Deloitte Access Economics

The economic impact of the 'Information Glut'

Hitachi Data Systems

November 2011

Deloitte.

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Glossary

AUD	Australian dollars
DAE-RGEM	Deloitte Access Economics Regional General Equilibrium Model
FTE	Full-Time Equivalent
GDP	Gross Domestic Product
IDC	International Data Corporation
NPV	Net Present Value
NZD	New Zealand dollars

Executive Summary

Exploitation of information is fundamental to business success. Technological advances over the past decade have led to exponential growth in the amount of data that can be captured and stored by businesses. Managed effectively, these data have the power to improve performance by creating new market opportunities and fresh insights into business operations.

However the proliferation of data also creates new challenges for businesses. If information management practices do not keep pace with the burgeoning volume of data, businesses can quickly become overwhelmed. Failure to effectively manage information can hamper productivity and potentially damage customer relations and business reputation. Businesses can also miss potential opportunities to access new markets and improve performance.

A survey commissioned by Hitachi Data Systems suggests that large numbers of businesses in Australia and New Zealand are indeed struggling to keep pace with the information overload and the cost to businesses, and the economy more broadly, is substantial.

Economic impact of the 'information glut'

This report estimates the scale of potential economic value of improving information management across Australian and New Zealand businesses. While the paucity of available data limits the precision with which the potential impact can be estimated, the results nonetheless highlight that improving information management has the potential to unlock considerable economic value.

The analysis in this report draws on a survey of 400 firms undertaken on behalf of Hitachi Data Systems across Australia and New Zealand. Estimates of the potential productivity gain that could be achieved were based on:

- the proportion of survey respondents who stated that they are currently experiencing a high level of information overload; and
- the estimated average amount of time that employees have saved in businesses that have previously invested in their information management systems.

The economic impact of the potential productivity gain is estimated using Deloitte Access Economics' regional general equilibrium model framework.

This methodology understates the total potential economy-wide benefits that could be achieved from more efficient utilisation of information. Firms that are experiencing moderate challenges have been excluded from the calculation, and the benefits from improved business analytics are not included in the analysis. The estimates are also conservative when compared to a UK survey undertaken by Capgemini (2008).

Conversely, the analysis does not account for the cost of investing in system upgrades. Nonetheless, the results demonstrate that the scale of potential benefits that could be achieved across the economy is significant.

Results

There are two scenarios explored in this report:

- Scenario A: Labour productivity improvement for Australia of 0.15% and New Zealand 0.26% - this scenario is based upon the survey results; and
- Scenario B: Labour productivity improvement for Australia of 0.21% and New Zealand 0.39% - this provides a high case and allows for some sensitivity analysis.

Both scenarios are modelled as a productivity improvement in 2011 that is maintained out to 2020.

Under the modelling assumptions for Scenario A, the net present value (NPV) of Australian GDP is modelled to increase by A$19.4 billion over the period 2011 to 2020 and New Zealand GDP is modelled to increase by NZ$3.1 over the same period (Table i). In the first year of investment, 2011 GDP is modelled to increase by around A$2.9 billion in Australia and NZ$0.4 billion in New Zealand.

Table i: Modelled GDP impact, 2011, 2015 and 2020

	NPV*	2011	2015	2020
	Scenario A			
Australia GDP (A$m)	19,443	2,942	2,648	3,251
New Zealand GDP (NZ$m)	3,092	429	428	509
	Scenario B			
Australia GDP (A$m)	27,953	4,223	3,810	4,672
New Zealand GDP (NZ$m)	4,649	645	645	764

Source: Deloitte Access Economics
* Using a 7% discount rate

As expected, the results for Scenario B are around one third higher than those in Scenario A. NPV Australian GDP is modelled to increase by almost A$28.0 billion between 2011 and 2020, and New Zealand GDP is modelled to increase by NZ$4.6 billion over the same period. In the first year of investment, 2011 GDP is modelled to increase by about A$4.2 billion in Australia and NZ$0.6 billion in New Zealand.

Deloitte Access Economics
October 2011

1 Background

1.1 Aim of the study

Efficient information management systems are critical components of a successful, modern business. Used effectively, information has the power to drive improved business performance and improve economic efficiency throughout the economy.

However failure to effectively manage information can be costly. Increased digitisation of records and a wide range of business applications mean that, if an organisation's computerised data is poorly organised, there can be large staff productivity costs associated with time spent searching for the correct data. In addition to these productivity costs are missed opportunities to utilise business analytics to capture information that may help to improve performance or identify new business opportunities.

It is in this context that Hitachi commissioned Deloitte Access Economics to analyse information mismanagement and the 'information glut' in Australia. This study provides an assessment of how information mismanagement is impeding businesses, and undertakes an economic impact analysis of how improved information management could facilitate improvements to business productivity and the broader economy.

In September 2009, Hitachi published the results of a survey conducted by Sweeney Research of 400 senior IT decision makers across Australia and New Zealand. The survey includes a wide variety of sectors and business sizes, with one in three respondents stating that their firm suffered from an 'information glut', that is, too much digital information stored inappropriately, to the point that information mismanagement is interfering with business operations. The survey qualitatively addresses the degree and manner in which 'information gluts' affect these firms, and also identifies those businesses most prone to the effects of too much data by size and sector.

This study was undertaken in parallel with an updated version of the September 2009 survey. While this survey is reviewed in a separate report, the outcomes of this survey feed into the modelling presented here.

1.2 Study approach

The methodology adopted is as follows:

- Desktop research was undertaken, reviewing what information management is, how firms define an 'information glut', and the cost of information mismanagement;
- Consultations were undertaken with a range of businesses across different industries, in order to get a sense of the magnitude of the problem of the 'information glut' and how improving information management systems leads to productivity improvements amongst staff who work with data;
- Estimates of the productivity gains from improved information management have been generated using survey results and other data sources; and

- Deloitte Access Economics' regional general equilibrium model (DAE-RGEM) framework has been utilised to estimate the economy-wide impacts of alleviating the 'information glut'.

The remainder of the report is structured as follows:

- Chapter 2 discusses the concept of the 'information glut', why it is occurring, and some of the costs involved in mismanaging information. It also discusses some of the differences in information management across sectors.
- Chapter 3 reviews information on the extent of the data glut.
- Chapter 4 then presents the modelling framework, assumptions and results.

2 The importance of information

The amount of data transmitted around the world is growing at a phenomenal rate. Rapid technological development over the past decade has also lead to a proliferation in the volume of data captured and stored by businesses across all sectors of the economy. This ranges from email communications with suppliers, seasonal transaction data, revenue and expenditure figures, to client backgrounds and histories.

While these data on their own have little application, their value lies in the information that can be extracted when collated and analysed on a broad scale, from insights on business operations to market trends and predictions.

The challenge for businesses is to organise their data in a manner that allows them to realise the potential benefits of their information. As the amount of data available to businesses continues to grow, so too do the opportunities to exploit this asset to improve performance. However the costs associated with failing to manage data effectively are also increasing.

2.1 Information overload

The Economist estimates that the amount of data created worldwide is growing at a compound rate of 60% per year (The Economist, 2010). This rapid proliferation has primarily been driven by technological development. New methods of communication and improvements in the capacity to capture digital information, together with the decline in the price of technological infrastructure, has led to the capture and storage of vast amounts of digital information that were previously unavailable.

For example, the development of the cash register in 1879 led to previously unavailable information by recording every transaction and providing an instant overview of business turnover. Fast forward to 2011 and technological development has allowed for sales data to be collected in greater detail and in much vaster quantities.

To obtain an idea of the sheer rate at which data is being generated, the units in which they are measured are a thousand times greater than the one before. For example, while a portable storage device earlier this century commonly had capacity for several megabytes of data, most devices now hold several gigabytes and even terabytes of data. Table 2.1 details the exponential increase in these data units.

Table 2.1: Units of data

Unit	Size	What it means
Bit (b)	1 or 0	Short for 'binary digit'
Byte (B)	8 bits	Enough information for an English letter or number in computer code
Kilobyte (KB)	1,000 or 2^{10} bytes	One page of typed text is 2KB
Megabyte (MB)	1,000KB or 2^{20} bytes	Typical pop song is 4MB
Gigabyte (GB)	1,000MB or 2^{30} bytes	A two-hour film can be compressed to 1-2GB
Terabyte (TB)	1,000GB or 2^{40} bytes	All the catalogued books in America's Library of Congress is 15TB
Petabyte (PB)	1,000TB or 2^{50} bytes	All letters delivered by America's postal service in 2010 is 5PB; Google processes 1PB every hour
Exabyte (EB)	1,000PB or 2^{60} bytes	Equivalent to 10 billion copies of The Economist
Zettabyte (ZB)	1,000EB or 2^{70} bytes	Total amount of information in existence in 2010 is forecast to be around 1.2ZB
Yottabyte (YB)	1,000ZB or 2^{80} bytes	Currently too big to imagine

Source: The Economist, 2010

Research by the University of California in San Diego found that in 2008, American households were bombarded with 3.6 zettabytes of data, equivalent to 34 gigabytes per person per day (The Economist, 2010). This was largely attributed to video games and television, and represents the extent of data usage, which is likely to increase further.

As more individuals and businesses gain access to tools for sharing information, particularly the internet and related applications, the pace of growth in digital information continues to quicken. This is compounded by the fact that there are now many more people who interact with information. 1 billion people worldwide entered the middle class between 1990 and 2005, and this increase in wealth has led to an increase in literacy and hence volumes of information (The Economist, 2010).

It is against this backdrop that effective information management – making sense of this proliferation in data – is becoming critical for business success.

2.2 The importance of effective information management

The value of data lies in the way in which they are organised and interpreted. As noted by the chief economist at Google, Hal Varian, while data are widely available, what is scarce is the ability to extract wisdom from them (The Economist, 2010).

The success of individual businesses, as well as improvements in economic prosperity more broadly, is largely determined by how effectively capital and labour are organised. Information is crucial for determining the most efficient way to allocate these resources. Moreover, information is allowing businesses to interact with suppliers and customers more effectively.

Developments in the capture and utilisation of data have already driven significant improvements in economic efficiency. Returning to the example of the cash register, the ability to analyse store transaction data has enabled retailers to identify correlations and trends in sales. With this information, stock management and forecasting can be improved and the most effective promotions identified, allowing stores to retain customers and prevent defections. For example, data shows that consumers purchase greater quantities of non-perishable snack food prior to natural disasters, and supermarkets can increase stock prior to seasons with forecasted wild weather to meet the upcoming demand.

The exponential growth in data will continue to present opportunities for businesses to improve efficiency. However the potential costs associated with poor information management will also increase as the volume of data continues to grow. A study by Oracle found that the average worker was spending 61.55 minutes per week locating documents in either email, personal folders or shared file servers in 2010, and once the information has been found, a further 74 minutes per week was spent converting it to different forms or re-entering it into different documents (Oracle, 2010).

Other costs of mismanagement include those associated with the potential for lost sales, poor customer interactions or reputational damage. There are also security risks presented where data is not appropriately stored relative to its classification, with potential for exploitation. Information is also a perishable asset, in that its value to the user depreciates if investments are not made promptly, with usefulness diminishing over time.

Case study: IT Organisation

One IT business consulted during the preparation of this report provides a classic example of a business that has been built around data management.

This business is a medium sized business, with around 50 employees, with a focus on the investment industry. Information is critical to the firm and, therefore, so is effective information management. Indeed, the firm estimated that around 50% of its operating budget is spent on information management.

Through recent rapid expansion, the amount of information the firm holds has increased by around 300% over the past five years. Consequently, their systems have many inefficiencies, prominent among which are design flaws (e.g. too many commands required to get to the required data) and not knowing what critical data is missing.

The primary consequence of not managing data properly is a customer satisfaction risk, as well as productivity losses from search times. To combat this, the firm is progressively updating systems, as well as outsourcing some services to accommodate for future growth and maximise efficiency benefits.

2.3 Sectoral differences

The importance of information, and hence effective information management, varies by industry. Financial services companies and complex service firms (such as banks and insurance companies) depend largely on information in their line of business, while for manufacturing firms which tend to have a larger stock of physical infrastructure, information adds less value to businesses.

Hillard (2010) proposed a rule of thumb that expresses the economic value of business information in terms of the percentage of the market value of the company. As shown in Table 2.2, it is estimated that up to 80% of the value of complex services firms like banks is associated with information. Although the value is much lower for simple manufacturing firms where value is based more from the contributions of physical capital and labour, these figures suggest that around one-third of the firm value is dependent on information derived from their supply chain, customer records and manufacturing formulas (Hillard, 2010).

The majority of industries are in the middle of this range, with 50-60% of value tied up in information. This includes the retail sector, telecommunications, pharmaceutical companies and utility firms.

These values can be used, in conjunction with information from Deloitte Access Economics' consultations, to scale the shock across sectors of the economy in the modelling component of this report.

Table 2.2: Estimated proportion of value related to information

Sector	Proportion of value tied up in information
Simple manufacturing	30-40%
Telecommunication, utilities and other infrastructure-related services	50-60%
Complex intangible service companies such as financial service providers	70-80%
Resource sector providers	40-60%

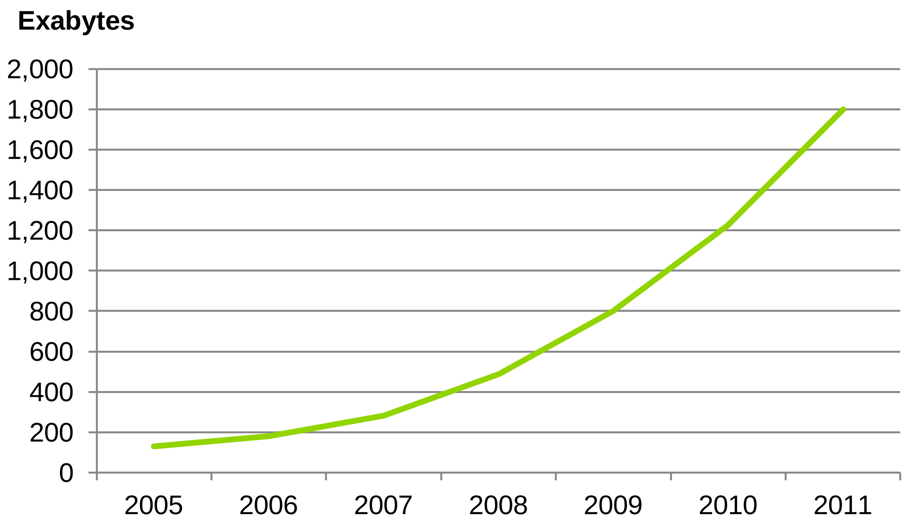
Source: Hillard (2010)

Within these industries, some parts of organisations may gain more than others from a more effective information strategy. A study undertaken by Capgemini (2008) in the UK suggests that customer management, information technology, finance and sales were the areas with the greatest potential to benefit from better information exploitation (Capgemini, 2008).

2.4 Trends in data and information creation

As shown in Chart 2.1, the creation of information has grown exponentially in recent years. Estimates by the International Data Corporation (IDC) indicate that the creation of digital information has grown by 10 fold, from 130 exabytes in 2005 to 1227 exabytes in 2010. IDC estimate that there will be 1,800 exabytes of information created and stored in 2011, while The Economist (2011) estimates that the volume of data stored doubles every 18 months.

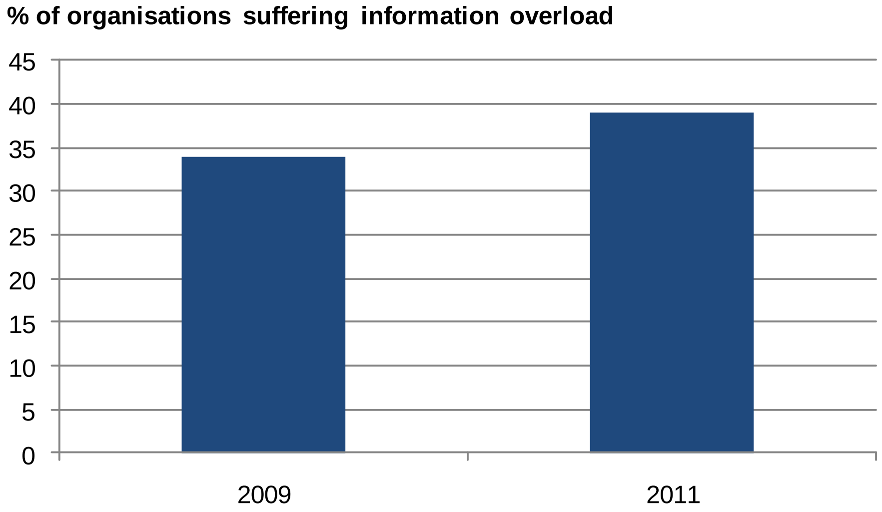
Chart 2.1: Digital data created



Source: IDC

This exceptional growth in the creation and storage of information presents a huge challenge for businesses. Surveys commissioned by Hitachi Data Systems in 2009 and 2011 indicate that the proportion of firms are suffering from information overload has been increasing in recent years. The survey found that 39% of organisations in 2011 were overloaded by the information they have to manage, up from 34% in 2009.

Chart 2.2: Organisations suffering information overload



Source: Ogilvy Illumination 2011, Sweeney Research 2009

The 2011 survey also indicated that a major barrier to further investment in information management is competing IT and non-IT investment priorities. With relatively difficult economic conditions outside of the resource sectors, Australian businesses have downgraded their investment intentions in 2011 and this is likely to be a factor weighing on information infrastructure investment plans.

3 Data on the 'information glut'

3.1 International experience

Past international studies suggest that the economic impact of the 'information glut' is large. Capgemini (2008) conducted a study in the UK which estimated that private sector businesses could improve performance by 29% with more effective exploitation of information, and by 24% for the public sector. Based upon these productivity improvements the study finds that poor utilisation of information assets by businesses in the UK cost an estimated £46 billion per year in missed opportunity for private sector profits in 2008, and a further £21 billion per year in administrative costs for the public sector.

More recently, Oracle (2010) undertook a similar study, finding that inefficient storage and work practices were costing UK companies up to £900 million per week. Based on a survey of 2,000 adults in the UK Oracle found that:

- The average worker spends a little over one hour each week locating documents or files either from e-mail, personal folders or in the business shared file servers;
- A further 74 minutes each week is spent copying, pasting and re-entering the same information into different documents;
- 96% are open to the introduction of new technologies to help make their working practices more efficient;
- 44% of respondents identified insufficient training as a barrier to adopting new technologies, while just over one third (35%) stated that new technologies were not simple or intuitive to use.

In the US, a 2010 Forbes Insights survey of 200 business and IT executives of companies with revenue in excess of US$500 million found that data-related problems cost respondents, on average, US$5 million per year, with one-fifth of respondents estimating annual costs in excess of US$20 million. However, while 95% of those surveyed agreed that strong information management is critical for business success, only 85% of respondents indicated that they treated information as a strategic asset, suggesting a potential information management gap.

3.2 Consultations

To complement the survey data used in the modelling exercise, six consultations on information management practices were conducted with businesses across a range of sectors. The consultations were not used directly in the modelling exercise. Instead, they provided a useful cross check for the survey information and a more in-depth understanding of the challenges faced by businesses.

The consultation process for this study revealed a substantial increase in the volume of information stored by their organisations over the past couple of years. Estimates of the increase in the amount of data stored ranged from 30% to a 300%, and all anticipate that the amount of information will continue to grow solidly over the next couple of years, with estimates ranging from 50% to 150%.

While most of these businesses expect their current systems will be able to cope with the increased volume of data over the next one to two years, over the longer term problems are anticipated. None of those consulted believe that their current systems will be able to cope with the increase in data over the next five years.

The majority of interviewees indicated that the most important types of data were customer records, compliance and financial reporting information; however the state of current data management systems varied somewhat. Some viewed their data management as more sophisticated than their competitors, while others stated that they may have slipped behind their competitors. However they all have said that their systems are well below where they would ideally like them to be.

Some factors that were identified as influencing the extent of information mismanagement included:

- Involvement in mergers and takeovers of other firms, with significant challenges and major inefficiencies emerging from integrating the data management systems.
- Slow change in legislative arrangements regarding information management procedures. In some cases this meant that, until recently, some documents had to be kept in paper form.

The share of employees who need access to information systems and average amount of time that employees of these businesses spend utilising the information systems varied substantially across the businesses consulted. These were highest among the financial and professional firms, who estimated that most employees would access at least some parts of the systems, and spend at least one-third of their day searching and accessing data in the system.

The potential benefit of improved information management systems was thought to be large. Most interviewees estimated that they could reduce the amount of time employees spend searching and accessing data by between 30-50% if they had more efficient data management systems. This has the potential to unlock substantial labour productivity benefits as well as a range of other efficiency gains to firms.

Case study: Nestle

Over the past decade Nestle has overhauled its IT systems to improve the quality of its data. Through improving information management and the efficiency of information sharing across the firm, a wide range of operational improvements were unlocked. For example, its American operation was able to save US$30 million just by reducing the number of specifications and cutting its number of suppliers for vanilla. It is estimated that the overall value of these operational improvements globally topped US$1 billion.

Source: The Economist 2010

4 Impact of the 'information glut'

4.1 Methodology

General equilibrium modelling using DAE-RGEM, incorporating the productivity improvement described in the previous chapter, has been undertaken to capture the economic impacts of the 'information glut'.

The productivity improvement is modelled as a sustained one-off productivity shock, and the results capture the benefits to businesses from improved information management, as well as the flow-on effects through the economy of these improvements.

This approach looks at the question of what the cost of the 'information glut' is through the reverse angle; that is, the modelling considers a hypothetical scenario where businesses suffering from information overload improve their productivity commensurate with previous information management investment outcomes, against a counterfactual of information management levels remaining at current standards. The assumptions used in the modelling are based upon the findings of the survey conducted in parallel with this analysis. Key parameters used in developing the shock are detailed in Table 4.1.

Table 4.1: Key modelling parameters

Parameter	Unit of measurement
Whether the organisation is suffering from information overload	Yes/No (Only "yes" response considered here)
Impact of overload	Scale (Only "A great deal" and "A lot" considered here)
Share of employees required to access data daily	Percentage
Time spent by those employees accessing data daily	Minutes per day per employee
Time savings from improved information management	Minutes per day per employee

Detail of how these parameters are used to develop a productivity shock is presented in Appendix B. The experience of one of Australia's banks (detailed below) is broadly in line with these survey-based assumptions.

Case study: Large Australian Bank

During the consultation process Deloitte Access Economics spoke with a major Australian bank. This bank employs more than 20,000 staff, and its experience with information management reflects the experience of survey participants overall.

The bank uses digital information at two levels. Broadly speaking, all staff utilise operations systems, with estimates that, on average, staff spend around 30% of their time using this data.

More narrowly, a much smaller subset of employees use the full suite of information management systems as a key tool for managing operations, banker performance, finance and regulatory reporting.

At both levels, accurate and timely information is vital to the smooth operation of the business, both within and across business units. Without proper information management there are potentially enormous negative consequences to operations. These include increased rework and costs, poor business decisions, reputation damage, incorrect strategic decisions, and in extreme cases of mismanagement, potential to lose their banking licence.

There are also substantial upsides to effective information management, including increased market opportunities, improved efficiency, and ultimately better return on equity for shareholders.

While some aspects of the banks' information management systems are excellent (e.g. security), other aspects are less mature, including staff skills and training, standards, policies and procedures and information sharing practices. Further, the age and number of different source systems and lack of coordination in information investment has increased the complexity of the system over time, leading to an 'information glut' problem. As the volume of data continues to increase, new investment initiatives and governance procedures are being undertaken in order to address these issues.

Overall, the bank estimates that investment in top-level information management systems could save around 5% of time employees spend accessing information across the company.

4.2 Scenarios

The outcomes of this methodology produce an estimate in terms of full-time equivalent (FTE) workers. This is the number of hours of time saved by workers across the economy from improved information management. It reflects time that is instead spent creating more value-add to the economy rather than time wasted on unproductive search activity. This is converted to a proportional shock of these FTE time savings as a share of the total labour force to derive a shock for the modelling.

There are two scenarios explored in this report:

- Labour productivity improvement for Australia of 0.15% and New Zealand 0.26%.
  - This scenario is based upon the outcomes of the survey, which showed that improvements in data management led to average productivity gains in searching for data of 21% in Australia and 20% in New Zealand.
  - The survey results were also used to conservatively estimate that 5% of employees in Australia and 10% of employees in New Zealand are impacted by information overload. This drives the difference in outcomes across countries.
- Labour productivity improvement for Australia of 0.21% and New Zealand 0.39%.
  - Scenario B is based on time improvements of 30% for both Australia and New Zealand. This scenario allows for some sensitivity analysis.
  - The assumed proportion of employees impacted by information overload in Australia and New Zealand remain unchanged under this scenario, at 5% and 10% respectively.

Table 4.2: Estimated labour productivity shock (%)

Labour Productivity	Scenario A	Scenario B
Australia	0.15	0.26
New Zealand	0.21	0.39

Source: Deloitte Access Economics

Both scenarios are modelled as a productivity improvement in 2011 that is maintained out to 2020.

4.3 Results

The discussion in this chapter focuses on the findings of the general equilibrium modelling used to estimate the impact recent investment in information management systems has had on the on employment and GDP.

The modelling is based on two scenarios, with the main inputs into the modelling sourced from a recent survey undertaken for Hitachi. More detail on the survey and how the modelling shocks were estimated can be found in Appendix B.

The survey allowed us to estimate the labour productivity improvement for those businesses and their employees who are experiencing information overload. The survey was conducted in Australia and New Zealand.

Scenario A

Under the modelling assumptions for Scenario A, net present value (NPV) Australian GDP is modelled to increase by A$19.4 billion over the modelling period 2011 to 2020, while in New Zealand it is forecast to increase by NZ $3.1 billion (Table 4.3). In the first year of investment, 2011 Australian's GDP is modelled to increase by about A$2.9 billion.

Table 4.3: Scenario A – Modelled impact, 2011, 2015 and 2020

	NPV*	2011	2015	2020
	Australia			
GDP ($m AUD)	19,443	2,942	2,648	3,251
Employment (FTE)		16,217	6,457	7,129
	New Zealand			
GDP ($m NZD)	3,092	429	428	509
Employment (FTE)		1,803	782	802

Source: Deloitte Access Economics
* Using a 7% discount rate

This increase in Australian GDP is modelled as a 0.21% increase in GDP in 2011, tapering away to 0.18% by 2020 (Table 4.4).

Australian employment would also increase over the modelling period. In 2011, FTE employment is expected to be 16,200 above than the base case where there is no improvement in information management standards, while by 2020, the FTE employment is around 7,130 higher than the base case.

Wages are also modelled to increase over the modelling period, with a 0.1% rise by 2020, driven by the increase in labour productivity. As a result, household consumption is also forecast to be higher.

Table 4.4: Scenario A – Deviations from the reference case, 2011, 2015 and 2020 (%)

	2011	2015	2020
	Australia		
GDP	0.21	0.17	0.18
FTE	0.17	0.06	0.06
Household consumption	0.22	0.15	0.15
Wages	0.07	0.10	0.10
	New Zealand		
GDP	0.21	0.20	0.21
FTE	0.14	0.06	0.06
Household consumption	0.17	0.16	0.18
Wages	0.07	0.13	0.14

Source: Deloitte Access Economics

The results in New Zealand follow a similar pattern to those in Australia. Over the modelling period New Zealand GDP is modelling to increase by just under NZ$3.1 billion. Employment also increases, with FTE employment around 1,800 above the base case in 2011 and around 800 above the base case by 2020. New Zealand also experiences higher wages and household consumption as a result of the labour productivity improvement.

Scenario B

Under the modelling assumptions for Scenario B, NPV Australian GDP is modelled to increase by almost A$28.0 billion over the modelling period 2011 to 2020, see Table 4.5. In the first year of investment 2011 GDP is modelled to increase by about A$4.2 billion. As expected, these results are about one third higher than those in Scenario A.

Table 4.5: Scenario B – Modelled impact, 2011, 2015 and 2020

	NPV	2011	2015	2020
	Australia			
GDP ($m AUD)	27,953	4,223	3,810	4,672
Employment (FTE)		23,306	9,319	10,192
	New Zealand			
GDP ($m NZD)	4,649	645	645	764
Employment (FTE)		2,711	1,180	1,198

Source: Deloitte Access Economics
* Using a 7% discount rate

This increase in Australian GDP is modelled as a 0.30% in 2011, tapering away to 0.25% by 2020 (Table 4.6).

Australian employment is also modelled to increase over the period, with employment around 23,300 higher than the base case in 2011 and around 10,200 higher by 2020.

Wages are expected to increase over the modelling period, with growth of 0.14% driven by the increase in labour productivity. Household consumption is also modelled to increase as a result of higher wages.

Table 4.6: Scenario B – Deviations from the reference case, 2011, 2015 and 2020 (%)

	2011	2015	2020
	Australia		
GDP	0.30	0.24	0.25
FTE	0.24	0.09	0.09
Household consumption	0.31	0.21	0.21
Wages	0.11	0.14	0.14
	New Zealand		
GDP	0.32	0.30	0.32
FTE	0.20	0.09	0.08
Household consumption	0.26	0.24	0.26
Wages	0.10	0.20	0.22

Source: Deloitte Access Economics

Over the modelling period NPV New Zealand GDP is expected to increase by just under NZ$4.6 billion. Employment also increases, to be 2,700 above the base case in 2011 and

1,200 higher by 2020. New Zealand also experiences higher wages and household consumption as a result of the labour productivity improvement.

The magnitude of these results are conservative when compared to a study undertaken by Capgemini (2008) in the UK, which found that better use of information could increase UK GDP by £67 billion.

Comparing these results with recent Australian microeconomic reforms shows that the potential gains from improved information management are significant. In 2006, the Productivity Commission estimated the potential long-run benefits of a series of reforms proposed as part of the Council of Australian Government's (COAG) National Reform Agenda. The Commission found that a 5% improvement in productivity of health service delivery could add up to around 0.42% of real GDP, while a 5% improvement in road and rail freight transport productivity has the potential to increase GDP by an estimated 0.36%.

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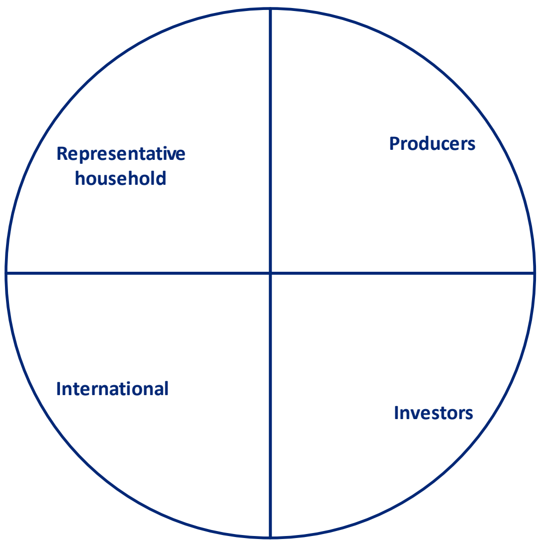
Appendix A: DAE-RGEM technical note

The Deloitte Access Economics Regional General Equilibrium Model (DAE-RGEM) is a large scale, dynamic, multi-region, multi-commodity computable general equilibrium model of the world economy. The model allows policy analysis in a single, robust, integrated economic framework. This model projects changes in macroeconomic aggregates such as gross domestic product (GDP), employment, export volumes, investment and private consumption. At the sectoral level, detailed results such as output, exports, imports and employment are also produced.

The model is based upon a set of key underlying relationships between the various *components* of the model, each which represent a different group of agents in the economy. These relationships are solved simultaneously, and so there is no logical start or end point for describing how the model actually works.

Figure A.1 shows the key components of the model for an individual region. The components include a representative household, producers, investors and international (or linkages with the other regions in the model, including other Australian States and foreign regions). Below is a description of each component of the model and key linkages between components. Some additional, somewhat technical, detail is also provided.

Figure A.1: Key components of DAE-RGEM



DAE-RGEM is based on a substantial body of accepted microeconomic theory. Key assumptions underpinning the model are:

- The model contains a 'regional consumer' that receives all income from factor payments (labour, capital, land and natural resources), taxes and net foreign income from borrowing (lending).

- Income is allocated across household consumption, government consumption and savings so as to maximise a Cobb-Douglas (C-D) utility function.
- Household consumption for composite goods is determined by minimising expenditure via a CDE (Constant Differences of Elasticities) expenditure function. For most regions, households can source consumption goods only from domestic and imported sources. In the Australian regions, households can also source goods from interstate. In all cases, the choice of commodities by source is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption for composite goods, and goods from different sources (domestic, imported and interstate), is determined by maximising utility via a C-D utility function.
- All savings generated in each region are used to purchase bonds whose price movements reflect movements in the price of creating capital.
- Producers supply goods by combining aggregate intermediate inputs and primary factors in fixed proportions (the Leontief assumption). Composite intermediate inputs are also combined in fixed proportions, whereas individual primary factors are combined using a CES production function.
- Producers are cost minimisers, and in doing so choose between domestic, imported and interstate intermediate inputs via a CRESH production function.
    - The model contains a more detailed treatment of the electricity sector that is based on the 'technology bundle' approach for general equilibrium modelling developed by ABARE (1996).[1]
- The supply of labour is positively influenced by movements in the real wage rate governed by an elasticity of supply.
- Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. A global investor ranks countries as investment destinations based on two factors: global investment and rates of return in a given region compared with global rates of return. Once the aggregate investment has been determined for Australia, aggregate investment in each Australian sub-region is determined by an Australian investor based on: Australian investment and rates of return in a given sub-region compared with the national rate of return.
- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.
- Prices are determined via market-clearing conditions that require sectoral output (supply) to equal the amount sold (demand) to final users (households and government), intermediate users (firms and investors), foreigners (international exports), and other Australian regions (interstate exports).
- For internationally-traded goods (imports and exports), the Armington assumption is applied whereby the same goods produced in different countries are treated as imperfect substitutes. But in relative terms imported goods from different regions

[1] Australian Bureau of Agricultural and Resource Economics (ABARE), 1996, *MEGABARE: Interim Documentation*, Canberra.

are treated as closer substitutes than domestically-produced goods and imported composites. Goods traded interstate within the Australian regions are assumed to be closer substitutes again.

- The model accounts for greenhouse gas emissions from fossil fuel combustion. Taxes can be applied to emissions, which are converted to good-specific sales taxes that impact on demand. Emission quotas can be set by region and these can be traded, at a value equal to the carbon tax avoided, where a region's emissions fall below or exceed their quota.

The representative household

Each region in the model has a so-called *representative household* that receives and spends all income. The *representative household* allocates income across three different *expenditure* areas: private household consumption; government consumption; and savings.

Going clockwise around Figure A.1, the representative household interacts with producers in two ways. First, in allocating expenditure across household and government consumption, this sustains demand for production. Second, the representative household owns and receives all income from factor payments (labour, capital, land and natural resources) as well as net taxes. Factors of production are used by producers as *inputs into production* along with intermediate inputs. The level of production, as well as supply of factors, determines the amount of income generated in each region.

The *representative household's* relationship with investors is through the supply of investable funds – savings. The relationship between the *representative household* and the international sector is twofold. First, importers compete with domestic producers in consumption markets. Second, other regions in the model can lend (borrow) money from each other.

Some detail

- The representative household allocates income across three different expenditure areas – private household consumption; government consumption; and savings – to maximise a Cobb-Douglas utility function.
- Private household consumption on composite goods is determined by minimising a CDE (Constant Differences of Elasticities) expenditure function. Private household consumption on composite goods from different sources is determined is determined by a CRESH (Constant Ratios of Elasticities Substitution, Homothetic) utility function.
- Government consumption on composite goods, and composite goods from different sources, is determined by maximising a Cobb-Douglas utility function.
- All savings generated in each region is used to purchase bonds whose price movements reflect movements in the price of generating capital.

Producers

Apart from selling goods and services to households and government, producers sell products to each other (intermediate usage) and to investors. Intermediate usage is where one producer supplies inputs to another's production. For example, coal producers supply inputs to the electricity sector.

Capital is an input into production. Investors react to the conditions facing producers in a region to determine the amount of investment. Generally, increases in production are accompanied by increased investment. In addition, the production of machinery, construction of buildings and the like that forms the basis of a region's capital stock, is undertaken by producers. In other words, investment demand adds to household and government expenditure from the representative household, to determine the demand for goods and services in a region.

Producers interact with international markets in two main ways. First, they compete with producers in overseas regions for export markets, as well as in their own region. Second, they use inputs from overseas in their production.

Some detail

- Sectoral output equals the amount demanded by consumers (households and government) and intermediate users (firms and investors) as well as exports.
- Intermediate inputs are assumed to be combined in fixed proportions at the composite level. As mentioned above, the exception to this is the electricity sector that is able to substitute different technologies (brown coal, black coal, oil, gas, hydropower and other renewables) using the 'technology bundle' approach developed by ABARE (1996).
- To minimise costs, producers substitute between domestic and imported intermediate inputs is governed by the Armington assumption as well as between primary factors of production (through a CES aggregator). Substitution between skilled and unskilled labour is also allowed (again via a CES function).
- The supply of labour is positively influenced by movements in the wage rate governed by an elasticity of supply is (assumed to be 0.2). This implies that changes influencing the demand for labour, positively or negatively, will impact both the level of employment and the wage rate. This is a typical labour market specification for a dynamic model such as AE-RGEM. There are other labour market 'settings' that can be used. First, the labour market could take on long-run characteristics with aggregate employment being fixed and any changes to labour demand changes being absorbed through movements in the wage rate. Second, the labour market could take on short-run characteristics with fixed wages and flexible employment levels.

Investors

Investment takes place in a global market and allows for different regions to have different rates of return that reflect different risk profiles and policy impediments to investment. The global investor ranks countries as investment destination based on two factors: current economic growth and rates of return in a given region compared with global rates of return.

Some detail

- Once aggregate investment is determined in each region, the regional investor constructs capital goods by combining composite investment goods in fixed proportions, and minimises costs by choosing between domestic, imported and interstate sources for these goods via a CRESH production function.

International

Each of the components outlined above operate, simultaneously, in each of the four regions of the model. That is, for any simulation the model forecasts changes to trade and investment flows within, and between, regions subject to optimising behaviour by producers, consumers and investors. Of course, this implies some global conditions must be met such as global exports and global imports are the same and that global debt repayments equals global debt receipts each year.

Appendix B: Labour productivity modelling

There are two scenarios explored in this report:

- Scenario A: A Labour productivity improvement for Australia of 0.15% and New Zealand 0.26%.
    - Scenario A is based on surveyed improvements of time savings in searching for data of 21% in Australia and 20% in New Zealand
- Labour productivity improvement for Australia of 0.21% and New Zealand 0.39%.
    - Scenario B is based on time savings of 30% for both Australia and New Zealand. This provides for sensitivity analysis of the results.

This Appendix provides some further details on how the time savings estimated under each scenario were converted to changes in labour productivity.

Scenario A

The first issue for the analysis is to determine what proportion of businesses are experiencing information overload. Table B.1 below shows the proportion of firms experiencing information overload in Australia and New Zealand based on a Hitachi Survey.

Table B.1: Proportion of firms experiencing information overloads (%)

Is the organisation experiencing information overload?	Yes	No
Australia	38	62
New Zealand	42	58

Source: Hitachi survey.

However, there may be some firms who experience information overload which only has a moderate or limited impact on their business. Table B.2 below shows how those firms who identified that they were experiencing information overload felt it had impacted their business. The final row of Table B.2 shows the proportion of firms who indicated that information overload affected them either “a lot” or “a great deal.”

Table B.2: Impact on organisations that experience information overload (%)

Impact on organisation	Australia	New Zealand
A great deal	8	12
A lot	12	19
A moderate amount	73	67
Not at all	4	2
Don't know	3	0
Total with an impact*	20	31

Note: * Those who state that the impact is either "a great deal" or "a lot" are regarded as have been impacted by information overload.
Source: Hitachi survey.

Based on these two tables the proportion of all firms who are impacted by information overload either "a lot" or a "great deal" can be determined by multiplying the proportion of firms experiencing information overload with the proportion who are impacted "a lot" or "a great deal" by information overload. The proportion of all firms which are impacted by information overload either "a lot" or "a great deal" is shown in the third row of Table B.3 below.

Having ascertained the proportion of firms who are impacted by information overload, this then needs to be weighted by the proportion of employees in these firms who are involved in accessing data on a daily basis (given that we have survey information on time savings for these individuals).

The median proportion of employees who are involved in accessing data on a daily basis across the firms surveyed by Hitachi was 70% in Australia and 75% in New Zealand. Multiplying these figures by the proportion of all firms impacted by information overload implies that 5% of employees in Australia and 10% of employees in New Zealand are impacted by information shown in the final row of Table B.3.

Table B.3: Proportion of firms and employed impacted by information overload (%)

	Australia	New Zealand
Proportion experiencing information overload	38	42
Proportion of firms experiencing information overload impacted "a lot" or "a great deal"	20	31
Proportion of all firms impacted by information overload	8 (38 x 20/100)	13 (42 x 31/100)
Proportion of employees required to access data on a daily basis	70	75
Proportion of all employees impacted by information overload	5 (8x70/100)	10 (13 x 75/100)

Source: Deloitte Access Economics.
Note: Numbers may be subject to rounding errors.

It is then necessary to determine the impact in terms of time savings for employees of firms investing in information management systems. Survey results from Hitachi indicate that, those employees who access data every day, the median time spent doing so was 61 minutes. Results also show that the introduction of information management systems resulted in an estimated time saving of 21% in Australia and 20% in New Zealand.

This implies that each worker that accesses the data information system could save 1.1 hours per week in Australia and 1.0 hour per week in New Zealand. Assuming a 38 hour average week, it is estimated that investing in information management systems could achieve a 2.8% time saving for workers who access information management systems in Australia, and 2.7% time saving in New Zealand.

Finally, to convert these time savings into changes in labour productivity, the average time savings as a proportion of total working hours is multiplied by the proportion of employees impacted by information overload. This process is shown in Table B.4 below.

Table B.4: Estimated labour productivity shock (%)

	Australia	New Zealand
Proportion of all employees impacted by information overload	5	10
Time saving as a proportion of working hours	2.8	2.7
Labour productivity shock	0.15	0.26
	(5 x 2.8/100)	(10 x 2.7/100)

Source: Deloitte Access Economics.
Note: Numbers may be subject to rounding errors.

Scenario B

Scenario B adopts the same methodology as Scenario A except that based on some of the responses from the consultations outlined above, it is assumed that the reduction in time spent searching for data is equivalent to 30%.

The estimated labour productivity shocks under these Scenarios A and B are shown in Table B.5 below. Scenario B increases the size of the change in labour productivity shock from 0.15% to 0.21% and the size of the labour productivity shock in New Zealand from 0.26% to 0.39%.

Table B.5: Estimated labour productivity shock (%)

Labour Productivity	Scenario A	Scenario B
Australia	0.15	0.21
New Zealand	0.26	0.39

Source: Deloitte Access Economics.

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