and use our brains to pick apart the simple solutions, avoiding them if we can logically determine when they would fail.

Our risk-centric view of this strategy would be:

- Every action you take on a project has it's own Attendant Risks.
- The bigger or more complex the action, the more Attendant Risk it'll have.
- The reason you're taking action *at all* is because you're trying to reduce risk elsewhere on the project
- Therefore, the biggest Pay-Off is likely to be the one with the least Attendant Risk.
- So, usually this is going to be the simplest thing.

So, "Do The Simplest Thing That Could Possibly Work" is really a helpful guideline for Navigating the Risk Landscape, but this analysis shows clearly where it's left wanting:

- *Don't* do the simplest thing if there are other things with a better Pay-Off available.

[4] https://en.wikipedia.org/wiki/Extreme_programming

3.7 Summary

So, here we've looked at Meeting Reality, which basically boils down to taking actions to manage risk and seeing how it turns out:

- Each Action you take is a step on the Risk Landscape
- Each Action exposes new Hidden Risks, changing your Internal Model.
- Ideally, each action should reduce the overall Attendant Risk on the project (that is, puts it in a better place on the Risk Landscape

Could it be that *everything* you do on a software project is risk management? This is an idea explored in the next chapter.

CHAPTER 4

All Risk Management

In this chapter, I am going to propose the idea that everything you do on a software project is Risk Management.

In the last chapter, we observed that all the activities in a simple methodology had a part to play in exposing different risks. They worked to manage risk prior to them creating bigger problems in production.

Here, we'll look at one of the tools in the Project Manager's tool-box, the RAID Log[1], and observe how risk-centric it is.

4.1 RAID Log

Many project managers will be familiar with the RAID Log. It's simply four columns on a spreadsheet: **Risks**, **Actions**, **Issues** and **Decisions**.

Let's try and put the following Risk into the RAID Log:

> "Debbie needs to visit the client to get them to choose the logo to use on the product, otherwise we can't size the screen areas exactly."

- So, is this an **action**? Certainly. There's definitely something for Debbie to do here.
- Is it an **issue**? Yes, because it's holding up the screen-areas sizing thing.
- Is it a **decision**? Well, clearly, it's a decision for someone.
- Is it a **risk**? Probably: Debbie might go to the client and they *still* don't make a decision. What then?

[1] `http://pmtips.net/blog-new/raid-logs-introduction`

4.2 Let's Go Again

This is a completely made-up example, deliberately chosen to be hard to categorise. Normally, items are more one thing than another. But often, you'll have to make a choice between two categories, if not all four.

This *hints* at the fact that at some level it's all about risk:

4.3 Every Action Attempts to Mitigate Risk

The reason you are *taking* an action is to mitigate a risk. For example:

- If you're coding up new features in the software, this is mitigating Feature Risk (which we'll explore in more detail later).
- If you're getting a business sign-off for something, this is mitigating the risk of everone not agreeing on a course of action (a Coordination Risk).
- If you're writing a specification, that's mitigating the type of "Developer Misimplementation Risk" we saw in the last chapter.

4.4 Every Action Has Attendant Risk.

- How do you know if the action will get completed?
- Will it overrun, or be on time?
- Will it lead to yet more actions?
- What Hidden Risk will it uncover?

Consider *coding a feature* (as we did in the earlier Development Process chapter). We saw here how the whole process of coding was an exercise in learning what we didn't know about the world, uncovering problems and improving our Internal Model. That is, flushing out the Attendant Risk of the Goal In Mind.

And, as we saw in the Introduction, even something *mundane* like the Dinner Party had risks.

4.5 An Issue is Just A Type of Risk

- Because issues need to be fixed. . .
- And fixing an issue is an action. . .
- Which, as we just saw also carry risk.

One retort to this might be to say: "An issue is a problem I have now, whereas a risk is a problem that *might* occur." I am going to try and break that mind-set in the coming pages, but I'll just start with this:

- Do you know *exactly* how much damage this issue will do?
- Can you be sure that the issue might not somehow go away?

Issues then, just seem more "definite" and "now" than *risks*, right? This classification is arbitrary: they're all just part of the same spectrum, they all have inherent uncertainty, so there should be no need to agonise over which column to put them in.

4.6 Goals Are Risks Too

In the previous chapters, we've introduced something of a "diagram language" of risk. Let's review it:

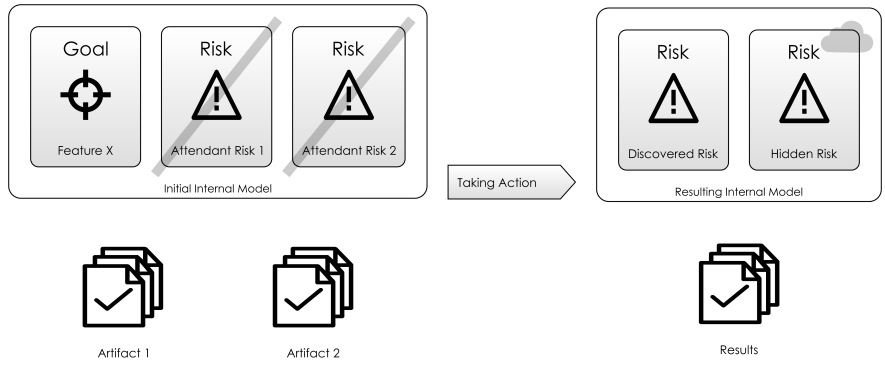


Figure 4.1: Risk-First Diagram Language

Goals live inside our Internal Model, just like Risks. It turns out, that functionally, Goals and Risks are equivalent. For example, The Goal of "Implementing Feature X" is equivalent to mitigating "Risk of Feature X not being present".

Let's try and back up that assertion with a few more examples:

Goal	Restated As A Risk
Build a Wall	Mitigate the risk of something getting in / out

Goal	Restated As A Risk
Land a man on the moon	Mitigate the risk of looking technically inferior during the cold war
Move House	Mitigate the risks/problems of where you currently live

There is a certain "interplay" between the concepts of risks, actions and goals. After all, on the Risk Landscape they correspond to a starting point, a movement, and a destination. From a redundancy perspective, any one of these can be determined by knowing the other two.

Psychologically, humans are very goal-driven: they like to know where they're going, and are good at organising around a goal. However, by focusing on goals ("solutionizing") it's easy to ignore alternatives. By focusing on "Risk-First", we don't ignore the reasons we're doing something.

4.7 Every Decision is About Pay-Off.

- By the very nature of having to make a decision, there's the risk you'll decide wrongly.
- And, making a decision takes time, which could add risk to your schedule.
- And what's the risk if the decision doesn't get made?

Sometimes, there will be multiple moves available on the Risk Landscape and you have to choose. Let's take a hypothetical example: You're on a project and you're faced with the decision - release now or do more testing?

Obviously, in the ideal world, we want to get to the place on the Risk Landscape where we have a tested, bug-free system in production. But we're not there yet, and we have funding pressure to get the software into the hands of some paying customers. The table below shows an example:

Risk Managed	Action	Attendant Risk	Pay-Off
Funding Risk	Go Live	Reputational Risk, Operational Risk	MEDIUM
Implementation Risk	User Acceptance Test	Worse Funding Risk, Operational Risk	LOW

This is (a simplification of) the dilemma on lots of software projects - *test further*, to reduce the risk of users discovering bugs (Implementation Risk) which would cause us reputational damage, or *get the release done* and reduce our Funding Risk by getting paying clients sooner.

In the above table, it *appears* to be better to do the "Go Live" action, as there is a greater Pay Off. The problem is, actions are not *commutative*, i.e. the order you do them in counts.

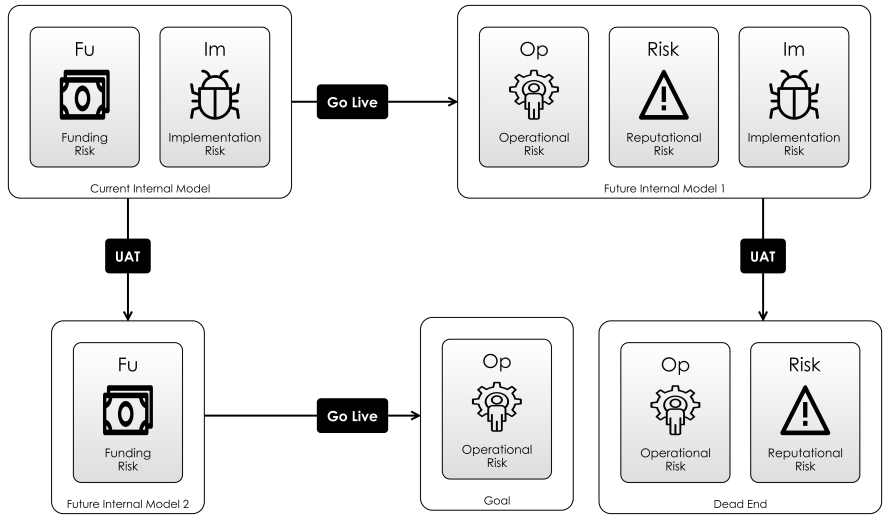


Figure 4.2: UAT or Go Live: Where will you end up?

Figure 4.2 shows our decision as *moves on the Risk Landscape*. Whether you "Go Live" first, or "UAT" first makes a difference to where you will end up. Is there a further action you can take to get you from the "Dead End" to the "Goal"? Perhaps.

Failure

So, when we talk about a project "failing", what do we mean?

Usually, we mean we've failed to achieve a goal, and since *goals are risks*, it is simply the scenario where we are overwhelmed by Attendant Risks: there is *no* action to take that has a good-enough Pay Off to get us out of our hole.

4.8 What To Do?

It makes it much easier to tackle the RAID log if there's only one list. But you still have to choose a *strategy*: Do you tackle the *most important* risk on the list, or the *most urgent*, or take the action with the biggest Pay Off and deal with it?

In the next chapter, Evaluating Risk we'll look at some approaches to choosing what to do.

CHAPTER 5

Evaluating Risk

Here, I am going to re-cap on some pre-existing risk management theory in order to set the scene for the next chapter which heads back to looking at risk on software projects.

5.1 Risk Registers

Most developers are familiar with recording issues in an issue tracker. For all of the same reasons, it's good practice to record the risks you face running a project or an operation in a Risk Register[1]. Typically, this will include for each risk:

- The **name** of the risk, or other identifier.
- A **categories** to which the risk belongs (this is the focus of the Risk Landscape chapter in Part 2).
- A **brief description** or name of the risk to make the risk easy to discuss
- Some estimate for the **Impact**, **Probability** or **Risk Score** of the risk.
- Proposed actions and a log of the progress made to manage the risk.

Some points about this description:

A Continuum of Formality

Remember back to the Dinner Party example at the start: the Risk Register happened *entirely in your head*. There is a continuum all the way from "in your head" through "using a spreadsheet" to dedicated Risk Management software.

[1] https://en.wikipedia.org/wiki/Risk_register

It's also going to be useful *in conversation*, and this is where the value of the Risk-First approach is: providing a vocabulary to *talk about risks* with your team.

Probability And Impact

Probability is how likely something is to happen, whilst **Impact** is the cost (usually financial) when it does happen.

In a financial context (or a gambling one), we can consider the overall **Risk Score** as being the sum of the **Impact** of each outcome multiplied by it's **Probability**. For example, if you buy a 1-Euro ticket in a raffle, there are two outcomes: win or lose. The impact of *winning* would be (say) a hundred Euros, but the **probability** might be 1 in 200. The impact of *losing* would be the loss of 1 Euro, with

Outcome	Impact	Probabilty	Risk Score
Win	+ 99 EUR	1 in 200	.5 EUR
Lose	- 1 EUR	199 in 200	-.99 EUR

Risk Management in the finance industry *starts* here, and gets more complex, but often (especially on a software project), it's better to skip all this, and just figure out a Risk Score. This is because if you think about "impact", it implies a definite, discrete event occurring, or not occurring, and asks you then to consider the probability of that occurring.

Risk-First takes a view that risks are a continuous quantity, more like *money* or *water*: by taking an action before delivering a project you might add a degree of Schedule Risk, but decrease the Operational Risk later on by a greater amount.

5.2 Risk Matrix

A risk matrix presents a graphical view on where risks exist. Here is an example, showing the risks from the dinner party in the A Simple Scenario chapter:

This type of graphic is *helpful* in deciding what to do next, although alternatively, you can graph the overall **Risk Score** against the Pay-Off. Easily mitigated risk (on the right), and worse risks (at the top) can therefore be dealt with first (hopefully).

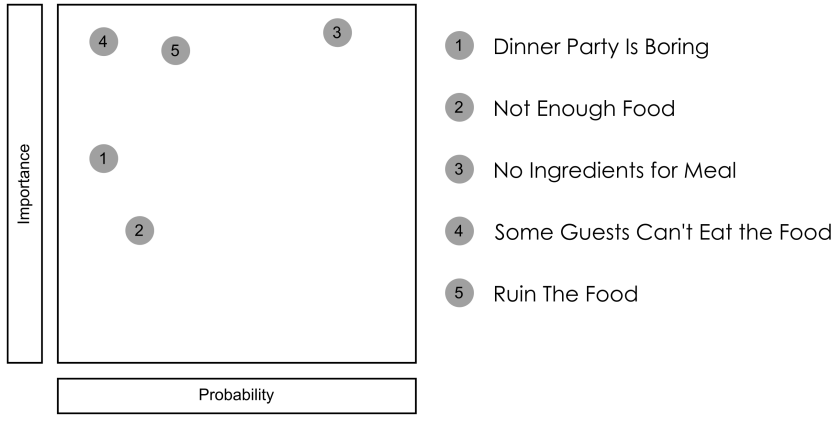


Figure 5.1: Risk Register of Dinner Party Risks

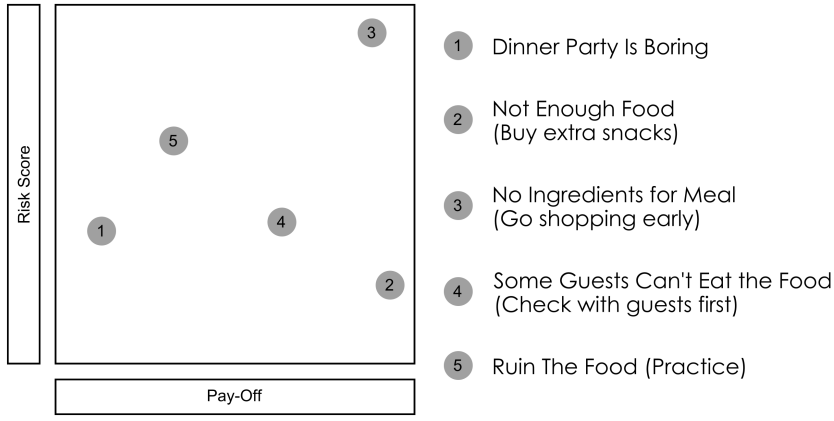


Figure 5.2: Risk Register of Dinner Party Risks, Considering Pay-Off

5.3 Unknown Unknowns

One of the criticisms of the Risk Register approach is that of mistaking the map for the territory. That is, mistakenly believing that what's on the Risk Register *is all there is*.

In the preceding discussions, I have been careful to point out the existence of Hidden Risks for that very reason. Or, to put another way:

> "What we don't know is what usually gets us killed"
> - Petyr Baelish, *Game of Thrones*

Donald Rumsfeld's famous Known Knowns is also a helpful conceptualisation:

- **A *known* unknown** is an Attendant Risk. i.e. something you are aware of, but where the precise degree of threat can't be established.
- **An *unknown* unknown** is a Hidden Risk. i.e a risk you haven't even thought to exist yet.

5.4 Risk And Uncertainty

Arguably, this site uses the term 'Risk' wrongly: most literature suggests risk can be measured[2] whereas uncertainty represents things that cannot.

I am using **risk** everywhere because later we will talk about specific risks (e.g. Boundary Risk or Complexity Risk), and it doesn't feel grammatically correct to talk about those as **uncertainties**, especially given the pre-existing usage in Banking of terms like Operational Risk[3] or Reputational risk[4] which are also not really a-priori measurable.

5.5 The Opposite Of Risk Management

Let's look at the classic description of Risk Management:

> "Risk Management is the process of thinking out corrective actions before a problem occurs, while it's still an abstraction.

[2] https://keydifferences.com/difference-between-risk-and-uncertainty.html

[3] https://en.wikipedia.org/wiki/Operational_risk

[4] https://www.investopedia.com/terms/r/reputational-risk.asp

> The opposite of risk management is crisis management, trying to figure out what to do about the problem after it happens."
>
> —Waltzing With Bears, *De Marco, Lister*[5]

This is not how Risk-First sees it:

First, we have the notion that Risks are discrete events, again. Some risks *are* (like gambling on a horse race), but most *aren't*. In the Dinner Party, for example, bad preparation is going to mean a *worse* time for everyone, but how good a time you're having is a spectrum, it doesn't divide neatly into just "good" or "bad".

Second, the opposite of "Risk Management" (or trying to minimise the "Down-side") is either "Upside Risk Management", (trying to maximise the good things happening), or it's trying to make as many bad things happen as possible.

Third, Crisis Management is *still just Risk Management*: the crisis (Earthquake, whatever) has *happened*. You can't manage it because it's in the past. All you can do is Risk Manage the future (minimize further casualties and human suffering, for example).

Yes, it's fine to say "we're in crisis", but to assume there is a different strategy for dealing with it is a mistake: this is the Fallacy of Sunk Costs[6].

5.6 Invariances #1: Panic Invariance

You would expect then, that any methods for managing software delivery should be *invariant* to the level of crisis in the project. If, for example, a project proceeds using Scrum[7] for eight months, and then the deadline looms and everyone agrees to throw Scrum out of the window and start hacking, then *this implies there is a problem with Scrum*, and that it is not *Panic Invariant*. In fact, many tools like Scrum don't consider this:

- If there is a production outage during the working week, we don't wait for the next Scrum Sprint to fix it.
- Although a 40-hour work-week *is a great idea*, this goes out of the window if the databases all crash on a Saturday morning.

In these cases, we (hopefully calmly) *evaluate the risks and Take Action*.

[5] http://amzn.eu/d/i0IDFA2

[6] https://en.wikipedia.org/wiki/Escalation_of_commitment

[7] https://en.wikipedia.org/wiki/Scrum_(software_development)

This is **Panic Invariance**: your methodology shouldn't need to change given the amount of pressure or importance on the table.

5.7 Invariances #2: Scale Invariance

Another test of a methodology is that it shouldn't fall down when applied at different *scales*. Because, if it does, this implies that there is something wrong with the methodology. The same is true of physical laws: if they don't apply under all circumstances, then that implies something is wrong. For example, Newton's Laws of Motion fail to calculate the orbital period of Mercury, which led to Einstein trying to improve on them with the Theory of Relativity[8].

Some methodologies are designed for certain scales: Extreme Programming is designed for small, co-located teams. And, that's useful. But the fact it doesn't scale tells us something about it: chiefly, that it considers certain *kinds* of risk, while ignoring others. At small scales, that works ok, but at larger scales, other risks (such as team Coordination Risk) increase too fast for it to work.

So ideally, a methodology should be applicable at *any* scale:

- A single class or function
- A collection of functions, or a library
- A project team
- A department
- An entire organisation

If the methodology *fails at a particular scale*, this tells you something about the risks that the methodology isn't addressing. It's fine to have methodologies that work at different scales, and on different problems. One of the things Risk-First explores is trying to place methodologies and practices within a framework to say *when* they are applicable.

5.8 Value vs Speed

"Upside Risk"

"Upside Risk" isn't a commonly used term: industry tends to prefer "value", as in "Is this a value-add project?". There is plenty of theory surrounding

[8] https://en.wikipedia.org/wiki/Theory_of_relativity

Value, such as Porter's Value Chain[9] and Net Present Value[10]. This is all fine so long as we remember:

- **The probability of Pay-Off is risky**: Since the value is created in the future, we can't be certain about it happening - we should never consider it a done-deal. **Future Value** is always at risk. In finance, for example, we account for this in our future cash-flows by discounting them according to the risk of default.
- **The Pay-Off amount is risky**: Additionally, whereas in a financial transaction (like a loan, say), we might know the size of a future payment, in IT projects we can rarely be sure that they will deliver a certain return. On some fixed-contract projects this sometimes is not true: there may be a date when the payment-for-delivery gets made, but mostly we'll be expecting an uncertain pay-off.
- Humans tend to be optimists (especially when there are lots of Hidden Risks), hence our focus on Downside Risk. Sometimes though, it's good to stand back and look at a scenario and think: am I capturing all the Upside Risk here?

Speed

Figure 5.3 reproduces a figure from Rapid Development[11] by Steve McConnell. This is *fine*, McConnell is structuring the process from the perspective of *delivering as quickly as possible*. However, here, I want to turn this on it's head. Software Development from a risk-first perspective is an underexplored technique, and I believe it offers some useful insights. So the aim here is to present the case for viewing software development like this:

As we will see, *Speed* (or Schedule Risk as we will term it) is one risk amongst others that need to be considered from a risk-management perspective. There's no point in prioritising *speed* if the software fails in production due to Operational Risk issues and damages trust in the product.

Eisenhower's Box

Eisenhower's Box is a simple model allowing us to consider *two* aspects of risk at the same time:

- How valuable the work is (Importance, Value).

[9] https://en.wikipedia.org/wiki/Value_chain

[10] https://en.wikipedia.org/wiki/Net_present_value

[11] http://a.co/d/ddWGTB2

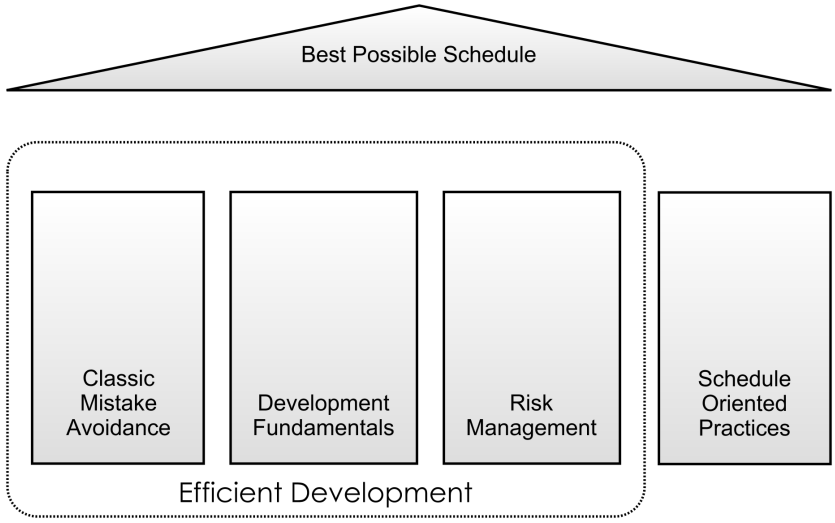


Figure 5.3: Pillars, From Rapid Development By Steve McConnell

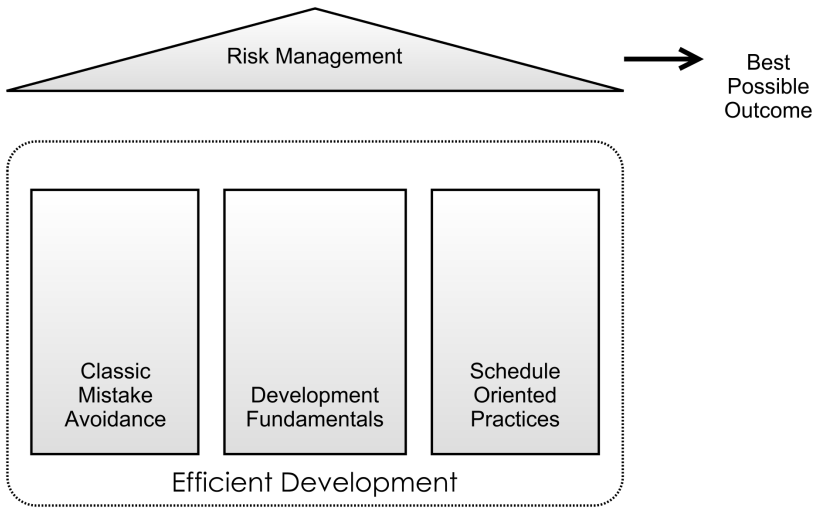


Figure 5.4: Pillars, re-arranged

	Urgent	Not Urgent
Important	Crying Baby Kitchen Fire Some Calls	Exercise Vocation Planning
Not Important	Interruptions Distractions Other Calls	Trivia Busy Work Time Wasters

***Figure 5.5: A basic "Eisenhower box" to help evaluate urgency and importance. Items may be placed at more precise points within each quadrant. - Adapted From Time Management,* Wikipedia[12]**

- How soon it is needed (Urgency, Time).

The problem is, we now need to take a call on whether to do something that is *urgent* or something that is *important*.

5.9 Discounting

Net Present Value allows us to discount value in the future, which offers us a way to reconcile these two variables. The further in the future the value is realised, the bigger the discount. This is done because payment *now* is better than payment in the future: there is the risk that something will happen to prevent that future payment. This is why we have *interest rates* on loan payments.

In diagram ref{npv.png} , you can see two future payments, Payment **A** of £100 due in one year, and Payment **B** of £150 due in 10 years. By discounting at a given rate (here at a high rate of 20% per year) we can compare their worth *now*. At this discount rate, Payment **A**, - arriving next year - has a far greater value.

Can we do the same thing with risk? Let's introduce the concept of Net Present Risk, or NPR:

> Net Present Risk is the *Impact* of a Future risk, discounted to a common level of *Urgency*.

Let's look at a quick example to see how this could work out. Let's say you had the following risks:

- Risk **A**, which will cost you £50 in 5 day's time.

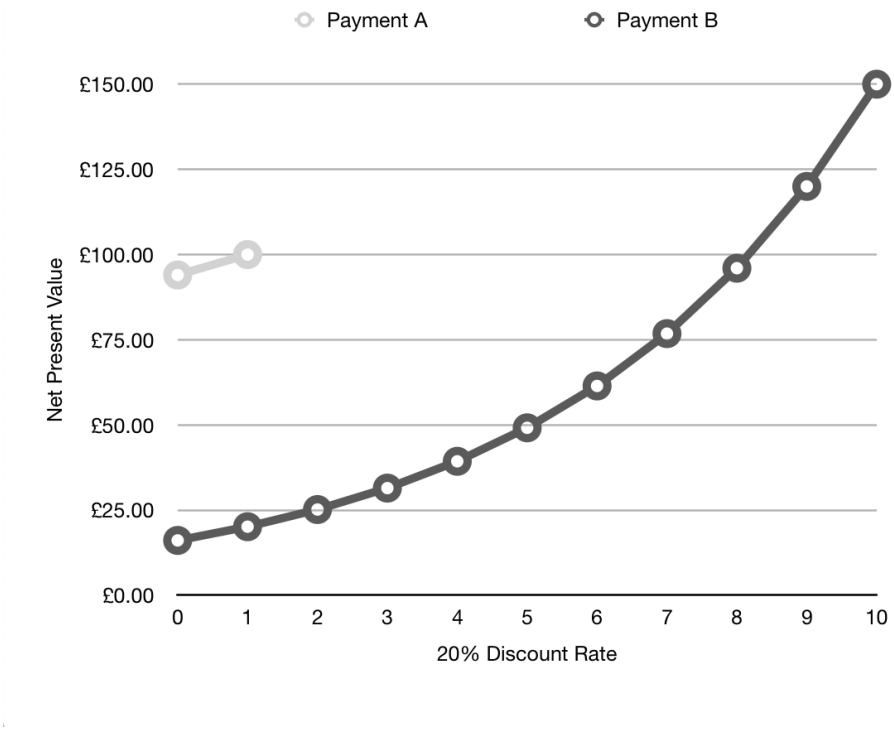


Figure 5.6: Net Present Value Discounting

- Risk **B**, which will cost you £70 in 8 day's time.

Which has the biggest NPR? Well, it depends on the discount rate that you apply. Let's assume we are discounting at 6% per *day*. A graph of the discounted risks looks like this:

On this basis, the biggest NPR is **B**, at about £45. If we increase the discount factor to 20%, we get a different result:

Now, risk **A** is bigger.

Because this is *Net* Present Risk, we can also use it to make decisions about whether or not to mitigate risks. Let's assume the cost of mitigating any risk *right now* is £40. Under the 6% regime, only Risk **B** is worth mitigating today, because you spend £40 today to get rid of £45 of risk (today).

Under the 20% regime, neither are worth mitigating. The 20% Discount Rate may reflect that sometimes, future risks just don't materialise.

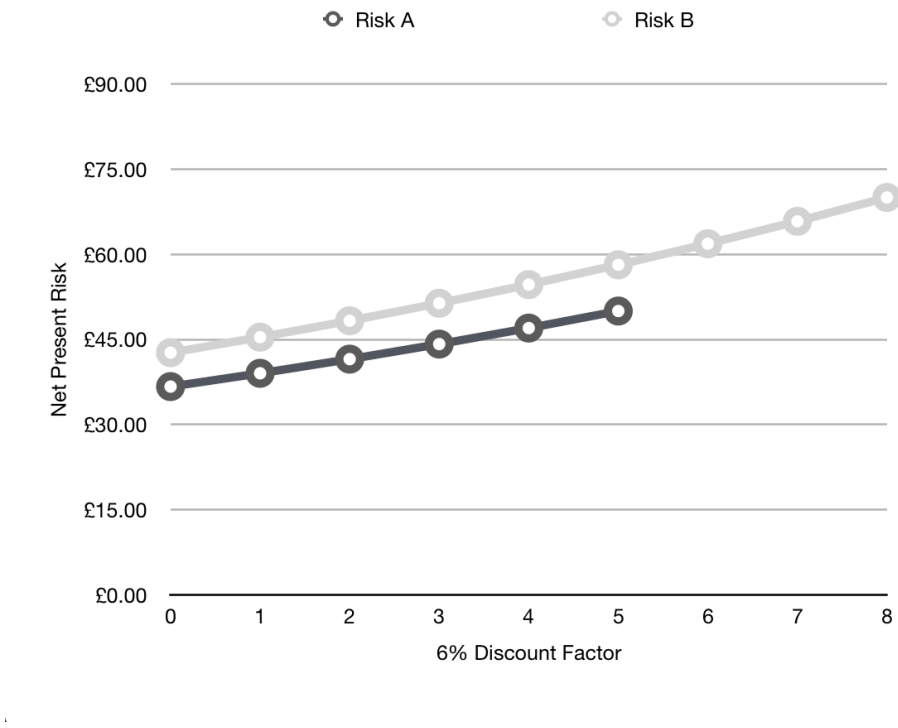


Figure 5.7: Net Present Risk, 6% Discount Rate

Discounting the Future To Zero

I have worked in teams sometimes where the blinkers go down, and the only thing that matters is *now*. Anything with a horizon over a week is irrelevant. Regimes of such hyper-inflation[13] are a sure sign that something has *really broken down* within a project. Consider in this case a Discount Factor of 60% per day, and the following risks:

- Risk A: £10 cost, happening *tomorrow*
- Risk B: £70 cost, happening in *5 days*.

Risk B is almost irrelevant under this regime, as this graph shows:

Why do things like this happen? Often, the people involved are under incredible job-stress: usually they are threatened on a daily basis, and therefore feel they have to react. In a similar way, publicly-listed companies also often

[13] https://en.wikipedia.org/wiki/Hyperinflation

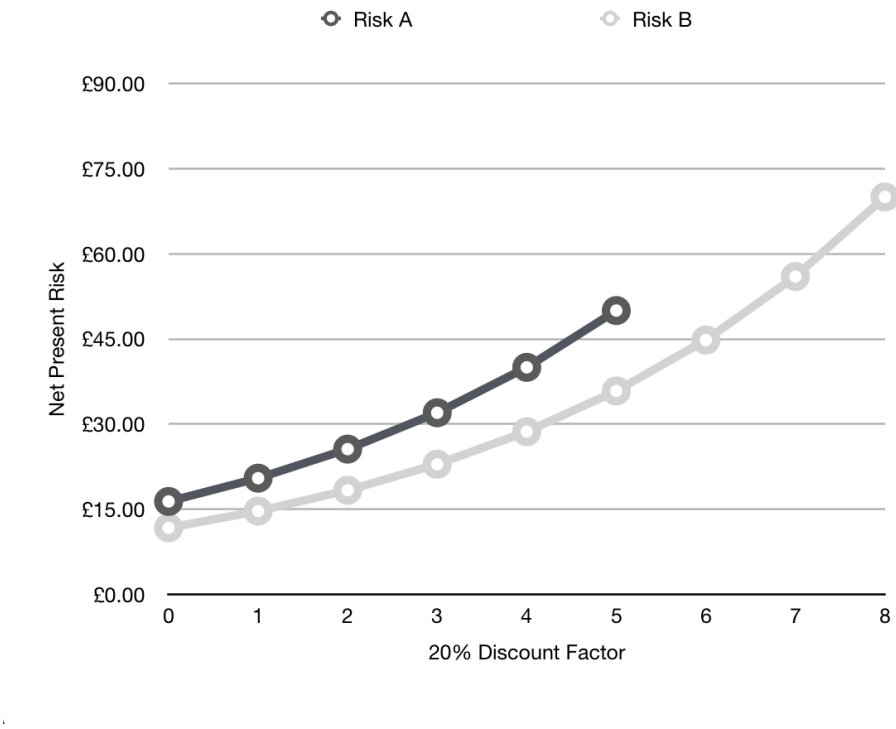


Figure 5.8: Net Present Risk, 20% Discount Rate

apply short-term focus, because they only care about the *next annual report*, which limits their horizons and ability to consider future risk.

Under these circumstances, we often see *Pooh-Bear Procrastination*:

> "Here is Edward Bear coming downstairs now, bump, bump, bump, on the back of his head, behind Christopher Robin. It is, as far as he knows, the only way of coming downstairs, but sometimes he feels that there really is another way. . . if only he could stop bumping for a moment and think of it!"
>
> —A. A. Milne, *Winne-the-Pooh*[14]

5.10 Is This Scientific?

Enough with the numbers and the theory: Risk-First is an attempt to provide a practical framework, rather than a scientifically rigorous analysis. For

[14] http://amzn.eu/d/acJ5a2j

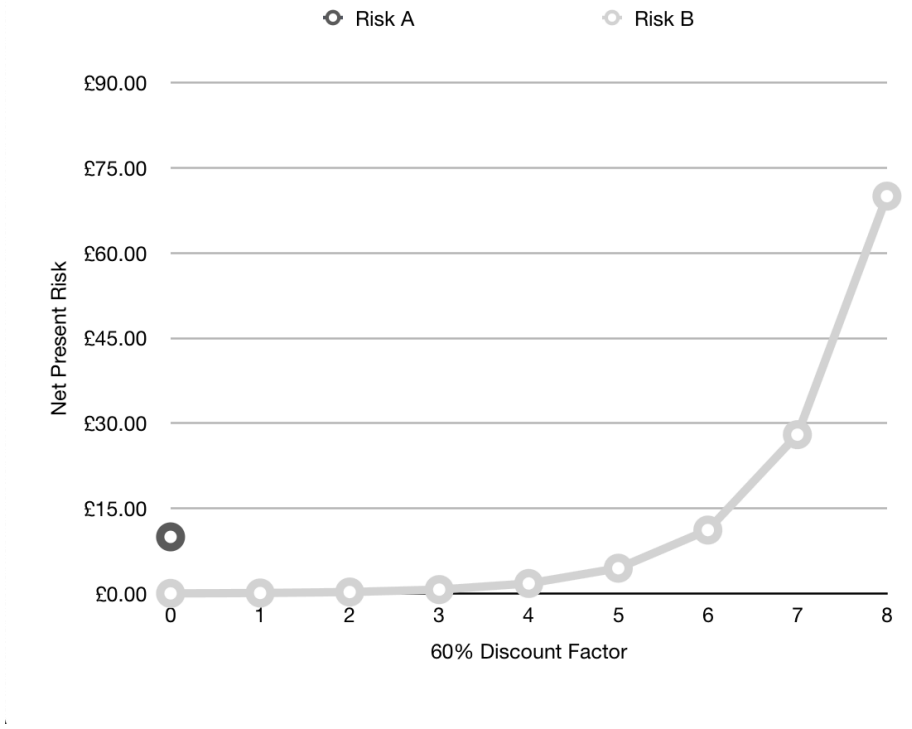


Figure 5.9: Net Present Risk, 60% Discount Rate

software development, you should probably *give up* on trying to compute risk numerically. You *can't* work out how long a software project will take based purely on an analysis of (say) *function points*. (Whatever you define them to be).

- First, there isn't enough scientific evidence for an approach like this. We *can* look at collected data about IT projects, but techniques and tools advance rapidly.
- Second, IT projects have too many confounding factors, such as experience of the teams, technologies used etc. That is, the risks faced by IT projects are *too diverse* and *hard to quantify* to allow for meaningful comparison from one to the next.
- Third, as soon as you *publish a date* it changes the expectations of the project (see Student Syndrome).
- Fourth, metrics get misused and gamed (as we will see in a later chapter).

Reality is messy. Dressing it up with numbers doesn't change that and you

risk fooling yourself. If this is the case, is there any hope at all in what we're doing? Yes: *forget precision*. You should, with experience be able to hold up two separate risks and answer the question, "is this one bigger than this one?"

With that in mind, let's look at how we can meet reality as fast and often as possible.

CHAPTER 6

Cadence

Let's go back to the model again, introduced in Meeting Reality:

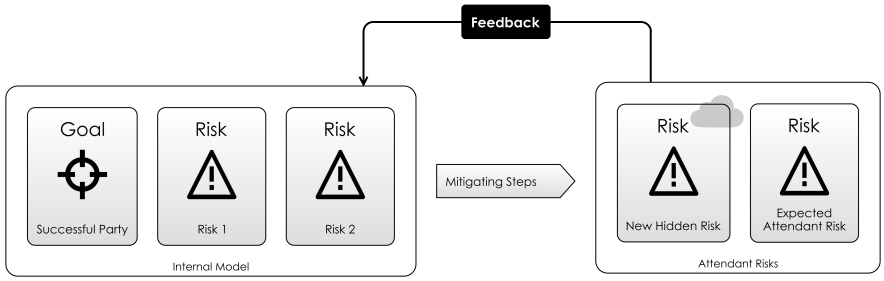


Figure 6.1: Meeting Reality: reality is changed and so is your internal model.

As you can see, it's an idealized **Feedback Loop**.

How *fast* should we go round this loop? The longer you leave your goal in mind, the longer it'll be before you find out how it really stacks up against reality.

Testing your goals in mind against reality early and safely is how you'll manage risk effectively, and to do this, you need to set up **Feedback Loops**. e.g.

- **Bug Reports and Feature Requests** tell you how the users are getting on with the software.
- **Monitoring Tools and Logs** allow you to find out how your software is doing in reality.

- **Dog-Fooding** i.e using the software you write yourself might be faster than talking to users.
- **Continuous Delivery**[1] is about putting software into production as soon as it's written.
- **Integration Testing** is a faster way of meeting *some* reality than continually deploying code and re-testing it manually.
- **Unit Testing** is a faster feedback loop than Integration Testing.
- **Compilation** warns you about logical inconsistencies in your code.

.. and so on.

Time / Reality Trade-Off

This list is arranged so that at the top, we have the most visceral, most *real* feedback loop, but at the same time, the slowest.

At the bottom, a good IDE can inform you about errors in your Internal Model in real time, by way of highlighting compilation errors . So, this is the fastest loop, but it's the most *limited* reality.

Imagine for a second that you had a special time-travelling machine. With it, you could make a change to your software, and get back a report from the future listing out all the issues people had faced using it over its lifetime, instantly.

That'd be neat, eh? If you did have this, would there be any point at all in a compiler? Probably not, right?

The whole *reason* we have tools like compilers is because they give us a shortcut way to get some limited experience of reality *faster* than would otherwise be possible. Because, cadence is really important: the faster we test our ideas, the more quickly we'll find out if they're correct or not.

Development Cycle Time

Developers often ignore the fast feedback loops at the bottom of the list above, because the ones nearer the top *will do*. In the worst cases, changing two lines of code, running the build script, deploying and then manually testing out a feature. And then repeating.

If you're doing it over and over, this is a terrible waste of time. And, you get none of the benefit of a permanent suite of tests to run again in the future.

The Testing Pyramid[2] hints at this truth:

[1] `https://en.wikipedia.org/wiki/Continuous_delivery`

[2] `http://www.agilenutshell.com/episodes/41-testing-pyramid`

- **Unit Tests** have a *fast feedback loop*, so have *lots of them*.
- **Integration Tests** have a slightly *slower feedback loop*, so have *few of them*. Use them when you can't write unit tests (at the application boundaries).
- **Manual Tests** have a *very slow feedback loop*, so have *even fewer of them*. Use them as a last resort.

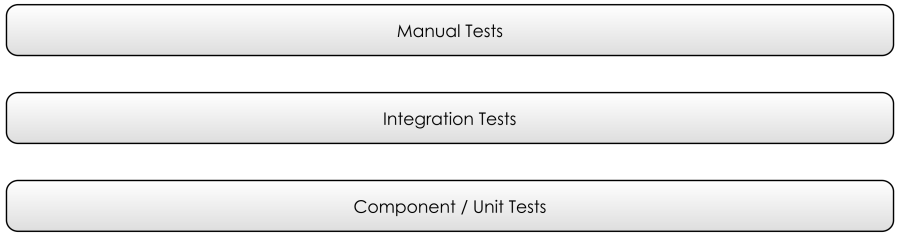


Figure 6.2: The Testing Pyramid

Production

You could take this chapter to mean that Continuous Delivery (CD) is always and everywhere a good idea. That's not a bad take-away, but it's clearly more nuanced than that.

Yes, CD will give you faster feedback loops, but even getting things into production is not the whole story: the feedback loop isn't complete until people have used the code, and reported back to the development team.

The right answer is to use multiple feedback loops:

In the next chapter De-Risking we're going to introduce a few more useful terms for thinking about risk.

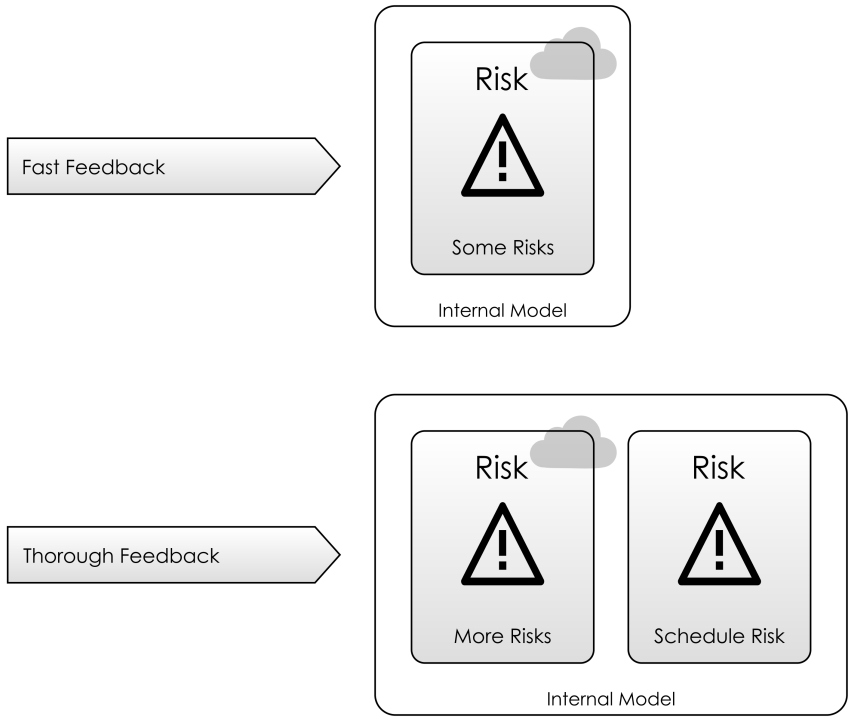


Figure 6.3: Different actions have different feedback loops

CHAPTER 7

De Risking

It's important not only to consider the Attendant Risks you're trying to mitigate, but the ones you're likely to pick up in the process. This means picking a careful path through the Risk Landscape. This is the essence of *De-Risking*.

> "To take steps to make (something) less risky or less likely to involve a financial loss."
>
> —De-Risk,*OxfordDictionaries.com*[1]

Some simple examples of this might be:

- **Safety-nets and ropes** de-risk climbing. But, the activity of climbing itself is otherwise much unchanged.
- **Backups and Source-Control** de-risk the development process by reducing the impact of computer failure. Our process is changed *slightly* by this imposition, but we're not massively inconvenienced.
- **Insurance** de-risks owning a house, going on holiday or driving a car. Usually, the payment is small enough not to impact us too much.
- **The National Health Service (NHS)** de-risks medical expense by pooling health-care costs across the entire population. If you were struck down with a debilitating illness, then at least you wouldn't also have to pay to get better.

Let's look at some common strategies for De-Risking.

[1] https://en.oxforddictionaries.com/definition/de-risk

7.1 Mitigate

Mitigating the risk is taking steps towards minimising either it's likelihood or impact (as we discussed in the Evaluating Risk chapter). This is the main approach we will be looking at in Part 2. We'll break down risk into its different types and look at the general mitigations for each. The examples above of De-Risking were all mitigations. (Safety-nets, for example, mitigate the impact of hitting the ground.)

7.2 Avoid

Avoiding a risk, means taking a route on the Risk Landscape *around* the risk. For example, if you are working in a team which has no experience of relational databases, then *storing data in files* might be a way to avoid the Learning-Curve Risk associated with this technology.

Of course, you may pick up other, more serious Attendant Risks as a result: Relational Databases are software solutions to many kinds of Coordination Risk problem.

Not launching an online service *avoids* the Operational Risk involved in running one. Although you avoid the upsides too.

7.3 Transfer

Transferring risk means *making it someone else's problem*. For example, when I buy home insurance, the impact of my house burning down is reduced. It hasn't gone away completely, but at least the financial element of it is handled by the insurance company.

In part 2, we'll see how **Transfer** of risk is an essential feature of Software as a Service. Inside organisations, **Transfer** of risk can become a political game:

> "... ownership results in 'one throat to choke' for audit functions [and] from ownership comes responsibility. A lot of the political footwork in an enterprise revolves around trying to not own technologies. Who wants to be responsible for Java usage across a technology function of dozens of thousands of staff, any of whom might be doing crazy stuff? You first, mate."
>
> —Why Are Enterprises So Slow?, *zwischenzugs.com*[2]

[2] https://zwischenzugs.com/2018/10/02/why-are-enterprises-so-slow/

7.4 Ignore / Accept

Accepting a risk is to deal with it when it arises. One example is the Key-Man Risk involved in having a super-star programmer on the team. Although there would be fallout if they left, they are often mitigating more risk than they cause.

Another example is using particular software dependencies: Building a mobile application which requires a Facebook account to log in might give rise to the risk that people without Facebook accounts can't log in, but might simplify the software to such an extent that it's worthwhile.

Whereas **Accepting** a risk seems to imply an eyes-wide-open examination, **Ignoring** seems to imply that either the risk is so insignificant it doesn't warrant evaluation, or so daunting that it can't be stared down. Either way, **Ignoring** a risk amounts to the same thing as **Accepting** it, since you're not doing anything about it.

Accepting a risk has to occur *before* we can **Mitigate** it.

A Nice Problem To Have

Ignoring or **Accepting** risks is a lot less work than **Mitigating** them, and sometimes it can feel negligent to just add them to the backlog or risk-register without doing anything immediately about them. One useful test I have found is whether "This would be a nice problem to have". For example:

> "Running out of space in the database would be a nice problem to have, because it would mean we have lots of users"

> "Users complaining about lacking function X would be a nice problem to have, because it would mean they were using the system"

Applying this kind of logic at the start of a project leads you towards building a Minimum Viable Product[3].

[3] https://en.wikipedia.org/wiki/Minimum_viable_product

Learned Helplessness

Sometimes, risks just go away on their own. Learned Helplessness[4] on the other hand, is where we *could* do something about the risk, but fail to see that as an option:

> "Learned helplessness is behaviour typical of animals, and in rare cases humans, that occurs when the subject endures repeatedly painful or otherwise aversive stimuli which it is unable to escape or avoid. After such experience, the organism often fails to learn or accept"escape" or "avoidance" in new situations where such behavior would likely be effective. "
>
> —Learned Helplessness, *Wikipedia*[5]

7.5 Contain

Containing risks means setting aside sufficient time or money to deal with them if they occur. This is an excellent approach for Hidden Risk or entire sets of minor Attendant Risks.

Whenever a project-manager builds slack into a project plan, this is **Containment**. "Time-Boxing" is also containment: this is where you give a piece of work a week (say) to prove itself. If it can't be done in this time, we move on and try a different approach.

In the chapter on Schedule Risk we are going to look in detail at how this works.

7.6 Exploit

Exploiting as a strategy usually means taking advantage of the upside of a risk. For example, ensuring enough stock is available to mitigate the risk of a rush on sales over the Christmas period, or ensuring your website has enough bandwidth to capture all the traffic headed towards it after it's featured on television.

Going back to the example of home insurance, the Insurance company is **exploiting** the risk of my house burning down by selling me insurance. This is a common pattern: wherever there is risk, there is likely to be a way to profit from it.

[4] https://en.wikipedia.org/wiki/Learned_helplessness

[5] https://en.wikipedia.org/wiki/Learned_helplessness

Later, in the chapter on Process Risk we'll be looking at how **exploiting risk** can happen organically within a company.

7.7 Re-cap

Let's look at the journey so far:

- In A Simple Scenario we looked at how risk pervades every goal we have in life, big or small. We saw that risk stems from the fact that our Internal Model of the world couldn't capture everything about reality, and so some things were down to chance.
- In the Development Process we looked at how common software engineering conventions like Unit Testing, User Acceptance Testing and Integration could help us manage the risk of taking an idea to production, by *gradually* introducing it to reality in stages.
- Then, generalizing the lessons of the Development Process article, we examined the idea that Meeting Reality frequently helps flush out Hidden Risks and improve your Internal Model.
- In It's All Risk Management we took a leap of faith: Could *everything* we do just be risk management? And we looked at the RAID log and thought that maybe it could be.
- Next, in A Software Project Scenario we looked at how you could treat the project-as-a-whole as a risk management exercise, and treat the goals from one day to the next as activities to mitigate risk.
- Evaluating Risk was an aside, looking at some terminology and the useful concept of a Risk Register.
- We looked at Cadence, and how feedback loops allow you Navigate the Risk Landscape more effectively, by showing you more quickly when you're going wrong.

What this has been building towards is supplying us with a vocabulary with which to communicate to our team-mates about which Risks are important to us, which actions we believe are the right ones, and which tools we should use.

In the next chapter we will see an example of this in action.

CHAPTER 8

A Conversation

After so much theory, it seems like it's time to look at how we can apply these principles in the real world.

The following is based the summary of a real issue around the time of writing. It's heavily edited and anonymized, and I've tried to add the Risk-First vocabulary along the way, but otherwise, it's real.

Some background: **Synergy** is an online service with an app-store, and **Eve** and **Bob** are developers working for **Large Corporation LTD**, which wants to have an application accepted into Synergy's app-store.

Synergy's release process means that the app-store submission must happen in a few weeks, so this is something of a hard deadline: if we miss it, the next opportunity for release will be four months away.

8.1 A Risk Conversation

Eve: We've got a problem with the Synergy security review.

Bob: Tell me.

Eve: Well, you know Synergy did their review and asked us to upgrade our Web Server to only allow TLS version 1.1 and greater?

Bob: Yes, I remember: We discussed it as a team and thought the simplest thing would be to change the security settings on the Web Server, but we all felt it was pretty risky. We decided that in order to flush out Hidden Risk, we'd upgrade our entire production site to use it *now*, rather than wait for the app launch.

Eve: Right, and it *did* flush out Hidden Risk: some of our existing software broke on Windows 7, which sadly we still need to support. So, we had to back it out.

Bob: Ok, well I guess it's good we found out *now*. It would have been a disaster to discover this after the app had gone live on Synergy's app-store.

Eve: Yes. So, what's our next-best action to mitigate this?

Bob: Well, we could go back to Synergy and ask them for a reprieve, but I think it'd be better to mitigate this risk now if we can... they'll definitely want it changed at some point.

Eve: How about we run two web-servers? One for the existing content, and one for our new Synergy app? We'd have to get a new external IP address, handle DNS setup, change the firewalls, and then deploy a new version of the Web Server software on the production boxes.

Bob: This feels like there'd be a lot of Attendant Risk: we're adding Complexity Risk to our estate, and all of this needs to be handled by the Networking Team, so we're picking up a lot of Bureaucracy Risk. I'm also worried that there are too many steps here, and we're going to discover loads of Hidden Risks as we go.

Eve: Well, you're correct on the first one. But, I've done this before not that long ago for a Chinese project, so I know the process - we shouldn't run into any new Hidden Risk.

Bob: OK, fair enough. But isn't there something simpler we can do? Maybe some settings in the Web Server?

Eve: Well, if we were using Apache, yes, it would be easy to do this. But, we're using Baroque Web Server, and it *might* support it, but the documentation isn't very clear.

Bob: OK, and upgrading to Apache is a *big* risk, right? We'd have to migrate all of our configuration...

Eve: Yes, let's not go there. So, *changing* the settings on Baroque, we have the risk that it's not supported by the software and we're back where we started. Also, if we isolate the Synergy app stuff now, we can mess around with it at any point in future, which is a big win in case there are other Hidden Risks with the security changes that we don't know about yet.

Bob: OK, I can see that buys us something, but time is really short and we have holidays coming up.

Eve: Yes. How about for now, we go with the isolated server, and review next week? If it's working out, then great, we continue with it. Otherwise,

if we're not making progress next week, then it'll be because our isolation solution is meeting more risk than we originally thought. In that case, we can attempt the settings change instead.

Bob: Fair enough, it sounds like we're managing the risk properly, and because we can hand off a lot of this to the Networking Team, we can get on with mitigating our biggest risk on the project, the authentication problem, in the meantime.

Eve: Right. I'll check in with the Networking Team each day and make sure it doesn't get forgotten.

8.2 Isn't It Obvious?

At this point, you might be wondering what all the fuss is about. This stuff is all obvious! It's what we do anyway! Perhaps. Risk management *is* what we do anyway:

> "We've survived 200,000 years as humans. Don't you think there's a reason why we survived? We're good at risk management."
>
> —Nassim Nicholas Taleb, author of *The Black Swan*[1]

The problem is that although all this *is* obvious, it appears to have largely escaped codification within the literature, practices and methodologies of software development. Further, while it is obvious, there is a huge hole: Successful De-Risking depends heavily on individual experience and talent.

In the next chapter, we are going to briefly look at software methodology, and how it comes up short in when addressing risk.

[1] https://www.zerohedge.com/news/2018-03-13/taleb-best-thing-society-bankruptcy-goldman-sachs

CHAPTER 9

One Size Fits No One

In All Risk Management we made the case that any action you take on a software project is to do with managing risk, and the last chapter, A Conversation was an example of this happening.

Therefore, it stands to reason that software methodologies are all about risk management too. Since they are prescribing a particular day-to-day process, or set of actions to take, they are also prescribing a particular approach to managing the risks on the project.

Back in the Development Process chapter, we introduced an example software methodology that a development team might follow when building software. It included steps like *analysis*, *coding* and *testing*. And, we looked at how each of these actions reduces risk in the software delivery process.

We looked at how following a process would expose risks that might be hidden to the members of the team: it doesn't matter if a developer doesn't know that he's going to break "Feature Y", because the *Integration Testing* part of the process will mitigate this risk in the testing stage, rather than in production (where it becomes more expensive).

In this chapter, we're going to have a brief look at some different software methodologies, and see how different methodologies prioritise different risks.

9.1 Waterfall

> "The waterfall development model originated in the manufacturing and construction industries; where the highly structured physical environments meant that design changes became prohibitively expensive much sooner in the development process.

> When first adopted for software development, there were no recognized alternatives for knowledge-based creative work."
>
> —Waterfall Model, *Wikipedia*[1]

Figure 9.1: Waterfall Actions

Waterfall[2] is a family of methodologies advocating a linear, stepwise approach to the processes involved in delivering a software system. The basic idea behind Waterfall-style methodologies was that the software process is broken into distinct stages, usually including:

- Requirements Capture
- Specification
- Implementation
- Verification
- Delivery and Operations
- Sign Offs at each stage

Because Waterfall methodologies are borrowed from *the construction industry*, they manage the risks that you would care about in a construction project. Specifically, minimising the risk of rework, and the risk of costs spiralling during the physical phase of the project. For example, pouring concrete is significantly easier than digging it out again after it sets.

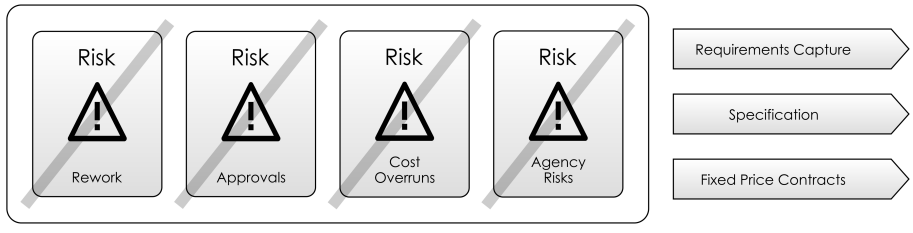


Figure 9.2: Waterfall, Specifications and Requirements Capture

[1] https://en.wikipedia.org/wiki/Waterfall_model

[2] https://en.wikipedia.org/wiki/Waterfall_model

Construction projects are often done by tender. This means that the supplier will bid for the job of completing the project, and deliver it to a fixed price. This is a risk-management strategy for the client: they are transferring the risk of construction difficulties to the supplier, and avoiding the Agency Risk that the supplier will "pad" the project and take longer to implement it than necessary, charging them more in the process. In order for this to work, both sides need to have a fairly close understanding of what will be delivered, and this is why a specification is created.

In a construction scenario, this makes a lot of sense. But, *software projects are not the same as building projects*. There are two key criticisms of the Waterfall approach when applied to software:

> "1. Clients may not know exactly what their requirements are before they see working software and so change their requirements, leading to redesign, redevelopment, and re-testing, and increased costs."
>
> "2. Designers may not be aware of future difficulties when designing a new software product or feature."
>
> —Waterfall Model, *Wikipedia*[3]

So, the same actions Waterfall prescribes to mitigate rework and cost-overruns in the building industry do not address (and perhaps exacerbate) the two issues raised above when applied to software.

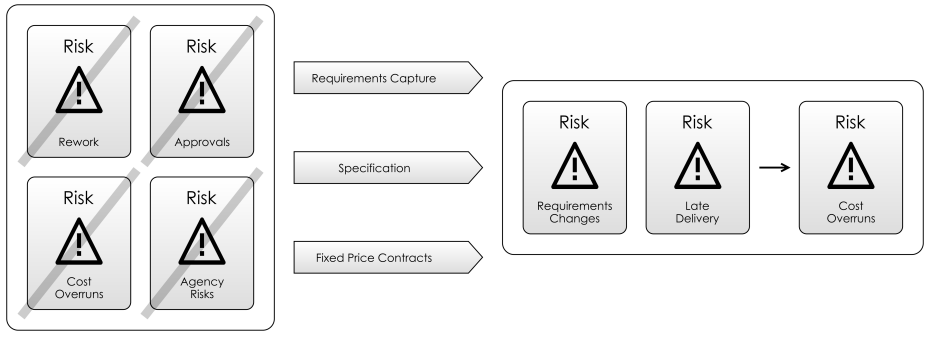


Figure 9.3: Waterfall, Applied to a Software Project

As you can see in the above diagram, some of the risks on the left *are the same* as the ones on the right: the actions taken to manage them made no

[3] https://en.wikipedia.org/wiki/Waterfall_model#Supporting_arguments

difference (or made things worse). The inability to manage these risks led to the identification of a "Software Crisis", in the 1970's:

> "Software crisis is a term used in the early days of computing science for the difficulty of writing useful and efficient computer programs in the required time... The software crisis was due to the rapid increases in computer power and the complexity of the problems that could not be tackled."
>
> —Software Crisis, *Wikipedia*[4]

9.2 Alternative Methodologies

The software crisis showed that, a lot of the time, up-front requirements-capture, specification and fixed-price bids did little to manage risk on software projects. So it's not surprising that by the 1990's, various different groups of software engineers were advocating "Agile" techniques, which did away with these actions.

In "Extreme Programming Explained[5]", Kent Beck breaks down his methodology, Extreme Programming, listing the risks he wants to address and the actions he proposes to address them with. The above diagram summarises the main risks and actions he talks about. These are different risks to those addressed by Waterfall, and unsurprisingly, this leads to different actions too.

Later in Risk-First, we will be going deeper on methodologies, examining them using a Risk-First perspective to understand what makes each one work, what they value and how they treat different risks. To get there, we need to have a model of the risks we face on a software project, and this is the subject of Part 2, in the next chapter.

Until then though, let's cover at a high-level the basic differences we see in some of the methodologies:

- **Lean Software Development[6]**: While Waterfall borrows from risk management techniques in the construction industry, Lean Software Development applies the principles used in Lean Manufacturing[7], which was developed at Toyota in the last century. Lean takes the view that

[4] https://en.wikipedia.org/wiki/Software_crisis

[5] http://amzn.eu/d/1vSqAWa

[6] https://en.wikipedia.org/wiki/Lean_software_development

[7] https://en.wikipedia.org/wiki/Lean_manufacturing

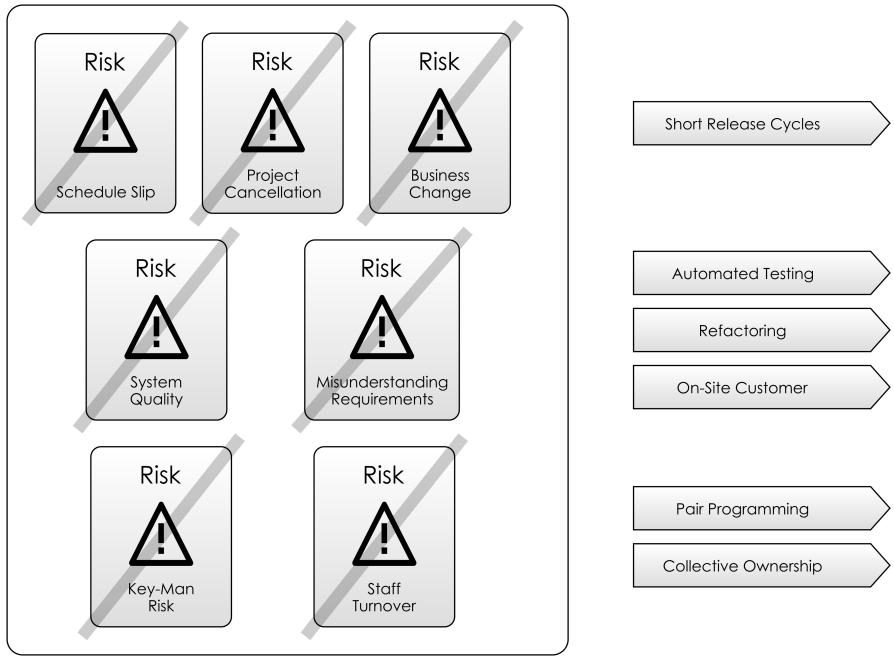


Figure 9.4: Risks, and the practices that manage them in Extreme Programming

the biggest risk in manufacturing is from waste, where waste is inventory, over-production, work-in-progress, time spent waiting or defects in production. Applying this approach to software means minimising work-in-progress, frequent releases and continuous improvement.

- **Project Management Body Of Knowledge (PMBoK)**[8]: This is a formalisation of traditional project management practice. It prescribes best practices for managing scope, schedule, resources, communications, dependencies, stakeholders etc. on a project. Although "risk" is seen as a separate entity to be managed, all of the above areas are sources of risk within a project, as we will see in Part 2.

- **Scrum)**: Is a popular Agile methodology. Arguably, it is less "extreme" than Extreme Programming, as it drops Pair Programming[9] and the always-available customer requirements, and promotes a limited set of agile practices, such as frequent releases, daily meetings, a product

[8] https://en.wikipedia.org/wiki/Project_Management_Body_of_Knowledge

[9] https://en.wikipedia.org/wiki/Pair_programming

owner and retrospectives. This simplicity arguably makes it simpler to learn and adapt to and probably contributes to Scrum's popularity over XP.

- **DevOps**[10]: Many software systems struggle with the disconnect between "in development" and "in production". DevOps is an acknowledgement of this, and is about more closely aligning the feedback loops between the developers and the production system. It champions activities such as continuous deployment, automated releases and automated monitoring.

9.3 Effectiveness

> "All methodologies are based on fear. You try to set up habits to prevent your fears from becoming reality."
>
> —Extreme Programming Explained, *Kent Beck*[11]

The promise of any methodology is that it will help you manage certain Hidden Risks. But this comes at the expense of the *effort* you put into the practices of the methodology. As we've said many times, a lot of the problems on a software project are Hidden Risks, and so there is an act of faith here: we are following a methodology because it purports to avoid risks we don't actually know about.

A methodology offers us a route through the Risk Landscape, based on the risks that the designers of the methodology care about. When we use the methodology, it means that we are baking into our behaviour actions to avoid those risks.

When we take action according to a methodology, we expect the Pay-Off, and if this doesn't materialise, then we feel the methodology is failing us. But it could just be that it is inappropriate to the *type of project* we are running. Our Risk Landscape may not be the one the designers of the methodology envisaged. For example:

- NASA can't do Agile when launching space craft: there's no two-weekly launch that they can iterate over, and the the risks of losing a rocket or satellite are simply too great to allow for iteration in production. The risk profile is just all wrong for Agile: you need to manage the risk of *losing hardware* over the risk of *requirements changing*.

[10] https://en.wikipedia.org/wiki/DevOps

[11] http://amzn.eu/d/1vSqAWa

- Equally, regulatory projects often require big, up-front, waterfall-style design: keeping regulators happy is often about showing that you have a well-planned path to achieving the regulation. Often, the changes need to be reviewed and approved by regulators and other stakeholders in advance of their implementation. This can't be done with an approach of "iterate for a few months".

- At the other end of the spectrum, Facebook used to have[12] an approach of "move fast and break things". This may have been optimal when they were trying mitigate the risk of being out-innovated by competitors within the fast-evolving sphere of social networking.

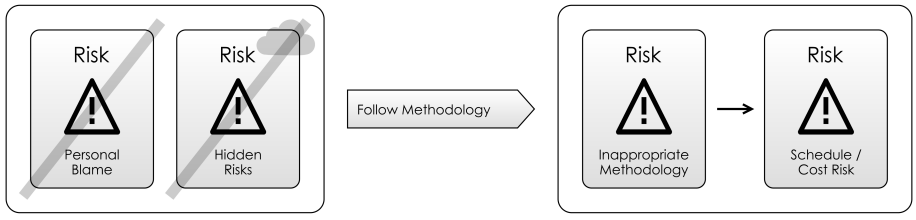


Figure 9.5: Inappropriate Methodologies create their own risks

9.4 Choosing A Methodology

There is value in adopting a methodology as a complete collection of processes: Choosing a methodology (or any process) reduces the amount of thinking individuals have to do. Following a process may avoid the risks, whether the implementer knows about them or not. And, it becomes the process that is responsible for failure, not the individual (as shown in the above diagram).

If we genuinely care about our projects, then it's critical that we match the choice of methodology to the risk profile of the project. We need to understand exactly what risks our methodology will help us with, and which it won't; where it is appropriate, and where it isn't.

An off-the-shelf methodology is unlikely to fit the risks of our project exactly. Sometimes, we need to break down methodologies into their component practices, and apply just the practices we need. This requires a much more fine-grained understanding of how the practices work, and what they bring.

[12] https://mashable.com/2014/04/30/facebooks-new-mantra-move-fast-with-stability/?europe=true

So different methodologies advocate different practices, and different practices manage different risks. If we want to understand methodologies, or even choose the right practices from one, we really need to understand the *types of risks* we face on software projects. This is where we go next in Part 2.

Part II

Risk

CHAPTER 10

Risk Landscape

10.1 Why Should We Categorise The Risks?

This is a "spotters' guide" to risks, not an in-depth encyclopedia.

If we were studying insects, this might be a guide giving you a description and a picture of each insect, telling you where to find it and what it does. That doesn't mean that this is *all* there is to know. Just as a scientist could spend her entire life studying a particular species of bee, each of the risks we'll look at really has a whole sub-discipline of Computer Science attached to it, which we can't possibly hope to cover all of.

As software developers, we can't hope to know the detailed specifics of the whole discipline of Complexity Theory[1], or Concurrency Theory[2]. But, we're still required to operate in a world where these things exist. So, we may as well get used to them, and ensure that we respect their primacy. We are operating in *their* world, so we need to know the rules.

Risk is messy. It's not always easy to tease apart the different components of risk and look at them individually. Let's look at a high-profile recent example to see why.

10.2 The Financial Crisis

In the Financial Services[3] industry, whole *departments* exist to calculate things like:

[1] https://en.wikipedia.org/wiki/Complexity_theory

[2] https://en.wikipedia.org/wiki/Concurrency_(computer_science)

[3] https://en.wikipedia.org/wiki/Financial_services

- Market Risk[4]: the risk that the amount some asset you hold/borrow/have loaned is going to change in value.
- Credit Risk[5]: the risk that someone who owes you a payment at a specific point in time might not pay it back.
- Liquidity Risk[6]: the risk that you can't find a market to sell/buy something, usually leading to a shortage of ready cash.

. . . and so on. But, we don't need to know the details exactly to understand this story.

They get expressed in ways like this:

> "we have a 95% chance that today we'll lose less than £100"

In the financial crisis, though, these models of risk didn't turn out to be much use. Although there are lots of conflicting explanations of what happened, one way to look at it is this:

- Liquidity difficulties (i.e. amount of cash you have for day-to-day running of the bank) caused some banks to not be able to cover their interest payments.
- This caused credit defaults (the thing that Credit Risk measures were meant to guard against) even though the banks *technically* were solvent.
- That meant that, in time, banks got bailed out, share prices crashed and there was lots of Quantitative Easing[7].
- All of which had massive impacts on the markets in ways that none of the Market Risk models foresaw.

All the Risks were correlated[8]. That is, they were affected by the *same underlying events*, or *each other*.

10.3 The Risk Landscape Again

It's like this with software risks, too, sadly.

[4] https://en.wikipedia.org/wiki/Market_risk

[5] https://en.wikipedia.org/wiki/Credit_risk

[6] https://en.wikipedia.org/wiki/Liquidity_risk

[7] https://en.wikipedia.org/wiki/Quantitative_easing

[8] https://www.investopedia.com/terms/c/correlation.asp

In Meeting Reality, we looked at the concept of the Risk Landscape, and how a software project tries to *navigate* across this landscape, testing the way as it goes, and trying to get to a position of *more favourable risk*.

It's tempting to think of our Risk Landscape as being like a Fitness Landscape[9]. That is, you have a "cost function" which is your height above the landscape, and you try and optimise by moving downhill in a Gradient Descent[10] fashion.

However, there's a problem with this: As we said in Risk Theory, we don't have a cost function. We can only guess at what risks there are. And, we have to go on our *experience*. For this reason, I prefer to think of the Risk Landscape as a terrain which contains *fauna* and *obstacles* (or, specifically Boundaries).

I am going to try and show you some of the fauna of the Risk Landscape. We know every project is different, so every Risk Landscape is also different. But, just as I can tell you that the landscape outside your window will probably will have some roads, trees, fields, forests, buildings, and that the buildings are likely to be joined together by roads, I can tell you some general things about risks too.

In fact, we're going to try and categorise the kinds of things we see on this Risk Landscape. But, this isn't going to be perfect:

- One risk can "blend" into another just like sometimes a "field" is also a "car-park" or a building might contain some trees (but isn't a forest).
- There is *correlation* between different risks: one risk may cause another, or two risks may be due to the same underlying cause.
- As we saw in Part 1, mitigating one risk can give rise to another, so risks are often *inversely correlated*.

10.4 We're all Naturalists Now

This is a new adventure. There's a long way to go. Just as naturalists are able to head out and find new species of insects and plants, we should expect to do the same. This is by no means a complete picture - it's barely a sketch.

It's a big, crazy, evolving world of software. Help to fill in the details. Report back what you find.

[9] https://en.wikipedia.org/wiki/Fitness_landscape

[10] https://en.wikipedia.org/wiki/Gradient_descent

10.5 Our Tour Itinerary

Below is a table outlining the different risks we'll see. There *is* an order to this: the later risks are written assuming a familiarity with the earlier ones. Hopefully, you'll stay to the end and see everything, but you're free to choose your own tour if you want to.

Risk	Description
Feature Risk	When you haven't built features the market needs, or they contain bugs, or the market changes underneath you.
Communication Risk	Risks associated with getting messages heard and understood.
Complexity Risk	Your software is so complex it makes it hard to change, understand or run.
Dependency Risk	Risks of depending on other people, products, software, functions, etc. This is a general look at dependencies, before diving into specifics like. . .
Scarcity Risk	Risks associated with having a dependency on time, money or some other limited resource.
Software Dependency Risk	When you choose to depend on a software library, service or function.
Process Risk	When you depend on a business process, or human process to give you something you need.
Boundary Risk	Risks due to making decisions that limit your choices later on. Sometimes, you go the wrong way on the Risk Landscape and it's hard to get back to where you want to be.
Agency Risk	Risks that staff have their own Goals, which might not align with those of the project or team.
Coordination Risk	Risks due to the fact that systems contain multiple agents, which need to work together.
Map And Territory Risk	Risks due to the fact that people don't see the world as it really is. (After all, they're working off different, imperfect Internal Models.)

Risk	Description
Operational Risk	Software is embedded in a system containing people, buildings, machines and other services. Operational risk considers this wider picture of risk associated with running a software service or business in the real world.

On each page we'll start by looking at the category of the risk *in general*, and then break this down into some specific sub-types. At the end, in Staging and Classifying we'll have a recap about what we've seen and make some guesses about how things fit together.

So, let's get started with Feature Risk.

CHAPTER 11

Feature Risk

Feature Risks are risks to do with functionality that you need to have in your software.

As a simple example, if your needs are served perfectly by Microsoft Excel, then you don't have any Feature Risk. However, the day you find Microsoft Excel wanting, and decide to build an Add-On is the day when you first appreciate some Feature Risk.

In a way, Feature Risk is very fundamental: if there were *no* feature risk, the job would be done already, either by you, or by another product, and the product would be perfect!

Not considering Feature Risk means that you might be building the wrong functionality, for the wrong audience or at the wrong time. And eventually, this will come down to lost money, business, acclaim, or whatever else reason you are doing your project for. So let's unpack this concept into some of it's variations.

11.1 Feature Fit Risk

This is the one we've just discussed above - the feature that you (or your clients) want to use in the software *isn't there*:

- This might manifest itself as complete *absence* of something you need, e.g "Why is there no word count in this editor?"
- It could be that the implementation isn't complete enough, e.g "why can't I add really long numbers in this calculator?"

Feature risks are mitigated by talking to clients and building things, which leads on to. . .

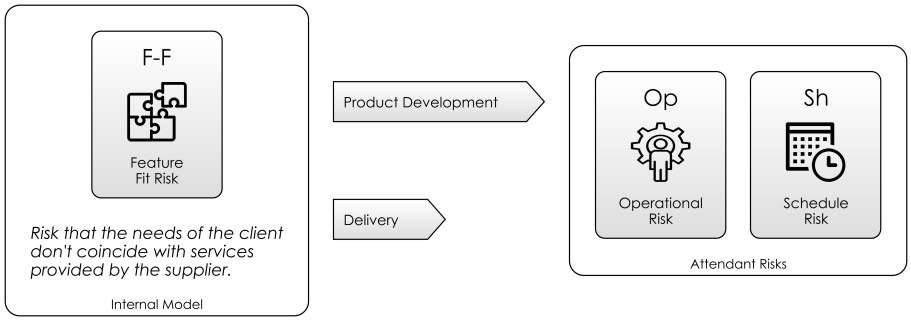


Figure 11.1: Feature Risk

11.2 Implementation Risk

Feature Risk also includes things that don't work as expected: That is to say, bugs[1]. Although the distinction between "a missing feature" and "a broken feature" might be worth making in the development team, we can consider these both the same kind of risk: *the software doesn't do what the user expects*.

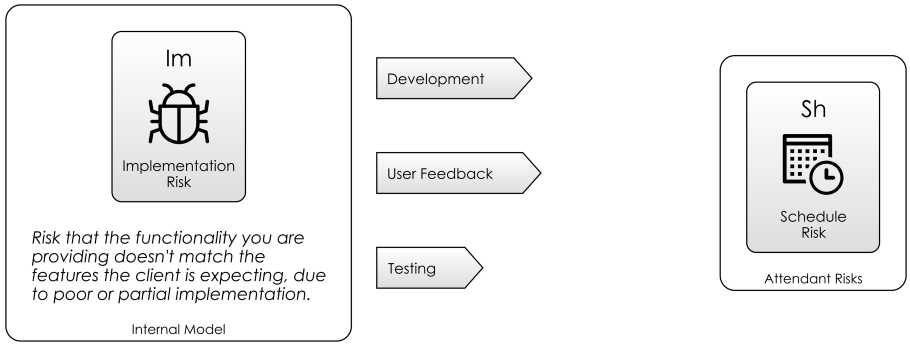


Figure 11.2: Implementation Risk

At this point, it's worth pointing out that sometimes, *the user expects the wrong thing*. This is a different but related risk, which could be down to training, documentation or simply a poor user interface. We'll look at that more in Communication Risk.

[1] `https://en.wikipedia.org/wiki/Software_bug`

11.3 Regression Risk

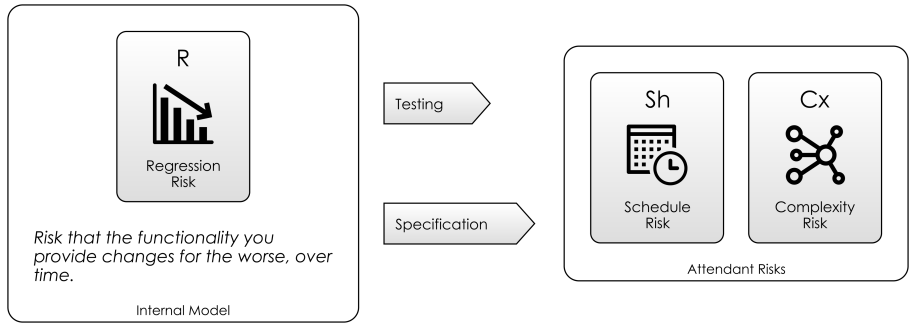


Figure 11.3: Regression Risk

Regression Risk is the risk of breaking existing features in your software when you add new ones. As with the previous risks, the eventual result is the same; customers don't have the features they expect. This can become a problem as your code-base gains Complexity, as it becomes impossible to keep a complete Internal Model of the whole thing in your head.

Delivering new features can delight your customers, breaking existing ones will annoy them. This is something we'll come back to in Reputation Risk.

11.4 Conceptual Integrity Risk

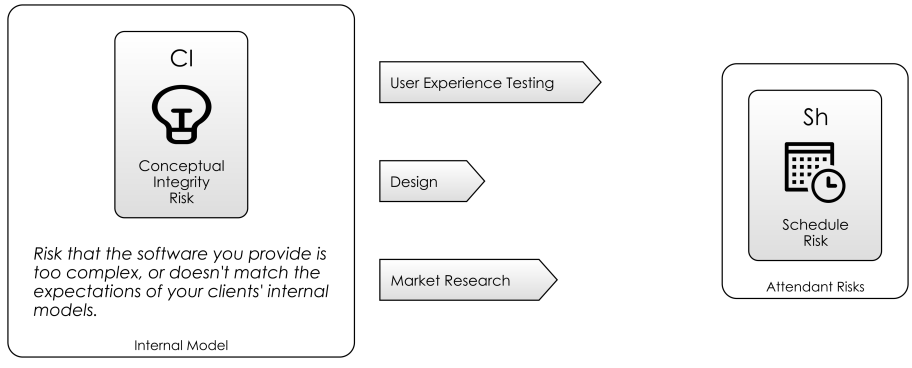


Figure 11.4: Conceptual Integrity Risk

Sometimes, users *swear blind* that they need some feature or other, but it runs at odds with the design of the system, and plain *doesn't make sense*. Often, the development team can spot this kind of conceptual failure as soon as it enters the Backlog. Usually, it's in coding that this becomes apparent.

Sometimes, it can go for a lot longer. I once worked on some software that was built as a score-board within a chat application. However, after we'd added much-asked-for commenting and reply features to our score-board, we realised we'd implemented a chat application *within a chat application*, and had wasted our time enormously.

Feature Phones[2] are a real-life example: although it *seemed* like the market wanted more and more features added to their phones, Apple's iPhone[3] was able to steal huge market share by presenting a much more enjoyable, more coherent user experience, despite being more expensive and having fewer features. Feature Phones had been drowning in increasing Conceptual Integrity Risk without realising it.

This is a particularly pernicious kind of Feature Risk which can only be mitigated by good Design. Human needs are fractal in nature: the more you examine them, the more complexity you can find. The aim of a product is to capture some needs at a *general* level: you can't hope to anticipate everything.

Conceptual Integrity Risk is the risk that chasing after features leaves the product making no sense, and therefore pleasing no-one.

11.5 Feature Access Risk

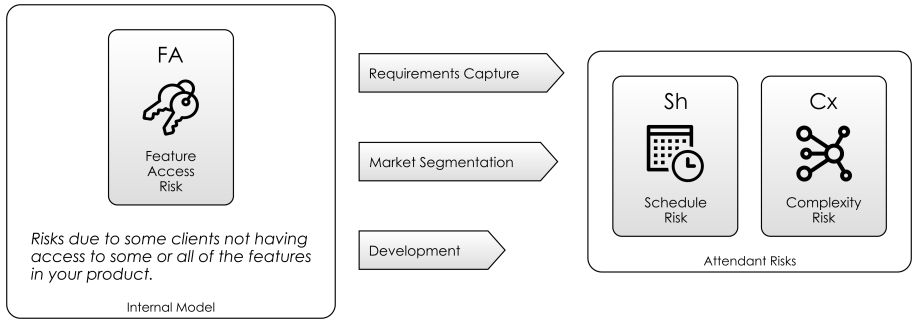


Figure 11.5: Feature Access Risk

[2] https://en.wikipedia.org/wiki/Feature_phone

[3] https://en.wikipedia.org/wiki/IPhone

Sometimes, features can work for some people and not others: this could be down to Accessibility[4] issues, language barriers or localisation.

You could argue that the choice of *platform* is also going to limit access: writing code for XBox-only leaves PlayStation owners out in the cold. This is *largely* Feature Access Risk, though Dependency Risk is related here.

In Marketing, minimising Feature Access Risk is all about Segmentation[5]: trying to work out *who* your product is for, and tailoring it to that particular market. For developers, increasing Feature Access means increasing complexity: you have to deliver the software on more platforms, localised in more languages, with different configurations of features. Mitigating Feature Access Risk therefore means increased effort and complexity (which we'll come to later).

Market Risk

Feature Access Risk is related to Market Risk, which I introduced on the Risk Landscape page as being the value that the market places on a particular asset.

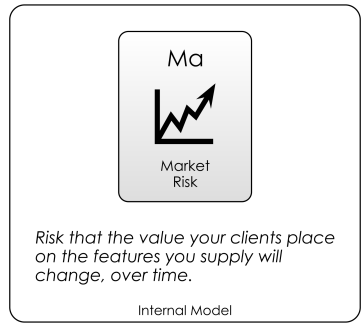


Figure 11.6: Market Risk

> "Market risk is the risk of losses in positions arising from movements in market prices."
>
> —Market Risk, *Wikipedia*[6]

[4] https://en.wikipedia.org/wiki/Accessibility

[5] https://en.wikipedia.org/wiki/Market_segmentation

[6] https://en.wikipedia.org/wiki/Market_risk

I face market risk when I own (i.e. have a *position* in) some Apple[7] stock. Apple's's stock price will decline if a competitor brings out an amazing product, or if fashions change and people don't want their products any more.

Since the product you are building is your asset, it makes sense that you'll face Market Risk on it: the *market* decides what it is prepared to pay for this, and it tends to be outside your control.

11.6 Feature Drift Risk

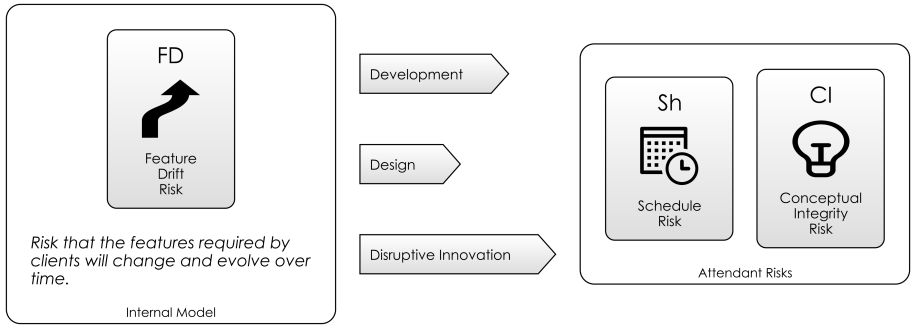


Figure 11.7: Feature Drift Risk

Feature Drift is the tendency that the features people need *change over time*. For example, at one point in time, supporting IE6 was right up there for website developers, but it's not really relevant anymore. The continual improvements we see in processor speeds and storage capacity of our computers is another example: the Wii was hugely popular in the early 2000's, but expectations have moved on now.

The point is: Requirements captured *today* might not make it to *tomorrow*, especially in the fast-paced world of IT. This is partly because the market *evolves* and becomes more discerning. This happens in several ways:

- Features present in competitor's versions of the software become *the baseline*, and they're expected to be available in your version.
- Certain ways of interacting become the norm (e.g. querty[8] keyboards, or the control layout in cars: these don't change with time).

[7] `http://apple.com`

[8] `https://en.wikipedia.org/wiki/QWERTY`

- Features decline in usefulness: *Printing* is less important now than it was, for example.

As we will see later in Boundary Risk, Feature Drift Risk is often a source of Complexity Risk, since you often need to add new features, while not dismantling old features as some users still need them.

Feature Drift Risk is *not the same thing* as **Requirements Drift**, which is the tendency projects have to expand in scope as they go along. There are lots of reasons they do that, a key one being the Hidden Risks uncovered on the project as it progresses.

Fashion

Fashion plays a big part in IT. By being *fashionable*, web-sites are communicating: *this is a new thing*, *this is relevant*, *this is not terrible*: all of which is mitigating a Communication Risk. Users are all-too-aware that the Internet is awash with terrible, abandon-ware sites that are going to waste their time. How can you communicate that you're not one of them to your users?

11.7 Delight

If this breakdown of Feature Risk seems reductive, then try not to think of it that way: the aim *of course* should be to delight users, and turn them into fans.

Consider Feature Risk from both the down-side and the up-side:

- What are we missing?
- How can we be *even better*?

11.8 Analysis

So far in this chapter, we've simply seen a bunch of different types of Feature Risk. But we're going to be relying heavily on Feature Risk as we go on in order to build our understanding of other risks, so it's probably worth spending a bit of time up front to classify what we've found.

The Feature Risks identified here basically exist in a space with at least 3 dimensions:

- **Fit**: How well the features fit for a particular client.

- **Audience**: The range of clients (the *market*) that may be able to use this feature.
- **Evolution**: The way the fit and the audience changes and evolves as time goes by.

Let's examine each in turn.

Fit

> "This preservation, during the battle for life, of varieties which possess any advantage in structure, constitution, or instinct, I have called Natural Selection; and Mr. Herbert Spencer has well expressed the same idea by the Survival of the Fittest"
>
> —Charles Darwin (Survival of the Fittest), *Wikipedia*[9].

Darwin's conception of fitness was not one of athletic prowess, but how well an organism worked within the landscape, with the goal of reproducing itself.

Feature Fit Risk, Conceptual Integrity Risk and Implementation Risk all hint at different aspects of this "fitness". We can conceive of them as the gaps between the following entities:

- Perceived Need: What the developers *think* the users want.
- Expectation: What the user *expects*.
- Reality: What they actually *get*.

For further reading, you can check out The Service Quality Model[10], which figure 11.8 is derived from. This model analyses the types of *quality gaps* in services, and how consumer expectations and perceptions of a service arise.

In the Staging And Classifying chapter, we'll come back and build on this model further.

Fit and Audience

Two risks, Feature Access Risk and Market Risk considers *Fit* for a whole *Audience* of users. They are different: just as it's possible to have a small audience, but a large revenue, it's possible to have a product which has low Feature Access Risk (i.e lots of users can access it without difficulty) but high

[9] https://en.wikipedia.org/wiki/Survival_of_the_fittest

[10] http://en.wikipedia.org/SERVQUAL

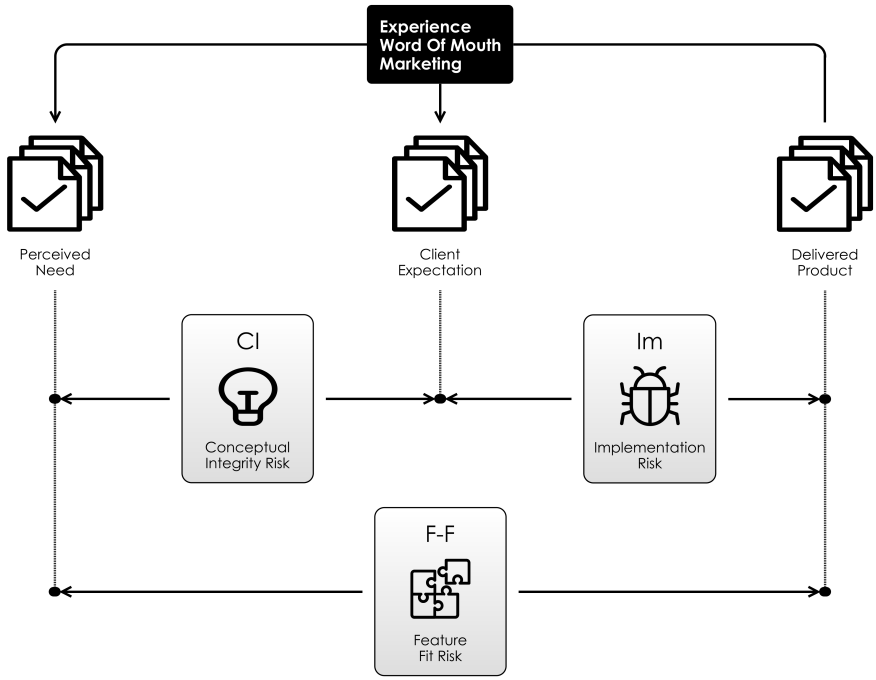


***Figure 11.8: Feature Risks Assembled: Fit Risks, shown as* gaps*, as in the* Service Quality Model**

Market Risk (i.e. the market is highly volatile or capricious in it's demands). *Online services* often suffer from this Market Risk roller-coaster, being one moment highly valued and the next irrelevant.

- **Market Risk** is therefore risk to *income* from the market changing.
- **Feature Access Risk** is risk to *audience* changing.

Fit, Audience and Evolution

Two risks further consider how the **Fit** and **Audience** *change*: Regression Risk and Feature Drift Risk. We call this *evolution* in the sense that:

- Our product's features *evolve* with time, and changes made by the development team.
- Our audience changes and evolves as it is exposed to our product and competing products.

- The world as a whole is an evolving system within which our product exists.

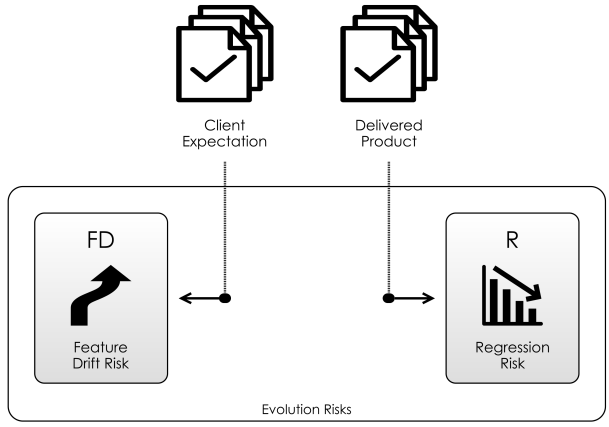


Figure 11.9: Risks of Evolution/Change either of the product or the expectations of clients.

11.9 Applying Feature Risk

Next time you are grooming the backlog, why not apply this:

- Can you judge which tasks mitigate the most Feature Risk?
- Are you delivering features that are valuable across a large audience? Or of less value across a wider audience?
- How does writing a specification mitigate Fit Risk? For what other reasons are you writing specifications?
- Does the audience *know* that the features exist? How do you communicate feature availability to them?

In the next chapter, we are going to unpack this last point further. Somewhere between "what the customer wants" and "what you give them" is a *dialog*. In using a software product, users are engaging in a *dialog* with its features. If the features don't exist, hopefully they will engage in a dialog with the development team to get them added.

These dialogs are prone to risk, and this is the subject of the next chapter, Communication Risk.

CHAPTER 12

Communication Risk

If we all had identical knowledge, there would be no need to do any communicating at all, and therefore and also no Communication Risk.

But, people are not all-knowing oracles. We rely on our *senses* to improve our Internal Models of the world. There is Communication Risk here - we might overlook something vital (like an on-coming truck) or mistake something someone says (like "Don't cut the green wire").

12.1 A Model Of Communication

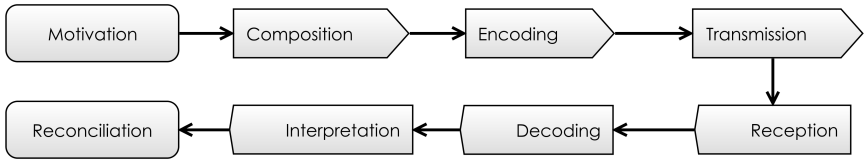


Figure 12.1: Shannon's Communication Model

In 1948, Claude Shannon proposed this definition of communication:

> "The fundamental problem of communication is that of reproducing at one point, either exactly or approximately, a message

selected at another point."

—A Mathematical Theory Of Communication, *Claude Shannon*[1] <!– tweet-end –>

And from this same paper, we get figure 12.1: We move from top-left ("I want to send a message to someone") to bottom left, clockwise, where we hope the message has been understood and believed. (I've added this last box to Shannon's original diagram.)

One of the chief concerns in Shannon's paper is the risk of error between **Transmission** and **Reception**. He creates a theory of information (measured in **bits**), the upper-bounds of information that can be communicated over a channel and ways in which Communication Risk between these processes can be mitigated by clever **Encoding** and **Decoding** steps.

But it's not just transmission. Communication Risk exists at each of these steps. Let's imagine a human example, where someone, **Alice** is trying to send a simple message to **Bob**:

Step	Potential Risk
Motivation	**Alice** might be **motivated** to send a message to tell **Bob** something, only to find out that *he already knew it*.
Composition	**Alice** might mess up the *intent* of the message: instead of "Please buy chips" she might say, "Please buy chops".
Encoding	**Alice** might not speak clearly enough to be understood.
Transmission	**Alice** might not say it *loudly* enough for **Bob** to hear.
Reception	**Bob** doesn't hear the message clearly (maybe there is background noise).
Decoding	**Bob** might not decode what was said into a meaningful sentence.
Interpretation	Assuming **Bob** *has* heard, will he correctly **interpret** which type of chips (or chops) **Alice** was talking about?
Reconciliation	Does **Bob** believe the message? Will he **reconcile** the information into his Internal Model and act on it? Perhaps not, if **Bob** thinks that there are chips at home already.

[1] https://en.wikipedia.org/wiki/A_Mathematical_Theory_of_Communication

12.2 Approach To Communication Risk

There is a symmetry about the steps going on in Shannon's diagram, and we're going to exploit this in order to break down Communication Risk into it's main types.

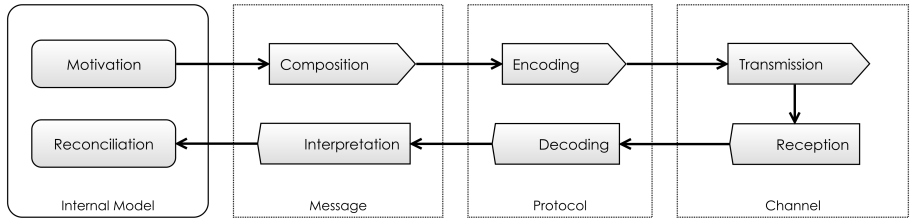


Figure 12.2: Communication Risk 2

To get inside Communication Risk, we need to understand **Communication** itself, whether between *machines*, *people* or *products*: we'll look at each in turn. In order to do that, we're going to examine four basic concepts in each of these settings:

- **Channels**[2]: the medium via which the communication is happening.
- **Protocols**[3]: the systems of rules that allow two or more entities of a communications system to transmit information.
- **Messages**[4]: The information we want to convey.
- **Internal Models**: the sources and destinations for the messages. Updating internal models (whether in our heads or machines) is the reason why we're communicating.

And, as we look at these four areas, we'll consider the Attendant Risks of each.

12.3 Channels

There are lots of different types of media for communicating (e.g. TV, Radio, DVD, Talking, Posters, Books, Phones, The Internet, etc.) and they all have different characteristics. When we communicate via a given medium, it's called a *channel*.

[2] https://en.wikipedia.org/wiki/Communication_channel

[3] https://en.wikipedia.org/wiki/Communication_protocol

[4] https://en.wikipedia.org/wiki/Message

The channel *characteristics* depend on the medium, then. Some obvious ones are cost, utilisation, number of people reached, simplex or duplex (parties can transmit and receive at the same time), persistence (a play vs a book, say), latency (how long messages take to arrive) and bandwidth (the amount of information that can be transmitted in a period of time).

Channel characteristics are important: in a high-bandwidth, low-latency situation, **Alice** and **Bob** can *check* with each other that the meaning was transferred correctly. They can discuss what to buy, they can agree that **Alice** wasn't lying or playing a joke.

The channel characteristics also imply suitability for certain *kinds* of messages. A documentary might be a great way of explaining some economic concept, whereas an opera might not be.

12.4 Channel Risk

Shannon discusses that no channel is perfect: there is always the **risk of noise** corrupting the signal. A key outcome from Shannon's paper is that there is a tradeoff: within the capacity of the channel (the **Bandwidth**), you can either send lots of information with *higher* risk that it is wrong, or less information with *lower* risk of errors.

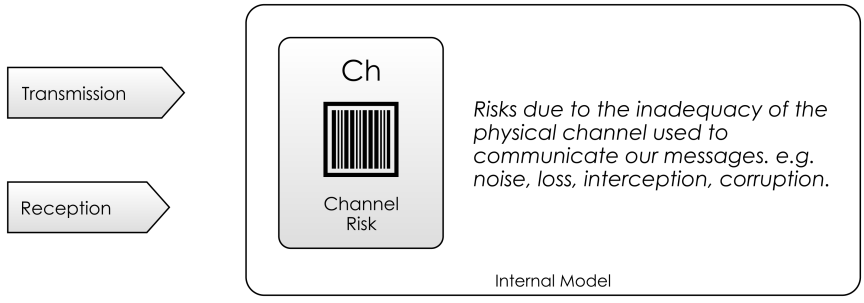


Figure 12.3: Communication Channel Risk

But channel risk goes wider than just this mathematical example: messages might be delayed or delivered in the wrong order, or not be acknowledged when they do arrive. Sometimes, a channel is just an inappropriate way of communicating. When you work in a different time-zone to someone else on your team, there is *automatic* Channel Risk, because instantaneous communication is only available for a few hours' a day.

When channels are **poor-quality**, less communication occurs. People will try to communicate just the most important information. But, it's often impossible to know a-priori what constitutes "important". This is why Extreme Programming recommends the practice of Pair Programming and siting all the developers together: although you don't know whether useful communication will happen, you are mitigating Channel Risk by ensuring high-quality communication channels are in place.

At other times, channels are crowded, and can contain so much information that we can't hope to receive all the messages. In these cases, we don't even observe the whole channel, just parts of it.

Marketing Communications

When we are talking about a product or a brand, mitigating Channel Risk is the domain of Marketing Communications[5]. How do you ensure that the information about your (useful) project makes it to the right people? How do you address the right channels?

This works both ways. Let's looks at some of the **Channel Risks** from the point of view of a hypothetical software tool, **D**, which would really useful in my software:

- The concept that there is such a thing as **D** which solves my problem isn't something I'd even considered.
- I'd like to use something like **D**, but how do I find it?
- There are multiple implementations of **D**, which is the best one for the task?
- I know **D**, but I can't figure out how to solve my problem in it.
- I've chosen **D**, I now need to persuade my team that **D** is the correct solution...
- ... and then they also need to understand **D** to do their job too.

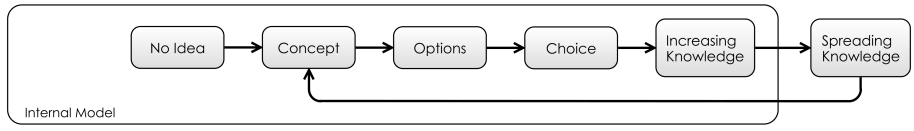


Figure 12.4: Communication Marketing

[5] https://en.wikipedia.org/wiki/Marketing_communications

Internal Models don't magically get populated with the information they need: they fill up gradually, as shown in figure 12.4. Popular products and ideas *spread*, by word-of-mouth or other means. Part of the job of being a good technologist is to keep track of new **Ideas**, **Concepts** and **Options**, so as to use them as Dependencies when needed.

12.5 Protocols

> "A communication protocol is a system of rules that allow two or more entities of a communications system to transmit information."
>
> Communication Protocol, Wikipedia[6]

In this chapter, I want to examine the concept of Communication Protocols and how they relate to Abstraction, which is implicated over and over again in different types of risk we will be looking at.

Abstraction means separating the *definition* of something from the *use* of something. It's a widely applicable concept, but our example below will be specific to communication, and looking at the abstractions involved in loading a web page.

First, we need to broaden our terminology. Although so far we've talked about **Senders** and **Receivers**, we now need to talk from the point of view of who-depends-on-who. That is, Clients and Suppliers.

- If you're *depended on*, then you're a **"Supplier"** (or a **"Server"**, when we're talking about actual hardware).
- If you require communication with something else, you're a **"Client"**.

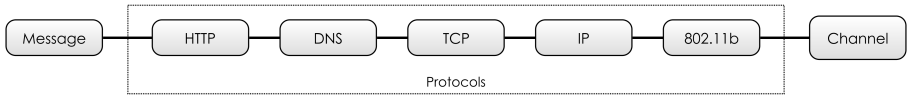


Figure 12.5: Protocol Stack

In order that a web browser (a **client**) can load a web-page from a **server**, they both need to communicate with shared protocols. In this example, this is going to involve (at least) six separate protocols, as shown in figure 12.5.

[6] https://en.wikipedia.org/wiki/Communication_protocol

Let's examine each protocol in turn when I try to load the web page at the following address using a web browser:

```
http://google.com/preferences
```

1. DNS - Domain Name System

The first thing that happens is that the name "google.com" is *resolved* by DNS. This means that the browser looks up the domain name "google.com" and gets back an IP address.

This is some Abstraction: instead of using the machine's IP Address[7] on the network, `216.58.204.78`, I can use a human-readable address, `google.com`.

The address `google.com` doesn't necessarily resolve to that same address each time: *They have multiple IP addresses for `google.com`*, but as a user, I don't have to worry about this detail.

2. IP - Internet Protocol

But this hints at what is beneath the abstraction: although I'm loading a web-page, the communication to the Google server happens by IP Protocol[8] - it's a bunch of discrete "packets" (streams of binary digits). You can think of a packet as being like a real-world parcel or letter.

Each packet consists of two things:

- An **IP Address**, which tells the network components (such as routers and gateways) where to send the packet, much like you'd write the address on the outside of a parcel.
- The **Payload**, the stream of bytes for processing at the destination. Like the contents of the parcel.

But, even this concept of "packets" is an Abstraction. Although all the components of the network understand this protocol, we might be using Wired Ethernet cables, or WiFi, 4G or *something else* beneath that.

3. 802.11 - WiFi Protocol

I ran this at home, using WiFi, which uses IEEE 802.11 Protocol[9], which allows my laptop to communicate with the router wirelessly, again using an agreed,

[7] https://en.wikipedia.org/wiki/IP_address

[8] https://en.wikipedia.org/wiki/Internet_Protocol

[9] https://en.wikipedia.org/wiki/IEEE_802.11

standard protocol. But even *this* isn't the bottom, because this is actually probably specifying something like MIMO-OFDM[10], giving specifications about frequencies of microwave radiation, antennas, multiplexing, error-correction codes and so on. And WiFi is just the first hop: after the WiFi receiver, there will be protocols for delivering the packets via the telephony system.

4. TCP - Transmission Control Protocol

Another Abstraction going on here is that my browser believes it has a "connection" to the server. This is provided by the TCP protocol.

But, this is a fiction - my "connection" is built on the IP protocol, which as we saw above is just packets of data on the network. So there are lots of packets floating around which say "this connection is still alive" and "I'm message 5 in the sequence" and so on in order to maintain this fiction.

This all means that the browser can forget about all the details of packet ordering and so on, and work with the fiction of a connection.

5. HTTP - Hypertext Transfer Protocol

If we examine what is being sent on the TCP connection, we see something like this:

```
> GET /preferences HTTP/1.1
> Host: google.com
> Accept: */*
>
```

This is now the HTTP protocol proper, and these 4 lines are sending information *over the connection* to the Google server, to ask it for the page. Finally, Google's server gets to respond:

```
< HTTP/1.1 301 Moved Permanently
< Location: http://www.google.com/preferences
...
```

In this case, Google's server is telling us that the web page has changed address. The `301` is a status code meaning the page has moved: Instead of `http://google.com/preferences`, we want `http://www.google.com/preferences`.

[10] https://en.wikipedia.org/wiki/MIMO-OFDM

Summary

By having a stack of protocols, we are able to apply Separation Of Concerns[11], each protocol handling just a few concerns:

Protocol	Abstractions
`HTTP`	URLs, error codes, pages.
`DNS`	Names of servers to IP Addresses.
`TCP`	The concept of a "connection" with guarantees about ordering and delivery.
`IP`	"Packets" with addresses and payloads.
`WiFi`	"Networks", 802.11 flavours, Transmitters, Antennas, error correction codes.

`HTTP` "stands on the shoulders of giants": Not only does it get to use pre-existing protocols like `TCP` and `DNS` to make it's life easier, it got `802.11` "for free" when this came along and plugged into the existing `IP` protocol. This is the key value of abstraction: you get to piggy-back on *existing* patterns, and use them yourself.

12.6 Protocol Risk

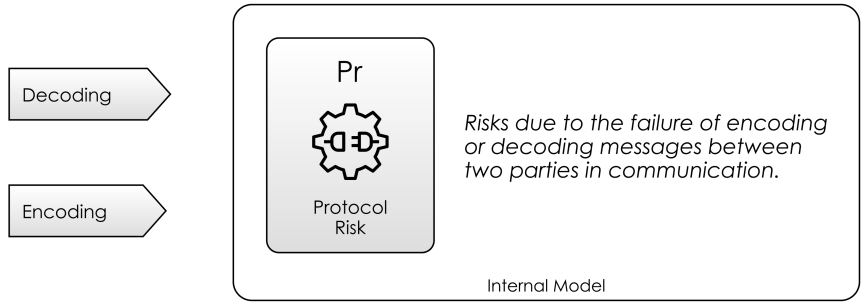


Figure 12.6: Communication Protocols Risks

Hopefully, the above example gives an indication of the usefulness of protocols within software. But for every protocol we use, we have Protocol Risk. This is a problem in human communication protocols, but it's really com-

[11] `https://en.wikipedia.org/wiki/Separation_of_concerns`

mon in computer communication because we create protocols *all the time* in software.

For example, as soon as we define a Javascript function (called **b** here), we are creating a protocol for other functions (**a** here) to use it:

```
function b(a, b, c) {
    return a+b+c;
}

function a() {
    var bOut = b(1,2,3);
    return "something "+bOut;       // returns "something 6"
}
```

If function **b** then changes, say:

```
function b(a, b, c, d /* new parameter */) {
    return a+b+c+d;
}
```

Then, **a** will instantly have a problem calling it and there will be an error of some sort.

Protocol Risk also occurs when we use Data Types[12]: whenever we change the data type, we need to correct the usages of that type. Note above, I've given the `JavaScript` example, but I'm going to switch to `TypeScript` now:

```
interface BInput {
    a: string,
    b: string,
    c: string,
    d: string
}

function b(in: BInput): string {
    return in.a + in.b + in.c + in.d;
}

function a() {
```

[12] https://en.wikipedia.org/wiki/Data_type

```
    var bOut = b({a: 1, b: 2, c: 3);        // new parameter d missing
    return "something "+bOut;
}
```

By using a static type checker[13], we can identify issues like this, but there is a tradeoff: we mitigate Protocol Risk, because we define the protocols *once only* in the program, and ensure that usages all match the specification. But the tradeoff is (as we can see in the TypeScript code) more *finger-typing*, which means Codebase Risk in some circumstances.

Nevertheless, static type checking is so prevalent in software that clearly in most cases, the trade-off has been worth it: Even languages like Clojure[14] have been retro-fitted with type checkers[15].

Let's look at some further types of Protocol Risk:

Protocol Incompatibility Risk

The people you find it *easiest* to communicate with are your friends and family, those closest to you. That's because you're all familiar with the same protocols. Someone from a foreign country, speaking a different language and having a different culture, will essentially have a completely incompatible protocol for spoken communication to you.

Within software, there are also competing, incompatible protocols for the same things, which is maddening when your protocol isn't supported. Although the world seems to be standardizing, there used to be *hundreds* of different image formats. Photographs often use TIFF[16], RAW[17] or JPEG[18], whilst we also have SVG[19] for vector graphics, GIF[20] for images and animations and PNG[21] for other bitmap graphics.

Protocol Versioning Risk

Even when systems are talking the same protocol, there can be problems. When we have multiple, different systems owned by different parties, on their own upgrade cycles, we have **Protocol Versioning Risk**: the risk that either

[13] https://en.wikipedia.org/wiki/Type_system#Static_type_checking

[14] https://clojure.org

[15] https://github.com/clojure/core.typed/wiki/User-Guide

[16] https://en.wikipedia.org/wiki/TIFF

[17] https://en.wikipedia.org/wiki/Raw_image_format

[18] https://en.wikipedia.org/wiki/JPEG

[19] https://en.wikipedia.org/wiki/Scalable_Vector_Graphics

[20] https://en.wikipedia.org/wiki/GIF

[21] https://en.wikipedia.org/wiki/Portable_Network_Graphics

client or supplier could start talking in a version of the protocol that the other side hasn't learnt yet. There are various mitigating strategies for this. We'll look at two now: **Backwards Compatibility** and **Forwards Compatibility**.

Backward Compatibility

Backwards Compatibility mitigates Protocol Versioning Risk. Quite simply, this means, supporting the old format until it falls out of use. If a supplier is pushing for a change in protocol it either must ensure that it is Backwards Compatible with the clients it is communicating with, or make sure they are upgraded concurrently. When building web services[22], for example, it's common practice to version all APIs so that you can manage the migration. Something like this:

- Supplier publishes `/api/v1/something`.
- Clients use `/api/v1/something`.
- Supplier publishes `/api/v2/something`.
- Clients start using `/api/v2/something`.
- Clients (eventually) stop using `/api/v2/something`.
- Supplier retires `/api/v2/something` API.

Forward Compatibility

`HTML` and `HTTP` provide "graceful failure" to mitigate Protocol Risk: while its expected that all clients can parse the syntax of `HTML` and `HTTP`, it's not necessary for them to be able to handle all of the tags, attributes and rules they see. The specification for both these standards is that if you don't understand something, ignore it. Designing with this in mind means that old clients can always at least cope with new features, but it's not always possible.

`JavaScript` *can't* support this: because the meaning of the next instruction will often depend on the result of the previous one.

Do human languages support this? To some extent! New words are added to our languages all the time. When we come across a new word, we can either ignore it, guess the meaning, ask or look it up. In this way, human language has **Forward Compatibility** features built in.

Protocol Implementation Risk

A second aspect of Protocol Risk exists in heterogeneous computing environments, where protocols have been independently implemented based on

[22] `https://en.wikipedia.org/wiki/Web_service`

standards. For example, there are now so many different browsers, all supporting variations of `HTTP`, `HTML` and `JavaScript` that it becomes impossible to test comprehensively over all the different versions. To mitigate as much Protocol Risk as possible, generally we test web sites in a subset of browsers, and use a lowest-common-denominator approach to choosing protocol and language features.

12.7 Messages

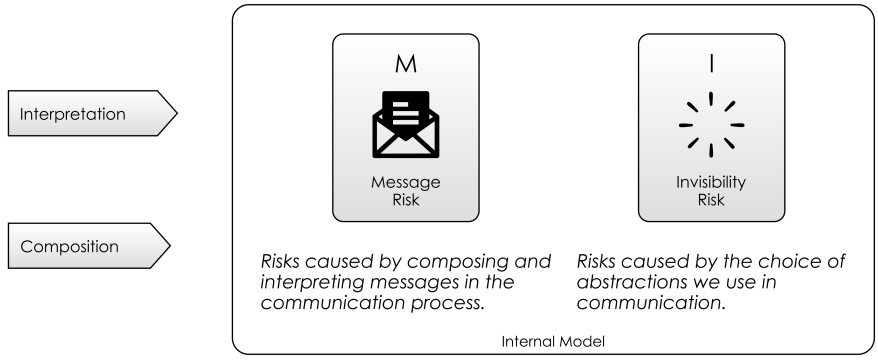


Figure 12.7: Message Risk

Although Shannon's Communication Theory is about transmitting **Messages**, messages are really encoded **Ideas** and **Concepts**, from an **Internal Model**. Let's break down some of the risks associated with this:

Internal Model Assumption Risk

When we construct messages in a conversation, we have to make judgements about what the other person already knows. For example, if I want to tell you about a new JDBC Driver[23], this pre-assumes that you know what JDBC is: the message has a dependency on prior knowledge. Or, When talking to children, it's often hard work because they *assume* that you have knowledge of everything they do.

This is called Theory Of Mind[24]: the appreciation that your knowledge is different to other people's, and adjusting you messages accordingly. When

[23] `https://en.wikipedia.org/wiki/JDBC_driver`

[24] `https://en.wikipedia.org/wiki/Theory_of_mind`

teaching, this is called The Curse Of Knowledge[25]: teachers have difficulty understanding students' problems *because they already understand the subject*.

Message Dependency Risk

A second, related problem is actually Dependency Risk, which is covered more thoroughly in a later chapter. Often, to understand a new message, you have to have followed everything up to that point already.

The same **Message Dependency Risk** exists for computer software: if there is replication going on between instances of an application, and one of the instances misses some messages, you end up with a "Split Brain[26]" scenario, where later messages can't be processed because they refer to an application state that doesn't exist. For example, a message saying:

```
Update user 53's surname to 'Jones'
```

only makes sense if the application has previously processed the message

```
Create user 53 with surname 'Smith'
```

Misinterpretation Risk

For people, nothing exists unless we have a name for it. The world is just atoms, but we don't think like this. *The name is the thing*.

> "The famous pipe. How people reproached me for it! And yet, could you stuff my pipe? No, it's just a representation, is it not? So if I had written on my picture "This is a pipe", I'd have been lying!"
>
> —Rene Magritte, of *The Treachery of Images*[27]

People don't rely on rigorous definitions of abstractions like computers do; we make do with fuzzy definitions of concepts and ideas. We rely on Abstraction to move between the name of a thing and the *idea of a thing*.

This brings about Misinterpretation Risk: names are not *precise*, and concepts mean different things to different people. We can't be sure that other people have the same meaning for a name that we have.

[25] https://en.wikipedia.org/wiki/Curse_of_knowledge

[26] https://en.wikipedia.org/wiki/Split-brain_(computing)

[27] https://en.wikipedia.org/wiki/The_Treachery_of_Images

Invisibility Risk

Another cost of Abstraction is Invisibility Risk. While abstraction is a massively powerful technique, (as we saw above, Protocols allow things like the Internet to happen) it lets the function of a thing hide behind the layers of abstraction and become invisible.

Invisibility Risk In Conversation

Invisibility Risk is risk due to information not sent. Because humans don't need a complete understanding of a concept to use it, we can cope with some Invisibility Risk in communication, and this saves us time when we're talking. It would be *painful* to have conversations if, say, the other person needed to understand everything about how cars worked in order to discuss cars.

For people, Abstraction is a tool that we can use to refer to other concepts, without necessarily knowing how the concepts work. This divorcing of "what" from "how" is the essence of abstraction and is what makes language useful.

The debt of Invisibility Risk comes due when you realise that *not* being given the details *prevents* you from reasoning about it effectively. Let's think about this in the context of a project status meeting, for example:

- Can you be sure that the status update contains all the details you need to know?
- Is the person giving the update wrong or lying?
- Do you know enough about the details of what's being discussed in order to make informed decisions about how the project is going?

Invisibility Risk In Software

Invisibility Risk is everywhere in software. Let's consider what happens when, in your program, you create a new function, **f**:

- First, by creating **f**, you have *given a piece of functionality a name*, which is abstraction.
- Second, **f** *supplies* functionality to clients, so we have created a client-supplier relationship.
- Third, these parties now need to communicate, and this will require a protocol. In a programming language, this protocol is the arguments passed to **f**, and the response *back* from **f**.

But something else also happens: By creating **f**, you are saying "I now have this operation. The details, I won't mention again, but from now on, it's called **f**" Suddenly, the implementation of "**f**" hides and it is working invisibly. Things go on in **f** that people don't necessarily need to understand. There may be some documentation, or tacit knowledge around what **f** is, and what it does, but it's not necessarily right.

*Referring to **f** is a much simpler job than understanding **f**.*

We try to mitigate this via (for the most part) documentation, but this is a terrible deal: because we can't understand the original, (un-abstracted) implementation, we now need to write some simpler documentation, which *explains* the abstraction, in terms of further abstractions, and this is where things start to get murky.

Invisibility Risk is mainly Hidden Risk. (Mostly, *you don't know what you don't know*.) But you can carelessly *hide things from yourself* with software:

- Adding a thread to an application that doesn't report whether it's worked, failed, or is running out of control and consuming all the cycles of the CPU.
- Redundancy can increase reliability, but only if you know when servers fail, and fix them quickly. Otherwise, you only see problems when the last server fails.
- When building a web-service, can you assume that it's working for the users in the way you want it to?

When you build a software service, or even implement a thread, ask yourself: "How will I know next week that this is working properly?" If the answer involves manual work and investigation, then your implementation has just cost you in Invisibility Risk.

12.8 Internal Models

So finally, we are coming to the root of the problem: communication is about transferring ideas and concepts from one Internal Model to another.

The communication process so far has been fraught with risks, but we have a few more to come.

Trust & Belief Risk

Although protocols can sometimes handle security features of communication (such as Authentication[28] and preventing man-in-the-middle attacks[29]), trust goes further than this, it is the flip-side of Agency Risk, which we will look at later: can you be sure that the other party in the communication is acting in your best interests?

Even if the receiver trusts the communicator, they may not believe the message. Let's look at some reasons for that:

- Weltanschauung (World View)[30]: The ethics, values and beliefs in the receiver's Internal Model may be incompatible to those from the sender.
- Relativism[31] is the concept that there are no universal truths. Every truth is from a frame of reference. For example, what constitutes *offensive language* is dependent on the listener.
- Psycholinguistics[32] is the study of humans aquire languages. There are different languages and dialects, (and *industry dialects*), and we all understand language in different ways, take different meanings and apply different contexts to the messages.

From the point-of-view of Marketing Communications, choosing the right message is part of the battle. You are trying to communicate your idea in such a way as to mitigate Trust & Belief Risk.

Learning-Curve Risk

If the messages we are receiving force us to update our Internal Model too much, we can suffer from the problem of "too steep a Learning Curve[33]" or "Information Overload[34]", where the messages force us to adapt our Internal Model too quickly for our brains to keep up.

Commonly, the easiest option is just to ignore the information channel completely in these cases.

Reading Code

It's often been said that code is *harder to read than to write*:

[28] https://en.wikipedia.org/wiki/Authentication

[29] https://en.wikipedia.org/wiki/Man-in-the-middle_attack

[30] https://en.wikipedia.org/wiki/World_view

[31] https://en.wikipedia.org/wiki/Relativism

[32] https://en.wikipedia.org/wiki/Psycholinguistics

[33] https://en.wikipedia.org/wiki/Learning_curve

[34] https://en.wikipedia.org/wiki/Information_overload

> "If you ask a software developer what they spend their time doing, they'll tell you that they spend most of their time writing code. However, if you actually observe what software developers spend their time doing, you'll find that they spend most of their time trying to understand code." - When Understanding Means Rewriting, *Coding Horror*[35]

By now it should be clear that it's going to be *both* quite hard to read and write: the protocol of code is actually designed for the purpose of machines communicating, not primarily for people to understand. Making code human readable is a secondary concern to making it machine readable.

But now we should be able to see the reasons it's harder to read than write too:

- When reading code, you are having to shift your Internal Model to wherever the code is, accepting decisions that you might not agree with and accepting counter-intuitive logical leaps. i.e. Learning Curve Risk. *(cf. Principle of Least Surprise[36])*
- There is no Feedback Loop between your Internal Model and the Reality of the code, opening you up to Misinterpretation Risk. When you write code, your compiler and tests give you this.
- While reading code *takes less time* than writing it, this also means the Learning Curve is steeper.

12.9 Communication Risk Wrap Up

In this chapter, we've looked at Communication Risk itself, and broken it down into six sub-types of risk, as shown in figure 12.9. Again, we are calling out *patterns* here: you can equally classify communication risks in other ways. However, concepts like Learning-Curve Risk and Invisibility Risk we will need again. Also, note how these risks are, in a sense, opposite:

- The higher the level of abstraction you use, the less you need to learn, but at the expense of extra invisibility.
- The more you peel back abstractions, the more you expose, but the more complex things are to understand.

[35] https://blog.codinghorror.com/when-understanding-means-rewriting/

[36] https://en.wikipedia.org/wiki/Principle_of_least_astonishment

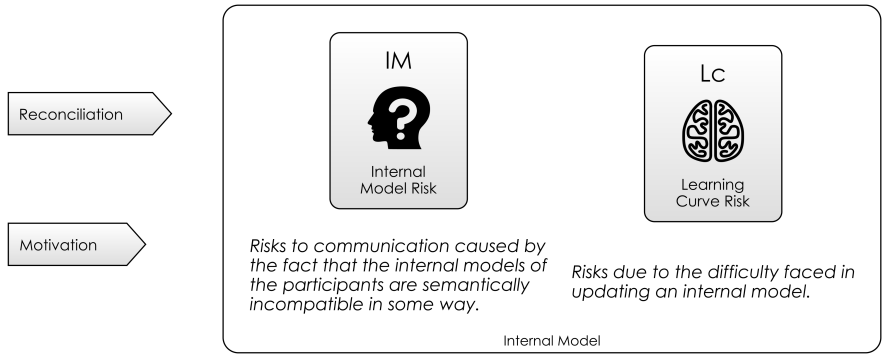


Figure 12.8: Internal Model Risks

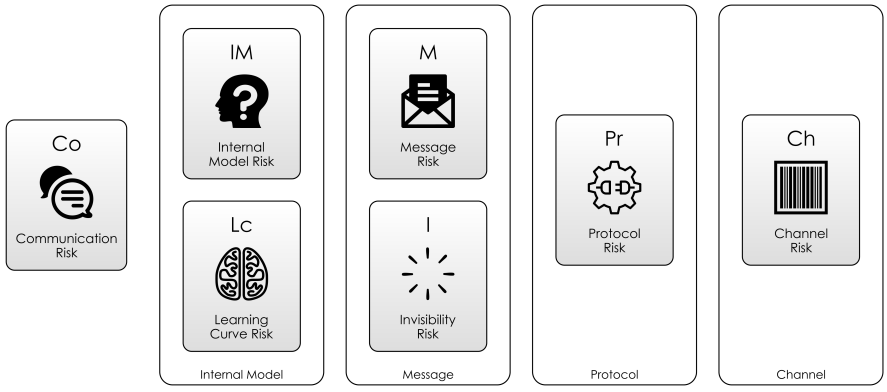


Figure 12.9: Communication Marketing

In the next chapter, we will address complexity head-on, and understand how Complexity Risk manifests in software projects.

CHAPTER 13

Complexity Risk

Complexity Risk are the risks to your project due to its underlying "complexity". Over the next few chapters, we'll break down exactly what we mean by complexity, looking at Dependency Risk and Boundary Risk as two particular sub-types of Complexity Risk.

13.1 Codebase Risk

In this chapter, we're going to start by looking at *code you write*: the size of your code-base, the number of modules, the interconnectedness of the modules and how well-factored the code is.

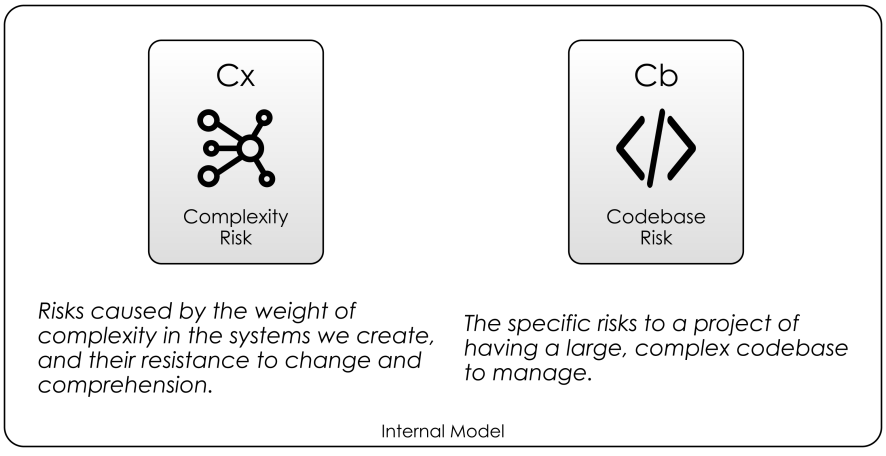


Figure 13.1: Complexity Risk and Codebase Risk

You could think of this as Codebase Risk. We'll look at three separate measures of codebase complexity and talk about Technical Debt, before looking at areas in which Complexity Risk is at it's greatest.

13.2 Kolmogorov Complexity

The standard Computer-Science definition of complexity, is Kolmogorov Complexity[1]. This is:

> "... the length of the shortest computer program (in a predetermined programming language) that produces the object as output." - Kolmogorov Complexity, Wikipedia

This is a fairly handy definition for us, as it means that to in writing software to solve a problem, there is a lower bound on the size of the software we write. In practice, this is pretty much impossible to quantify. But that doesn't really matter: the techniques for *moving in that direction* are all that we are interested in, and this basically amounts to compression.

Let's say we wanted to write a JavaScript program to output this string:

```
abcdabcdabcdabcdabcdabcdabcdabcdabcdabcd
```

We might choose this representation:

```
function out() {                                              (7 )
    return "abcdabcdabcdabcdabcdabcdabcdabcdabcdabcdabcd" (45)
}                                                             (1 )
```

The numbers in brackets indicate how many symbols each line contains, so in total, this code block contains **53 symbols**, if you count `function`, `out` and `return` as one symbol each.

But, if we write it like this:

```
const ABCD="ABCD";                                            (11)

function out() {                                              (7 )
    return ABCD+ABCD+ABCD+ABCD+ABCD+ABCD+ABCD+                (16)
```

[1] https://en.wikipedia.org/wiki/Kolmogorov_complexity

```
        ABCD+ABCD+ABCD;                                    (6 )
}                                                          (1 )
```

With this version, we now have **41 symbols** (**ABCD** is a single symbol, because we could have called it anything). And with this version:

```
const ABCD="ABCD";                                         (11)

function out() {                                           (7 )
    return ABCD.repeat(10)                                 (7 )
}                                                          (1 )
```

. . . we have **26 symbols**.

Abstraction

What's happening here is that we're *exploiting a pattern*: we noticed that `ABCD` occurs several times, so we defined it a single time and then used it over and over, like a stamp.

By applying abstraction, we can improve in the direction of the Kolmogorov limit. And, by allowing ourselves to say that *symbols* (like `out` and `ABCD`) are worth one complexity point, we've allowed that we can be descriptive in our `function` name and `const`. Naming things is an important part of abstraction, because to use something, you have to be able to refer to it.

Trade-Off

Generally, the more complex a piece of software is, the more difficulty users will have understanding it, and the more difficulty developers will have changing it. We should prefer the third version of our code over either the first or second because of it's brevity.

But we could go further down into Code Golf[2] territory. This javascript program plays FizzBuzz[3] up to 100, but is less readable than you might hope:

```
for(i=0;i<100;)document.write(((++i%3?'':'Fizz')+
(i%5?'':'Buzz')||i)+"<br>")                                (62)
```

[2] https://en.wikipedia.org/wiki/Code_golf

[3] https://en.wikipedia.org/wiki/Fizz_buzz

So there is at some point a trade-off to be made between Complexity Risk and Communication Risk. After a certain point, reducing Kolmogorov Complexity further risks making the program less intelligible.

13.3 Connectivity

A second, useful measure of complexity comes from graph theory, and that is the connectivity of a graph:

> "... the minimum number of elements (nodes or edges) that need to be removed to disconnect the remaining nodes from each other"
>
> —Connectivity, *Wikipedia*[4])

To see this in action, have a look at the below graph:

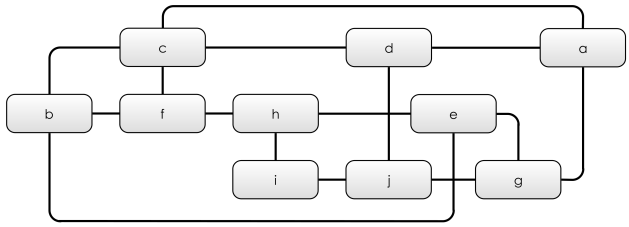


Figure 13.2: Graph 1, 2-Connected

It has 10 vertices, labelled **a** to **j**, and it has 15 edges (or links) connecting the vertices together. If any single edge were removed from figure 13.2, the 10 vertices would still be linked together. Because of this, we can say that the graph is *2-connected*. That is, to disconnect any single vertex, you'd have to remove *at least* two edges.

As a slight aside, let's consider the **Kolmogorov Complexity** of this graph, by inventing a mini-language to describe graphs. It could look something like this:

```
<item> : [<item>,]* <item>     # Indicates that the item
                               # before the colon
```

[4] https://en.wikipedia.org/wiki/Connectivity_(graph_theory

```
                                # has a connection to all
                                # the items after the colon
```

So our graph could be defined like this:

```
a: b,c,d
b: c,f,e
c: f,d
d: j
e: h,j
f: h
g: j
h: i
i: j
                                                        (39)
```

Let's remove some of those extra links:

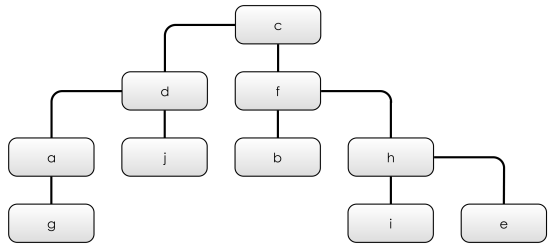


Figure 13.3: Graph 2, 1-Connected

In this graph, I've removed 6 of the edges. Now, we're in a situation where if any single edge is removed, the graph becomes *unconnected*. That is, it's broken into distinct chunks. So, it's *1-connected*.

The second graph is clearly simpler than the first. And, we can show this by looking at the **Kolgomorov Complexity** in our little language:

```
a: d,g
b: f
c: d,f
d: j
f: h
```

```
e: h
h: i
                                                    (25)
```

Connectivity is also **Complexity**. This carries over into software too: because heavily connected software is more complex than less-connected software, it is harder to reason about and work with, and the reason programs with greater connectivity are harder to work with is that changing one module potentially impacts many others. Let's dig into this further.

13.4 Hierarchies and Modularisation

In the second, simplified graph, I've arranged it as a hierarchy, which I can do now that it's only 1-connected. For 10 vertices, we need 9 edges to connect everything up. It's always:

```
edges = vertices - 1
```

Note that I could pick any hierarchy here: I don't have to start at **c** (although it has the nice property that it has two roughly even sub-trees attached to it).

How does this help us? Imagine if **a** - **j** were modules of a software system, and the edges of the graph showed communications between the different sub-systems. In the first graph, we're in a worse position:

- Who's in charge? What deals with what?
- Can I isolate a component and change it safely?
- What happens if one component disappears?

But, in the second graph, it's easier to reason about, because of the reduced number of connections and the new hierarchy of organisation.

On the down-side, perhaps our messages have farther to go now: in the original, **i** could send a message straight to **j**, but now we have to go all the way via **c**. But this is the basis of Modularisation[5] and Hierarchy[6].

As a tool to battle complexity, we don't just see this in software, but everywhere in our lives. Society, business, nature and even our bodies:

[5] https://en.wikipedia.org/wiki/Modular_programming

[6] https://en.wikipedia.org/wiki/Hierarchy

- **Organelles** - such as Mitochondria[7].
- **Cells** - such as blood cells, nerve cells, skin cells in the Human Body[8].
- **Organs** - like hearts livers, brains etc.
- **Organisms** - like you and me.

The great complexity-reducing mechanism of modularisation is that *you only have to consider your local environment*.

13.5 More Abstraction

A variation on this graph connectivity metric is our third measure of complexity, Cyclomatic Complexity[9]. This is:

```
Cyclomatic Complexity = edges  vertices + 2P,
```

Where **P** is the number of **Connected Components** (i.e. distinct parts of the graph that aren't connected to one another by any edges).

So, our first graph had a **Cyclomatic Complexity** of 7. `(15 - 10 + 2)`, while our second was 1. `(9 - 10 + 2)`.

Cyclomatic complexity is all about the number of different routes through the program. The more branches a program has, the greater it's cyclomatic complexity. Hence, this is a useful metric in Testing and Code Coverage[10]: the more branches you have, the more tests you'll need to exercise them all.

Our second graph has a **Cyclomatic Complexity** of 1 (the minimum), but we can go further through abstraction, because this representation isn't minimal from a **Kolmogorov Complexity** point-of-view. For example, we might observe that there are further similarities in the graph that we can "draw out":

Here, we've spotted that the structure of subgraphs **P1** and **P2** are the same: we can have the same functions there to assemble those. Noticing and exploiting patterns of repetition is one of the fundamental tools we have in the fight against Complexity Risk.

So, we've looked at some measures of software structure complexity, in order that we can say "this is more complex than this". However, we've not really said why complexity entails Risk. So let's address that now by looking at two analogies, Mass and Technical Debt.

[7] https://en.wikipedia.org/wiki/Mitochondrion

[8] https://en.wikipedia.org/wiki/List_of_distinct_cell_types_in_the_adult_human_body

[9] https://en.wikipedia.org/wiki/Cyclomatic_complexity

[10] https://en.wikipedia.org/wiki/Code_coverage

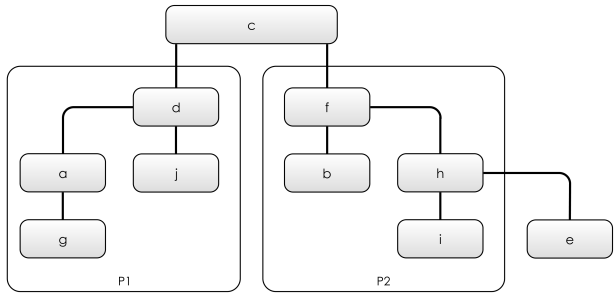


Figure 13.4: Complexity 3

13.6 Complexity is Mass

The first way to look at complexity is as **Mass** : a software project with more complexity has greater mass than one with less complexity. Newton's Second Law states:

F = m**a**, (Force = Mass x Acceleration)

That is, in order to move your project *somewhere new*, and make it do new things, you need to give it a push, and the more mass it has, the more **Force** you'll need to move (accelerate) it.

You could stop here and say that the more lines of code a project contains, the higher it's mass. And, that makes sense, because in order to get it to do something new, you're likely to need to change more lines.

But there is actually some underlying sense in which this is true in the real, physical world too, as discussed in this Veritasium[11] video. To paraphrase:

> "Most of your mass you owe due to $E = mc^2$, you owe to the fact that your mass is packed with energy, because of the **interactions** between these quarks and gluon fluctuations in the gluon field... what we think of as ordinarily empty space... that turns out to be the thing that gives us most of our mass."
>
> —Your Mass is NOT From the Higgs Boson, *Veritasium*[12]

[11] https://www.youtube.com/user/1veritasium

[12] https://www.youtube.com/watch?annotation_id=annotation_3771848421&feature=iv&src_vid=Xo232kyTsO0&v=Ztc6QPNUqls

I'm not an expert in physics, *at all*, and so there is every chance that I am pushing this analogy too hard. But, substituting quarks and gluons for pieces of software we can (in a very handwaving-y way) say that more complex software has more **interactions** going on, and therefore has more mass than simple software.

If we want to move *fast* we need simple codebases.

At a basic level, Complexity Risk heavily impacts on Schedule Risk: more complexity means you need more force to get things done, which takes longer.

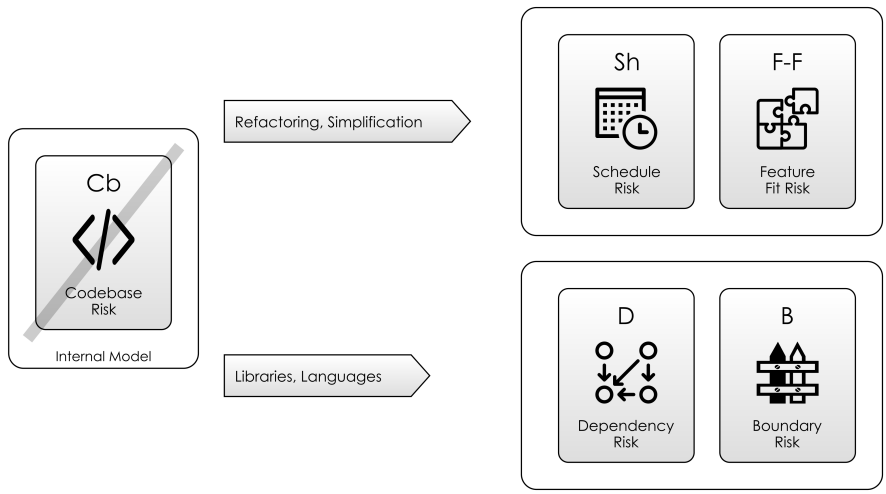


Figure 13.5: Complexity Risk and some mitigations

13.7 Technical Debt

The most common way we talk about unnecessary complexity in software is as Technical Debt:

> "Shipping first time code is like going into debt. A little debt speeds development so long as it is paid back promptly with a rewrite... The danger occurs when the debt is not repaid. Every minute spent on not-quite-right code counts as interest on that debt. Entire engineering organisations can be brought to a stand-

> still under the debt load of an unconsolidated implementation, object-oriented or otherwise."
>
> Ward Cunningham, 1992[13]

Building a perfect first-time solution is a waste, because perfection takes a long time. You're taking on more attendant Schedule Risk than necessary and Meeting Reality more slowly than you could.

A quick-and-dirty, over-complex implementation mitigates the same Feature Risk and allows you to Meet Reality faster.

But, having mitigated the Feature Risk, you are now carrying more Complexity Risk than you necessarily need, and it's time to think about how to Refactor[14] the software to reduce this risk again.

13.8 Kitchen Analogy

It's often hard to make the case for minimising Technical Debt: it often feels that there are more important priorities, especially when technical debt can be "swept under the carpet" and forgotten about until later. (See Discounting The Future.)

One helpful analogy I have found is to imagine your code-base is a kitchen. After preparing a meal (i.e. delivering the first implementation), *you need to tidy up the kitchen*. This is just something everyone does as a matter of *basic sanitation*.

Now of course, you could carry on with the messy kitchen. When tomorrow comes and you need to make another meal, you find yourself needing to wash up saucepans as you go, or working around the mess by using different surfaces to chop on.

It's not long before someone comes down with food poisoning.

We wouldn't tolerate this behaviour in a restaurant kitchen, so why put up with it in a software project?

13.9 Feature Creep

In Brooks' essay "No Silver Bullet - Essence and Accident in Software Engineering", a distinction is made between:

[13] https://en.wikipedia.org/wiki/Technical_debt

[14] https://en.wikipedia.org/wiki/Code_refactoring

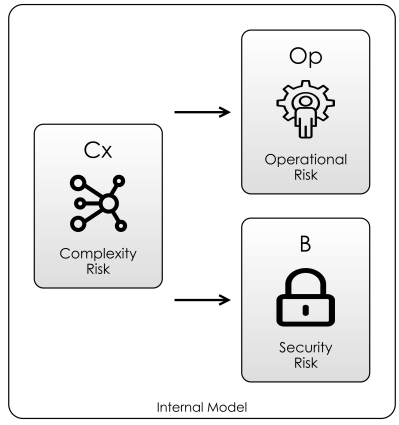


Figure 13.6: Complexity Risk and it's implications

- **Essence**: *the difficulties inherent in the nature of the software.*
- **Accident**: *those difficulties that attend its production but are not inherent.* - Fred Brooks, *No Silver Bullet*[15]

The problem with this definition is that we are accepting features of our software as *essential*.

Applying Risk-First, if you want to mitigate some Feature Risk then you have to pick up Complexity Risk as a result. But, that's a *choice you get to make*.

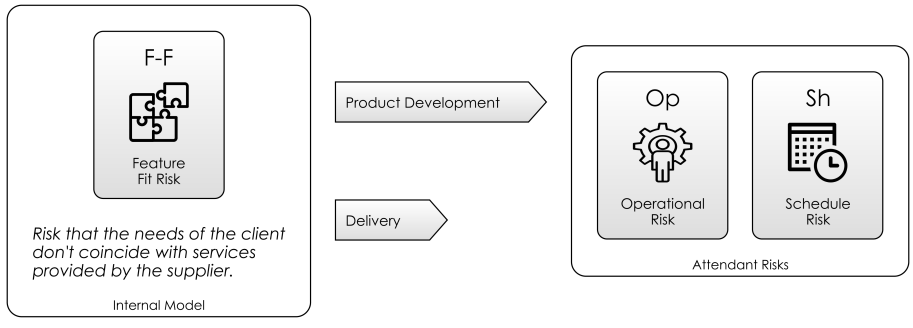


Figure 13.7: Mitigating Feature Fit Risk (from Feature Risk)

[15] https://en.wikipedia.org/wiki/No_Silver_Bullet

Therefore, Feature Creep[16] (or Gold Plating[17]) is a failure to observe this basic equation: instead of considering this trade off, you're building every feature possible. This has an impact on Complexity Risk, which in turn impacts Communication Risk and also Schedule Risk.

Sometimes, feature-creep happens because either managers feel they need to keep their staff busy, or the staff decide on their own that they need to keep themselves busy. This is something we'll return to in Agency Risk.

13.10 Dead-End Risk

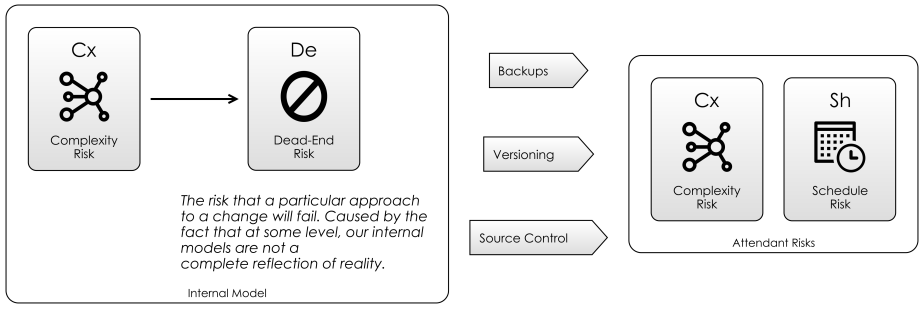


Figure 13.8: Dead-End Risk

Dead-End Risk is where you take an action that you *think* is useful, only to find out later that actually, it was a dead-end, and your efforts were wasted.

For example, let's say that the Accounting sub-system needed password protection (so you built this). Then the team realised that you needed a way to *change the password* (so you built that). Then, that you needed to have more than one user of the Accounting system so they would all need passwords (OK, fine).

Finally, the team realises that actually logging-in would be something that all the sub-systems would need, and that it had already been implemented more thoroughly by the Approvals sub-system.

At this point, you realise you're in a **Dead End**:

- **Option 1: Continue.** You carry on making minor incremental improvements to the accounting password system (carrying the extra Complexity Risk of the duplicated functionality).

[16] https://en.wikipedia.org/wiki/Feature_creep

[17] https://en.wikipedia.org/wiki/Gold_plating_(software_engineering)

- **Option 2: Merge.** You rip out the accounting password system, and merge in the Approvals system, surfacing new, hidden Complexity Risk in the process, due to the difficulty in migrating users from the old to new way of working. There is Implementation Risk here.
- **Option 3: Remove** You start again, trying to take into account both sets of requirements at the same time, again, possibly surfacing new hidden Complexity Risk due to the combined approach. Rewriting code or a whole project can seem like a way to mitigate Complexity Risk, but it usually doesn't work out too well. As Joel Spolsky says:

> There's a subtle reason that programmers always want to throw away the code and start over. The reason is that they think the old code is a mess. And here is the interesting observation: they are probably wrong. The reason that they think the old code is a mess is because of a cardinal, fundamental law of programming: *It's harder to read code than to write it.* - Things You Should Never Do, Part 1, *Joel Spolsky*[18]

Sometimes, the path across the Risk Landscape will take you to dead ends, and the only benefit to be gained is experience. No one deliberately chooses a dead end - often you can take an action that doesn't pay off, but frequently the dead end appears from nowhere: it's a Hidden Risk. The source of a lot of this hidden risk is the complexity of the risk landscape.

Version Control Systems[19] like Git[20] are a useful mitigation of Dead-End Risk, because using them means that at least you can *go back* to the point where you made the bad decision and go a different way. Additionally, they provide you with backups against the often inadvertent Dead-End Risk of someone wiping the hard-disk.

13.11 Where Complexity Hides

So far, we've focused mainly on Codebase Risk, but this isn't the only place complexity appears in software. We're going to cover a few of these areas now, but be warned, this is not a complete list by any means:

- Algorithmic (Space and Time) Complexity
- Memory Management

[18] https://www.joelonsoftware.com/2000/04/06/things-you-should-never-do-part-i/

[19] https://en.wikipedia.org/wiki/Version_control

[20] https://en.wikipedia.org/wiki/Git

- Protocols / Types
- Concurrency / Mutability
- Networks / Security
- The Environment

Space and Time Complexity

There is a whole branch of complexity theory devoted to how the software *runs*, namely Big O Complexity[21].

Once running, an algorithm or data structure will consume space or runtime dependent on it's performance characteristics, which may well have an impact on the Operational Risk of the software. Using off-the-shelf data structures and algorithms helps, but you still need to know their performance characteristics.

The Big O Cheat Sheet[22] is a wonderful resource to investigate this further.

Memory Management

Memory Management (and more generally, all resource management in software) is another place where Complexity Risk hides:

> "Memory leaks are a common error in programming, especially when using languages that have no built in automatic garbage collection, such as C and C++."
>
> —Memory Leak, *Wikipedia*[23]

Garbage Collectors[24] (as found in Javascript or Java) offer you the deal that they will mitigate the Complexity Risk of you having to manage your own memory, but in return perhaps give you fewer guarantees about the *performance* of your software. Again, there are times when you can't accommodate this Operational Risk, but these are rare and usually only affect a small portion of an entire software-system.

Protocols And Types

As we saw in Communication Risk, whenever two components of a software system need to interact, they have to establish a protocol for doing so.

[21] https://en.wikipedia.org/wiki/Big_O_notation

[22] http://bigocheatsheet.com

[23] https://en.wikipedia.org/wiki/Memory_leak

[24] https://en.wikipedia.org/wiki/Garbage_collection_(computer_science)

As systems become more complex, and the connectedness increases, it becomes hard to manage the risk around versioning protocols. This becomes especially true when operating beyond the edge of the compiler's domain.

Although type checking helps mitigate Protocol Risk in the small, when software systems grow large it becomes hard to communicate their intent and keep their degree of connectivity low, and you end up with the Big Ball Of Mud:

> "A big ball of mud is a software system that lacks a perceivable architecture. Although undesirable from a software engineering point of view, such systems are common in practice due to business pressures, developer turnover and code entropy."
>
> —Big Ball Of Mud, *Wikipedia*[25]

Concurrency / Mutability

Although modern languages include plenty of concurrency primitives, (such as the java.util.concurrent[26] libraries), concurrency is *still* hard to get right.

Race conditions[27] and Deadlocks[28] *thrive* in over-complicated concurrency designs: complexity issues are magnified by concurrency concerns, and are also hard to test and debug.

Recently, languages such as Clojure have introduced persistent collections[29] to alleviate concurrency issues. The basic premise is that any time you want to *change* the contents of a collection, you get given back a *new collection*. So, any collection instance is immutable once created. The tradeoff is again attendant Performance Risk to mitigate Complexity Risk.

An important lesson here is that choice of language can reduce complexity: and we'll come back to this in Software Dependency Risk.

Networking / Security

There are plenty of Complexity Risk perils in *anything* to do with networked code, chief amongst them being error handling and (again) protocol evolution.

---

[25] https://en.wikipedia.org/wiki/Big_ball_of_mud

[26] https://docs.oracle.com/javase/9/docs/api/java/util/concurrent/package-summary.html

[27] https://en.wikipedia.org/wiki/Race_condition

[28] https://en.wikipedia.org/wiki/Deadlock

[29] https://en.wikipedia.org/wiki/Persistent_data_structure

In the case of security considerations, exploits *thrive* on the complexity of your code, and the weaknesses that occur because of it. In particular, Schneier's Law says, never implement your own cryptographic scheme:

> "Anyone, from the most clueless amateur to the best cryptographer, can create an algorithm that he himself can't break. It's not even hard. What is hard is creating an algorithm that no one else can break, even after years of analysis."
>
> Bruce Schneier, 1998[30]

Luckily, most good languages include cryptographic libraries that you can include to mitigate these Complexity Risks from your own code-base.

This is a strong argument for the use of libraries. But, when should you use a library and when should you implement yourself? This is again covered in the chapter on Software Dependency Risk.

The Environment

The complexity of software tends to reflect the complexity of the environment it runs in, and complex software environments are more difficult to reason about, and more susceptible to Operational Risk and Security-Risk.

In particular, when we talk about the environment, we are talking about the number of dependencies that the software has, and the risks we face when relying on those dependencies. So the next stop in the tour is a closer look at Dependency Risk.

[30] https://en.wikipedia.org/wiki/Bruce_Schneier#Cryptography

CHAPTER 14

Dependency Risk

Dependency Risk is the risk you take on whenever you have a dependency on something (or someone) else.

One simple example could be that the software service you write might depend on hardware to run on: If the server goes down, the service goes down too. In turn, the server depends on electricity from a supplier, as well as a network connection from a provider. If either of these dependencies aren't met, the service is out of commission.

Dependencies can be on *events*, *people*, *teams*, *processes*, *software*, *services*, *money* and pretty much *any resource*, and while every project will need some of those, they also *add risk* to any project because the reliability of the project itself is now a function involving the reliability of the dependency.

In order to avoid repetition, and also to break down this large topic, we're going to look at this over 7 chapters:

- In this first chapter will look at dependencies *in general*, and some of the variations of Dependency Risk.
- Next, we'll look at Scarcity Risk, because time and money are scarce resources in every project.
- We'll cover Deadline Risk, and discuss the purpose of Events and Deadlines, and how they enable us to coordinate around dependency use.
- Then, we'll move on to look specifically at Software Dependency Risk, covering using libraries, software services and building on top of the work of others.
- After, we'll take a look at Process Risk, which is still Dependency Risk, but we'll be considering more organisational factors and how bureaucracy comes into the picture.

- Next, we'll take a closer look at Boundary Risk and Dead-End Risk. These are the risks you face in making choices about what to depend on.
- Finally, we'll wrap up this analysis with a look at some of the specific problems around depending on other people or businesses in Agency Risk.

14.1 Why Have Dependencies?

Luckily for us, the things we depend on in life are, for the most part, abundant: water to drink, air to breathe, light, heat and most of the time, food for energy.

This isn't even lucky though: life has adapted to build dependencies on things that it can *rely* on.

Although life exists at the bottom of the ocean around hydrothermal vents[1], it is a very different kind of life to us, and has a different set of dependencies given it's circumstances.

This tells us a lot about Dependency Risk right here:

- On the one hand, depending on something else is very often helpful, and quite often essential. (For example, all life seem to depend on water).
- However, as soon as you have dependencies, you need to take into account of their *reliability*. (Living near a river or stream gives you access to fresh water, for example).
- Successful organisms *adapt* to the dependencies available to them (like the thermal vent creatures).
- There is likely to be *competition* for a dependency when it is scarce (think of droughts and famine).

So, dependencies are a trade-off. They give with one hand and take with the other. Our modern lives are full of dependency (just think of the chains of dependency needed for putting a packet of biscuits on a supermarket shelf, for example), but we accept this risk because it makes life *easier*.

14.2 Dependency Fit Risk

In order to illustrate some of the different Dependency Risks, let's introduce a running example: trying to get to work each day. There are probably a few

[1] `https://en.wikipedia.org/wiki/Hydrothermal_vent`

alternative ways to make your journey each day, such as *by car*, *walking* or *by bus*. These are all alternative dependencies but give you the same *feature*: they'll get you there.

Normally, we'll use the same dependency each day. This speaks to the fact that each of these approaches has different Fit Risk. Perhaps you choose going by bus over going by car because of the risk that owning the car is expensive, or that you might not be able to find somewhere to park it.

But the bus will take you to lots of in-between places you *didn't* want to go. This is also Fit Risk and we saw this already in the chapter on Feature Risk. There, we considered two problems:

- The feature (or now, dependency) doesn't provide all the functionality you need. This was Fit Risk. An example might be your supermarket not stocking everything you want to buy.
- The feature / dependency provides far too much, and you have to accept more complexity than you need. This was Conceptual Integrity Risk. An example of this might be the supermarket being *too big*, and you spend a lot longer navigating it than you wanted to.

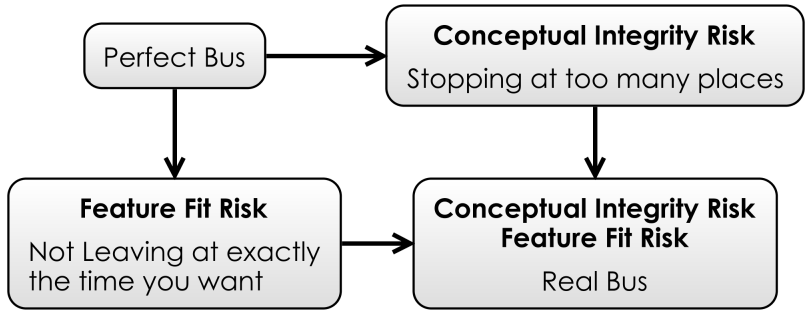
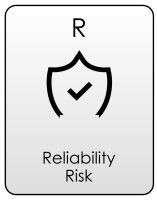


Figure 14.1: Feature Fit: A Two-Dimensional Problem (at least)

14.3 Reliability Risk

This points at the problem that when we use an external dependency, we are at the mercy of its reliability.

"... Reliability describes the ability of a system or component to function under stated conditions for a specified period of time."
—Reliability Engineering, *Wikipedia*[2]



- Risks of not getting benefit from a dependency due to it's reliability.

Figure 14.2: Reliability Risk

Unreliability manifests itself when a dependency fails you under certain sets of circumstances. It's easy to think about reliability for something like a bus: sometimes, it's late due to weather, or cancelled due to driver sickness, or the route changes unexpectedly due to road works.

In software, it's no different: Unreliability is the flip-side of Feature Implementation Risk. It's caused in the gap between the real behaviour of the software and the expectations for it.

There is an upper bound on the reliability of the software you write, and this is based on the dependencies you use and (in turn) the reliability of those dependencies:

- If a component **A** depends on component **B**, unless there is some extra redundancy around **B**, then **A** *can't* be more reliable than **B**.
- Is **A** or **B** a Single Point Of Failure[3] in a system?
- Are there bugs in **B** that are going to prevent it working correctly in all circumstances?

This kind of stuff is encapsulated in the science of Reliability Engineering[4]. For example, Failure mode and effects analysis (FEMA)[5]:

[2] https://en.m.wikipedia.org/wiki/Reliability_engineering

[3] https://en.wikipedia.org/wiki/Single_point_of_failure

[4] https://en.wikipedia.org/wiki/Reliability_engineering

[5] https://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis

> "... was one of the first highly structured, systematic techniques for failure analysis. It was developed by reliability engineers in the late 1950s to study problems that might arise from malfunctions of military systems."
>
> —FEMA, *Wikipedia*[6]

This was applied on NASA missions, and then in the 1970's to car design following the Ford Pinto exploding car[7] affair.

14.4 Proxies For Reliability

Because of Trust Risk and Invisibility Risk, we cannot always establish reliability for a dependency, and this is a huge area of concern in software when choosing dependencies, as we will see in the chapter on Software Dependency Risk.

In the Communication Risk chapter we looked at Marketing Communications and talked about the levels of awareness that you could have with a dependency.

Let's apply this to our Bus scenario:

- Am I aware that there is public transport in my area?
- How do I find out about the different options?
- How do I choose between buses, taxis, cars etc.
- How do I understand the timetable, and apply it to my problem?
- Is it a reliable enough solution?

Silo Mentality

Finding out about bus schedules is easy. But in a large company, Communication Risk and especially Invisibility Risk are huge problems. This tends to get called "Silo Mentality[8]", that is, ignoring what else is going on in other divisions of the company or "not invented here"[9] syndrome:

> "In management the term silo mentality often refers to information silos in organisations. Silo mentality is caused by divergent goals of different organisational units."
>
> —Silo Mentality, *Wikipedia*[10]

[6] https://en.wikipedia.org/wiki/Failure_mode_and_effects_analysis

[7] https://en.wikipedia.org/wiki/Ford_Pinto#Design_flaws_and_ensuing_lawsuits

[8] https://en.wikipedia.org/wiki/Information_silo#Silo_mentality

[9] https://en.wikipedia.org/wiki/Not_invented_here

[10] https://en.wikipedia.org/wiki/Information_silo#Silo_mentality

Ironically, *more communication* might not be the answer, because even with more communication you still cannot determine reliability. If channels are provided to discover functionality in other teams you can still run into Trust Risk (why should I believe in the quality of this dependency?) or Agency Risk (unwarranted self-promotion).

14.5 Complexity Risk

While dependencies (like the bus, or the supermarket) make life simpler for you, they do this by taking on complexity for you.

In our software, Dependencies are a way to manage Complexity Risk, and we'll investigate that in much more detail in Software Dependency Risk. The reason for this is that a dependency gives you an abstraction: you no longer need to know *how* to do something, (that's the job of the dependency), you just need to interact with the dependency properly to get the job done. Buses are *perfect* for people who can't drive, after all.

But this means that all of the issues of abstractions that we covered in Communication Risk apply. For example, there is Invisibility Risk because you probably don't have a full view of what the dependency is doing. Nowadays, bus stops have a digital "arrivals" board which gives you details of when the bus will arrive, and shops publish their opening hours online. But, abstraction always means the loss of some detail - the bus might be two minutes away but could already be full.

14.6 Dependencies Are Complex

In Rich Hickey's talk, Simple Made Easy[11] he discusses the difference between *simple* software systems and *easy* (to use) ones, heavily stressing the virtues of simple over easy. It's an incredible talk and well worth watching.

But: living systems are not simple. Not anymore. They evolved in the direction of increasing complexity because life was *easier* that way. In the "simpler" direction, life is first *harder* and then *impossible*, and then an evolutionary dead-end.

Depending on things makes *your job easier*. It's just division of labour[12] and dependency hierarchies, as we saw in Complexity Risk.

Our economic system and our software systems exhibit the same tendency-towards-complexity. For example, the television in my house now is *vastly*

[11] https://www.infoq.com/presentations/Simple-Made-Easy

[12] https://en.wikipedia.org/wiki/Division_of_labour

more complicated than the one in my home when I was a child. But, it contains much more functionality and consumes much less power and space.

14.7 Managing Dependency Risk

Arguably, managing Dependency Risk is *what Project Managers do*. Their job is to meet the Goal by organising the available dependencies into some kind of useful order.

There are *some* tools for managing dependency risk: Gantt Charts[13] for example, arrange work according to the capacity of the resources (i.e. dependencies) available, but also the *dependencies between the tasks*. If task **B** requires the outputs of task **A**, then clearly task **A** comes first and task **B** starts after it finishes. We'll look at this more in Process Risk.

We'll look in more detail at project management in the *practices* part, later. But now let's get into the specifics with Scarcity Risk.

[13] `https://en.wikipedia.org/wiki/Gantt_chart`

CHAPTER 15

Scarcity Risk

While Reliability Risk (which we met in the previous chapter) considers what happens when a *single dependency* is unreliable, scarcity is about *quantities* of a dependency, and specifically, *not having enough*.

In the previous chapter, we talked about the *reliability* of the bus: it will either arrive or it wont. But what if, when it arrives, it's already full of passengers? There is a *scarcity of seats*: you don't much care which seat you get on the bus, you just need one. Let's term this, Scarcity Risk - Risk of not being able to access a dependency in a timely fashion due to it's scarcity.

Any resource (such as disk space, oxygen, concert tickets, time or pizza) that you depend on can suffer from *scarcity*, and here, we're going to look at five particular types, relevant to software.

Here are a selection of mitigations:

- **Buffers**: Smoothing out peaks and troughs in utilisation.
- **Reservation Systems**: giving clients information *ahead* of the dependency usage about whether the resource will be available to them.
- **Graceful degradation**: Ensuring *some* service in the event of oversubscription. It would be no use allowing people to cram onto the bus until it can't move.
- **Demand Management**: Having different prices during busy periods helps to reduce demand. Having "first class" seats means that higher-paying clients can get service even when the train is full. Uber[1] adjust prices in real-time by so-called Surge Pricing[2]. This is basically turning Scarcity Risk into a Market Risk problem.

[1] `https://www.uber.com`

[2] `https://www.uber.com/en-GB/drive/partner-app/how-surge-works/`

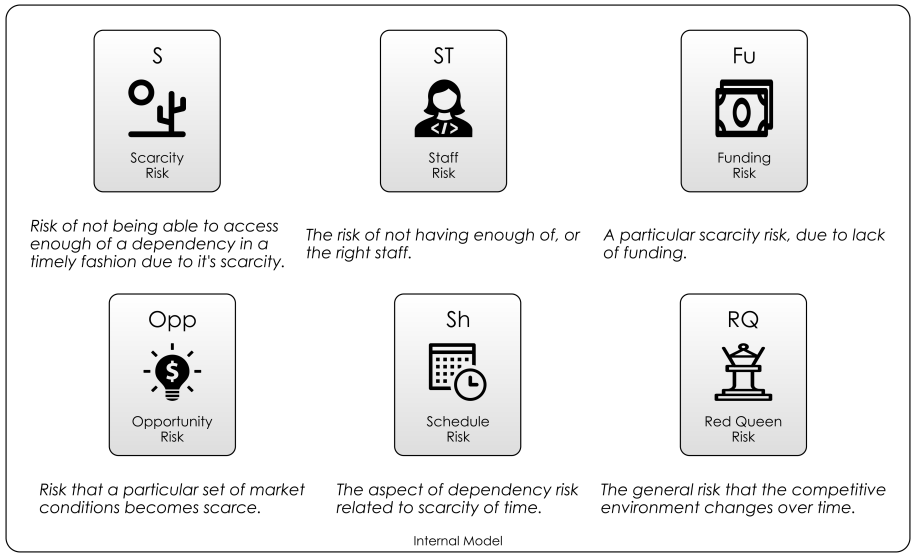


Figure 15.1: Scarcity Risk and it's variations

- **Queues**: Again, these provide a "fair" way of dealing with scarcity by exposing some mechanism for prioritising use of the resource. Buses operate a first-come-first-served system, whereas emergency departments in hospitals triage according to need.
- **Pools**: Reserving parts of a resource for a group of customers, and sharing within that group.
- **Horizontal Scaling**: allowing a scarce resource to flexibly scale according to how much demand there is. (For example, putting on extra buses when the trains are on strike, or opening extra check-outs at the supermarket.)

Much like Reliability Risk, there is science for it:

- Queue Theory[3] is all about building mathematical models of buffers, queues, pools and so forth.
- Logistics[4] is the practical organisation of the flows of materials and goods around things like Supply Chains[5].

[3] https://en.wikipedia.org/wiki/Queueing_theory

[4] https://en.wikipedia.org/wiki/Logistics

[5] https://en.wikipedia.org/wiki/Supply_chain

- And Project Management[6] is in large part about ensuring the right resources are available at the right times. We'll be taking a closer look at that in Risk-First Part 3 chapters on Prioritisation and the Project Management Body Of Knowledge.

15.1 Funding Risk

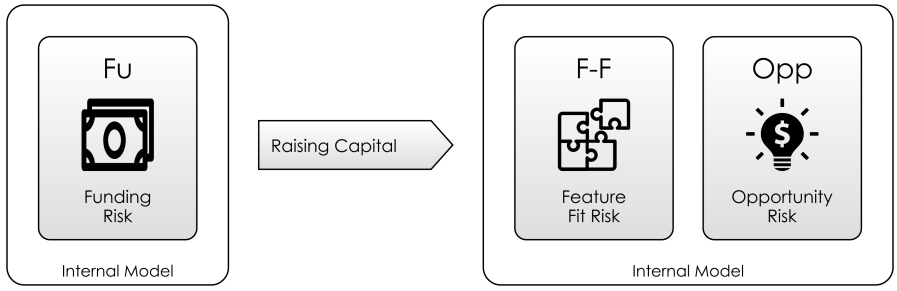


Figure 15.2: Funding Risk

On a lot of software projects, you are "handed down" deadlines from above, and told to deliver by a certain date or face the consequences. But sometimes you're given a budget instead, which really just adds another layer of abstraction to the Schedule Risk: That is, do I have enough funds to cover the team for as long as I need them?

This grants you some leeway as now you have two variables to play with: the *size* of the team, and *how long* you can run it for. The larger the team, the shorter the time you can afford to pay for it.

In startup circles, this "amount of time you can afford it" is called the "Runway"[7]: you have to get the product to "take-off" (become profitable) before the runway ends.

Startups often spend a lot of time courting investors in order to get funding and mitigate this type of Schedule Risk. But, as shown in figure 15.2, this activity usually comes at the expense of Opportunity Risk and Feature Risk, as usually the same people are trying to raise funds as build the project itself.

[6] https://en.wikipedia.org/wiki/Project_management

[7] https://en.wiktionary.org/wiki/runway

15.2 Staff Risk

Since the workforce is a scarce resource, it stands to reason that if a startup has a "Runway", then the chances are that the founders and staff do too, as this article explores[8]. It identifies the following risks:

- Company Cash: The **Runway** of the startup itself
- Founder Cash: The **Runway** for a founder, before they run out of money and can't afford their rent.
- Team Cash: The **Runway** for team members, who may not have the same appetite for risk as the founders do.

You need to consider how long your staff are going to be around, especially if you have Key Man Risk[9] on some of them. People like to have new challenges, or move on to live in new places, or simply get bored, and replacing staff can be highly risky.

The longer your project goes on for, the more Staff Risk you will have to endure, and you can't rely on getting the best staff for failing projects.

15.3 Schedule Risk

Schedule Risk is very pervasive, and really underlies *everything* we do. People *want* things, but they *want them at a certain time*. We need to eat and drink every day, for example. We might value having a great meal, but not if we have to wait three weeks for it.

And let's go completely philosophical for a second: Were you to attain immortality, you'd probably not feel the need to buy *anything*. You'd clearly have no *needs*, and anything you wanted, you could create yourself within your infinite time-budget. Rocks don't need money, after all.

In the chapter on Feature Risk we looked at Market Risk, the idea that the value of your product is itself at risk from the morés of the market, share prices being the obvious example of that effect. In Finance, we measure this using *money*, and we can put together probability models based on how much money you might make or lose.

With Schedule Risk, the underlying measure is *time*:

- "If I implement feature X, I'm picking up something like 5 days of Schedule Risk."

[8] https://www.entrepreneur.com/article/223135

[9] https://en.wikipedia.org/wiki/Key_person_insurance#Key_person_definition

- "If John goes travelling that's going to hit us with lots of Schedule Risk while we train up Anne."

. . . and so on. Clearly, in the same way as you don't know exactly how much money you might lose or gain on the stock-exchange, you can't put precise numbers on Schedule Risk either.

Student Syndrome

Student Syndrome[10] is, according to Wikipedia:

> "Student syndrome refers to planned procrastination, when, for example, a student will only start to apply themselves to an assignment at the last possible moment before its deadline." - *Wikipedia*

Arguably, there is good psychological, evolutionary and risk-based reasoning behind procrastination: if there is apparently a lot of time to get a job done, then Schedule Risk is low. If we're only ever mitigating our *biggest risks*, then managing Schedule Risk in the future doesn't matter so much. Putting efforts into mitigating future risks that *might not arise* is wasted effort.

Or at least, that's the argument: If you're Discounting the Future To Zero then you'll be pulling all-nighters in order to deliver any assignment.

So, the problem with Student Syndrome is that the *very mitigation* for Schedule Risk (allowing more time) is an Attendant Risk that *causes* Schedule Risk: you'll work within the more generous time allocation more slowly and you'll end up revealing Hidden Risk *later*. And, discovering these hidden risks later causes you to end up being late because of them.

15.4 Opportunity Risk

Opportunity Risk is really the concern that whatever we do, we have to do it *in time*. If we wait too long, we'll miss the Window Of Opportunity[11] for our product or service.

Any product idea is necessarily of it's time: the Goal In Mind will be based on observations from a particular Internal Model, reflecting a view on reality at a specific *point in time*.

[10] https://en.wikipedia.org/wiki/Student_syndrome

[11] https://en.wikipedia.org/wiki/Window_of_opportunity

How long will that remain true for? This is your *opportunity*: it exists apart from any deadlines you set yourself, or funding options. It's purely, "how long will this idea be worth doing?"

With any luck, decisions around *funding* your project will be tied into this, but it's not always the case. It's very easy to under-shoot or overshoot the market completely and miss the window of opportunity.

The iPad

For example, let's look at the iPad[12], which was introduced in 2010 and was hugely successful.

This was not the first tablet computer. Apple had already tried to introduce the Newton[13] in 1989, and Microsoft had released the Tablet PC[14] in 1999. But somehow, they both missed the Window Of Opportunity. Possibly, the window existed because Apple had changed changed the market with their release of the iPhone, which left people open to the idea of a tablet being "just a bigger iPhone".

But maybe now, the iPad's window is closing? We have more *wearable computers* like the Apple Watch[15], and voice-controlled devices like Alexa[16] or Siri[17]. Peak iPad was in 2014, according to this graph[18]. tbd add graph.

So, it seems Apple timed the iPad to hit the peak of the Window of Opportunity.

But, even if you time the Window Of Opportunity correctly, you might still have the rug pulled from under your feet due to a different kind of Scarcity Risk, such as. . .

15.5 Red-Queen Risk

A more specific formulation of Schedule Risk is Red Queen Risk, which is that whatever you build at the start of the project will go slowly more-and-more out of date as the project goes on.

This is named after the Red Queen quote from Alice in Wonderland:

[12] https://en.wikipedia.org/wiki/History_of_tablet_computers

[13] https://en.wikipedia.org/wiki/Apple_Newton

[14] https://en.wikipedia.org/wiki/Microsoft_Tablet_PC

[15] https://en.wikipedia.org/wiki/Apple_Watch

[16] https://en.wikipedia.org/wiki/Amazon_Alexa

[17] https://en.wikipedia.org/wiki/Siri

[18] https://www.statista.com/statistics/269915/global-apple-ipad-sales-since-q3-2010/

> "My dear, here we must run as fast as we can, just to stay in place. And if you wish to go anywhere you must run twice as fast as that." - Lewis Carroll, *Alice in Wonderland*[19]

The problem with software projects is that tools and techniques change *really fast*. In 2011, 3DRealms released Duke Nukem Forever after 15 years in development[20], to negative reviews:

> "... most of the criticism directed towards the game's long loading times, clunky controls, offensive humor, and overall aging and dated design." - *Duke Nukem Forever, Wikipedia*

Now, they didn't *deliberately* take 15 years to build this game (lots of things went wrong). But, the longer it took, the more their existing design and code-base were a liability rather than an asset.

Personally, I have suffered the pain on project teams where we've had to cope with legacy code and databases because the cost of changing them was too high. And any team who is stuck using Visual Basic 6.0[21] is here. It's possible to ignore Red Queen Risk for a time, but this is just another form of Technical Debt which eventually comes due.

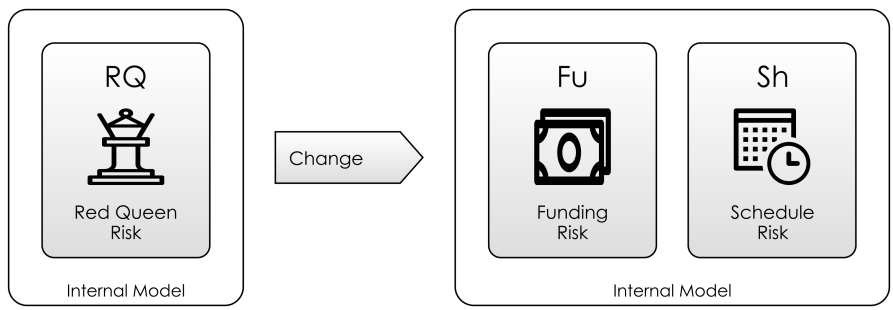


Figure 15.3: Red Queen Risk

In this chapter, we've looked at various risks to do with scarcity of time, as a quantity we can spend like money. But frequently, we have a dependency on a specific *event*. On to Deadline Risk.

[19] https://www.goodreads.com/quotes/458856-my-dear-here-we-must-run-as-fast-as-we

[20] https://en.wikipedia.org/wiki/Duke_Nukem_Forever

[21] https://en.wikipedia.org/wiki/Visual_Basic

CHAPTER 16

Deadline Risk

Let's examine dependencies on *events*.

We rely on events occuring all the time in our lives, and event dependencies are simple to express: usually, a *time* and a *place*. For example:

- "The bus to work leaves at 7:30am" or
- "I can't start shopping until the supermarket opens at 9am".

In the first example, you can't *start* something until a particular event happens. In the latter example, you must *be ready* for an event at a particular time.

16.1 Events Mitigate Risk...

Having an event occur in a fixed time and place is mitigating risk:

- By taking the bus, we are mitigating our own Schedule Risk: we're (hopefully) reducing the amount of time we're going to spend on the activity of getting to work. It's not entirely necessary to even take the bus: you could walk, or go by another form of transport. But, effectively, this just swaps one dependency for another: if you walk, this might well take longer and use more energy, so you're just picking up Schedule Risk in another way.
- Events are a mitigation for Coordination Risk: A bus needn't necessarily *have* a fixed timetable: it could wait for each passenger until they turned up, and then go. (A bit like ride-sharing works). This would be a total disaster from a Coordination Risk perspective, as one person could

cause everyone else to be really really late. Having a fixed time for doing something mitigates Coordination Risk by turning it into Schedule Risk. Agreeing a date for a product launch, for example, allows lots of teams to coordinate their activities.

- If you drive, you have a dependency on your car instead. So, there is often an *opportunity cost* with dependencies. Using the bus might be a cheap way to travel. You're therefore imposing less Dependency Risk on a different scarce resource - your money.

16.2 But, Events Lead To Attendant Risk

By *deciding to use the bus* we've Taken Action. By agreeing a *time* and *place* for something to happen, you're introducing Deadline Risk. Miss the deadline, and you miss the bus.

As discussed above, *schedules* (such as bus timetables) exist so that *two or more parties can coordinate*, and Deadline Risk is on *all* of the parties. While there's a risk I am late, there's also a risk the bus is late. I might miss the start of a concert, or the band might keep everyone waiting.

In software development, deadlines are set in order to *coordinate work between teams*. For example, having a product ready in production at the same time as the marketing campaign starts. Fixing on an agreed deadline mitigates inter-team Coordination Risk.

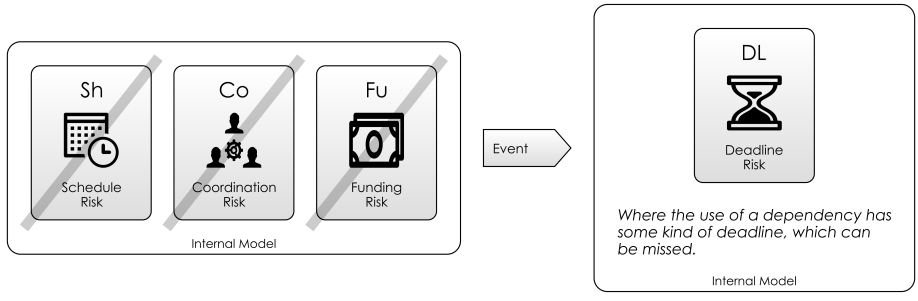


***Figure 16.1: Action Diagram showing risks mitigated by having an* event**

16.3 Slack

Each party can mitigate Deadline Risk with *slack*. That is, ensuring that the exact time of the event isn't critical to your plans:

- Don't build into your plans a *need* to start shopping at 9am.
- Arrive at the bus-stop *early*.

The amount of slack you build into the schedule is likely dependent on the level of risk you face: I tend to arrive a few minutes early for a bus, because the risk is *low* (there'll be another bus along soon), however I try to arrive over an hour early for a flight, because I can't simply get on the next flight straight away, and I've already paid for it, so the risk is *high*.

Deadline Risk becomes very hard to manage when you have to coordinate actions with lots of tightly-constrained events. So what else can give? We can reduce the number of *parties* involved in the event, which reduces risk, or, we can make sure all the parties are in the same *place* to begin with.

16.4 Deadlines

Often when running a software project, you're given a team of people and told to get something delivered by a certain date. i.e. you have an artificially-imposed deadline on delivery.

What happens if you miss the deadline? It could be:

- The funding on the project runs out, and it gets cancelled.
- You have to go back to a budgeting committee, and get more money.
- The team gets replaced, because of lack of faith.

.. or something else.

Deadline Risk can be introduced by an authority in order to *sharpen focus* and reduce Coordination Risk. This is how we arrive at tools like SMART Objectives[1] and KPI's (Key Performance Indicators)[2].

Deadlines change the way we evaluate goals, and the solutions we choose because they force us to reckon with Deadline Risk. For example, in JFK's quote:

> "First, I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the Earth." - John F. Kennedy, 1961

[1] https://en.wikipedia.org/wiki/SMART_criteria

[2] https://en.wikipedia.org/wiki/Performance_indicator

The 9-year timespan came from an authority figure (the president) and helped a huge team of people coordinate their efforts and arrive at a solution that would work within a given time-frame. The Deadline Risk allowed the team to focus on mitigating the risk of missing that deadline.

Compare with this quote:

> "I love deadlines. I love the whooshing noise they make as they go by." - Douglas Adams[3]

As a successful author, Douglas Adams *didn't really care* about the deadlines his publisher's gave him. The Deadline Risk was minimal for him, because the publisher wouldn't be able to give his project to someone else to complete.

16.5 Deadline Risk and Schedule Risk

Schedule Risk and Deadline Risk are clearly related: they both refer to the risk of running out of time. However, the *risk profile* of each is very different:

- Schedule Risk is *continuous*, like money. i.e. You want to waste as little of it as possible. Every extra day you take compounds Schedule Risk additively, and a day wasted at the start of the project is much the same as a day wasted at the end.
- Deadline Risk is *binary*. The impact of Deadline Risk is either zero (you make it in time) or one (you are late and miss the flight). You don't particularly get a reward for being early.

So, these are two separate concepts, and both are useful.

[3] https://en.wikipedia.org/wiki/Douglas_Adams

Part III

Application

CHAPTER 17

Coming Next

- preview of what's to come in part 3.

part 3 is in the next book.

The point of part 2 is to give a taxonomy for talking about risk.

Bad to leave on the failure notes, let's talk about some successes.

3. What's To Come

- risk based debugging.
- risk based coding.

CHAPTER 18

Estimates

In this chapter, we're going to put a Risk-First spin on the process of Estimating. But, in order to get there, we first need to start with understanding *why* we estimate. We're going to look at some "Old Saws" of software estimation and what we can learn from them. Finally, we'll bring our Risk-First menagerie to bear on de-risking the estimation process.

18.1 The Purpose Of Estimating

Why bother estimating at all? There are two reasons why estimates are useful:

1. **To allow for the creation of *events*.** As we saw in Deadline Risk, if we can put a date on something, we can mitigate lots of Coordination Risk. Having a *release date* for a product allows whole teams of people to coordinate their activities in ways that hugely reduce the need for Communication. "Attack at dawn" allows disparate army units to avoid the Coordination Risk inherent in "attack on my signal". This is a *good reason for estimating*, because by using events you are mitigating Coordination Risk. This is often called a *hard deadline*.

2. **To allow for the estimation of the Pay-Off of an action.** This is a *bad reason for estimating*, as we will discuss in detail below. But briefly, the main issue is that Pay-Off isn't just about figuring out Schedule Risk - you should be looking at all the other Attendant Risks of the action too.

18.2 How Estimates Fail

Estimates are a huge source of contention in the software world:

> "Typically, effort estimates are over-optimistic and there is a strong over-confidence in their accuracy. The mean effort overrun seems to be about 30% and not decreasing over time."
>
> —Software Development Effort Estimation, *Wikipedia*[1].

In their research "Anchoring and Adjustment in Software Estimation", Aranda and Easterbrook[2] asked developers split into three groups (A, B and Control) to give individual estimates on how long a piece of software would take to build. They were each given the same specification. However:

- Group A was given the hint: "I admit I have no experience with software, but I guess it will take about two months to finish".
- Group B were given the same hint, except with *20* months.

How long would members of each group estimate the work to take? The results were startling. On average:

- Group A estimated 5.1 months.
- The Control Group estimated 7.8 months.
- Group B estimated 15.4 months.

The anchor mattered more than experience, how formal the estimation method, or *anything else*. *We can't estimate time at all*.

18.3 Is Risk To Blame?

Why is it so bad? The problem with a developer answering a question such as:

> "How long will it take to deliver X?"

Is the following:

- The developer and the client likely don't agree on exactly what X is, and any description of it is inadequate anyway (Invisibility Risk).

[1] https://en.m.wikipedia.org/wiki/Software_development_effort_estimation

[2] http://www.cs.toronto.edu/%7Esme/papers/2005/ESEC-FSE-05-Aranda.pdf

- The developer has a less-than-complete understanding of the environment he will be delivering X in (Complexity Risk and Map And Territory Risk.
- The developer has some vague ideas about how to do X, but he'll need to try out various approaches until he finds exactly the right one (Boundary Risk and Learning-Curve Risk).
- The developer has no idea what Hidden Risk will surface when he starts work on it.
- The developer has no idea what will happen if he takes too long and misses the date by a day/week/month/year (Schedule Risk).

. . . and so on.

The reason the estimate of *time* is wrong is because All Activity Is About Mitigating Risk and the estimate of *risk* is wrong.

So what are we to do? It's a problem as old as software itself, and in deference to that, let's examine the estimating problem via some "Old Saws".

18.4 Old Saw No. 1: The "10X Developer"

> "A 10X developer is an individual who is thought to be as productive as 10 others in his or her field. The 10X developer would produce 10 times the outcomes of other colleagues, in a production, engineering or software design environment."
>
> —10X Developer, *Techopedia*[3]

Let's try and pull this apart:

- How do we measure this "productivity"? In Risk-First terms, this is about taking action to *transform* our current position on the Risk Landscape to a position of more favourable risk. A "10X Developer" then must be able to take actions that have much higher Pay-Off than a "1X Developer". That is, mitigating more existing risk, and generating less Attendant Risk.
- It stands to reason then, that someone taking action *faster* will leaving us with less Schedule Risk.
- However, if they are *more expensive*, they may leave us with greater Funding Risk afterwards.

[3] https://www.techopedia.com/definition/31673/10X-developer

- But, Schedule Risk isn't the only risk being transformed: The result might be bugs, expensive new dependencies or spaghetti-code complexity.
- The "10X" developer *must* also leave behind less of these kind of risks too.
- That means that the "10X Developer" isn't merely faster, but *taking different actions*. They are able to use their talent and experience to see actions with greater pay-off than the 1X Developer.

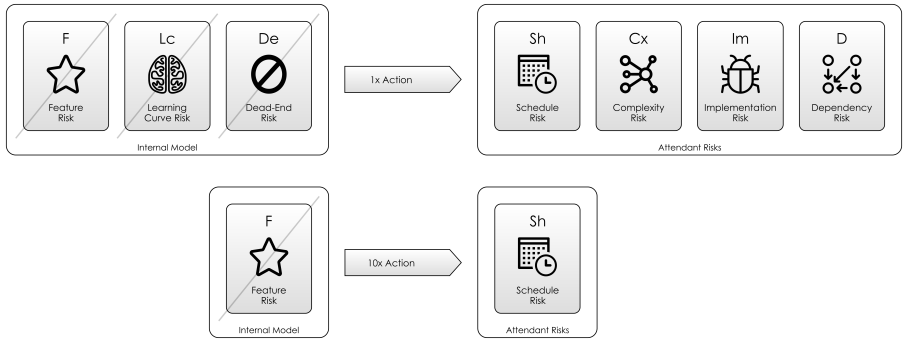


Figure 18.1: 1x Task vs 10X Task

Does the "10X Developer" even exist? Crucially, it would seem that such a thing would be predicated on the existence of the "1X Developer", who gets "1X" worth of work done each day. It's not clear that there is any such thing as an average developer who is mitigating risk at an average rate.

Even good developers have bad days, weeks or projects. Taking Action is like placing a bet. Sometimes you lose and the Pay-Off doesn't appear:

- The Open-Source software you're trying to apply to a problem doesn't solve it in the way you need.
- A crucial use-case of the problem turns out to change the shape of the solution entirely, leading to lots of rework.
- An assumption about how network security is configured turns out to be wrong, leading to a lengthy engagement with the infrastructure team.

The easiest way to be the "10X developer" is to have *done the job before*. If you're coding in a familiar language, with familiar libraries and tools, delivering a

cookie-cutter solution to a problem in the same manner you've done several times before, then you will be a "10X Developer" compared to *you doing it the first time*:

- There's no Learning Curve Risk, because you already learnt everything.
- There's no Dead End Risk because you already know all the right choices to make.

18.5 Old Saw No. 2: Quality, Speed, Cost: Pick Any Two

> "The Project Management Triangle (called also the Triple Constraint, Iron Triangle and Project Triangle) is a model of the constraints of project management. While its origins are unclear, it has been used since at least the 1950s. It contends that:
>
> - The quality of work is constrained by the project's budget, deadlines and scope (features).
> - The project manager can trade between constraints.
> - Changes in one constraint necessitate changes in others to compensate or quality will suffer."
>
> – Project Management Triangle, *Wikipedia*[4]

From a Risk-First perspective, we can now see that this is an over-simplification. If *quality* is a Feature Fit metric, *deadlines* is Schedule Risk and *budget* refers to Funding Risk then that leaves us with a lot of risks unaccounted for:

- I can deliver a project in very short order by building a bunch of screens that *do nothing* (accruing _stunning levels of Implementation Risk as I go).
- Or, by assuming a lottery win, the project's budget is fine. (Although I would have *huge* Funding Risk because *what are the chances of winning the lottery?*.
- Brooks' Law contradicts this by saying you can't trade budget for deadlines:

[4] https://en.wikipedia.org/wiki/Project_management_triangle

"Brooks' law is an observation about software project management according to which"adding human resources to a late software project makes it later".

—Brooks Law, *Wikipedia*[5]

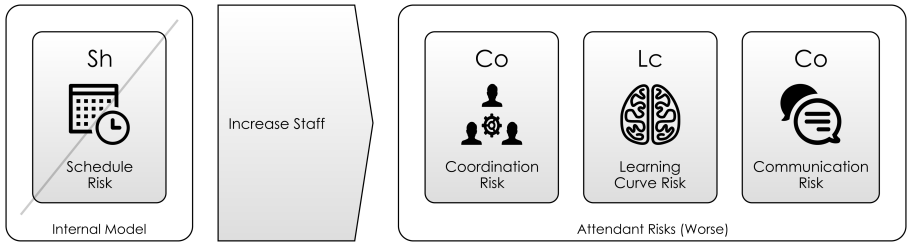


Figure 18.2: Brooks' Law, Risk-First Style

Focusing on the three variables of the iron triangle isn't enough. You can game these variables by sacrificing others: we need to be looking at the project's risk *holistically*.

- There's no point in calling a project complete if the dependencies you are using are unreliable or undergoing rapid change
- There's no point in delivering the project on time if it's an Operational Risk nightmare, and requires constant round-the-clock support and will cost a fortune to *run*. (Working on a project that "hits it's delivery date" but is nonetheless a broken mess once in production is too common a sight.)
- There's no point in delivering a project on-budget if the market has moved on and needs different features.

Old Saw No. 3: Parkinson's Law

We've already looked at Parkinson's Law in the chapter on Agency Risk, but lets recap:

"Parkinson's law is the adage that 'work expands so as to fill the time available for its completion'." Parkinson's Law, *Wikipedia*[6]

[5] https://en.wikipedia.org/wiki/Brooks_law

[6] https://en.wikipedia.org/wiki/Parkinsons_law

Let's leave aside the Agency Risk concerns this time. Instead, let's consider this from a Risk-First perspective. *Of course* work would expand to fill the time available: *Time available* is an *absence of Schedule Risk*, it's always going to be sensible to exchange free time to reduce more serious risks.

This is why projects will *always* take at least as long as is budgeted for them.

A Case Study

Let's look at a quick example of this in action, taken from Rapid Development by Steve McConnell[7]. At the point of this excerpt, Carl (the Project Manager) is discussing the schedule with Bill, the project sponsor:

> "I think it will take about 9 months, but that's just a rough estimate at this point," Carl said. "That's not going to work," Bill said. "I was hoping you'd say 3 or 4 months. We absolutely need to bring that system in within 6 months. Can you do it in 6?" (1)

Later in the story, the schedule has slipped twice and is about to slip again:

> . . . At the 9-month mark, the team had completed detailed design, but coding still hadn't begun on some modules. It was clear that Carl couldn't make the 10-month schedule either. He announced the third schedule slip number— to 12 months. Bill's face turned red when Carl announced the slip, and the pressure from him became more intense. (2)

At point (2), Carl's tries to mitigate Feature Risk by increasing Schedule Risk, although he knows that Bill will trust him less for doing this, as shown below:

> Carl began to feel that his job was on the line. Coding proceeded fairly well, but a few areas needed redesign and reimplementation. The team hadn't coordinated design details in those areas well, and some of their implementations conflicted. At the 11-month oversight-committee meeting, Carl announced the fourth schedule slip— to 13 months. Bill became livid. "Do you have any idea what you're doing?" he yelled. "You obviously don't have any idea! You obviously don't have any idea when the project is

[7] http://amzn.eu/d/eTWKOsK

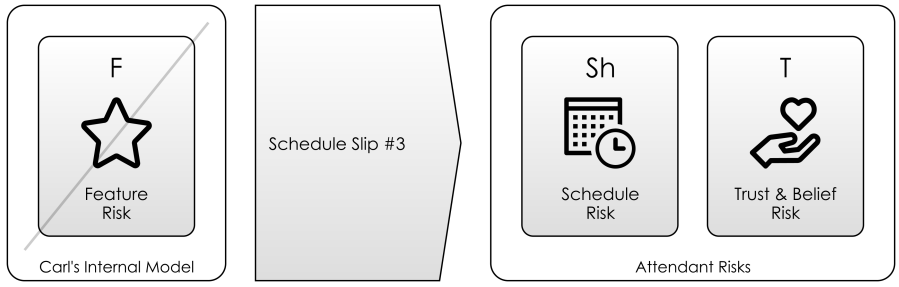


Figure 18.3: Carl's Schedule Slip increases Trust and Belief Risks

going to be done! I'll tell you when it's going to be done! It's going to be done by the 13-month mark, or you're going to be out of a job! I'm tired of being jerked around by you software guys! You and your team are going to work 60 hours a week until you deliver!" (3)

At point (3), the schedule has slipped again, and Bill has threatened Carl's job. Why did he do this? Because *he doesn't trust Carl's evaluation of the Schedule Risk*. By telling Carl that it's his job on the line, he makes sure Carl appreciates the Schedule Risk. However, forcing staff to do overtime is a dangerous ploy: it could disenfranchise the staff, or cause corners to be cut:

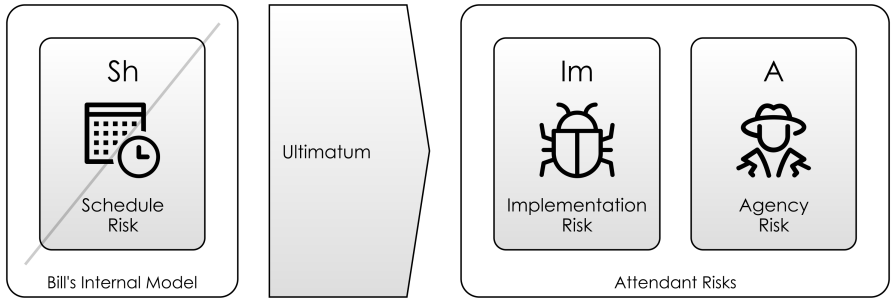


Figure 18.4: Bill's Ultimatum

Carl felt his blood pressure rise, especially since Bill had backed him into an unrealistic schedule in the first place. But he knew

that with four schedule slips under his belt, he had no credibility left. He felt that he had to knuckle under to the mandatory overtime or he would lose his job. Carl told his team about the meeting. They worked hard and managed to deliver the software in just over 13 months. Additional implementation uncovered additional design flaws, but with everyone working 60 hours a week, they delivered the product through sweat and sheer willpower. "
(4) - McConnell, Steve, *Rapid Development*

At point (4), we see that Bill's gamble worked (for him at least): the project was delivered on time by the team working overtime for two months. This was lucky - it seems unlikely that no-one quit and that the code didn't descend into a mess in that time.

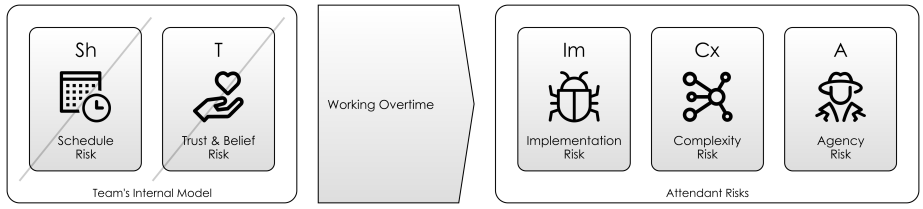


Figure 18.5: Team Response

Despite this being a fictional (or fictionalised) example, it rings true for many projects. What *should* have happened at point (1)? Both Carl and Bill estimated incorrectly... Or did they?

18.6 Agile Estimation

One alternative approach, must espoused in DevOps/Agile is to pick a short-enough period of time (say, two days or two weeks), and figure out what the most meaningful step towards achieving an objective would be in that time. By fixing the time period, we remove Schedule Risk from the equation, don't we?

Well, no. First, how to choose the time period? Schedule Risk tends to creep back in, in the form of something like Man-Hours[8] or Story Points[9]:

"Story points rate the relative effort of work in a Fibonacci-like format: 0, 0.5, 1, 2, 3, 5, 8, 13, 20, 40, 100. It may sound

[8] https://en.wikipedia.org/wiki/Man-hour

[9] https://www.atlassian.com/agile/project-management/estimation

> counter-intuitive, but that abstraction is actually helpful because it pushes the team to make tougher decisions around the difficulty of work."
>
> —Story Points, *Atlassian*[10]

Second, the strategy of picking the two-day action with the greatest Pay-Off is *often good*. (After all, this is just Gradient Descent, and that's a perfectly good way for training Machine Learning[11] systems.) However, just like following a river downhill from the top of a mountain will *often* get you to the sea, it probably won't take the shortest path, and sometimes you'll get stuck at a lake.

The choice of using gradient descent means that you have given up on Goals: Essentially, we have here the difference between "Walking towards a destination" and "Walking downhill". Or, if you like, a planned economy and a market economy. But, we don't live in *either*: everyone lives in some mixture of the two: our governments *have plans* for big things like roads and hospitals, and taxes. Other stuff, they leave to the whims of supply and demand. A project ends up being the same.

18.7 Risk-First Estimating

Let's figure out what we can take away from the above experiences:

- **From the "10X Developer" Saw:** the difference made by experience implies that a lot of the effort on a project comes from Learning Curve Risk and Dead End Risk.
- **From "Quality, Speed, Cost":** we need to be considering *all* risks, not just some arbitrary milestones on a project plan. Project plans can always be gamed, and you can always leave risks unaccounted for in order to hit the goals.
- **From the Parkinson's Law:** giving people a *time budget*, you absolve them from Schedule Risk... at least until they realise they're going to overrun. This gives them one less dimension of risk to worry about, but means they end up taking all the time you give them, because they are optimising over the remaining risks.
- Finally, the lesson from Agile Estimation is that *just iterating* is sometimes not as efficient as *using your intuition and experience* to find a more optimal path.

[10] `https://www.atlassian.com/agile/project-management/estimation`

[11] `https://en.wikipedia.org/wiki/Machine_learning`

How can we synthesise this knowledge, along with what we've learned into something that makes more sense?

Tip #1: Estimating Should be About *Estimating Pay Off*

For a given action / road-map / business strategy, what Attendant Risks are we going to have:

- What bets are we making about where the market will be?
- What Communication Risk will we face explaining our product to people?
- What Feature Fit risks are we likely to have when we get there?
- What Complexity Risks will we face building our software? How can we avoid it ending up as a Big Ball Of Mud?
- Where are we likely to face Boundary Risks and Dead End Risks

Instead of the Agile Estimation being about picking out a story-point number based on some idealised amount of typing that needs to be done, it should be about surfacing and weighing up risks. e.g:

- "Adding this new database is problematic because it's going to massively increase our Dependency Risk."
- "I don't think we should have component A interacting with component B because it'll introduce extra Communication Risk which we will always be tripping over."
- "I worry we might not understand what the sales team want and are facing Feature Implementation Risk. How about we try and get agreement on a specification?"

Tip #2: The Risk Landscape is Increasingly Complex: Utilise This

If you were travelling across London from Ealing (in the West) to Stratford (in the East) the *fastest* route might be to take the Central Line. You could do it via the A406 road, which would take a *bit* longer. It would *feel* like you're mainly going in completely the wrong direction doing that, but it's much faster than cutting straight through London and you don't pay the congestion charge.

In terms of risk, they all have different profiles. You're often delayed in the car, by some amount. The tube is *generally* reliable, but when it breaks down or is being repaired it might end up quicker to walk.

Figure 18.6: Journey via the Central Line

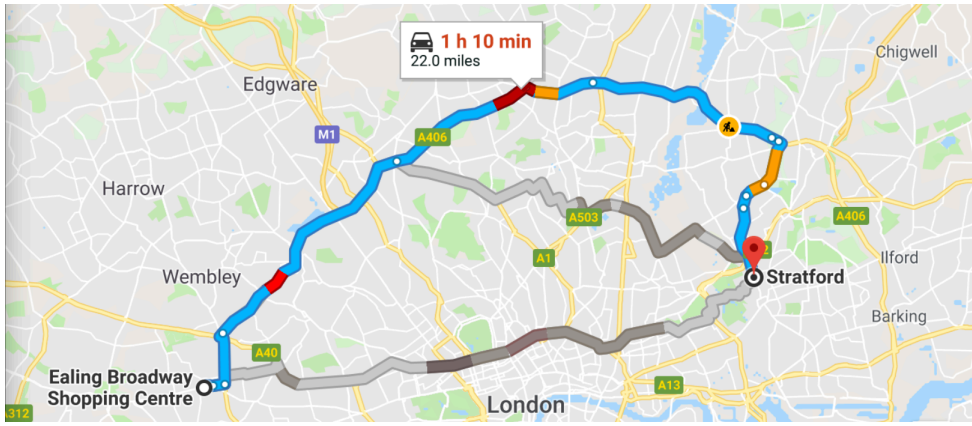


Figure 18.7: Journey by Car

If you were doing this same journey on foot, it's a very direct route, but would take five times longer. However, if you were making this journey a hundred years ago, that might be the way you chose (horseback might be a bit faster).

In the software development past, *building it yourself* was the only way to get anything done. It was like London *before road and rail*. Nowadays, you are bombarded with choices. It's actually *worse than London* because it's not even a two-dimensional geographic space and there are multitudes of different routes and acceptable destinations. Journey planning on the software Risk Landscape is an optimisation problem *par excellence*.

Because the modern Risk Landscape is so complex:

- There can be orders of magnitude difference in *time*, with very little difference in destination.

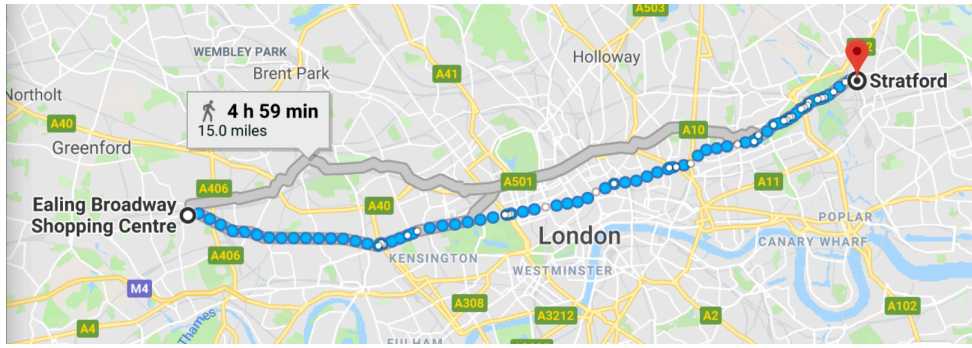


Figure 18.8: Journey on Foot

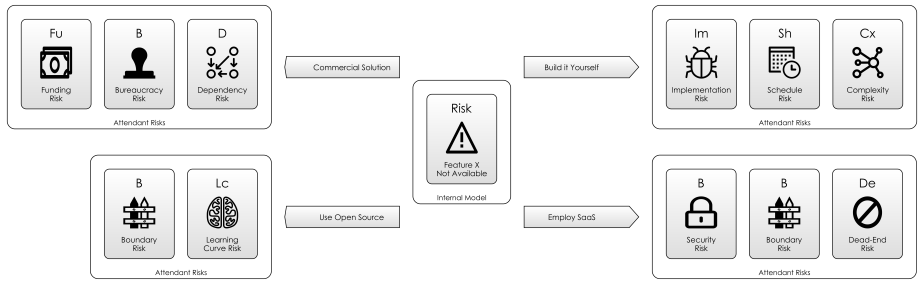


Figure 18.9: Possible Moves On The Risk Landscape

- If it's Schedule Risk you're worried about, *Code Yourself* isn't a great solution (for the whole thing, anyway). "Take the tube" and at least partly use something someone built already. There are probably multiple alternatives you can consider.
- If no one has built something similar already, then why is that? Have you formulated the problem properly?
- Going the wrong way is *so much easier*.
- Dead-Ends (like a broken Central Line) are much more likely to trip you up.
- You need to keep up with developments in your field. Read widely.

Tip #3: Meet Reality Early on the Biggest Risks

In getting from A to B on the Risk Landscape, imagine that all the Attendant Risks are the stages of a journey. Some might be on foot, train, car and so on. In order for your course of action to work, all the stages in the journey have to succeed.

Although you might have to make the steps of a journey in some order, you can still mitigate risk in a different order. For example, checking the trains are running, making sure your bike is working, booking tickets and taxis, and so on.

The *sensible* approach would be to test the steps *in order from weakest to strongest*. This means working out how to meet reality for each risk in turn, in order from biggest risk to smallest.

Often, a *strategy* will be broken up into multiple actions. *Which are the riskiest actions?* Figure this out, using the Risk-First vocabulary and the best experience you can bring to bear, then, perform the actions which Pay Off the biggest risks first.

As we saw from the "10X Developer" Saw, Learning Curve Risk and Dead End Risk, are likely to be the biggest risks. How can we front-load this and tackle these earlier?

- *Having a vocabulary* (like the one Risk-First provides) allows us to *at least talk about these*. e.g. "I believe there is a Dead End Risk that we might not be able to get this software to run on Linux."
- Build mock-ups:
  - UI wireframes allow us to bottom out the Communication Risk of the interfaces we build.
  - Spike Solutions allow us to de-risk algorithms and approaches before making them part of the main development.
  - Test the market with these and meet reality early.
- Don't pick delivery dates far in the future. Collectively work out the biggest risks with your clients, and then arrange the next possible date to demonstrate the mitigation.
- Do actions *early* that are *simple* but are nevertheless show-stoppers. They are as much a source of Hidden Risk as more obviously tricky actions.

Tip #4: Talk Frankly About All The Risks

Let's get back to Bill and Carl. What went wrong between points `(1)` and `(2)`? Let's break it down:

- **Bill *wants* the system in 3-4 months.** It doesn't happen.
- **He says it "must be delivered in 6 months", but this doesn't happen either.** However, the world (and the project) doesn't end: *it carries*

on. What does this mean about the truth of his statement? Was he deliberately lying, or just espousing his view on the Schedule Risk?

- **Carl's original estimate was 9 months.** Was he working to this all along? Did the initial brow-beating over deadlines at point `(1)` contribute to Agency Risk in a way that *didn't* happen at point `(2)`?
- **Why *did* Bill get so angry?** His understanding of the Schedule Risk was, if anything, *worse* than Carl's. It's not stated in the account, but it's likely the Trust Risk moved upwards: Did his superiors stop trusting him? Was his job at stake?
- **How could including this risk in the discussion have improved the planning process?** Could the conversation have started like this instead?

> "I think it will take about 9 months, but that's just a rough estimate at this point," Carl said. "That's not going to work," Bill said. "I was hoping you'd say 3 or 4 months. I need to show the board something by then or I'm worried they will lose confidence in me and this project".
>
> "OK," said Carl. "But I'm really concerned we have huge Feature Fit Risk. The task of understanding the requirements and doing the design is massive."
>
> "Well, in my head it's actually pretty simple," said Bill. "Maybe I don't have the full picture, or maybe your idea of what to build is more complex than I think it needs to be. That's a massive risk right there and I think we should try and mitigate it right now before things progress. Maybe I'll need to go back to the board if it's worse than I think."

Tip #5: Picture Worrying Futures

The Bill/Carl problem is somewhat trivial (not to mention likely fictional). How about one from real life? On a project I was working on in November some years ago, we had two pieces of functionality we needed: Bulk Uploads and Spock Integration. (It doesn't really matter what these are). The bulk uploads would be useful *now*. But, the Spock Integration wasn't due until January. In the Spock estimation meeting I wrote the following note:

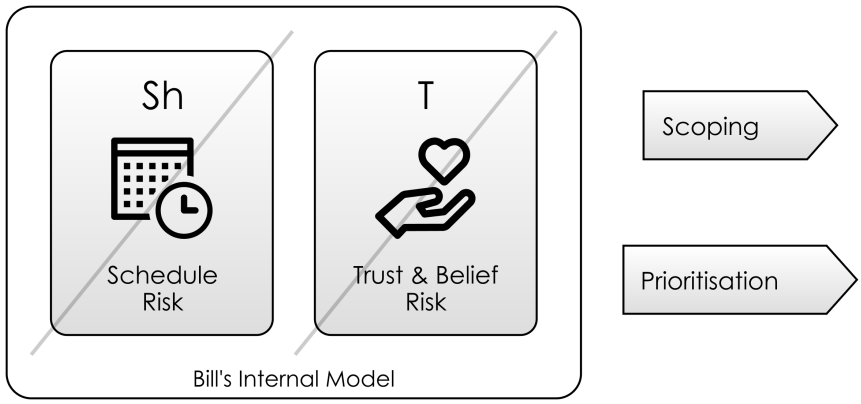


Figure 18.10: Identifying The Action

> "Spock estimates were 4, 11 and 22 until we broke it down into tasks. Now, estimates are above 55 for the whole piece. And worryingly, we probably don't have all the tasks. We know we need bulk uploads in November. Spock is January. So, do bulk uploads?"

The team *wanted* to start Bulk Uploads work. After all, from these estimates it looked like Spock could easily be completed in January. However, the question should have been:

> "If it was February now, and we'd *got nothing done*, what would our biggest risk be?"

Missing Bulk Uploads wouldn't be a show-stopper, but missing Spock would be a huge regulatory problem. *Start work on the things you can't miss.*

This is the essence of De-Risking.