This paper was presented by Pas Tomasiello of Dematic Pty Ltd as the Henry Spurrier lecture, a memorial to Henry Spurrier (1868 - 1942) in appreciation of his life work which was devoted to the advancement of the science and art of road transport

Supply Chain Trends – Technology 2020

Impact, Initiatives and Technology

What will life be like in the future? What choices will we be making and what decisions will be forced upon us? How will we live and work? How will technology make our lives easier? You may marvel at the technology available today compared to 20 years ago and ask "How will we communicate and obtain information in the future? How will we travel? How important will mobility be to us? How will the internet change our lives? Will virtual networks alter the cultural make-up of our society?"

There are countless questions that one can raise about the future. The methods by which the scientific community, the corporate sector, and society approach the issue of tomorrow's world are correspondingly diverse.

In search of answers to some of these questions, Dematic conducted a survey among experts throughout Europe to find out what changes they thought we could expect to see in the economy, technology, the political arena, and society during the next 16 years. The results of this survey are contained in the report *Horizons 2020*.

Mega Trends

The interesting thing about 2020 as a planning horizon is that it is sufficiently close to the present that we can recognise familiar aspects of life as it is now but also far enough into the future that there are new things for us to discover.

Ten mega trends were identified as key developments that were considered inevitable and that will have a major influence on the shape of tomorrow:

- Increasing globalism
- Increasing longevity
- Fewer children in the family
- Higher significance of women in the economy and society
- Increasing mobility (delocalization)
- Increasing migration from developing toward developed nations
- Increasing relevance of virtual communities
- Acceleration of technological knowledge creation and product cycles
- Increasingly networked communications media
- Free choice of way of life

A number of these mega trends will shape the nature of logistics and the supply chain. And the supply chain was highlighted as a key factor in defining our lifestyles in the year 2020–from its ability to provide competitive advantage within industry to the way it will shape our lives as consumers.

Supply Chain Trends Toward 2020

What are the factors that will shape the nature of the Supply Chain in 2020? By focusing on the trends that will remain valid in the long term we can present an overall picture.

The following list covers the significant trends that will influence our supply chain and present challenges for many and opportunities for some:

- Increasing cost of labour
- Decreasing cost of technology
- Consumer trends placing higher demands
- Increasing land, building, inventory costs
- Increased regulation
- Expansion of third party logistics providers

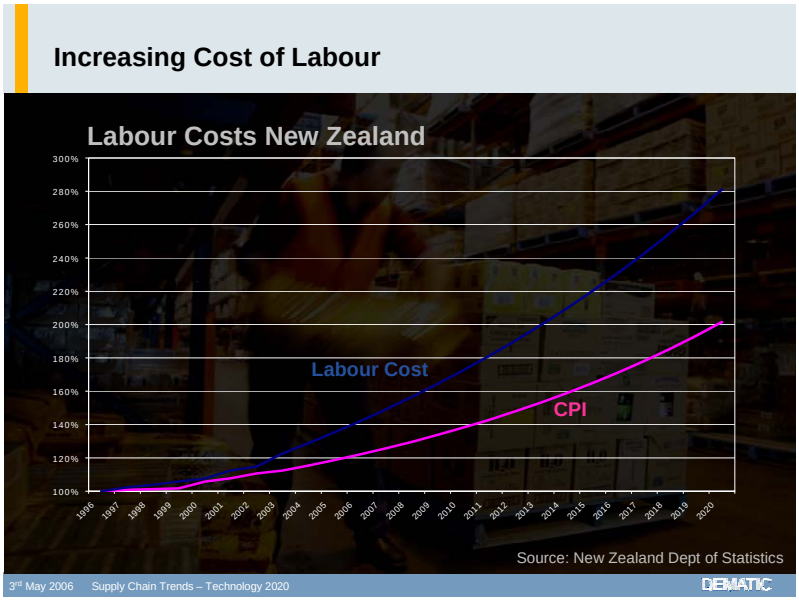
Increasing Cost of Labour

In 1995, the average warehouse worker earned about $15 per hour, today the same worker earns over $20 per hour–an increase of 40%. At the same time, CPI increases have culminated in less than a 20% increase.

As in Australia, the real wage rises in New Zealand seem to have been more than covered by the strong increase in the productivity of labour across most sectors. As a result we have seen rising real wages with a low inflation rate.

In both countries, employers, employee groups and governments are quick to take the credit. But many believe two other factors have kept the lid on inflation. The first is greater competition (and certainly a stronger dollar helps this) and the second, according to the Sydney Morning Herald's, Ross Gittins, is low inflation taking much of the heat out of wage bargaining. When prices are rising by 2 or 3% a year, employers have little trouble agreeing to a 3 or 4 % pay rise, thus yielding workers a modest but attractive real wage increase. However when prices are rising by 7%, there will be a much greater resistance to a 7% pay rise and one of 8% or higher may not be possible.

I'm not inclined to make predictions on CPI over the next 15 years, but there is little doubt that employers will be hard pressed to cut back on the trend already in place. This will apply even more under high inflationary pressures or higher interest rates. So in 2020, as illustrated below, the rate for a warehouse worker could easily jump to over $42 per hour.



We also need to consider other pressures on wages such as employment levels and the availability of hot skills.

At present our working age population is growing by close to 50,000 per year. By 2020 our working age population is expected to increase by just 50,000 for the entire decade–not 50,000 per year but for the whole ten years.

The following chart shows the age profile of New Zealand's population in 1984 compared to the profile of the labour force in 2004.

So if labour contributes to an average 30%- 40% of your cost of distribution, how will this impact on your costs? Effectively this translates to a minimum 20% rise in the cost of distribution.

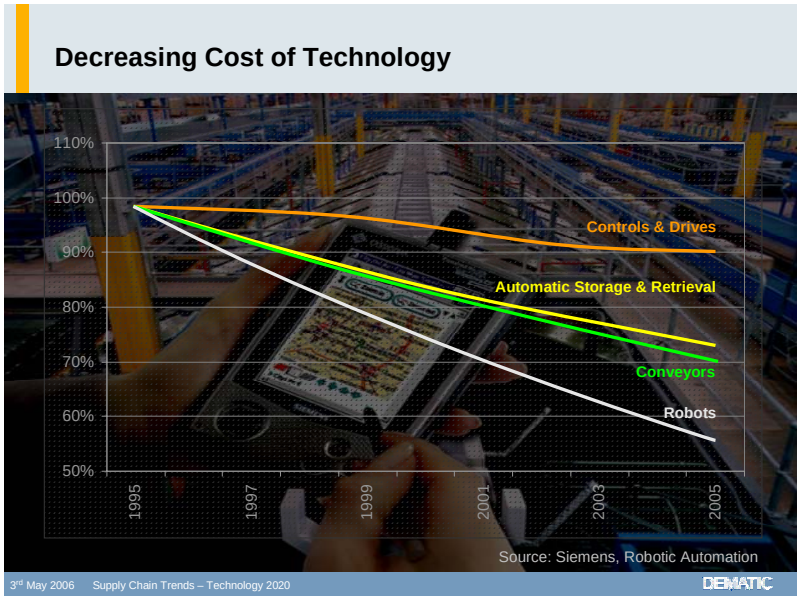
Decreasing Cost of Technology

Inflationary pressures aside, many industries have experienced real decreases in costs. These have been either in the form of real price decreases, price decreases against inflation or more functionality for the same or modest price increases. The computer industry is a good example of this.

At his Keynote address to the Intel Developer Forum in Feb 2003, Craig Barrett, CEO of Intel, had this to say: “Whether it's increasing functionality, performance, form factor, processing power, memory density, whatever you want, this is essentially what Moore's Law provides us. It provides us with the ability to do more and more on an annual basis–to shrink and to reduce the cost of the functionality we had last year. Volume economics is also important. The worldwide semiconductor industry today is an approximately US$150 billion industry. And it’s anti-inflationary–it provides more functions at less cost each year.”

In 1965, Gordon Moore, the founder of Intel, predicted that we would see a doubling of the number of transistors (i.e. twice the power, twice the memory) every 12 months or so. In the mid 1970s, Moore revised this prediction to a doubling every 18 or 24 months and forecast this level of performance for the next decade or so.

In the following illustration you can see some examples of cost reduction specific to the materials handling industry. These are typical components that can make up an automated distribution centre system.



So what has driven these price decreases?

Certainly increased globalisation has lead to significant changes in competitive pressures and resulted in greater consumer choice and, accordingly, better pricing.

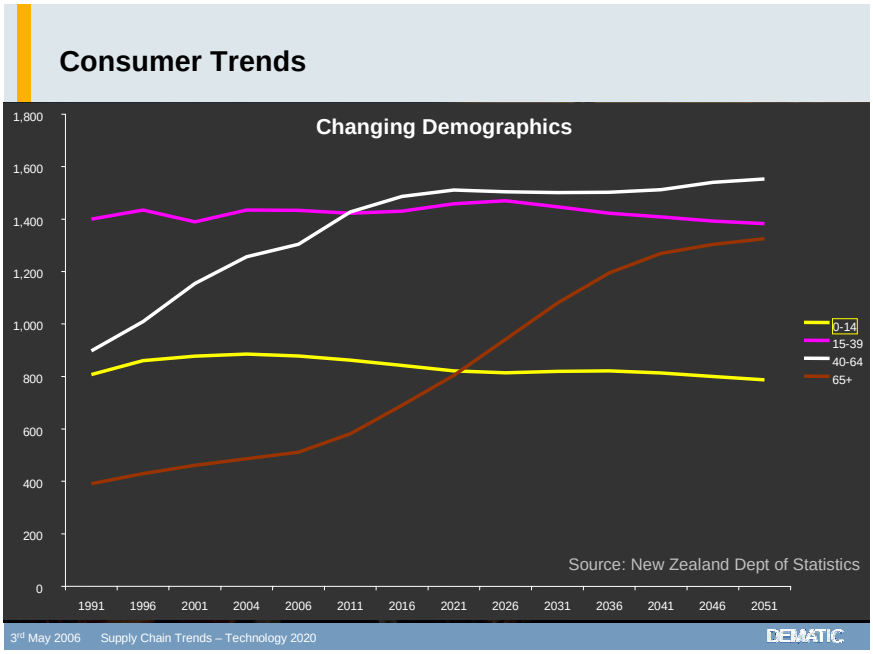
In response, many organisations have embarked on cost reduction strategies in an attempt to regain profitability. This has led to many reviewing standard designs and using technology to reduce non value-added waste by introducing concepts such as lean manufacturing. A good example of this is in the robotics industry. Colin Wells from Robotic Automation advises that over the last 10 years, prices have dropped 30% whilst payloads have increased 60% over the same period.

Consumer Trends

What about consumer trends and the demographics of our population?

In 2001, there were about two children for every person aged 65 or over. By 2051 it is projected that there will be about three people aged 65 or over for every two children.

The population is getting older. Today our average age is 35. By 2020 it will be 45. Why is this? Well, we are getting married and having kids later, and when we do have kids, we're having less of them. Our birth rate is below the replacement rate.

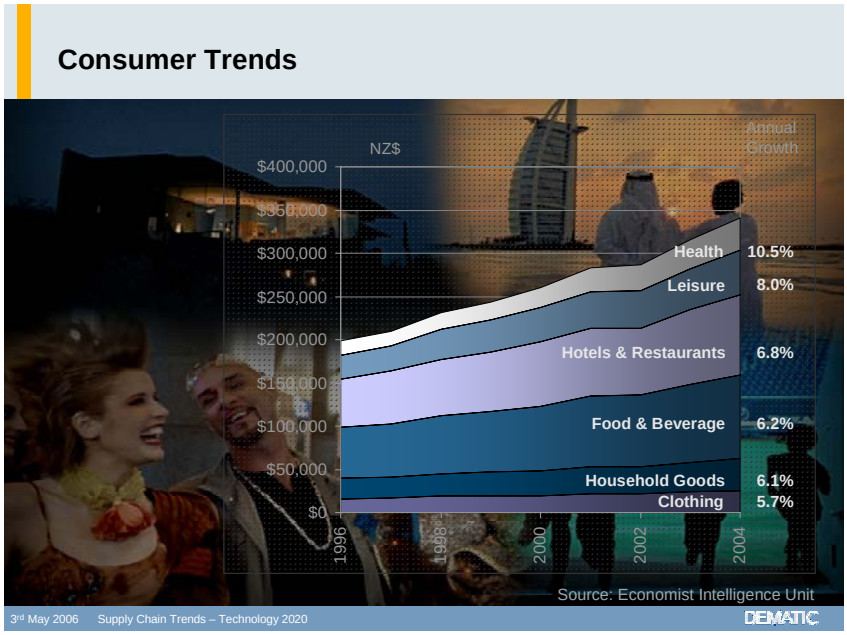


To emphasise the problem, many workers choose to retire early but our life expectancy from the age of 65 has increased by 50% from 77 to 83. Thus it will be no surprise that governments are looking at ways to encourage people to work longer.

This means we have an aging population, are working longer with more disposable income, and are encouraged to lead healthier and more active lives.

Knowing that we need to work longer, and with a greater emphasis on prevention rather than cure, will encourage spending on health, leading to a greater focus on fresh food and related products. Hence, increasing service related issues within the supply chain will emerge.

We are already seeing trends in health. New Zealand's spending on health has shown the highest growth over the last eight years. This trend also sees people spend more on leisure as they try to balance their work-life strategies.



At the other end of the scale we have the eco boomers, the off-spring of the baby boomers. Born between 1982 and 1995 they are already having an impact on entire segments of the economy. They spend their own money and that of their parents. But what do they want?

They are the first to grow up with computers at home, multi-channel cable TV, mobile phones, music downloads and instant messages. It's a generation that has always been "tapped in".

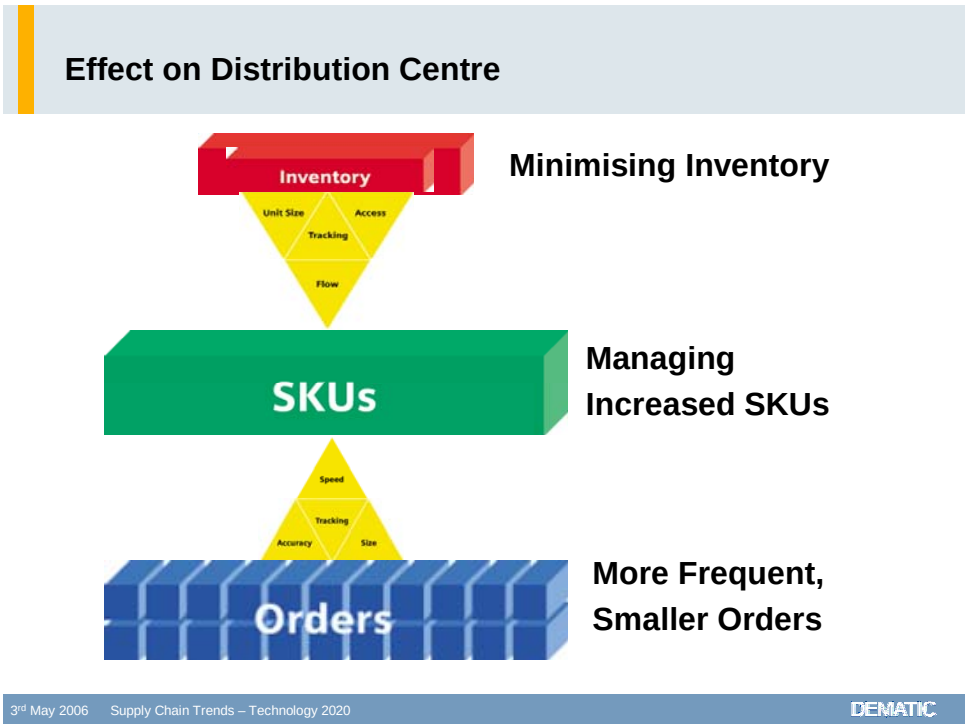
Increasing Land, Building and Inventory Costs

Between 1981 and 2004, the price of property in New Zealand, after adjusting for inflation, increased on average by 105%. However, it increased by almost 700% in Auckland City pinpointing the fact that city retail space is becoming increasingly expensive and well above the inflation rate. The Centre of Housing Research in New Zealand concluded that land prices, rather than building and construction costs, have had the greatest effect on this growth.

It is pertinent at this point to examine the effect of increasing land, building and inventory costs on a distribution centres. This is best achieved by assessing the impact on three commonly used variables or characteristics of a DC: SKUs, inventory and order profile.

Consumer choice and lifestyle, as previously discussed, will drive a proliferation of products so DC's, as well as retailers, will need to manage increased SKUs. Against increased land and building costs, the space available for any one SKU, both at DC or retail level, will decrease. Consider also the objective of financial managers and accountants to reduce inventory levels. How many of you in operations have been told that you have too much stock?

So we have more SKUs but we need to keep less of each in the supply chain. We achieve this by moving to more frequent, smaller orders, the complexities of which become the subject of detailed distribution centre and supply chain design.



Increased Regulation

From a regulatory perspective, the specific issues in which government regulation will most impact the supply chain will be occupational health and safety.

Around the world, OH&S is influencing designs at an increasing rate, from factories to airports. Distribution centres are being targeted in Europe, the States and increasingly in Australia and New Zealand.

The Workplace Health and Safety Strategy for New Zealand to 2015 was developed in 2005 to provide a national vision and strategic direction for workplace health and safety over the next ten years. It is estimated that several hundred New Zealanders die each year as a result of occupational diseases and traumatic work injuries. In addition, the Accident Compensation Corporation (ACC) received over 214,000 claims for work-related injuries and disease in 2003/04–equivalent each year to one claim for every nine workers. The costs to individuals, their family and the community are enormous, as are the losses to business through reduced productivity.

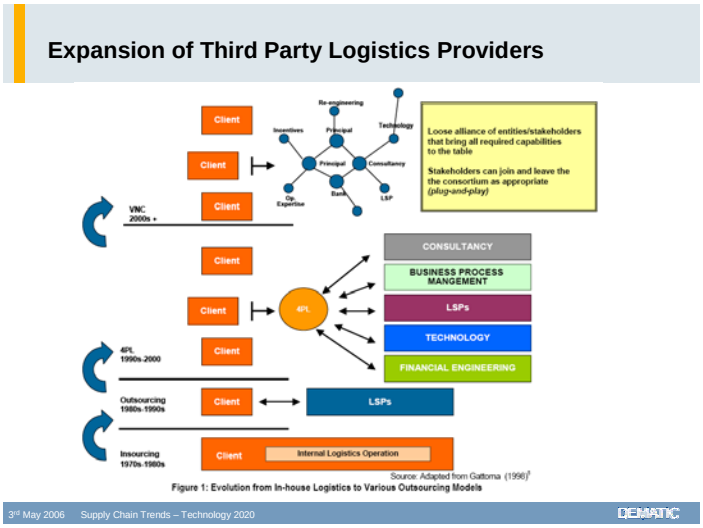
Over the past decade, New Zealand workplaces have responded to the regulatory framework provided by the Health & Safety in Employment Act 1992. The HSE Act is administered by the Occupational Safety and Health Service of the Department of Labour. The new Strategy will help New Zealand prepare for workplace health and safety challenges arising from changes in demographics, forms of employment, technology, and industry make-up.

Expansion of Third Party Logistics Providers

Logistics service providers, mainly in the form of third party providers (3PLs), have become an integral part of many supply chains. As competitive pressures increase, these 3PLs are becoming more integrated with their customers. This is being achieved by creating strategic alliances and partnerships with other complementary service providers that enhance the overall value propositions on offer.

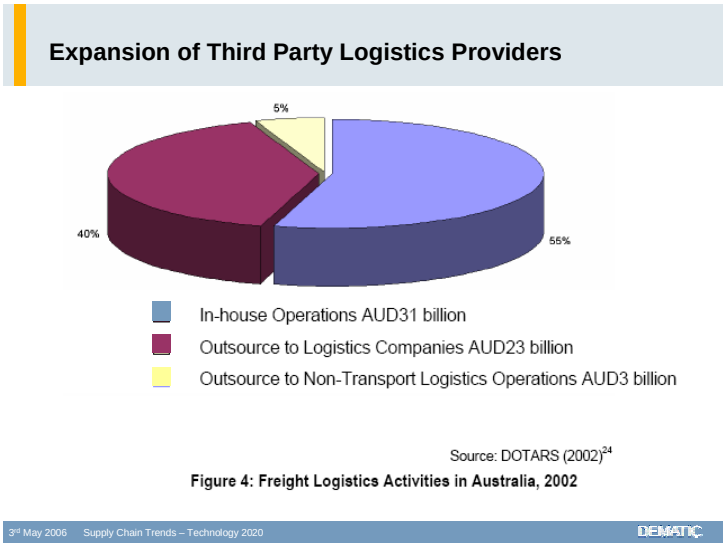
Integrated logistics providers have also emerged, offering integrative services that go beyond basic transportation and warehousing functions.

The following diagram shows the evolution of logistics providers over the past 30 years ranging from in-house logistics with a focus on productivity, cost-savings and functional excellence, to various outsourcing business models.



New business models in supply chain management include fourth party logistics (4PLs) providers, where the entire set of supply chain processes is outsourced to a separate management entity. We are also seeing a modification of the strict configuration of the

above two models as corporations organise into less rigid networks to gain access to capabilities, without long-term equity commitments.

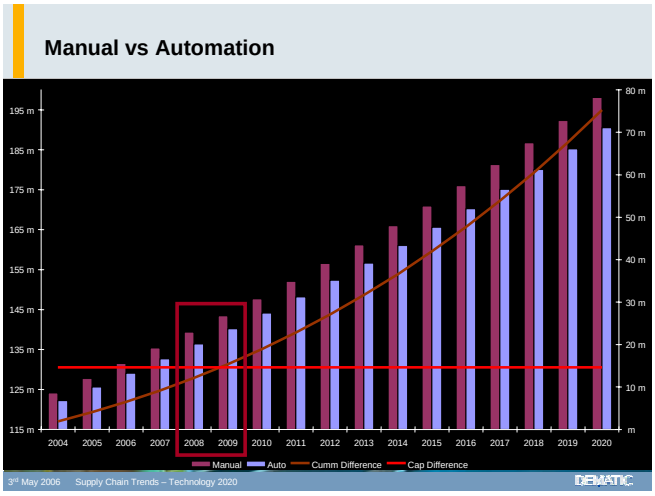


The Bureau of Transport and Regional Economics Australia estimated the total of cost of logistics in Australia in 2002 to be $57 billion. This is 9.2% of Australia's GDP and represents a significant proportion of economic activity in Australia. But more importantly, 45% of this activity was performed by the freight logistics industry as opposed to in-house logistics operations. This is a broad estimate because it is difficult to determine the scope of increasingly complex logistics networks but it reiterates the fact that networked logistics models such as 3PL and 4PL are a significant component of national economies now and towards 2020.

Manual vs Automation

Having looked at some supply chain trends let's turn our attention to initiatives and technology addressing these trends.

The following model evaluates the impact of automation.



This model is based on the average of collective data across similar businesses and distribution centres. We considered automating the replenishment task and technologies to increase pick productivity and to reduce footprint. We have not introduced inflation and therefore, all dollars are at 2004 levels.

The differential between the cost of distribution for a manual versus an automated distribution centre which, in the base year 2004, is approximately $2 million as shown by the difference in the two bars. We then note that this differential is, as expected, greater in 2020 than in 2004. Furthermore, in building these costs year by year, this increase in differential becomes more apparent. Next we look at the cumulative difference as plotted on the right hand side of the graph which shows a $75 million saving over the 16 year period.

Against a capital cost of the automation in this model of approximately $15 million, the resultant return on investment period is four to five years–a typical ROI period for the types of technology and automation we used in this particular model.

This type of modelling allows us to test the ROI against varying parameters such as those already discussed: land costs, building costs, technology costs and cost of labour each of which can singularly and collectively impact the ROI.

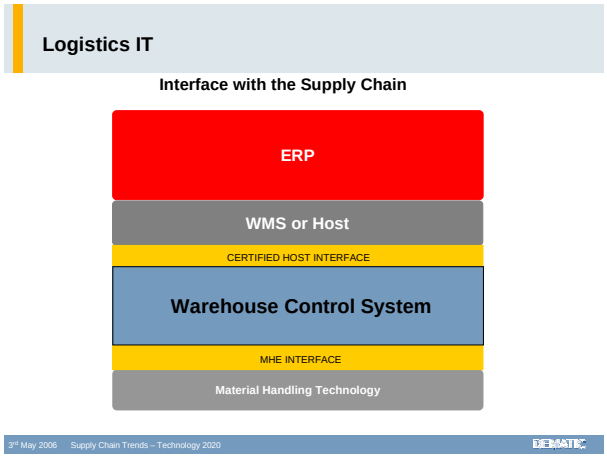
Where is the Opportunity?

It's worth spending a minute on which areas of a traditional DC operation, automation and technology may be best suited.

The task of order fulfilment can account for up to 65% of the labour costs of a DC so it comes as no surprise that automating, and/or applying technology to the various tasks within order fulfilment usually provides the best overall ROI. To this extent, conveyors, robotics, automatic storage and replenishment systems and picking technologies such as voice directed and pick-to-light are often the base inclusions of such systems.

Logistics IT

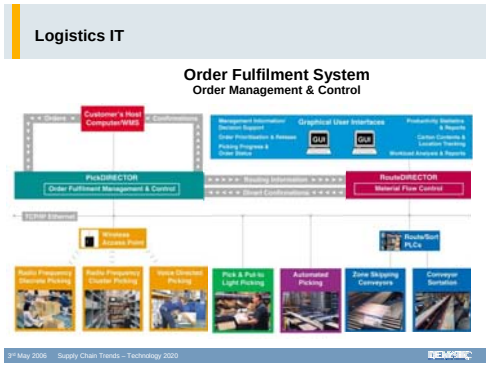
Let's now paint a picture of the interfaces between the supply chain and the software modules of a distribution business.



If we start at the business ERP system, we see that it interfaces to what is commonly called a warehouse management system (or WMS) which manages the overall inventory and location control within the DC.

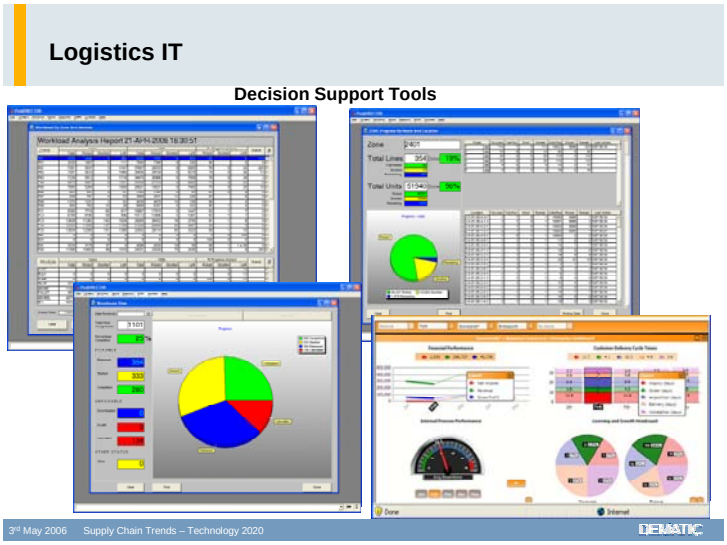
The WMS usually interfaces with a warehouse control system (WCS) which in turn interfaces with materials handling automation and technology.

Apart from interfaces to technology and automation which we will look at shortly, the WCS manages the processes and functions within the DC, from receiving product, storing it or putting it away into picking locations, through to picking the product and ancillary functions such as resource management and cycle counting.



As part of the WCS, an order fulfilment system is responsible for order management and control. A typical architecture of order fulfilment software commences with an interface between the WMS and order fulfilment software. This interface is an order-level interface whereby the WMS downloads order to the order fulfilment system. The order fulfilment system manages the picking of those orders using a combination of automation and technology and uploads confirmations of orders back into the WMS.

The order fulfilment system will typically support a wide range of picking hardware, from wireless technologies such as RF and voice activated picking, pick-to-light and automated picking technologies. It can be easily integrated with conveyor systems for routing and sortation. Finally, adding any number of terminals to the network, the system provides managerial and supervisory data either in query style requests or reports as required. Within this data you will usually find various decision support tools.



There is a trend today to go to “dashboard” style support tools giving the operator instant and simultaneous visibility into the many parameters defining the operation. Order fulfilment systems are increasingly offering prediction tools allowing operators to plan ahead, an essential tool for resource planning amidst what is often a variable workload.

Information Flow

Let’s now draw our attention to the technology of information flow.

Mobility

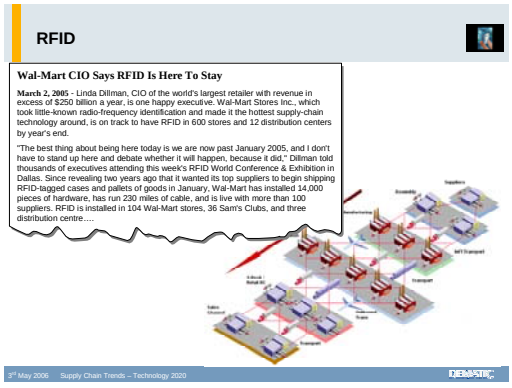
It goes without saying we live in the information age, where those that have is dictated by those that know. In many respects we are always “online”, from our mobile phone to our wireless broadband connections we live within the mobile information net. We go to Internet cafes not to meet the people next door but to meet the people half way across the world. We don’t think twice about calling a colleague in Europe on the mobile as we travel home at night knowing they are travelling along some autobahn on their way to work.

Look back only twenty years, when mobile phones were carried around as a brief case and the first laptop computer weighed 12 kilograms and cost the equivalent of $20 thousand. Today we have PDA's converging with mobile phones to provide incredible processing power and information storage in the palm of our hand. In future we will see more processing power and more memory but the real advances will be in the man machine interface.

Wearable devices is one example where your pen, jewellery and eye glasses, even your shoes will communicate with one another to provide a range of functionality to the user without the need to carry ancillary devices.

RFID

RFID is the buzzword in the logistics and material handling industry today.



There has been a lot of speculation about how this "technology of the future" can provide businesses with a real competitive advantage.

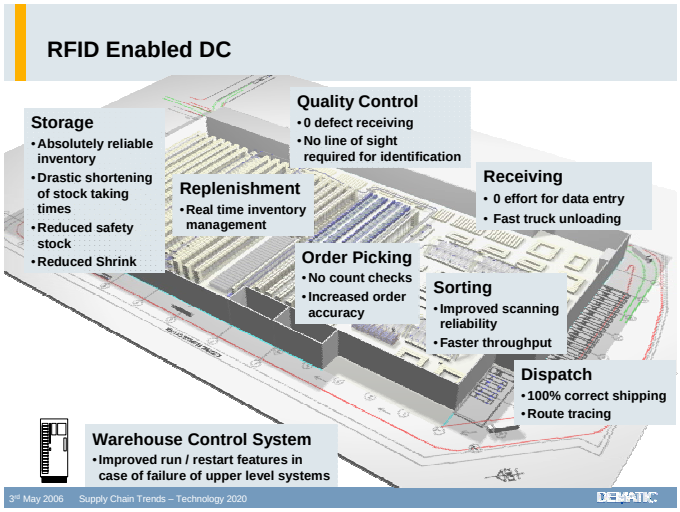
By now many of you would have heard the stories. June 10 2003, Linda Dillman, CIO of Wal-Mart, walks into a packed room and announces Wal-Mart will ask its top 100 supplies to provide RFID on pallets and cartons by January 2005. Shortly after, several other retailers and large organizations make similar announcements. Now, some 16 months after that deadline, commentators are still debating issues of compliance, and success.

This is what Dillman told thousands of executives attending the RFID World Conference & Exhibition in Dallas: "The best thing about being here today is we are now past

January 2005, and I don't have to stand up here and debate whether it will happen, because it did." Since revealing that it wanted its top suppliers to begin shipping RFID-tagged cases and pallets of goods in January 2005, Wal-Mart has installed 14,000 pieces of hardware, has run 230 miles of cable, and is live with more than 100 suppliers. RFID is installed in 104 Wal-Mart stores, 36 Sam's Clubs, and three distribution centres.

Whilst Wal-Mart has been cagey about the benefit it will receive through the adoption of RFID, many have speculated it to be in the 100's of millions if not billions of dollars. They are also cagey about what they have learnt over the past 2 years. To quote Dillman again: "Processes in the past year have changed, and Wal-Mart has learned what's needed for rapid deployment of RFID technology and how to minimize deployment costs. The model we had a year ago, you couldn't have deployed it in 104 stores," she said. "The message I want you to take away is that it's working-we aren't doing it as an exercise," Dillman told attendees. "From the manufacturer to the suppliers to the customer, there is a benefit."

Her advice? Start sooner rather than later. And start small. Wal-Mart's team in the first year had five associates who made this happen; today they have nine. If you have a small group that understands the business and have faith, you can make it happen. Recognize it's a journey - not a single step."



So beyond the advantages of storing more data, having dynamic data, multiple reading, etc RFID offers the opportunity for a step change. Don't limit your self to improving the accuracy or speed of current processes–look for opportunities to reengineer the process and eliminate some steps.

Over twenty years ago we talked about how the computer chip would revolutionise our world, and it's certainly done that. It has also revolutionised our industry. Just over 10 years ago we introduced mobile computing in the form of RF Data terminals which gave the computer chip mobility and changed the way we manage and operate with the supply chain. Now we have the ultimate in mobility where the flow of information and product has been married. And while the technology has been around for some years, I think it true to say we are just beginning to understand the possibilities.

Augmented Reality

Now for something a little more into the realm of future gazing…

Augmented reality is a new form of interaction between humans and technology in which the user is given supplementary visual information, for example, via data-glasses. Unlike a heads-up-display, this supplementary information is context dependent, i.e. drawn from and fitted to the real object being viewed, for example, a component.
In this case what a technician actually sees will be complemented by a visual representation of the relevant fitting instructions for the component. Augmented reality can replace the old-style handbook.

A coordinating project called **ARVIKA** aims to research and realise augmented-reality-technologies that will support development, production and servicing in relation to complex technical products in a user-oriented manner. Dematic has been developing these technologies and is currently reviewing applications within the supply chain such as augmented reality order picking that will provide all the benefits of current picking technologies but with far less cost.

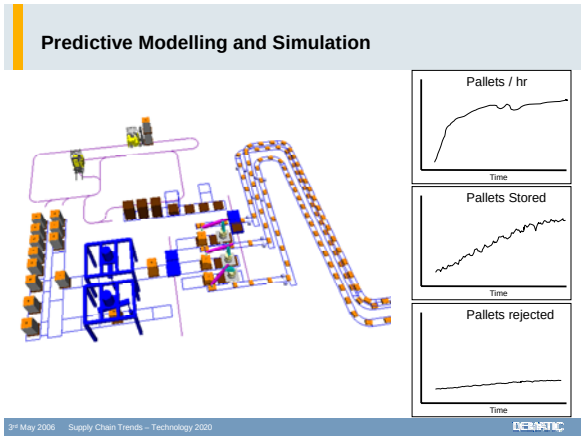
So effectively what we are seeing is the convergence of voice technology, RF and heads-up-display, combined to give a device that provides the operator with information in the most appropriate form.

Predictive Modelling & Simulation

So how do you know you have the right solution?

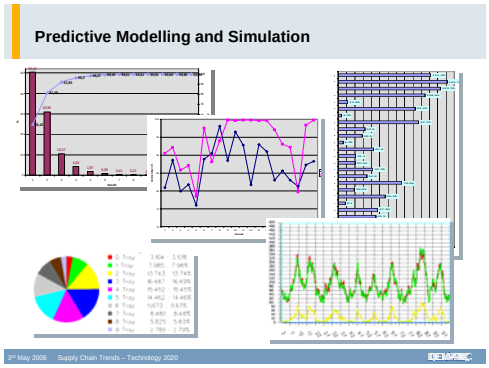
Simulation is a powerful tool in the right hands but is very sensitive to the quality of the data used and the quality of the model. It requires an experienced designer to make sure the data is right and therefore the model is sound.

A word of caution: what you see here as 3D images are only a minor part of what this technology can provide. Sure you can get a good view of the system through the video files but this can be done in more detail with far more appropriate tools. You can also get a good view of bottlenecks but you don't see the solution.



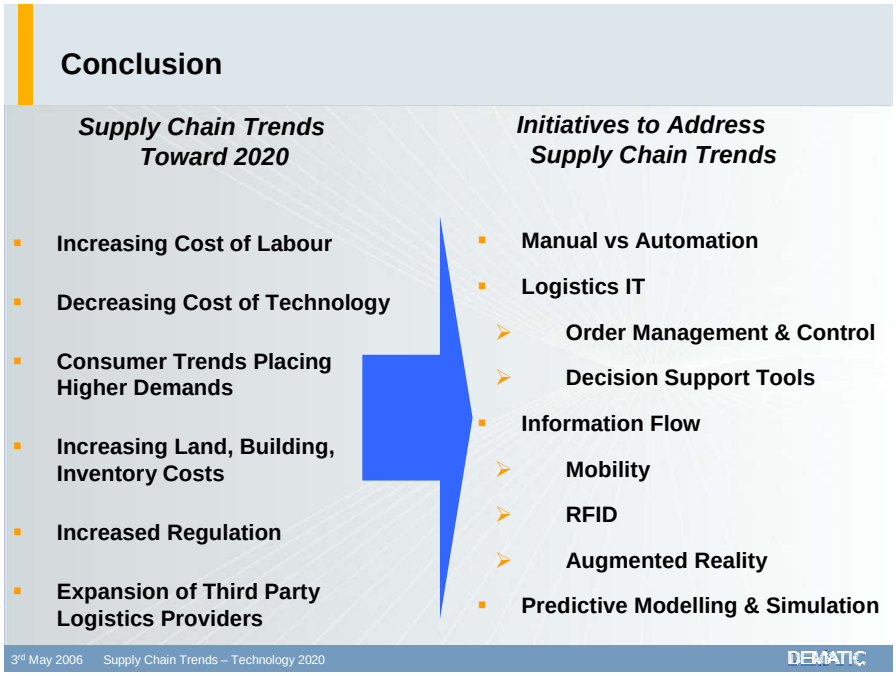
The true benefit of simulation is the hard information you get out of it.

Many people are concerned that automated solutions do not seem to offer them the flexibility they need. And in some cases this concern is warranted. But many times we have seen technology applied inappropriately and most often people do not take the time to test the chosen concept against possible future scenarios. It is the time spent testing the solution that allows you to build in flexibility. In many cases you can make what is only a minor modification during the design phase at no cost, which when implemented can save you millions down the track.



In the future, increases in computer power will transform simulation from a validation tool into a testing tool under an emulation environment to test system performance under simulation load thus allowing us to test scenarios not possible without the real system running. The next step for simulation is for it to be used as a decision support tool when managing a business. By forecasting the day's orders, decisions can be made and outcomes evaluated. This technology can also be used for training and evaluation of new warehouse managers or supervisors much like a flight simulator.

Conclusion



This article only presents part of the picture that will be the year 2020.

In the wake of discussions on the 2020 scenarios, various “Trend Breakers” or disruptive factors were put forward that could influence the scenarios to the extent that they would loose all validity. These included:

Natural catastrophes	Tsunami
War and Terrorism	9/11
Political events	Bush, US ignores UN, effects on oil prices, end cold war, Berlin wall, change in immigration policy.
Loss of trust in technology	nuclear disaster, Chernobyl, Air travel, smog from cars, mobile phone radiation
Dangers to health	SARS, information fatigue
Radical changes in the structure of the population	tend to be forecasted

A thorough analysis of these trend breakers demonstrates that only a massive occurrence affecting entire regions would have the power to change the living world so drastically that the trends described could lose their validity. That’s not to say that some of these factors wouldn’t knock the ship of course for a while.

But that’s the point–change is inevitable. And how you react and deal with that change is how you create opportunities for the future.

The information around these topics, of which I have been able to share just a fraction, is incredible. I encourage you to take the time and research what the future holds for your business. Find a way to take time out of working in the business and work on it. The rewards you reap will be pay dividends now and into the future.