



International
Professional
Practice
Partnership

Transforming IT Professional Practice

GIC 2020 Skills Assessment

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2 Executive Summary

The role and purpose of professionalism [\[40\]](#) within ICT is clear and will not significantly change. However the knowledge, skills and abilities ICT professionals need to highlight risks and perhaps even whistle blow is constantly changing. That change will continue and accelerate in the years ahead.

The ICT industry is in a state of unprecedented growth and change. Companies in all sectors are struggling with ferocious competition to hold and win customers and remain competitive. They are constantly wondering if business relationships and the current technology to deliver business are appropriate for now and for the future.

Educators and other learning and development professionals are challenged to provide ICT professionals with appropriate skills and competencies. One possible outcome is the creation of specialized ICT flavoured courses in areas such as Mathematics, Operational Research and Statistics, and Economics (MORSE), Biology and Computing Science to meet demands. In the interim there is a need for competence certification as well as product and process certification.

This is a challenging time for ICT. Many of the methods, techniques, and solutions that evolved as the industry matured have been commoditised. During this evolution, technologies and new usage models have meant that certain subject areas require fewer people with a specific skill but those that remain in that skill area must have a deeper expert knowledge.

Maturity, reliability and availability of ICT technologies in many aspects of our lives has given rise to new areas that combine ICT and domain subject knowledge. The mobile healthcare market alone is estimated to be worth US\$60BN [\[39\]](#). This area currently poses the broadest range of challenges for professionals. The need for reliable, accurate, trusted systems is paramount for health and wellbeing of the individual. Compounding the ICT industry challenge, professionals are being asked to do more and more with technology, while investment in that technology and in their own constantly changing skill and knowledge needs is reduced.

Globalisation will feature more within an ICT professional's thinking. As information transparency increases the world citizens' view, localised regulatory controls will become part of the feature set of new applications developed for global use.

In addition to technical skill and knowledge, future ICT professionals will require a level of legal and commercial competence, underpinned by new

standards and guidelines for technology delivery. This is needed to better understand the broadening range of environments in which they find themselves working and also to help them interpret project impact and do the right things.

Note on recommendations:

Recommendations included in this report are focused on what IP3 should do and undertake as an influencing professional body. The findings and observations identify a number of other things that it would be nice to do. It is expected that market forces, vendors and necessity will deliver these. The recommendations outlined are those that will require broader consultation, agreement or are specifically complex.

3 Introduction

3.1 Background

There has been a significant emphasis on the shortfall of ICT skills in a number of countries over 2012, 2013 and 2014. There are ever increasing numbers of disputes raging from government, business and academia about the standards of ICT training, the readiness of school leavers and graduates for the modern ICT work environment, and a perceived acceleration in both the rate of change of ICT and the increased change in the way culture and business use technology. Citizen expectations of ICT technology are also changing and increasing.

These factors are driving ICT to new and evolving business models, operating models, methods and techniques from technology that is expected to drive commerce and organisations over the next 5 years.

3.2 Objective

To develop a vision of the types of skills and capabilities required within the IT profession for 2020 (some 5 years hence).

3.3 Scope

The vision needs to consider a number of factors:

- The general direction of the world in using computing for basic functions as well as for support and administration services.
- The impact of two opposing themes:
 - The first, the large computing themes that continue to accelerate. E.g. Moore's law increasing, analytics, communications convergence
 - The second, those themes that hamper change in the computing world. e.g. lack of education, standards in some areas of IT, lack of effective ways to support adoption of technology
- The impact of culture and society. Challenges are being made to legislation and compliance globally as citizen sentiment influences how computing technologies evolve.

- How ICT will attract and retain talent in the face of competition from other industries and sectors.
- Whether or not the computing industry has the right metrics in place to balance development and innovation, support, and control and maintenance.

3.4 Acknowledgements

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- A special thanks to all [GIC directors](#) who have taken the time and energy to consider the state of ICT now and over the next five years and provide analysis to help enrich this report.
- Appreciation is noted to the different industry representatives who have assessed the contents from a practitioner perspective.
- A very special thanks to Dave O’Leary IP3P for content review and editing.

3.5 Research method

In meeting the objective of this report trends in the ICT profession were explored. A number of qualitative discussions, survey commentary and trend analysis from a number of sources were also considered. This was supplemented by quantitative assessment of future market place growth. This information was used to assess the impact and change on the nature of skills required within by ICT profession going forward. This research design is best suited when a contextual understanding of an existing reality is desired (Yin 2009). Further, it enables deeper and richer insights into emergent phenomena (Willis et al. 2007).

There are a number of research reports, papers and predictions that identify key trends and technologies. While helpful, they rarely articulate how these directly define the new capabilities ICT professionals require.

Finally the report incorporated input from GIC Directors and invited ICT industry thought leaders and practitioners.

3.6 Licensing



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4 State of the IT industry

4.1 Traditional ICT

For a few years now some people have highlighted the ever changing boundaries of the IT world. These boundaries are starting to cross those of traditional science and engineering disciplines. This blurring of boundaries both enhances multi-disciplinary scientific endeavor and also dilutes and brings confusion to understanding of the specific domains that ICT is known for.

The traditional ICT leadership role in many organisations is being challenged and changed. For many corporations the ICT leader is the Chief Information Officer (CIO). The main job of that CIO is to meet the different business demands through the application of appropriate technology to inform effective decision-making. This role is morphing. For some, the CIO is seen as an ICT leader and a key member of the executive team. For others it is the traditional role of maintaining business as usual. Others look to “Chief Marketing Officer”, “Chief Innovation Officer”, “Chief Data Officer” and “Chief Digital Officer” variants of the CIO to bring new technologies and innovation.

Traditional ICT was the domain of hardware and software vendors. This has been disrupted by non-ICT-vendor technology companies. Such companies use technology to drive their business outcomes faster. They adapt faster, fail faster, and learn and apply innovation faster than some traditional ICT companies. The CIO and Chief Technical Officer (CTO) leaders in these companies often drive innovation and growth.

4.1.1 How many people are in ICT?

It has been extremely difficult to obtain definitive figures on the size of the global ICT workforce. Specific challenges have included the definition that many countries use to define who is and who is not part of the ICT industry, the ways that ICT professionals are counted as part of gross domestic product (GDP) statistics, as well as the categories assigned to individuals. Nevertheless, a figure has been extrapolated using available information.

As of 2013, the [United States Census Bureau](#) (USCB)^[4] estimated total world population at 7.179 [billion](#). The United Nations reports that 2.2 billion of these people are either near or living in multidimensional poverty. ^[4]

This gives an estimate of 4.9 billion people who may be available to contribute to the world wide ICT work force. From the United Kingdom (UK), USA, France and Australia it is estimated that 2.5% to 3.3 % of each nation's workforce is directly engaged in ICT. Over the 2015 to 2020 timeframe these percentages will increase. Some estimates state this increase will happen at a rate that this up to five times faster than other industries ^[7].

What percentage of this workforce number view ICT as a profession and an industry, rather a job? The answer to this question is of particular interest to IP3. Over 75,000 people are on the British Computer Society (BCS) membership list as of the 31st of August 2014 annual report. This represents some 3% of the UK ICT industry working population. A similar percentage appears to apply to Northern America and Australasia ICT industry institute membership populations.

Using this data as a basis for extrapolation, in 2013 between 123 million and 147 million people may be considered to be involved in the ICT industries. Of these some 3.7 million people would be thought to be members of some professional institute, or consider themselves on a career path to ICT professionalism.

4.1.2 Themes affecting the ICT Industry

4.1.2.1 *Parts of a more complex system*

Within large organisations there is less opportunity to enable growth or reduce cost by undertaking a single ICT system change. More frequently realisation of the value from ICT systems requires a number of changes across the business. These changes can impact processes, interactions with users and customers, data and technology. Such changes lead to the need for a deeper understanding of the processes, interactions and impact of change. In this change process ICT systems are sometimes perceived as both hiding what is happening and not being flexible enough to change. To improve transparency organisations require more direct and deliberate alignment between business planning, operations and ICT. The role of the business analyst is expanding to meet this demand, however their role is also growing to manage more and more complex business, technology, data and process challenges.

The current scale and pace of required change can be profound, increasing risk to the business. Those managing this complexity require a specialised skill set. At the same time they must manage a broader role overseeing assurance and alignment of the business with a deep understanding of the implications of technology change. This is demanding that people have a broader ecosystem perspective with insight not only into business operations and ICT, but into the preferred professional development and personal change pathways of the workforce. Those with this skill set may be seen as hybrid project managers, who focus on achieving the overall project outcome more than specific project management process. They understand how customers, users and the ICT workforce adopt new skills. They are constantly learning to develop the new capabilities the business requires. Senior experienced individuals who can look at organisational capability, understand the technology and deliver transformation are a corporate “must have”. Currently, individuals possessing this skill matrix are somewhat rare.

Development of the appropriate emerging skill sets and capacity in the ICT workforce by 2020 faces a number of challenges:

- A current shortage of skilled personnel who understand how to integrate emergent, new, ageing, and legacy technologies.
- The continuously expanding breadth and depth of required technical and product skills.
- The traditional corporate hiring approach of focusing on knowledge of specific products or technical skills as the key hiring criteria for ICT personnel.
- The need for more relationship based ICT personnel is creating pressure on traditional recruitment methods and strategies. The current challenge is acquiring and developing technical personnel who wish to grow and develop in the business and the need for these people to integrate understanding of the business with their understanding of ICT.
- The need for business to move faster and in more agile ways.

In the context of these challenges and to remain competitive, vendor organisations are collaborating to provide more linked or engineered systems reducing costs and providing integrated support agreements.

To drive sales these vendors have been invigorating their sales models with personnel who better understand customer needs, and who can look at how existing products sold can be maximized, thus retaining customers. This responds to a direct need to compete with a new type of software vendor, one providing products that appear to be more appropriate and specific but at a cheaper price point than those already procured from more traditional vendor sources.

As the progression towards the internet of things (IoT) ^[42], big data, mobility, collaboration and the convergence of telecoms and data, regardless of media and format, continues there has been a proliferation of new technologies and solutions. For some organisations the fragmented nature of including these is causing the organisation to re-think their overall approach to the role of ICT. One example of this kind of disruptive technology is cloud services.

For new companies and startups, the ease with which they can adopt technology to launch is a key enabler. Nevertheless, two to three years after taking on these new cloud based technologies, these startups are finding issues around integrating different systems, sharing data, and linking processes. By deploying into the cloud, the same challenges of integration, integrity of systems, record of fact and low cost operations still exist.

The use of new technologies and cheaper open source software is removing some perceived barriers to entry to the software development startup industry. The high price charged for some existing applications is making the software startup industry highly appealing. One outcome of this is an ICT workforce of very enterprising workers. They are developing outside of the larger administrative or commercial organisations. This workforce is quick, nimble and able to rapidly execute ideas. This emerging ICT group can be challenged when they need to scale and industrialise the products and services.

Finally since their products often reinvent what may already be available, intellectual development can also be lost, and along with it the potential enrichment of the ICT community.

4.1.2.2 New methods, new processes, new thinking

The computing industry is maturing and changing dramatically. In the last 4 years a number of disruptive technologies have emerged and become more popular. Many are heading for mainstream adoption. Strangely, some of these technologies and their associated business use cases have been around for decades. The combination of increased trust in ICT, the need for business growth, austerity measures, ICT economics and easier access to technology has led to further expansion of technology into new areas. There is a commonly held belief that improved education and understanding of these technologies over the years has also driven their adoption.

Agile development and its variants have arisen as a way to fail-fast, learn-fast, and deliver fast. This approach has, in successful organisations, given rise to stronger emphasis on engineering discipline and specifically on configuration management and deployment management processes. In others, its inappropriate application, poor lack of understanding and the failure of projects have set back the adoption of such methods. In these cases they are seen as risky or immature.

In the agile environment, individuals that succeed have a breadth and depth of knowledge, and maintain a focus on what the outcome should be within a framework that allows them to approach it as they see fit. A challenge for larger projects is making sure that framework is in place, maintained and governed.

4.1.2.3 Business Value of ICT

Organisations are starting to be categorised by the way in which they use technology:

- in love with computing technology;
- seeing it as an enabler;
- struggling to make sense of the technology and what it can do for the company;
- delivering compliance and legislation; or
- technology as a commodity.

A major construction firm CIO states that ICT is a commodity and that “cheap, reliable and secure” are all he really needs. He actively looks for a “design to assemble” approach, and the suggestion of building any software is not something he invests time in. The CIO of a global chemical manufacturer shared the same opinion. However, in the area of ICT, driving research for chemical compounds is where he focuses his innovation budget. A global bank prides itself on having the largest private network infrastructure to communicate internal information throughout the corporation.

ICT leadership within such operations blends deep understanding of business, competitive advantage and how ICT directly enables that business. A key concern for the ICT leadership team is helping the business understand this value and exploit the technology advantage.

Compliance, legislation and regulation have been an enabler in this area. In one case example, energy companies in Europe have been denied cybersecurity insurance until security due diligence had been undertaken. This example of failure of direct investment in ICT shows that there is potential for a very real impact on the very existence of the business.

The selection of the right CIO and a clear understanding of what is required from the ICT leader is needed if a business is going to increase revenues, gain market share and improve productivity. These questions need to be asked by companies and by aspiring CIOs.:

- Is ICT a support, an enabler, or a driver within this organisation?
- Is ICT transformation required within the organisation?

- What type of ICT leader is required to change the organisation?
- Is the ICT leader the right person for the ICT function,
- Has the ICT leader the FQ (future quotient) needed by the business, *and*
- Can the organisation fit with the ICT leader?

An overriding challenge for the ICT leader is understanding when and how to migrate from or integrate different organisational models such as using ICT for business value, ICT economics, changes in the ICT landscape, and how the competitors and customers are using ICT. Within the word economics lies the thrust of this analysis; that the skills, capabilities, learning and development needs for the workforce to develop, support, operate and use new technology are a key focus.

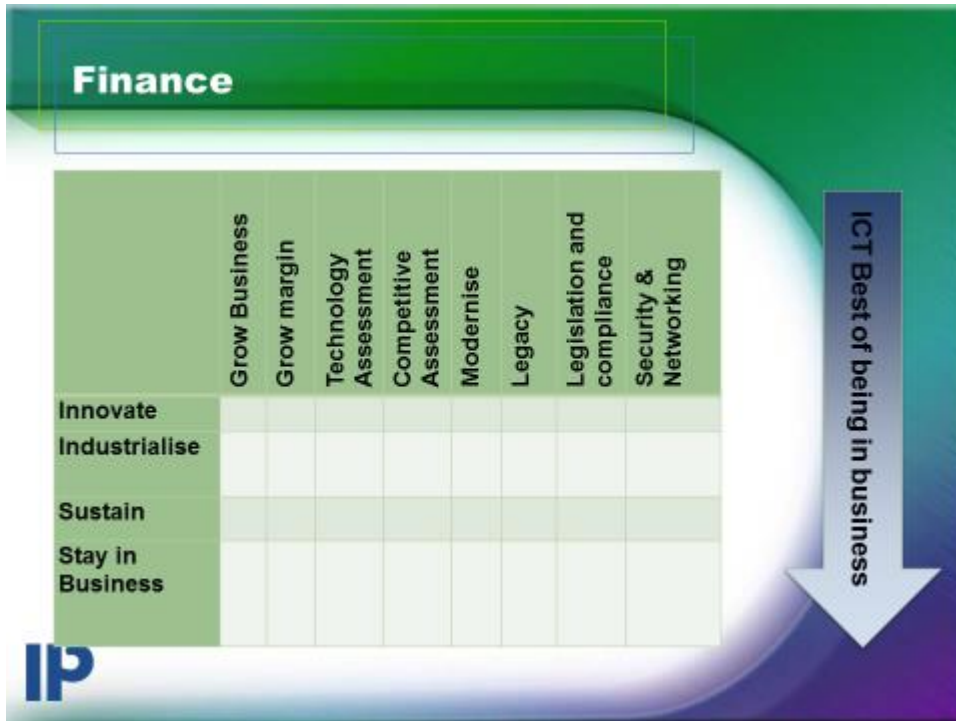
The rise of changing business models and the need for the ICT leader to maintain an external view of technology is becoming an ever increasing challenge. Some ICT leaders have paid little attention to how technology trends could assist the business, focusing instead on keeping the business running. It is even rarer that they consider how their competitors will use the technology. A few new technologies CIOs should consider are:

- 3D printing – Driving changes in logistics management; what is intellectual property; new pricing models;
- Data Equity – The value of data internally, externally and the ways in which that information can be monetised. What are the right types of information and ways to get this information to enable business improvement;
- The cloud – The value that it can bring short term and the restrictions that it can bring longer term;
- Automation – driving new self service capabilities.

A final challenge for the ICT leader is to assess what is required and not to make a change just to be seen doing something. Justifying the status quo is less costly than transformation. For some, significant investment has been made in ICT, in particular applications development. Changing such systems, which may provide minimal cost reduction, may not now, nor in the future, provide any intrinsic value to the business.

How is a modern CIO to make the right decision and communicate it effectively to the executive decision making team? The following table outlines one way a CIO may use their knowledge and business understanding to inform the discussion. The financial cost of

operating and managing the IT business is segmented into its constituent components. This shows clearly alignment between revenue enhancing ICT and cost based ICT enabling business decisions to be made based on business strategies.



4.1.3 Open Source

Open source is taking a more prominent position in many more industries and there are a greater number of companies offering enterprise level open source services and capabilities around support for open source software. Organisations attracted by the opportunity to increase margin by taking advantage of a cheap or free ware commodity software stack are increasing. The range of higher level software tools and capabilities from the open source marketplace, combined with the number of companies providing enterprise wrappers has moved the perception of open source software from geek software to commodity software.

Whilst reliability, availability and resilience of open source software improve, one broadly felt reality is that it still requires a pool of people to support and maintain the software. The number of companies supporting open source software has increased and this trend in providing support, customer service and consultancy

capabilities around the open source software stack continues to grow.

As some companies look for a lower cost way to operate their business by taking advantage of reduced computing and storage costs the appeal of open source will continue. The difficulty is finding sufficient people with the right skill set that can develop such systems at the appropriate price point, and how the open source components can integrate with existing enterprise software.

A secondary concern is the availability of open source software that can be industrialised and can meet enterprise level demands.

Open source is very popular in some countries as a cost effective way to initiate a business around core computing science skills. In response, some enterprise vendors are changing their business models to allow freely available software development licenses for their products.

4.1.4 Changing relationships

4.1.4.1 *Delivering systems*

Recent years have seen a trend towards delivering platforms and taking a more layered approach to architecting enterprise systems. This move towards platforms such as infrastructure as a service (IAAS), data as a service (DAAS), software as a service (SAAS), and platform as a service (PAAS), and the associated move towards engineered systems is simplifying the integration process of these products and allowing faster delivery of ICT capability. It should be noted that this provides an integrated set of products to deliver a specific capability. The need for differing or evolving capability means that these platforms may not be suitable for future needs. To some extent this has been beneficial for some customers. Others have stated they soon face the need to integrate the capabilities, or address the problem of business use cases that span the platforms. Here, ICT has the choice of mixing commodity specific capabilities with differentiated capabilities and commercial off the shelf (COTS) capabilities, developing frameworks of capabilities, or building from new. The challenge is getting this right. The role of the architect here is key as they are being asked to balance the technology, integration and the price/value of solutions to provide the right approach.

As business relationships develop, the need for cross departmental, cross enterprise processes, and data integration is expanding to a need for cross supply-chain, cross company, and cross industry sector integration. Lack of standards, security and integrity of systems and a vast range of different laws, regulation and compliance make this increasingly complex. Smaller agile companies are delivering niche systems, gaining market share, and moving faster than regulators and administrative authorities can respond.

4.1.4.2 *Co-opetition*

Recent years have seen the rise of collaboration between vendors and companies who, in the past, have been highly competitive. Companies are looking at those who were traditionally competitors and seeing how they can work together to provide more specialised services and capabilities.

This is placing new pressure on ICT vendors to integrate and engineer a number of tools together to ensure that the joint offering is market acceptable. Such innovation and product enhancement is driving new intellectual property (IP) and patents as well as identifying gaps as vendors come to understand the challenges users have experienced in integrating products together.

Organisations are also looking to be more collaborative and are making demands on their ICT departments to integrate with their partners', competitors' and suppliers' systems, processes and data. This gives rise to new and interesting security concerns. It also raises the challenge of designing the most appropriate trusted mechanisms for sharing such information.

The introduction of such new arrangements can change the focus of the ICT organisation from a provider of services to an enabler of technology, driving a need for new and changing skills. It also requires the ICT unit to be better integrated with the product and pricing business units, as the underlying costs for delivering the service change requiring revision of product and/or service cost models.

4.1.4.3 *Extended Supply Chain/Extended Value Chain*

Based on a number of cases, there is an increase in companies looking at their overall supply chain. Here the needs for the enterprise to interoperate and align the needs of the business with suppliers and buyers has driven new ways of integrating technologies and managing those technologies.

In essence the complexity of producer to consumer is rapidly shrinking with the removal of boundaries and the objective of giving the consumer what they want. This is erasing organisational boundaries leading to provision of a single platform for delivery. One good example of this is seen in the food retail industry where two themes have driven this change

1. Health and safety – Cases such as:
 - a. The horse meat scandal in Europe where beef was replaced by horse meat and sold in shops;
 - b. The story of a chemical substitute being contaminated and requiring nearly £100M of foodstuffs to be removed from retail outlets.
2. Differentiation
 - a. Supermarkets providing producers and growers with technology to ensure that they get the freshest goods at the right time and can proactively instruct producers to pick more produce, or not.
 - b. In manufacturing, greater real-time production of goods that assists all parts of the supply chain to deliver goods within a defined time frame to the right place so that customers do not lose out and everyone can make a profit.

Furthermore, ethical causes such as Fairtrade, organic, and free range products are driving a need for data lineage and validation of the provenance of products.

4.1.4.4 *Business Process Management (BPM)*

The introduction of the various everything as a service (XaaS) platforms and the need for more ubiquitous working environments from mobiles and wearables through to in-home technology is driving changes to business processes, and altering the way business processes are viewed. Mature discussions about business

capabilities and measurement of outcomes have shown the need for heightened business process governance.

With the need to correlate and synchronise information across the extended supply chain, business process management spans multiple companies and may have to integrate a number of different types of demand and supply chains. Here, there is a need to provide capabilities that [orchestrate](#) and [choreograph](#) information. New international standards are required to make this effective, to deliver operational efficiencies and effectiveness, and to monitor, measure and provide assurance.

While it is noted that many debates range about the relationship between workflow and business process management (BPM), for this report, BPM includes workflow.

4.1.4.5 *Automation*

In austere times, many industries focus on improving yield from existing customers, managing margins and cost reduction. For all of these there is a desire to increase the capability of existing processes to handle more situations in a robust, trusted and reliable fashion giving rise to an increase in automation. One particular objective is automating many processes and procedures that had previously relied on individuals for operational decisions.

Here automation is being driven outside of classical IT computing departments, though ICT is being used to enable the automation. In smaller companies automation of simple procedures such as the need to remember to make backups and copies of data is releasing resources to complete other work. Organisations are focusing more on thinking smarter and where they can use existing systems and technologies to automate.

On a larger scale the need for open and transparent reporting for regulation and legislation has led one global insurer to assess the production of their financial reporting in each country. This resulted in an automated solution that incorporated features for scheduling, cross system scheduling, standardising support and control processes, and documentation of the existing flow of automated processes. It reduced the workload in the ICT organisational unit by one person. Although undisclosed, there were vast amounts of resources within the user community released from mundane tasks

for reassignment to value adding tasks within the business. A few examples are:

- in some countries, teams to reconcile information disappeared;
- a reduction in management time;
- removal of audit checks, audit and completion of backups and updates
- clarity on when information was processed;
- reduced need to re-run financial accounting and revenue processes.

This led to the release of a number of financial accounts personnel to focus on other business priorities as well as allowing management to have more timely information.

4.1.4.6 Digital and Interaction

At the time of writing, the ICT industry is enamored with the word “digital”. Digital is being used to mean many different things, by different people, as they tackle business operational problems. One definition being used for “digital” is the sensing, analysis and decision framework used to bring the real world and the information world together. Within another use of the word “digital” it means the creation of new businesses that are digital only i.e. they rely totally on virtual customer interactions. Companies like MOO have developed totally computer based customer interactions leaving their people to focus on the creative and more challenging work of providing and delivering printed business cards. These businesses seek to have customer and supplier engagements that are all self-service yet deliver quality cost effective services to customers. Companies delivering a service with a reduced functionality set focused on specific types of customers are challenging major players in the market place. At the other end of the scale there are organisations who do not see the value, or cannot justify the value of digital. Rather than actively innovate, they await new products and features provided by their existing suppliers and vendors.

In the ICT world there are many different interpretations of the concept of digital. In this report digital covers the following areas:

4.1.4.6.1 User experience

A digital company makes use of technologies, channels and ways to interact with customers so that they have a pleasant set of experiences that achieve their and the company's desired outcome. Mobility sensor nets are delivering more and more of the information individuals want and need, such as their location. They are also capturing whether they are watching or participating in an event or social engagement. A range of use cases has been developed to streamline the process, provide better engagement and effectiveness and to provide expected output to the user. People first saw this with the introduction of the automated teller machine (ATM) in banking. Now that type of model is being introduced in a number of business operations, with ICT professionals ensuring that an engineered solution is integrated and the complexity is hidden behind the wall of the user interface. The customer expects to get money and that is the output she receives.

User experience is also impacting the workplace and its employees. Within organisations, the widening gap between existing ICT infrastructure and that within an individual's home and or pocket is such that to retain talent organisations are having to rethink the level and ability of the ICT systems required by their workforce.

4.1.4.6.2 Machine to machine interaction

Digital devices are being interfaced more frequently with traditional systems to enrich data, gather more specific information (context of data at a point in time) and allow instructions to be provided to those machines so that further action can be taken. The mechanisms, reliability and the need to provide non-fallible solutions is driving both the openness and sharing of such information as well as the need to provide more intelligent information about what can be sensed. In particular the upsurge in wearable technology that can sense information and provide records is noted.

In resource organisations such as oil and gas, mining and energy production, the need for more advanced mathematical and statistical methods has been a key digital driving force.

Digital technology is now used to understand the value of remaining unextracted resources, interpret and predict the demand for resources and understand the leakage and consumption of resources. There are a number of initiatives under way today that are driving use of data and technology. These are creating new jobs in such areas as:

- Smart meters [\[25\]](#);
- The digital oilfield;
- Health and safety;
- Sustainability;
- Federal and government incentives to monitor and understand resource consumption,
- Risk assessment; *and*
- Estimating remaining capacity of resources.

Machine to Machine also requires a range of standards to be developed - the following list is not exhaustive:

Machine to Machine Standards

- **Industrial Automation and Monitoring**
 - Factory Line Equipment Operation/Usage Tracking/Diagnostics/Service requests.
- **Telemedicine and Healthcare ICT**
 - Body Sensor and Diagnostic Reporting
 - Remote Physician consultation (non-voice, patient vitals/xray data access)
- **Security and Surveillance**
 - Home and enterprise security sensor monitoring, alerts, remote access & thermostat control, video monitoring
- **Telemetry**
 - Smart Meters, Sensors for energy industry.
- **Asset Tracking**
 - Inventory control, Geo-fencing
- **Fleet Management**
 - location and availability, Repossession and lockdown, Sales Force Tracking
- **Consumer Telematics**
 - In-vehicle entertainment/navigation, remote Diagnostics/Safety/Concierge Services, Vehicle Diagnostics
- **Advertising**
 - Digital billboards, in-store offers, special events
- **Consumer Applications**
 - Home monitoring, Financial and Retail POS/Kiosks
 - Digital cameras, e-readers, media players, gaming devices
- **Wireless data modules for laptops, netbooks, UMPCs, etc.**

Source: Requirements for Embedded CDMA Modules and Specialty Devices, CDG Document 176 V1, Chintan Tarakhia et al.

4.1.4.6.3 Control systems

[Control Systems](#) or at least components that enable the control and management of complex systems are becoming more prevalent in existing industries and in new ones as well. Although most of the engineering and design required to deliver control systems has been known for decades, it is now

being applied to the ICT industry. One example is within the data centre. Here, these control systems cost-effectively manage heating and cooling to maximise computational power of the servers.

Within smaller organisations the need to reduce complexity in an intelligent data driven way is leading to supervisory control and data acquisition (SCADA) -like systems being introduced.

Control systems are also fundamental necessities around the expansion of drone technologies. Currently, drones are being assessed for a number of usages such as taking samples from produce being grown e.g. wheat and potatoes, parcel delivery, and movement of freight, on roads and at sea.

Such systems require ICT talent with computer engineering, detailed programming, and decision science capabilities as well the knowledge skills and abilities required for measurement, calibration and correction.

4.1.4.6.4 [Visualisation](#)

The complexity and the interaction between different parts of systems has raised the need from business and from within ICT to have more effective methods and processes to communicate information. A new specialist discipline is forming around visualisation of information. The impact of improved visualisation leads to better ways to understand information and interact with the data. With the IoT and big data there are massively increased volumes of data to be interpreted. Understanding that data requires more effective ways to present, interpret and interact.

The visualisation space has grown over the last five years to a very specific set of methods, features and capabilities that are at their best in the gaming world. Visualisation has also contributed to the development of deeper insight into the psychology of understanding data, representing it, and helping humans make judgements about information.

4.1.4.6.5 [Gamification](#)

We see from many adventure and strategy games different and complex ways of gathering information and presenting that information in a meaningful way so that we can make a judgement on what is happening. When we look to our enterprise systems we typically find flat panel graphic representations of information. Gamification is already being introduced into working systems in isolated cases and as more systems adopt and integrate this approach it is an area where standards and further skills in integration will continue to evolve.

4.1.5 Consumerisation

There are a large number of reports and predictions identifying the need for further consumerisation and the delivery of personal engagement. This has been driven by a number of factors including:

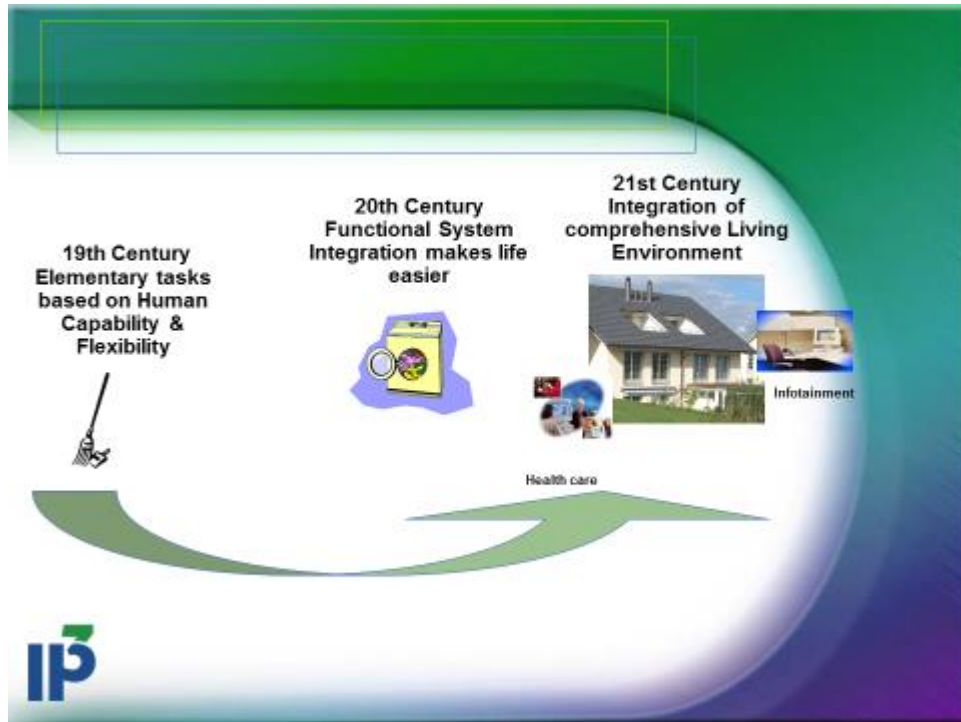
- The technology platform provided by the increasing availability and consumer adoption of smart phones, wearables and tablets worldwide;
- Corporate competitive need to understand more and more about customers, their opinions, wants, desires and needs; *and*
- The way individuals wish to interact with the world at work, at play and at home.

4.1.5.1 *Home life*

Technology at home has been a major theme for many decades now. The fridge that tells you what is going out of date, the kettle you can tell to boil from anywhere (<http://www.wifikettle.com/index.html>), and the computing system in your home entertainment system mixing text, videos and films and music in an integrated fashion may outperform the technology you may find in the workplace.

The ease by which things can be set up by the non-ICT specialist has also demystified technology that was previously thought to be too difficult for the common person. An example of this is [Western Digital's My Book Live™](#) that provides a storage platform in your home, and a private cloud, so your files, music, videos, etc. are available to you

and your family securely anywhere there is an internet connection. If you can set this up in your home in a day, why can't this be provided in your corporate ICT environment in a month?



4.1.5.2 *Telemedicine*

A significant number of reports from the World Health Organisation, Kaiser Permanente^[45], McKinsey, government agencies and others have increased awareness of the need for better ways to manage and control an ever increasing lifespan. In the developed countries people are living longer. In later life the complexity of caring for the elderly increases. This has led to a growing number of solutions to manage long term conditions. New business and healthcare models measuring the cost of healthcare are developing. Kaiser Permanent's healthcare model ^[15] is seen as one of the best globally using telemedicine and health informatics to drive wellbeing.

4.1.5.3 *Commuterism*

Travel, commuting and the drive to be connected and in touch at all times are becoming the norm in developed countries. This is reflected in the development and growing popularity of connected automobiles. There are still some large growth areas in adoption of mobile and connected services that are, as yet, untapped. The affordability and availability of smartphone technology in many developing countries has been limited by the availability of refurbished phones from more developed countries for resale. This is changing and rapidly driving the demand for more apps and capabilities.

New technologies in trains and ships and the rise of the driverless car all point to the need for a holistic approach to how technology and society interact and interoperate.

4.1.5.4 *Location Based Services*

Location based services where the technology you are wearing provides details of where you are and sometimes the type of environment that you are in i.e. submerged, driving, on foot, has given rise to a new dimension of providing information to the individual. Organisations that capture this information are using it to profile you, and through technology and mathematics, predict your needs.

4.1.6 Integration

Many organisations have mature systems integration environments. Many of the early integration projects were deployed using a relatively simplistic approach. This approach did not force organisations to understand the challenges that integrated systems make to the operational processes, organisation design and even job roles within the organisation. The perception that integration kept business departments separated and allowed them to operate independently has changed. The advent of platforms has focused less on adopting technical change and more on changing the way that the business operates. Integration is now perceived as a key platform delivering a number of characteristics for sharing data and for process information. These platforms are consistently available

and resilient. This shift has many organisations looking to shared services platforms and capabilities

The IoT, amongst many others, is driving digital business to rethink their integration approaches as they are a key enabler of existing systems and to transform to achieve their digital vision.

4.1.7 Security

The following key areas are set to continue to grow, become more complex and require ever increasing levels of sophistication. Like other areas as stated above, security product vendors are also looking at platform technologies to commoditise existing operating models.

A major factor is the ubiquitous nature of computing services. This reinforces the need for enhanced levels of identification and security across industries. This challenge is made greater when combined with deeper specific security defence mechanisms for some industries.

4.1.7.1 Cybersecurity

The need to protect information based intellectual property is driving a range of new technologies and methods to protect that information and access to systems. In reviewing many skill reports an increasingly sought after skill set in ICT recruitment is security and protection of assets. This is the case not only in the delivery of security and defence capabilities, but also the assessment of risks and determination of the appropriate security approaches.

4.1.7.2 Privacy

Everyone has a view on what can and cannot be said about themselves and, over time, that perspective may change. This makes the area of privacy difficult to handle. Concern over privacy has now entered the corporate reputation management realm as well. Companies are being targeted and information used from their LinkedIn™ and other social

media locations to make judgements about what is happening in the company and the challenges the company is facing.

A human resources manager was deeply surprised about the assessment of his company's talent. A recruitment firm was able to assess and analyse many of the department's employees and provide a profile of those likely to leave the company. This analysis was made using external freely available information the individuals had shared.

4.1.7.3 *Who am I*

Identity management, and specifically proving identity, continues to provide challenges as fraudsters apply technology to outwit computer systems. This has resulted in a significant rise in the number of techniques being used independently or collectively to establish that you are who you say you are. Key areas that are trending are: biometric, movement, memory, psychological and knowledge tests. All require computing professionals to work with interdisciplinary specialists to develop solutions.

With more and more information open and known on the internet, the standard identifier questions like the name of your favorite teacher, first pet name, and mother's maiden name all become quaint and old fashioned. In fact, these can all be gained from your social media interactions and open information making it easier for the intelligent criminal to mimic being you.

Currently the use of the mobile phone, prized possession above all others, is the most common device used to identify who we are. Across the world the adoption of mobile payment processes makes managing, exchanging and monitoring money more accessible.

Sociology, psychology and health are all becoming entwined here. If the use of your credit card identified anomalies you might expect fraud as a cause. However, what if it identified the early signs of dementia or Alzheimer's disease?

This poses interesting new boundaries for identity, behavior and how personal information is interpreted and used. It also defines yet another type of hybrid ICT skill set.

4.1.7.4 *Transparency*

As corporate globalisation increases transparency of information, openness, and the ability to measure and account for things is becoming a key driver for business and industry. Banking, capital markets, water resources, energy, resources, oil and gas, healthcare and government administration services are all becoming more open. A concern especially from large corporations, citizens and governments is knowing where data came from and its provenance.

More robust due diligence standards that support appropriate openness are required. In many jurisdictions, protection of personal information legislation has been or is being introduced.

4.1.8 Information Management and Big Data

There was significant hype in the 2012 to 2014 years about big data and information management. The key to this boom is the application of a number of technologies and sciences to deliver deeper insight and understanding of information. A second “wave” of this boom is the relative inexpensive way to integrate a range of discrete sciences and methods.

Countries around the world are investing to position themselves to exploit data opportunities, from the US \$200 million big data R&D [\[44\]](#) initiative and Japan’s Growth Strategy which allocates nearly US \$135 million for big data R&D, to smaller commitments from European governments.

4.1.8.1 *Big Data and Open Data*

Big data is bringing together a range of ICTs and computing analysis skills and blending those skills with other methods and sciences. The range of applications covers every discipline from Bioinformatics, to social sciences, to behavioural science, Psychology and Art.

This evolving discipline requires ICT professionals and practitioners to work closely with other professionals and data scientists to

provide value. This is demanding that ICT professionals be more attuned to the need for multidisciplinary skills in resolving problems.

The provision of open data, large sets of information that can be used by anyone, is driving the democratisation of information. This information is made understandable through better man-machine interface (MMI) approaches, in particular, visualisation of information.

Open Data is also creating new economies and insights. Governments are providing data so that it can drive GDP, however it can also drive challenges to reduce state and legislative administration costs.

4.1.8.2 Technology Storage

A range of new technologies, new methods, data, and media compression techniques are making this area more specialised. https://en.wikipedia.org/wiki/Multi-level_cell. New technologies and capabilities are being added to help with the vast array of different media sources being stored, analysed and rendered. <http://insidehpc.com/2014/03/ddn-advances-wos-object-storage-technology/>

4.1.8.3 Transparency/Provenance

Significant focus is being aimed on being able to know where data came from and its provenance. In some countries the government driven development of standards, techniques to mark and encrypt information, techniques to ensure that published information is not tampered with, and standards that allow information to be provided in an open and easily accessible way is pushing the development of cross company transparency as part of good business practice. This is being further encouraged through a number of compliance and operational risk agendas, many looking at policies and frameworks that will require agreement across governments.

4.1.8.4 *Connectivity*

A question within the big data and open data world is how are these data sets connected together? There are challenges in linking this information from a data level, context level and from a dependency level.

This is a new area where data analysts take on a broader role becoming the authority on the data, its content, data quality and anomalies, structure and processes. Establishing data connectivity between data sets is one of the keys required to drive business value from data.

4.1.9 Accessing information

The ease of accessing information at any age, in different ways, will increase challenges to cultural norms, wisdom of the ages, and personal and social group value systems.

4.1.10 *Managing ICT*

An evolving and complex issue within ICT is managing ICT itself. The rate of change within the ICT world, the need to align ICT to corporate goals and outcomes, the array of technologies, methods, programming styles and the maturing nature of ICT can sometimes overwhelm ICT leadership as well as ICT professionals.

There is an array of methods and standards to support leadership in bringing together the key components of managing an ICT environment.

Of note here is the information technology capability maturity framework (IT-CMF)^[14]

An additional concern is the perspective of corporate ICT. For many, the technology and capabilities of technology in the home and in personal applications appear to outstrip the ICT in the workplace. Many suppliers and vendors are seeking to simplify the complexity of their existing products providing more off the shelf type solutions.

Legacy systems are another challenge. Some organisations focus on new business value and stretch the capabilities of their staff to

manage and care for a widening range of technologies and applications that incorporate the modern and leading edge. Yet some do this while still requiring the support of legacy hardware and software important to the business. Often this is no longer warranted or supported by the original or any suppliers.

4.1.10.1 Operating Models

The changing nature of ICT, and the ICT role in the organisation, means that ICT transformation and agility, for some organisations, is key for business survival. The role of ICT had been of the “techy” or “geeky” people who made the complicated technology work. Over the last 20 years the consumerisation and commoditisation of technology, as well as recent movement to cloud services, has led to many organisations relying on ICT for efficiency of operations rather than as a competitive advantage. Increasing use of digital technologies is driving board level collaboration either through changing and developing leadership or through developing organisational capabilities.

4.1.10.2 Governance

Existing methods and processes are evolving to meet the maturing nature of the ICT Industry providing greater clarity and guidance. Frameworks such as control objectives for information and related technology (COBIT), are assisting organisations to handle increasing levels of regulation, legislation, security threats and risk resulting in companies putting appropriate risk and threat mitigation processes and procedures in place.

Through increased awareness of the risks of information technology the policies and additional governance required for business and industry is becoming clear. Standards and guidelines incorporated into legal frameworks are being challenged by corporations and citizens. Large corporations are seeking more consistent cross-government agreement on such matters as health and safety. Increasingly organisations are impacted by the need to have good governance to stay in business. The complexity of the regulations

and interpretations of these to create the appropriate policies standards and processes adds to the challenge. Both these areas are seen as growing the need for more information technology governance and a broader perspective of that governance.

For some organisations the boundary of where ICT governance differs from corporate governance is being questioned.^[13]

As this evolution matures it provides opportunities to deliver more corporate and integrated governance and less ICT specific governance.

4.1.10.3 IT Metrics and Measurement

The management and operation of ICT are evolving. A number of different organisations are seeking to provide the support and frameworks required to professionally execute that management and operational practice. In the UK the Chartered Institute of ICT has created an enterprise forum for government and business executives to have mentors and access to executive level information on all aspects of ICT including leadership, best practice and technology trends and directions.

Research firms such as Gartner and International Data Corporation (IDC), and industry forums including CIONet continue to identify an array of methods to measure the value and contribution of ICT to business. Key themes are: business engagement, sharing information and knowledge, building capability, and how these can be measured and monitored.

ICT specific metrics are becoming less important as organisations seek end to end service and outcome based results. Cost dynamics are driving movement from manual administration towards more automation. Several organisations are developing frameworks to assess and benchmark the efficiency and effectiveness of business operations. This includes how ICT is enabling the business.

4.1.10.4 Decommissioning systems

Recent analysis has shown that, in some large corporations, almost 20% of systems that have been decommissioned are still switched on and operating. At a joint UK business and ICT leader conference there was surprise that the percentage was so low. There was an

expectation from the fifty or so leaders in the room that the percentage was much higher. Key areas that lead to retaining and having those systems running are:

- Fear of a loss of data or data has not been correctly transferred to the new system
- The need to provide access to historical data that was deliberately not transferred across
- Fallback and failsafe
- Lack of business case or investment in decommissioning the system

4.1.10.5 *The value of legacy systems*

In some industries there is a view that everything needs to change. In others there is a clear need to assess and manage legacy systems and take the investment that has been made in existing assets and sustain it for as long as practical.

This creates a demand for ICT professionals to maintain skills and competence in aging technology, methods and processes. This increases the complexity of the ICT world and reduces a company's agility and adoption of new and emerging technology. This can be a serious problem particularly where competitors are using that technology to gain an advantage.

Typically legacy systems are left to stagnate and are rarely modernized to integrate effectively with new systems.

This gives rise for the need within some companies for technologists to retain the understanding of the limitations of existing technology and the impact of "rip and replace" on the business operations.

4.2 The state of the Computing Industry in 2020

So far this report has looked at the past and current state of ICT and the pressures that are pushing its evolving role in business and industry. The next section looks at possible change in the computing industry over the next 5 years 2015 thru 2020.

4.2.1 Getting personal

The personalised nature of both engagement, identification and creating profiles of people, organisations and communities will be a key focus. This is not just for individuals, but individual working patterns as well.

There will be increased need for computing professionals to work across a range of disciplines. There is a high likelihood that specialist new roles will be created that will require computing, social science, psychology and/or behavioural assessment skills to be part of the skill and knowledge set. Some of these combined skill sets are already being used in subject areas such as forensic fraud. This area and others will become more specialised than today, as environmental complexity increases.

A key area where these skills will be deployed is in business to consumer (i.e.) identifying supporting and informing business on marketing, selling approaches, up-sell opportunities and product development. Specific talents and knowledge such as business analysis, visualisation and interpretation of information, motivation, and understanding personal values will be a focus. Existing disciplines such as user experience, human computer interface and man machine interface will be specifically enhanced with additional skills and knowledge surrounding engagement.

There will be a continued need for computing professionals who currently work with existing disciplines and in particular an increasing need for more specialised skills and knowledge in:

- Bioinformatics
- Health informatics
- Biometrics
- Cybersecurity
- Cybernetics

Computing professionals, with a strong emphasis on computer science, will be required for this personal world to handle a greater level of technology and technical complexity. This includes the need to develop a significant number of standards for interoperability, control and management. This will drive a need for greater and specific architecture and design skills to turn complexity into simpler solutions.

The range of new technologies such as mobile, wearable, and embedded will require a broader engineering approach to the

development of computing solutions. Health and safety for the individual will be a key area for due diligence and assurance. Designing systems for more robust operational use will be a key feature for the adoption of new applications.

Technology is progressing at a faster rate than regulation, compliance and governance. In particular, there is an increasing concern across the world about privacy. Variations across countries show a complex mix of regulation and interpretation and misinterpretation of existing policy and rules.

This raises threats in today's society for children and the vulnerable who lack knowledge of the threat, are unaware of the risks and who may not be aware of how their digital life can harm them.

Recommendations:

1. Clarify the minimum global standard that should be expected of a computing professional for identifying, highlighting and challenging how business and organisations use information.
2. Consider how whistle blowing may be detrimental to a professional's employment, his citizenship, or his tenure in office and how as a profession this should be handled.
3. Establish a common framework of worldwide principles for the use of information that governments, corporations and individuals can refer to as a basic set of digital rights. This may lead to a set of minimum standards to protect individuals and provide guidance. Areas for concern are pornography, control of machines e.g. cybernetics or intercepting signals and asking pace-makers to shut down, and exploitation of an individual's personal circumstances or wellbeing. Finally one potentially controversial point: as more motivational, influencing and suggestive techniques are used by companies to offer products and services, how will the easily susceptible be protected?
4. Consider IP3's role in considering new ethical dilemmas within the ICT Industry.

4.2.2 Industrialising ICT

The major themes of mobile, apps, cloud, commoditisation, consumerisation, personal and big data will migrate from a number of isolated and fragmented approaches to an integrated and industrialised ICT environment.

This industrialisation will require a more holistic and globalised approach to be taken around new applications, requiring heightened skills in specific areas. The need for these specific skills will require some skills to be contracted on an as needed basis, while other digital capabilities may be part of how a business differentiates itself from its competitors.

Specific areas are:

- Autonomic processes
 - The scarcity of ICT people combined with their increasing cost will lead to the creation, or at least adoption of more automated tools and methods to manage, run and control ICT operations within organisations. Skills for support services and establishing better operations will be enhanced with additional technology and product knowledge to support running of the ICT service.
 - The creation of more tools that use point and click capabilities to deliver functionality will allow ICT staff to be more productive as they utilise existing services and or re-use bespoke coded services.
 - These technologies will require support and service staff to be aware of how technology services the organisation and to engage in business discussions. This is changing the nature of ICT organisations in a number of ways:
 - ICT helpdesk staff will become more like customer support staff with an ICT bias
 - Technical specialists are now more than one product specialists instead concentrating on how several technologies are integrated together with less need for depth of knowledge on one technology.
 - A focus on how technology can be used to run and operate the business, scripts automated and the operation of the ICT infrastructure flexed to meet changes in demand.
- Integration and interoperability
 - Industrial systems will require that those systems have methods and techniques that allow them to evolve and adapt. The current areas of application integration, enterprise services and the ability to create standards to integrate data, machines and processes together will make this area a more specialised discipline than currently acknowledged to be. There are some areas

like SCADA and ICT integration that are developing methods and processes. These may be applicable to other industry sectors. [\[26\]](#)

- The lack of standards in this area is a limiting factor.
- Security
 - Industrialising means that the systems are more mission critical and that trusted, reliable and secure methods will be key. Areas of skills that will be required are in security patterns, security threat analysis, and selection of appropriate security methods for the environment. Information security, entitlements to access information and identity management will be growth areas. [\[27\]](#)
 - This is particularly true as more health and fitness, home and travelling technologies need to interoperate.
 - The development of robust open integration and interoperability solutions for this predominantly consumer market will lead to either larger corporations providing entry level technologies or new incumbents developing proprietary methods and techniques.
 - The development of ethics training and a set of principles around security and the ethical conduct for security will be a mechanism to assist education of the ICT industry as well as a platform to open the debate with society.
 - Transparency of information impacts individuals, culture, companies, state, and values. The threat is that transparency of information may shift some ideologies.
- Reliable, available and robust
 - Observations show that technology needs to be available, robust and ready. There is a need, as part of industrialising, that technology be able to refactor systems for multi-tenancy, multi-platform deployment and to ensure that the refactoring provides an available and robust capability for the business. ICT testing and assurance personnel with the skill set needed to perform this level of specific testing are very rare. With some new systems relying on the usage of the system by the masses to test scalability, performance and simple recovery, many of the new techniques will have to become standards and more mainstream. Amazon lost its service in 2013. [\[28\]](#) This led to them developing specific techniques and methods to systematically close

Amazon services and still provide the level of robust service required by its customers.

- Disruption Management
 - With an increase in complexity there is a need for skills and competencies to manage disruptions within systems. Backup, recovery, business continuity, disaster recovery and continuity planning have been stalwarts in handling disruptions in the past. However interconnection, availability, interoperability and the ability to manage increases and decreases in demand have raised this higher on the operational risk agenda with an increased business focus.
 - There are many standards that consider the impact of disruption within organisations and tackle that disruption in a passive way handling it post incident. Intelligent organisations^[29] look to include disruption management as part of the architecture and design of systems making these systems more self and situation aware.

To deliver on these areas of industrialisation and provide the engineered solutions at this industrial scale, the disciplines of enterprise architecture, architecture, design and software engineering are key differentiators to enablement. It will be a challenge to provide the right architectural component design at a granular level to satisfy business demands for reliable cost effective solutions .

To achieve this individuals will need to develop capabilities to be more communicative and participative in a range of discussions including business planning, and competitive analysis (e.g. if our company does not use this technology will our competitors use it and what does that mean to us?). This will mean that deeper skills in architecture have to be augmented with ecosystem and business skills and knowledge. It is expected that structured systematic analysis and architecture skills will still be applied for ICT assurance and risk mitigation.

To deliver such capabilities and support the systems being delivered there is a need to have a greater understanding of the different components, the relationships and linkage between components and the way they interoperate. Configuration management and ICT asset management are areas that require a greater skill level structure and process to support the industrialisation process.

Recommendations:

1. Monitor the evolving nature of the specialised skills and identify how these skills may require new or specific guidelines in ethics.
2. The promotion of and/or the recognition of what makes good business ICT alignment and how business takes advantage of and uses technologies to drive the agenda and deliver business value.
3. Increased awareness of the social, health and safety impacts of security to citizens and organisations. A renewed focus for cybersecurity and its impact. Specifics to be tackled are identity management, biometrics, and coupling of security to person (machine and tissue together).
4. Promote the need for focus on disruption management as a new discipline within ICT.
5. Promote interoperability and integration standards at a minimum to support better and easier communication of information. As a case in point, some African states are looking to create shared government services that would provide standard healthcare, education and other government administration services to many African countries. Similarly, a number of Commonwealth members are looking to combine administration services and provide a central shared services capability.

4.2.3 Workforce of the future

The workforce of the future will change dramatically not only in technical skills and competencies through the rise of APIs, mobile applications, cloud services and big data, but also from the provision of tools and database technologies that support these.

As more and more commoditised solutions and businesses take advantage of cloud and hosted technologies, the emphasis for organisations will change from technical practitioners to greater commercial management.

Some organisations are already identifying the need for broader in-house technical and ICT skills (e.g. platform skills) and relying on other companies to provide specific rare skills. [\[30\]](#)

Similarly some vendor organisations provide a framework of software and hardware computing capabilities that allow application development and ease of deploying applications in many different ways and to different devices such as laptops, mobiles, and wearables.

There will be an increase in the number of teams for hire that will come fully prepared to undertake a project. Team members will

self-invest in their skills, knowledge, and product capability to deliver additional capacity to existing organisations.

It is expected that these teams, in addition to technical skills, will look to broader ICT industry issues such as cybersecurity, industry legislation and regulation as part of the additional value they provide to their clients. Such teams are already available in 2014 centered on specific technologies such as Microsoft™.

Transformation and innovation initiatives will capitalize on this team approach to deliver early insights, assess the impact of incorporating change within the client infrastructure and support application development. Successful teams will provide more leading edge thought and capabilities. They will have above average capability in project management, software design, engineering, architecture and testing.

With the current proliferation of new technologies and the ability to quickly and easily deliver new capabilities it is expected that there will be a greater percentage of people in the workforce that will have technical or specific product skills and knowledge e.g. open stack, however they may not have the formal training, skills and knowledge for delivering robust industrialised systems and capabilities.

With a different range of skills and capabilities it is expected that the gap between professional practitioners and computing resources will widen. This may make it more challenging for governments and corporations to distinguish who has the right expertise.

The ICT workforce will be more mobile, with organisations having to acknowledge that skilled people will work offshore or near-shore. This will lead to a more outcome based assessment of work and a higher reliance on the specification of requirements, and validation and assessment of the output to assure that what has been produced adheres to acceptance criteria. This leads to a greater demand for business analysis, testers and those who can architect and validate the incorporation of new features and capabilities into an existing system. This working pattern will challenge many of the existing ways we think about information and intellectual property.

For companies that wish to retain knowledge and experience in-house, the creation and development of skilled resources will require employers and recruitment firms to be more specific about the role, the culture and the working environment. The scarcity of talent may mean that corporate initiatives take longer to deliver. Some wise organisations, realizing the dilemma, are coupling longer

term strategic planning with internal investment in ICT and business skills. [\[31\]](#)

Recommendation:

1. That intellectual property, patents, trademarking and software copyright is reviewed as boundaries of accountability change. Existing case law is inconsistent. Countries and regions are providing different interpretations.
2. The development of new software and services shows that software is being initially marketed in domiciles where there are lower levels of compliance and fewer barriers to entering the market. Healthcare products in particular can take 18 to 24 months for UK and US regulatory approval, whereas in India, Philippines and Malaysia patients can take advantage of such technologies much more quickly. Global agreement on an approach that protects individuals should be pursued.
3. National GDP figures for countries wishing to gain a greater share of the global digital economy need to consider the experience and knowledge of industry as well as formal qualifications and certifications so they have an appropriate skilled workforce.

4.2.4 Regulation, risk and compliance

With all new technology comes opportunity both to do good and to take advantage of others.

Existing legislation and regulatory frameworks are unable to keep pace with the current introduction and adoption of new technologies. This is seen as the largest area of growth and challenge to the ICT industry professional. There are an ever increasing number of concerns as technology is adopted more fully in industries that have not typically used it. Technology is part of multi-agent systems [\[41\]](#) and the risk is that legislation and regulation will be created in a fragmented, proprietary way that will inhibit the adoption of safe policy. This could enable the unscrupulous to take advantage.

Variation across governments and industries is inhibiting real progress and a simpler set of agreed to guidelines will drive innovation, job creation and ultimately improve lives.

Recommendations:

1. Taking a broader business and risk perspective to social media interactions based on how it can be used and how it should not be used. If through using personal data to provide commercial services I could determine that you were suffering from a health disorder... Should I inform you? Does the legislation and governance for the purpose by which I use the data limit me from informing you? And if you were to find out, would you be liable to claim against me as I had your personal data and could have informed you? The boundaries in this digital world are very unclear. In [Gartner Top Industry Vertical Predictions for 2014](#) forecast that "Full-genome sequencing will stimulate a new market for medical data banks, with market penetration exceeding three percent by 2016."
2. The use of social media and incorporation of the social media into engagement strategies has led to a new set of risk guidelines such as social crisis plans. Such plans consider how a company should react based on the escalation or creation of a crisis through the openness and transparency of information. Guidelines, structures and knowledge of how to deal with such situations at a global/cross country level should be developed.
3. Initiatives are needed to reach agreement on a baseline set of principles for many industries simplifying the process and easing the transfer of information and goods worldwide. Intel™ is one company noted for tackling this problem globally by standardising and having one set of health and safety standards for use anywhere in the world, thus easing the transfer of key personnel from one location to another.
4. Gain a minimum agreement of ICT social policy for the use of information.
5. Promote a social risk policy for ICT, organisational and reputational risk.

4.2.5 Legacy skills and competence

Within most organisations there will be a mix of technologies and capabilities some leading edge, some commodity and some ageing or legacy.

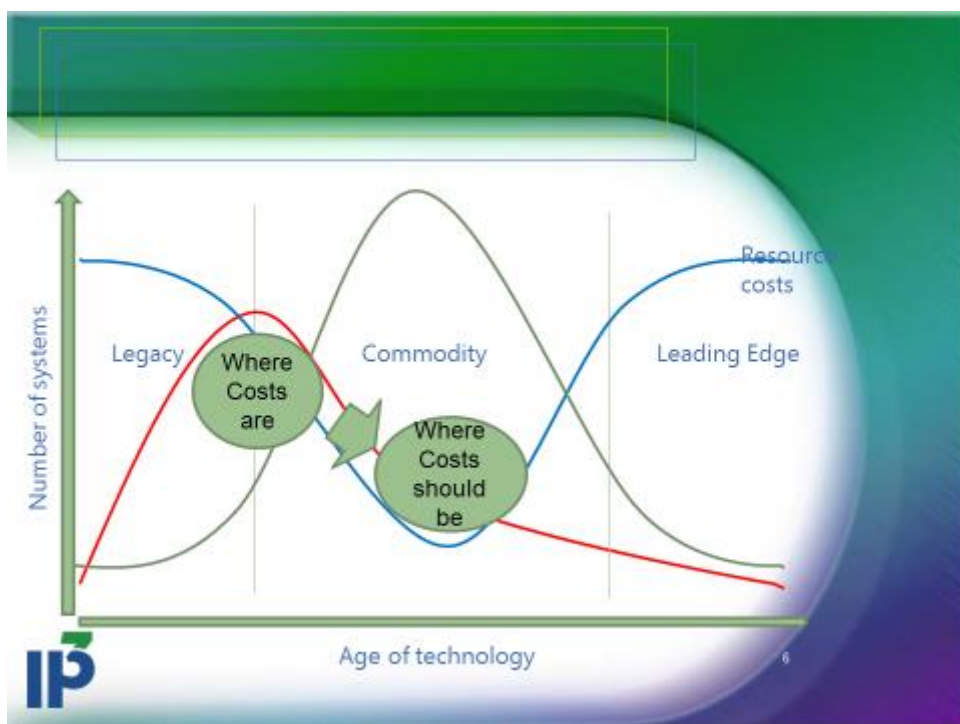
This legacy debt does not mean that the technology is useless or has no value. Sometimes it is core to the business. However, some of those technologies are no longer being supported. As part of the analysis it has been very difficult to quantify the challenge faced globally from systems and software that can be viewed as legacy.

The UK National Audit Report Managing the risk of legacy ICT ^[43] provides one source of quality information on the risk of legacy ICT systems.

There are however a number of specific observations that can be made:

1. If the systems are working and there is no need to replace the systems, they will continue to be used;
2. The approaches to managing such systems have moved from white box changes to more black box assessment (i.e. do not touch the system but let it do what it does).
3. As these systems get older the available pool of labour that can provide support diminishes.

It should be noted that some vendors appreciating these challenges as an opportunity are motivating and driving the development of new skills and capabilities in their teams on what some see as ageing technologies ^[32]



Recommendations

1. For some organisations and countries where the cost of developing ICT and digital capabilities in newer technologies is prohibitive, older and legacy technologies should be considered as an entry level to gain a foothold in very specific technology and platform capabilities. There are active groups worldwide

involved in VAX/VMS™ support and maintenance and revenue generating businesses providing support to programmed data processors (PDPs), ICL™ Mainframes and their database environments.

2. There are also specific industry sectors such as utilities who have a significant number of legacy and ageing operating systems. Long term reliability of these should be assessed.

4.2.6 Education and Knowledge

With this accelerated rate of technology there is a widening gap between professional understanding and application of science and those who, in general, provide practitioner level skills.

The provision of online skilling and certification assessments allows technical knowledge and skill to be provided. However this may not embed the awareness of ethical and sociotechnical considerations of computing. This skill-only process has the potential to widen the gap between professional and practitioner in the depth of computing understanding, its benefits and risks.

For some organisations there may be a need for a new role of ICT knowledge manager. This role would be responsible for the part of the organisation's corporate memory that retains why certain computer systems, technologies or methods were deployed. It would manage the challenge in transforming these to meet new initiatives. The ICT knowledge manager may also have a specific role focused on nothing less than keeping the company in business. These managers will rely on experience and knowledge of legacy systems. They will understand corporate strategy with an ICT focus, corporate governance with an ICT and audit focus, and be able to rationalise specific challenges in terms of moving from object to component based programming, inclusion of non-SQL based systems and the opportunity and challenge of multi-tenancy, to name a few.

Recommendation

1. Increased communication and education on the cultural and social shift that technology is enabling and the dilemmas arising.
2. Identify acceptable norms of behavior and set an internationally acceptable benchmark.
3. Establish and secure that all computing certification courses include updated views on the changing ICT industry and that updates are incorporated regularly into certifications.

4. Consider the role of the ICT knowledge manager discipline within organisations.
5. To combat the gap between ICT professional and practitioner ICT professionals need to master:
 - Communicating to lay people about technology, value benefit and impact;
 - Understanding of the fit of technology into a specific environments and industries;
 - Understanding the ICT role in multi-agent systems and the dependence between the different systems and technologies;
 - The ability to expand and explain more of the depth of technology and the root cause of technology change.
 - The ability to understand, communicate effectively and work with a range of professionals from other disciplines.

5 A vision for the Computing Industry professional

The definition for computing professionalism from the IFIP IP3 website states:

The most important reason [to examine and build ICT professionalism] stems from the extent to which the increasing pervasiveness of ICT has the potential to harm our economy and society. The extent to which ICT is embedded in our lives is inevitably growing. If we fail to take steps to mature the ICT profession, it is likely that the risks to society from ICT will grow to unacceptable levels.

So what are the steps towards maturity needed over the next 5 years?

From assessing the trends, maturing nature of the ICT industry and the way society is embracing ICT the professionals today, as outlined earlier in this document, ICT professionals should focus on the following areas to maintain themselves as leaders:

- Ethics on the use of information, in particular the social policies needed for ICT in health, wellness, privacy, and transparency
- Ethics on man and machine as an integrated organism (Cybernetics), Biometrics, Bioinformatics and multi-agent systems
- An increased emphasis on health and safety, legislation and conformance to regulations with the use of applications and the interpretation of information from these applications.
- An increased awareness of information and its impact on children, the weak willed and the infirm
- Deep collaboration with other professionals in a lateral leadership style including cultural sensing
- Become more fact based and risk conscious
- To have the resolve and ability to do the right thing, raising appropriate concerns

This leads to the following revised definition for the computing professional:

Given the reach of ICT in our lives, it is important for an ICT professional to be technically strong (in order to use the right technology for the relevant problem) ethically grounded (to ensure that technology is put to the right use), socially conscious (so that the technical solution takes into consideration elements of sustainability) and business savvy (to ensure commercial viability which is required for social prosperity and funding of new developments)

Appendix A - GIC 2020 Vision of IT Skills Abstract

Prepared by:	John Morton
Date:	21st of January 2013

Title :	2020 Vision of IT Skills
Background:	There is significant emphasis on a shortfall of ICT skills in a number of countries over 2012 and 2013. There is increasing change in the way culture and business use technology and expectations of ICT technology. There are new and evolving methods and techniques from new technology expected to drive commerce and organisations over the next 5 years.
Objective :	<i>To develop a vision of the types of skills and capabilities required for the ICT industry for 2020 (some 5 years hence).</i>
Scope :	<p>The Vision needs to consider a number of factors:</p> <p>The general direction of the world in using computing for basic functions as well as for support and administration services.</p> <p>It will also have to look at the large computing themes that continue to accelerate and those that hamper change in the computing world</p> <p>Culture and society have also to be considered, challenges are being made to legislation and compliance globally as citizen sentiment influences how computing technologies evolve.</p> <p>Competing Industries will vie for the same raw skill sets, how will computing remain sexy and relevant against more mature industries.</p> <p>Technology is evolving and change and the way that we use technology is evolving as well. Has the computing industry the right measures in place to balance development and innovation, support, control and maintenance?</p>
Deliverables :	<p>An executive summary of the state of Computing industry in 2020;</p> <p>A detailed assessment of the state of computing industry in 2020</p> <p>Assessment of the Global IT industry computing capabilities in 2013</p> <p>A vision for the Computing Industry professional status</p> <p>Presentation materials to be used at various conferences e.g. ITU WSIS, SAC, World Computer Congress, World CIO Forum, World Economic Forum, IP3 IFIP GA</p>

	<p>Specific recommendation report to the IP3</p> <p>Provide follow-up advice and report information gained from the collated material as and when required.</p>
Timetable :	A strong draft should be available by end of H1 2015, ready for socializing with a broader industry audience.
Composition :	<p>Identification of key themes and principles/assertions of computing in 2020</p> <p>Identification of key themes and inhibitors to the computing industry in 2020</p> <p>Establish a vision of the key computing capabilities expected from the following types of organisations:</p> <ul style="list-style-type: none"> • Government • Global business • Local business <p>Assess the gap between the computing capabilities in 2013 and those in 2020.</p> <p>Identify the type of skills, education and aptitude required to meet this gap.</p> <p>Identify the challenges of developing a professional workforce in the 2020 world : turnover of staff; Vocation versus a job; ageing skills; diversity of technology; the increasing need for multi-disciplinary teams; legacy technologies</p> <p>Suggest strategies, mechanisms. Processes and actions to meet this gap. Include here what organisations are doing to meet this as early adopters.</p> <p>Develop a framework for reviewing progress against the Vision and monitoring of strategies and actions.</p> <p>Feedback from other industry luminaries on their view of the 2020 vision</p>
Quality Criteria/ Acceptance :	<p>Must align to GIC TOR in the following areas:</p> <ul style="list-style-type: none"> • Articulate the needs of industry to IP3, specifically those which can be addressed though ICT professionalism, certification, and activities related to the IP3 mandate; • Propose specific initiatives aside from accreditation and ICT professional standards which IP3 may wish to undertake in order to collaborate more effectively with industry and specific outside groups;

	<ul style="list-style-type: none"> • Offer expert advice and insight in an effort to help IP3 remain responsive to the needs of industry with respect to ICT professionals, professional skills and competence; <p>GIC believe that this is a credible and worthy vision to place their combined names to the Vision.</p>
Estimated Man days:	To be in place by End of June 2014

Appendix B References

Please note that some of the links lead to articles that are under license. To use the licensed articles you must have a paid account, and cannot distribute the information. They are included for completeness and relevance.

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