The evolution of business models of information and communication technology suppliers
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Introduction

Most, though by no means all, definitions of business model focus on the individual organisation and its value creation and value offerings, or of the ecosystem associated with a particular supplier over a relatively short period, rather than the models of a whole industry and how they have evolved over many years. However, some definitions focus on higher level models (e.g. the subscription business model) as they apply across many companies or indeed several industries (Lambert and Davidson, 2013). This article examines the evolving business models of the whole information and communications technology (ICT) industry, as represented by the changes made in many firms, including external networks of partners and suppliers.

Business model definitions

Many business model definitions have a value or customer or market-oriented approach, making them particularly valuable for industrial marketing analysis (Osterwalder *et al.*, 2005). Osterwalder and Pigneur's (2010) Business Model Canvas identifies four main areas - product, customer, infrastructure and finance, developed into nine components - key partners, cost structure, key activities, key resources, value proposition, customer relationships, customer segments, channels and revenue streams. The canvas includes finding new ways to create value for customers and of leveraging external networks (Prahalad and Krishnan, 2008; Chesbrough, 2006; Mason and Mouzas, 2012; Amit and Zott, 2001; Parnell *et al*., 2018).

The popularity of use of the term "business model" in discussions of the ICT industries has been prompted partly by firms using disruptive web-based models that destabilised industries and markets, often using two sided platforms that bring together customers and suppliers, with the platform owner marketing both to suppliers on one side of the platform and customers (who may be businesses or final consumers) on the other. Web-based businesses acting as aggregators perform the same function of aggregating demand from consumers and businesses and supply from businesses (including sometimes consumers. Where the products being marketed are physical, the new business models may also include much more efficient and responsive management of logistics and supply chains (including manufacturing), by accelerating them, making them more cost-effective and able to handle a greater variety of goods and services, and more varied order sizes and production runs (Stott *et al*., 2016). A good example of such a platform is Amazon's 'Associate Program', which changed Amazon's model from selling only its own merchandise to allowing competitors to sell, using Amazon's logistics capabilities to deliver products. By changing its model, Amazon increased revenues by 800% and customer accounts by 750% (Amazon, 2013). However, each industry tends to have its own set of models. For example, in the pharmaceutical industry, models include specialist research, generic manufacturer, and downstream marketer.

ICT industry business models

In the ICT industry, several generic business models have been identified (Stabell and Fjeldstad, 1998). An updated list would include:

- Value chains, which transform inputs them by adding value, delivering higher-value products to customers – the most up to date version of this is Netflix.
- Platform providers, which include Microsoft Azure, Amazon Web Services, and Salesforce, which provide storage, software and a range of value-added services.
- Social, media and related services providers, such as Amazon, Google, Facebook, Netflix and Twitter who provide an added-value service themselves and/or a conduit for others to provide their services (games, data tracking, retailing, advertising). They may also exploit the ability of others to deliver a service on a reliable platform, and enable an ecosystem of partners to augment their capabilities.
- Subscription models, in which software and services are supplied on a subscription basis (software as a service), usually with the software and /or storage hosted remotely ("cloud").
- Solution shops, with experts to diagnose problems and recommend solutions – in the IT industry this corresponds with the solutions era and is discussed in our direct insurance case study. These solutions shops may be one stage in the value chain, which may involve other solution shops and/or networks.
- Facilitated user networks, such as in telecommunications, where the network supports business users.

Evolution of business models

The above ICT business models represent the latest steps in an evolution which has taken several decades. This evolution cannot be described simply, as it is the history of many product and service suppliers, supplying to each other as well as to final

customers in business, consumer and other markets. The models have evolved as a result of highly complex set of interactions among hundreds, even thousands of companies at all stages of development, in an industry whose boundaries and sub-divisions are at best fuzzy, whose customers are constantly evolving their use of the industry's output, and where the evolution of both sides of the market is relatively unpredictable.

Seemingly straightforward concepts, often combined with the business model concept, such as technology push/demand pull, technology roadmaps, scenario planning, product service systems, servitization, service-dominant logic, the resource-based view, industry or technology life cycles, alliances, open and closed innovation, ecosystems, value chains and solutions, are used to help us understand these markets. Some concepts, such as product-service systems and servitization, have long been integral to the provision of information technology and communications. The idea that products were sold in their own right, without regard for how they would be supported, would have been ridiculed even forty years ago, when the dominant and most profitable element of revenue was often after-the sale. More lately, the conversion of products into services has been an industry-wide trend, but started around forty years ago with the emergence of computing as a service (e.g. database bureaux) and implementation consultancy, and more lately with software as a service. One area related to these developments that is worth exploring in slightly more detail is the idea of solutions selling and marketing, which although also born forty years ago, has taken a modified form in a world of ecosystems and platforms, where solution architects and sales and marketing people play an important role in helping clients get what they need and ensuring that suppliers can deliver it.

Business model – innovation versus development

Schneider and Spieth (2013) identified a difference between business model innovation in which a new business model is created, and business model development, involving improvements and continuous innovations. Both of these are visible in the ICT industry, with clients involved heavily in the latter but sometimes in the former, where a radical change in supplier business model is made possible only because one of more large clients have agreed to be clients for the new product, service or solution, which turns out to lead to a new business model. This "first of a kind" process or FOAK, used extensively by IBM, is described in Cerasale and Stone (2004), and Frederich and Andrews (2009).

Table I. The Ansoff matrix for IT industry business models

Product	Market	Opportunity example	IT supplier example
Existing	Existing	Revising existing business model by improvement and continuous innovation.	Hardware or software upgrades i.e. enhancement of features to allow existing users to work faster, more accurately, more securely etc.
New	Existing	New product with completely different capabilities.	Allows existing users to do completely different things, computerise different areas, work in completely different ways with their customers, adopt new business models.
Existing	New	Radical reductions in costs of existing products.	New ways of manufacturing product, at all or at scale, or use of much more effective components, allows big reductions in costs, allows new categories of user to computerise and adopt new business models.
New	New	Completely new product range allows supplier to address totally new markets.	Supplier jumps categories, using an innovative approach which transforms their own business model and allows new sets of customers to adopt new business models.

Source: Authors

Verhoeven and Johnson (2017) suggest applying these ideas to product/market choices using the classic Ansoff (1958) growth matrix. In Table I, we apply their ideas and those of Schneider and Spieth (2013) to the information technology industry.

Open and closed innovation and ecosystems

The move from closed to open innovation (Chesbrough, 2003) has been a particular feature of the ICT industry, which has moved from domination by one firm (IBM) to a situation in which many firms cooperate to innovate. The closed paradigm, which relies on ownership and control of ideas, secrecy and market domination, has in general moved to an open one, in which co-operation with other innovating firms and opening up of programming interfaces has become the dominant model, with leaders still controlling the market, but by different mechanisms, often network effects, standards and acquisition of innovative partners e.g. Google, Microsoft. This shift started to take place in the 1990s and continues today. For the last two decades or more, whole ecosystems of companies have been involved in the development and marketing of the main information and communications technology products and services (Manikas and Hansen, 2013; Van Den Berk *et al.*, 2010). These ecosystems become fields in which suppliers and customers co-operate with each other to further product and service development, while the balance of power in an ecosystem is maintained carefully by their progenitors (Alves *et al.*, 2018). These ecosystems are managed explicitly, as can be seen in the approach of Amazon Web Services (Dudovsky, 2020) and SAP (Jansen *et al.*, 2019; Dowie *et al.*, 2017).

The importance of solution selling

There are many changes required in marketing in the business model change situation, but one of the prime requirements is a move to solutions selling and marketing. These disciplines were established in the 1990s and documented by many researchers, such as Cerasale and Stone (2004), Storbacka (2011), Sawhney (2006), Ulaga and Reinartz (2011), Epp and Price (2011), Shankar *et al.* (2009), Salle *et al.* (2007), Robert *et al.* (1998), Sharma and Molloy, (1999), Brady *et al.* (2005), Raddats and Burton (2014), Macdonald *et al.* (2016), Windahl and Lakemond (2010), Huikkola and Kohtamäki (2017), and Tuli *et al.* (2007). These authors and many others identified the different requirements for a successful solutions business – many of which were already present in companies selling large systems, but which needed to be combined and managed professionally, effectively and efficiently. They are identified in Table II.

Solution selling has changed quite dramatically since it first appeared in the 1980s, with its focus being increasingly on how salespeople from ICT providers, consultancies and the platform owners, help clients adapt their businesses to the changing business models of the ICT industry. This applies particularly today, with developments such as giant data platforms and the Internet of Things creating enormous and varied opportunities for new applications of systems and the associated requirement for solutions to enable them. Solution sales people now need to have intimate knowledge of the major third-party platforms used by customers and techniques for use of Internet of Things techniques in gathering and exploiting data. For example, at the time of writing, knowledge of and experience of working with Amazon Web Services and Salesforce.com were at a premium. However, the fundamental skills and knowledge required for solution selling remain those involved in consultative selling, including industry and/or functional knowledge, co-creation, value analysis, building and managing relationships, diagnostic skills, solution definition and presentation, negotiation and problem management.

Solution salespeople must demonstrate in-depth knowledge of the customer's business and industry and build strong personal relationships by creating and delivering customer value. Solution companies tend to avoid moving their salespeople too often to allow this to happen. This may demand specialist knowledge (about an industry for example). Solutions companies also employ specialist consultants, although some choose to partner for consulting capabilities. Most solution companies depend on partners to some degree. Some partnerships or alliances are "marriages of convenience", opportunistic and operational in nature. Others are more strategic, established between a few selected partners who come together for joint planning activities to which they often commit considerable resource. In solution companies, project management requires special competencies, skills, professions and career paths. Migration of very high volumes of data can take years, and meanwhile the client's service to its customers must be maintained.

Solution marketing is much more than services marketing although there are some similarities. Marketing must support the creation and delivery of solutions. Solution marketing combines industry marketing, offerings marketing and relationship marketing. Excellent examples of these can be seen on the websites of the major solutions companies, particularly demonstrated by focus on specific industries, reflected in the use of industry solutions experts as sales and marketing people. This is often reinforced by extensive use of thought leadership marketing.

Table II. Solutions marketing and selling requirements

Requirement type	Requirement	Detail
Sales, marketing and client/customer management capabilities	Industry (e.g. transport) and functional (e.g. finance) marketing skills and knowledge	Working with key influencers and other stakeholders, including (where appropriate) government and regulators.
	Industry and functional selling	Proposal preparation – from responding to request for information and invitation to tender Modifying proposal to meet requirements
	Key account management	Knowledge, frameworks, compensation and accountabilities.
	General and industry-based business consulting and pre-sales capabilities	Especially gathering data, translating it into insight into customer needs and potential solutions and into assessment of any issues likely to arise during solutions development and delivery, value assessment and value proposition development, and future-proofing solutions that are likely to be in place for many years.
	Contracting skills	Includes specification of realistic service level agreements and cost in the case of outsourced services, and of budgets and delivery deadlines for solutions to be managed by clients.
	After-sales support	Includes operational service capabilities and the ability to maintain, upgrade and renovate systems.
	Managing feedback from the client	On issues such as service quality, consistency and reliability, and acting upon it.
	Outsourcing management	Includes transfer of undertaking and (in some cases) transfer back.

Third party management capabilities	Partnering and alliance and ecosystem strategies, skills and processes	For partnering with other companies (particularly as innovation becomes more open) and with clients, where co-creation capabilities are essential).
	Merger and acquisition capability	Where solutions require closer working than would be possible via partnership.
Internal capabilities	Advanced financial and related capabilities	Needed for complex pricing and payment arrangements, developing revenue models, and risk assessment and mitigation.
	Systems engineering and systems integration and customisation capabilities	Includes deep knowledge of the integration and customisation requirements of different components of solutions (hardware, software, telecommunications etc.), whether coming from the company itself or from business partners (sometimes competitors) and managing and mitigating any risk and security issues.
	Process and service design strategies and techniques	Combining innovation and experience, especially for "first of a kind" solutions and then translating them into more standardised, repeatable, and lower cost robust offerings.
	Knowledge and innovation management	Includes sharing with clients and business partners, in some cases to support co-creation.
	Data management and analytics capabilities	To support improvements in solution efficiency, reporting etc.
	Manpower management	Recruitment, training, deployment, quality control.
	Change and project management	Experience and capability in managing projects, programmes, change and transformations (latterly digital transformations) for clients.
	Organisational capabilities	Especially organising to deliver all the above at scale and globally (in the case of large companies, particularly to meet the needs of very large and/or global clients), taking into account the need to vary solutions to meet local requirements, and also distributing workforces so that they could be close to customers.

Source: Authors

One of the issues raised by the rise of solutions marketing and selling has been the commoditisation of the word "solutions", not just in the computer industry but in the many industrial sectors where the move took place, such as mechanical engineering, health, mining, construction, financial services, defence, aerospace, land transport, logistics, materials handling, and telecommunications (Cerasale and Stone, 2004; Davies, 2004; Storbacka, 2011). Over a few years, every systems company became a "solutions company", whether they were a hardware company following a classic servitization process or a software or services company whose disciplines were already close to those required for solutions. This led to serious work on branding of these companies in terms of their solutions capabilities (as listed above) required at different stages of the solution sales and delivery process (Jalkala and Keranen, 2014). However, the extent of the transformation required was documented very fully by one of the companies involved, IBM (Gerstner, 2002; Jetter *et al.*, 2009), indicating the extent to which top leadership needed to be involved in the move to solutions provision.

Cycles of development

The ICT industry tends to evolve in cycles. These cycles start with definition of a new model, though the nature of the model is not necessarily clear to the participants on either side of the market. The model increases its coverage of the market and may consolidate to some extent. At some stage, the market that uses the model becomes dominated by a few large firms, but as it ages, the model becomes challenged by a new model, while costs for customers using the previous model tends to fall as it becomes commoditised. In some cases, periods of expansion may follow the introduction of an open platform or one or more standards that allow many producers to enter, leading to falling production costs and intense competition between suppliers. The new entrants using the existing model exploit the platform or standards, cutting prices and margins. The market as a whole becomes decentralized.

The lower price also attracts new users. This leads to a widening in the variety of users, as the low prices means that users now include those who would not have been prepared to pay the premium prices that would have been charged at the earlier stages of the development of the model. Entrepreneurs move in, hoping either to build big businesses or to have their businesses acquired by the incumbents - this can be seen very clearly today in the massive acquisition programs of companies such as Amazon, Google, Microsoft. These entrepreneurs may create new version of business models, hoping to achieve scale quickly without being destroyed by the incumbents. New standards may emerge, often using open-source approaches. These lead to further cost falls, until a new model emerges, in which customers' needs are met in different ways, usually not lower in price but nearly always more effective and often with lower user costs, as in business to business markets it is the effectiveness of the new approach which is attractive, not its cost.

Viewing business models through business histories

Below, we describe the four cycles of business model change that have characterised the ICT industry. This means using a historical perspective, including relying on the literature created at the time. Most of the authors of this article have been involved in more than one cycle, whether as managers in the protagonist firms or as consultants, and some in all cycles, and although this creates the possibility of bias in interpretation, it does have the benefit of ensuring that they can validate some of the descriptions of what occurred.

The value of the historical perspective in understanding the ICT industry was recognised by Mahoney (1988), who recognised the need for research that was less based on the personal reminiscences and biographies of those involved (often only when they are retired) and journalistic coverage. Making sense of a rapidly involving industry is difficult. This is for three reasons:

1. Knowledge evolves so quickly that choices made in the past may not seem sensible when seen from the point of view of today's knowledge.
2. The history of the industry is often seen as the history of what it produces rather than of the businesses (suppliers and customers) who constituted markets for information technology.
3. Today's protagonists are often unaware of the fact that the issues they are addressing are ones with long histories e.g. software project failure, which first emerged as an issue in the late 1960s (Mahoney, 1988).

Haigh (2011) points out that one of the problems is that the very definition of ICT has shifted radically in the last few decades, moving from a focus on computer hardware to a much broader focus on information and computing technologies, encompassing telecommunications, much wider issues of information management, as well as many other areas of activity. However, Haigh also emphasizes that researchers into the history of the industry are now more often professional historians, economist and other social scientists, producing more analytical and tested work. One outcome of these reflections on the nature of the history of the ICT industry is the idea that there are multiple histories of computing (Mahoney, 2005), focusing on different aspects e.g. the evolution of technology, the businesses, the applications, the customers, and so on.

However, the historical perspective, investigated by the above-mentioned professionals, can sometimes obscure the story of evolution, one that may be perceived better by those involved in the changes, even though this carries the risks mentioned above. The ICT industry is very complex, with different parts of it – and its client base – moving at different speeds. Nonetheless, the authors feel that it is worth while trying to extract the essence of each model, because it is the model changes that are significant in triggering changes on the client side, a topic which requires further research. What follows must therefore, however, be considered as a series of hypotheses rather than a proven set of empirical statements. This includes general statements about the new capabilities provided to clients of the ICT industry, a topic for further research.

The first model change – from customised to standard hardware and customised software

Transistors helped transform the ICT industry. They replaced expensive and inefficient vacuum tubes, allowing IBM to build a large business in the 1950s. Its IBM 650, which had to be configured to customer's individual requirements, was followed by System/360. This was a modular platform of interchangeable components with a general-purpose computer at its core. This could be argued to be the first change in business model. Modularity allowed higher volume production and lower cost. System/360 became the industry standard. It allowed IBM to control the ICT industry. IBM had two thirds of the market by the end of the 1960s. The other suppliers included other US companies such as Burroughs, Unisys, NCR, Control Data and Honeywell (known as the Bunch) and later Amdahl, and suppliers from other countries such as Siemens, ICL (later bought by Fujitsu), Hitachi and Fujitsu.

In 1969, Intel designed the first commercial microprocessor, the 4004. It was released in 1971. Before then, central processing units (CPUs) were mainly a set of components and circuits, so new applications demanded new implementations, other than in the Apollo space programme, which used microprocessors in 1966. Microprocessors consolidated most of the processing into one general integrated circuit. Standardization removed the need for the bespoking. Integrated circuits allowed computers to be much more powerful, and hardware components could be standardized around standardised processors, allowing powerful smaller computers to be designed and built at much lower cost. Digital Equipment's PDP8, the first minicomputer, was produced in 1965, followed by the PDP11. These minicomputers were supplied to whole new market of customers who needed mainframe computing but for smaller domains, often technical customers, such as smaller factories, research laboratories. IBM was slow into this market but did achieve a significant market share with its System 34 and System 36, and its Series/1 for engineering applications. These minicomputers were often used for distributed computing by companies that relied on mainframes for their main operations. Many new computer manufacturers emerged. They offered smaller, cheaper and faster minicomputers and then microcomputers. They included Digital Equipment, Prime, and Data General, but eventually every company involved in some way in producing computers seemed to have their own minicomputer and microcomputer ranges. Most of these were later absorbed into the survivors of the industry. Integrated circuits also allowed European and Japanese firms to get into the minicomputer market, but as had happened case with mainframes, firms in Europe and Japan lagged. American firms had high market shares in these markets too. IBM remained a successful, but its market share fell quickly as the market expanded.

One of the most significant enabling developments in the ICT industry in its early model was the rapid advances that were made in storage capacity. When the computing industry was born, physical media such as punched cards and then paper tapes,

followed by magnetic drums and then magnetic tapes, were the prime method of data storage. Electronic means of storage evolved steadily as the initial enabling technology of thin surface coatings allowed electronic data to be stored on magnetised services. Random access methods allowed much faster access times. At its peak, the rigid disk storage industry alone had a turnover of $15 billion (Christensen, 1993). Floppy disks took off with the advent of the word processor and then the personal computer. The initial dominance of IBM and then Control Data was challenged by the rise of the so-called "plug-compatible" manufacturers, such as Hitachi and Burroughs. The intense competitiveness of this market led to a rapid rise in the storability of data, with the major innovation being random-access, allowing data to be stored and retrieved much more quickly. Eventually, the whole industry was replaced, first partly by optical disk drives and then completely by memory chips, the rise of which is documented by Kim and Lee (2003), who identified the continuing impact of inter-firm competitiveness on the progress of the industry and thence on the ability of customers to store data securely, cheaply and in quickly accessible way.

Software at this stage was largely proprietary, sometimes customised to the needs of individual clients. This applied particularly to transactional and database software. The focus was on automation, consistent and predictable outcomes, and overall cost reduction, typically the focus of large companies. There was a high cost of entry for clients into computing, in terms of costs, skill requirements, requiring a long-term approach to amortisation of capital expenditure.

The establishment of this business model led to radical changes on the client side. For the first time, clients could gather, store, access and analyse very large volumes of data, although the processes for doing so could be slow and expensive. The most notable beneficiaries of this were clients with very large amounts of operational data. Up until 1950, banks main demand for systems was for office systems – accounting systems, punch card machines and the like. The computerisation of banks took place over the following thirty years, based on mainframe computers, using a highly centralised approach. This has only changed in the last decade or so with the move to blockchain technology, a more dispersed approach to computing and digitalisation of relationships with customers (Adeosun *et al*., 2009). Harianto and Pennings (1990), and Scherer (1982) identify that by 1974, the financial service sector accounted for most R & D expenditure. This was partly accounted for by the fact than banks were at the centre of massive national and global networks for money transmission, operating within and between banks and between banks and their customers, requiring very robust and secure systems. This trend has continued until today, although the appetite of other sectors for systems has reduced banking's share.

One other notable beneficiary of this stage of development were companies who managed very large numbers of customers. These included the industries which had benefitted from computerisation of operational data, but could now build customer databases. Examples of this were not just the financial services industry, which during this period could add new products and services which depended on the new capabilities available, such as credit cards, but other industries such as mail order, the utilities (power, water, telecommunications) and airlines. It can be argued that this was the period during which high volume computerised direct marketing using standard hardware and customised versions of existing database software became possible.

The second business model change – the move to software, standards and distributed computing

In 1980, IBM launched the IBM Personal Computer (PC), its first to use an Intel microprocessor. This followed a period in which many smaller firms had launched personal computers and similar devices, such as programmable terminals. The IBM PC was very successful but could easily be cloned. Intel's microprocessor development activity continued apace and powered the next model change and beyond. Similar developments took place across the whole range of computing hardware, including storage and printing, and the focus of competition moved to software, the next change of business model. Demand for software grew but small, software vendors found it hard to support different operating systems. In the early 1980s, demand for a standard operating system grew. Unix emerged at Bell Labs in 1970. It was free, open-source, and easy to port between systems and modify, so was used in most PC developments.

Microsoft's first operating system offering in 1980 was a Unix variant called Xenix. In 1980, Microsoft contracted with IBM to develop MS-DOS, allowing Microsoft to dominate PC operating systems (later with Windows), not just for IBM but for the many PC clone manufacturers. PC software vendors by then mostly had to build for Windows, although two other operating systems persisted e.g. CP/M, and Apple. Eventually, Microsoft consolidated the PC software industry. By 1991, over half of Microsoft's revenues came from the applications business, particularly office automation software such as spreadsheets and word processing (where earlier innovators such as WordPerfect, Wordstar, Supercalc and Lotus 1-2-3 were supplanted). In the same period, personal computers were increasingly connected within organisations using local area networks such as Ethernet, greatly increasing office efficiency. In business to business markets, the rise of the giant database and enterprise resource planning software companies, particularly Oracle and SAP, had a similar effect on that part of the market that was purely business, as opposed to the hybrid business/consumer market of PCs. They each absorbed several their competitors and added applications by in-house development and acquisition.

Apple was always a special case. Extremely design-conscious and with a strong focus on creativity, its personal computing and then mobile phone products were strongly differentiated and integrated with each other, and the iTunes platform saw Apple safely into the next model change. The first mouse was developed at Stanford University in 1968, and Xerox devised the first large computing system with a mouse, the Xerox 8000 system. Apple introduced its PC alternative, the Macintosh, in 1984, with

a GUI (Graphical User Interface) which gave PCs system stiff competition due to usability and professional software. Microsoft then developed its own PC-compatible Windows operating system with its own GUI.

Client-server computing, which appeared in the 1960s and continued to spread, began to spread even more widely at the beginning of the 1990s. Information technology became not just for processing transactions and handling content, but connecting an organization's processes. The distinction between computing, communication and content or knowledge began to weaken, as client-server technologies broke down organizational barriers. The commoditisation of computing allowed distributed processing and cost reduction. PCs could take some of the load through inexpensive Intel processors. This was needed to compensate for an as-yet relatively poor global network. This development also allowed the growth of individual development for smaller companies with lower entry barriers, leading to a rise in very accessible development kits such as Visual-Basic, dBase, Borland etc – all relying on the client-server.

Another aspect of distributed computing was a change in printing. Until distributed computing arrived, virtually all data was centralised, and so as a consequence was printing. By the time the data got to users, it was often in printed form, coming from big line printers which in large organisations pushed out mountains of reports on folding computer paper until more distributed printing arrived. Any data that needed distributing in small groups was often then photocopied and bound into reports. However, distributed computing brought with it distributed printing, initially as daisy wheel printers (suppliers included Diablo) and IBM's Golf Ball printer. Photocopier manufacturers, led by Xerox, identified that the copying process could be adapted to printing, with the image being reproduced being written directly onto the photocopying drum by a laser, instead of being transferred to it by a scan of an image. The laser printer arrived, and it was quickly developed into a machine which could handle very large volumes of output, with every image different. This led to the extensive use of laser printing in direct marketing, with each page customised to a particular customer e.g. bank statements, insurance policies, utility bills, competing with classic computer printers.

By 1998, ICT accounted for over 50% of US capital spending and one-third of the US economy's growth. It was the main driver of organizational change and of ways for organisations to add value to their customers (Weill and Broadbent, 1998). Outsourcing became established as one possible though not always successful way to reduce the costs of application development. One major problem with outsourcing was that it often applied to specific functions, focusing on cost, and this reduced the opportunity for recombining organisational functions for greater effectiveness. Outsourced outputs were often static while costs reduced, but the broader impact on organisational effectiveness was arguably impeded.

By this time, the idea of using IT as a strategic tool to support or even create market leadership, often as part of a wider transformation initiative, through three "value disciplines" operational excellence, customer intimacy, and product/service leadership, was becoming well-established (Treacy and Weirsma, 1995). This applied particularly to service businesses, which by then already dominated the economy. At that time, it was also becoming clear that IT investment by itself does not create competitive advantage but requires changes in the way business is structured and acts (Basu *et al*., 2003; Johnson *et al.*, 2001; Lewis *et al.*, 2001). One of the best examples of this was Dell Computing, which used IT to allow customers to cost-effectively customise personal computers and still achieve rapid delivery (Kraemer *et al.*, 2000).

The marketing requirements for the computer industry during the period of domination of this model were articulated by Stone and Macarthur (1984) and Stone (1985), using ideas adapted from general industrial marketing.

The third business model change – breaking out of the organization and the journey to digitalization

Although the Internet had been around for a long time, used in defence and academic life under a variety of names, the first PC modem came out in 1977. This was followed by a series of communications developments which led to the to the World Wide Web in 1991. In 1983, the US government standardised the Internet protocol. Proprietary computer networks existed but were expensive and incompatible with each other. Standardization based on the open and free internet protocol cut the cost of building computer networks, which were now interoperable. Standardisation of application protocols for linking and transferring files and for browsing the web let to the explosion of the Internet and the "dot.com" explosion – and the boom and bust. However, the Web continued to develop in an astonishing diversified way, with thousands of new firms and applications, spurred by the parallel explosion of the mobile phone industry.

The rate of growth rate of businesses' investment in ICT accelerated rapidly in the last two decades of the 20th century, particularly in the period 1995-2000, growing at 24 percent per year. After the end of the "dot.com boom" and following the end of the Y2K non-problem, it crashed. The crash occurred mainly in the telecommunications industry, which accounted for more than 2/3rds of the decrease in spending in the US (Doms, 2004). This was followed by the demise of many dot.com companies, but by 2003 investment in ICT was again growing fast, at 21 per cent per annum (Doms, 2004). This was despite the fact that, at the time, prices of computing equipment were falling at 20% per annum. This was due mainly to the falling prices and rapidly increasing capabilities of semiconductors and storage). At the same time, the capabilities of ICT hardware and software were increasing rapidly. In other words, the demand for ICT was very elastic, although demand was also stimulated by the fact that new generations of software required much more powerful personal computers (Doms, 2004), facilitated by the rapid development of faster and cheaper processor and memory capacity.

With the pace of innovation apparently accelerating, ICT suppliers were faced with the problem of dealing with a market where innovative users and laggards might be customers of equal importance, as it took some time for companies to get the full benefits of the ICT they were buying (Fichman, 2000). This meant that marketers had to be careful in their approach to customers and deploy different resources to deal with a wide variety of attitudes towards innovation amongst customers. They needed to take into account factors such as leadership, professionalism, technical competence, knowledge, receptiveness to change, capacity to absorb change, decision-making processes, nature and extent of prior experience, attitudes to fashions or fads in ICT (Abrahamson, 1996), existing stock of equipment or range of services already being used, relationships with consulting firms and structural characteristics such as how ICT was organised in client firms.

A particularly important aspect of this was the degree of involvement and support of senior executives in ICT management, which was identified as important as early as 1968 (Rockwell, 1968). Focus on this aspect increased steadily as the importance of ICT in competitive success became clearer. Many studies focused on identifying where this is important (e.g. type of industry, particularly degree of information intensity), how this happens, different models for success, and their results (Jarvenpaa and Ives, 1991).

In some cases, firms formed part of what became known as ecosystems, with several other firms who were in relationship with the target client using the same software. This was particularly the case with enterprise resource planning (ERP) systems and certain sectoral systems (e.g. in banking, airlines). Laggards paid the price of not being able to interface so easily with co-suppliers or their clients. This was a key design principle for Microsoft's early development standards for their partner ecosystem. Microsoft published standard interfaces, libraries, and Application Programming Interfaces that allowed several partners to interact on Windows with a common look and feel. It also created a very large grey market for software that conformed to consumer expectations and operational requirements.

All this meant that services salespeople emerged as a special breed of salesperson, with the skills of consultative selling. Particular attention needed to be paid to the networks of influence that senior client-side decision-makers were involved in, whether user groups of suppliers, or sectoral or general associations of chief information officers or other seniors, as word of mouth became even more important in this period, with the major benefit of attending conferences and exhibitions often being the networking with peers as opposed to the conference presentations or interacting with suppliers on the exhibition stands. Solutions were being crafted and sold, not individual items (Cerasale and Stone, 2004), and this led to the rise of solution selling and marketing, an approach which has become even more important today, as described earlier.

The fourth business model change – domination by platforms and centralisation, and advanced services

Google, Apple, Amazon, Microsoft and Salesforce used their user networks and data sets to expand rapidly. At the time of writing this was the current phase. Perhaps the most interesting aspect of this development is not the marketing by other companies to these companies, but their mutual relationships, or their relationships with other giants. For example, Netflix could not deliver its customer relationship management (CRM) without the data storage, analytics, web services and other capabilities supplied by Amazon Web Services and the CRM software capabilities of Salesforce. The relationship between Google and Amazon is both intensely competitive and co-operative, with some of Amazon's business resulting from leads generated by Google. The rest of the ICT industry, including former giants such as IBM and new giants such as Accenture, formerly just a consulting company but now a leader in outsourcing and digital marketing services, generate enormous revenues from helping commercial users migrate to and exploit these and other large platforms. New companies, such as eBay (a survivor from the dot.com boom of the 1990s, AirBnB and Uber) do well in a world where anybody can link to them and vice versa, in a world of open Application Programming Interfaces.

The rise of ICT services was already apparent in the late twentieth century, with most major suppliers, whether of hardware or software, becoming increasingly dependent on services revenue, for activities ranging from hardware maintenance to software enhancements (Wise and Baumgartner, 2000). This trend has continued and even accelerated (Han *et al*., 2010), not least because of the migration of most major software providers from on on-premise acquisition model, in which software packages were sold, to a licensing model (software as a service) in which the right to use the software was licensed for regular payments, often on a per user basis, and where the software was hosted in the cloud rather than on the client's site, allowing it to be continuously maintained and updated/upgraded. This led to new service requirements (Parasuraman, 1998), relating to factors such as the information provided to customers, setting of and delivery according to service standards, support for service staff, and identifying and meeting expectations. However, the digitalisation of many service processes and in some cases the moving of the onus for servicing from the supplier to the customer has changed the nature of the relationship between supplier and customer.

The complexity of modern large systems and the high volumes of data they generate (requiring storage, access and analysis) has provided an enormous stream of work for IT vendors, as the capabilities of different systems continue to advance. Where a client's systems are the result of the integration of several different commercial systems, this requires complex integration work to maintain and increased functionality as different systems advance. This is one reason for the emergence of the cloud-based platform giants, claiming to be able to manage this advancing functionality and integration. Initially the ICT services sector was focused on industry applications e.g. pharmaceutical or functional applications e.g. HR. By 2012, it had become the largest sector of the ICT industry (Rangarajan and Tiwari, 2015).

So, cloud computing provides ICT solutions as a service over the web instead of the customer owning and buying the ICT solution per se, although some clients use their own private cloud or a hybrid model (some private, some public cloud). The cloud is a large group of interrelated computers, allowing organisations to move their computing requirements to a shared platform and buy applications or infrastructure as a service, allowing big cost savings and increasing flexibility. The rise of cloud computing allows smaller firms to gain the advantages previously only available to larger firms, gaining the advantages of high availability of data and avoiding server crashes. The volume of data so stored is increasing rapidly. "Big Data" describes the very high volume, variety and required velocity of transmission of structured and unstructured data that is hard to process with traditional database and software techniques. Increasingly, cloud databases are being accessed from mobiles, as mobile broadband is redefining internet access, connecting four times as many people as landline telephony because of its reach, convenience, and functionality, as well as lower costs. Today, mobile phones are routinely used for a great variety of commercial and personal uses.

Special features of this fourth stage include the pervasiveness of computing (digitalization) in both client and supplier sides, and the increasing openness of interface between ICT and client companies, with significant movement of staff between them (often via consultancy route) and learning by client companies of techniques used in ICT industry (e.g. agile software development)

Conclusion

In this rapid excursion into the world of ICT business model change, we have identified the ways in which ICT supplier business models have changed. Our analysis shows this along with the rapid change, the business model changes overlapped, with the leaders advancing the model, and laggards often fading away into niches or being acquired by the leaders, whose performance was improved by acquisition. There has also been a significant change in market leadership.

Understanding the past and likely future changes is a necessary precursor to understanding how information management has changed, and how it has been at the centre of business model change by companies that use the outputs of the information technology industry, leading to changes in how they manage information – the subject of further research by the authors of this article.

Managerial implications

The ICT industry has become a very important force in leading to business model change in all industries, but the industry itself has also gone through dramatic changes in business model. Long-term planners, whether in the ICT industry or in client industries, should include in their planning their answer to the questions: "What is the next model change in the ICT industry and how does it affect my plans?". These are not easy to answer, and it can be argued that a scenario planning approach is appropriate, using data from ITC industry analysts such as IDC, but also classic "what if?" questions relating to issues such as the survival of change of major suppliers, the intervention of governments in the form of changes in trading relationships or regulations, and the adaptation of emerging techniques to changes in products and services. For example, as identified by Stone *et al.* (2020), artificial intelligence may have dramatic impacts on the way industries are managed and on how they use ICT to do it.

Implications for university teaching and research

Business model teaching is gradually being integrated into strategic management teaching, but business model evolution is not, so needs more attention. Students should be encouraged to focus on critical evaluation of business models, in particular, the weaknesses that they may have, which may give rise to the next phase of business model development in any industry that they are studying. The relationship between the industry that they are studying and the products, services and business models of the ICT industry should also be a focus for teaching and research.

Implications for government

Governments in many countries see the ICT industry as crucial to their development (Stone et al., 2019). This article makes it clear that the target they are trying to hit is a moving one. The relationship between the business model of the ICT industry and the business model of an economy as it relates to the ICT industry is a very important one, and success and failure in government strategizing in these areas, based upon understanding of ICT business models, is very evident in countries such as Japan, Singapore, Taiwan and China. This article should serve as a warning to such countries that their planning should be quite open ended and use scenario planning as suggested above.

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