# Information and Communication Technology and Small and Medium Sized Enterprises

# Information and Communication Technology and Small and Medium Sized Enterprises: From Theory to Practice

Edited by

Diane Poulin and Sébastien Tran

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# INTRODUCTION

As defined by the Organization for Economic Cooperation and Development (OECD), SMEs are companies employing less than 250 persons. Generally representing between 95% and 98% of companies worldwide (Marchesnay 2003) and a relatively significant portion of most macro-economic indicators regardless of activity sector (industry or services), they play a major role in the economies of most countries. Given the diversity of their activities and their positions in the various sectors and value chains, they form a very heterogeneous group, but they are nonetheless a driving force in terms of innovation and entrepreneurial dynamics. Despite the advantages offered by their size and their often more flexible and reactive structure, however, they can experience problems with economic competitiveness both internationally and with large companies in their activity sector.

The mid-1990s marked a clear discontinuity in competitive dynamics and the start of a period of innovation in Information and Communications Technologies (ICT). The Internet and enterprise software applications, such as Enterprise Resource Planning (ERP) and Customer Relationship Management (CRM), became practical tools for business. The Internet represented a major disruptive innovation for a broad set of industries, and generally ICT are widespread in most countries around the world

In the 1990s research began to report a positive relationship between ICT investment and productivity, provided there were investments in both information technology and organization. For example, corporate investments in ICT surged during this time from about $3.500 spent per worker in 1994 to about $8.000 in 2005, according to the U.S Bureau of Economic Analysis (BEA). Another study of Canadian manufacturing companies (plants) with ten or more employees (excluding food processing plants) drawn from Statistics Canada's Business Register shows that those with high productivity growth are more likely to be using more advanced ICT (Baldwin 2002). In an ever-changing and dynamic world, the adoption of ICT across the globe has permanently altered the rules of the game and the expectations of the new digital and inter-connected economies. Productivity is one of the indicators demonstrating

that ICT is a key factor by which firms can enhance their competitiveness.

SMEs are increasingly aware of the positive impact that ICT can have as these technologies spread through their organizations. Among the different tools for SME development and competitiveness, ICT have become widespread in every activity sector over the last several decades. Behind this very general acronym hides a multitude of technologies — for example, computers, Internet, groupware, Electronic Data Interchange (EDI) and Enterprise Resource Planning (ERP)—that are supposed to improve the performance of organizations.

One explanation for the pervasiveness of ICT is that these technologies theoretically permit gains in productivity, particularly in terms of transactions and coordination. The strategies implemented by companies to encourage ICT and electronic commerce are theoretically supposed to improve company performance through cost reductions and differentiation strategies. However, ICT provide only a partial explanation for performance improvement in most studies. As Solow's Paradox[1] indicates, measuring this performance gain has proven quite difficult and subject to debate.

Historically, large companies were the first to set up ICT (Antonelli 1986), both for organizational reasons (e.g., to maintain links with subsidiaries, to coordinate distant sites) and economic reasons (e.g., to better integrate processes, to automate data exchanges with key suppliers). In order to accomplish these goals, these pioneering companies had to restructure their operational processes, modify their organizational structures and redefine their core activities and their positions in the value chains. Thus, digitalizing a company's internal and external processes necessitates changes in organization and management. These changes often generate costs and risks that are proportionately greater for SMEs, which may also lack expertise and knowledge, leading to longer ICT implementation and appropriation phases.

The structural transformations in the various sectors have led to a greater organizational interdependence between firms, especially between

[1] In 1987, Robert Solow, Nobel laureate in economics, stated in “We Had Better Watch Out,” in the *New York Review of Books* (July 12, 1987):"You can see the computer age everywhere these days, except in the productivity statistics". This economist thus affirmed that the business world's massive investments in ICT didn't lead to significant gains in productivity.

large companies and SMEs, which are often sub-contractors providing goods and/or services. This is particularly true of transformations that, applying the concepts of vertical disintegration or networks, have pushed companies to re-center on their core activities and to modularize their production systems. The external pressure of large companies and clients has led numerous SMEs to set up ICT, especially in industrial sectors, as will be seen in the various chapters of this book.

Internet technologies are assumed to play a major role in the simultaneous processes of company disintegration and reinforcement of the interorganizational relationships between companies. According to OECD surveys, SMEs are increasing their use of ICT. A Eurostat survey of electronic commerce indicated that, by the end of 2000/beginning of 2001, nine out of ten SMEs were equipped with computers. Thus, it appears that the Internet has become a widely used tool in small companies. Although the use of the Internet in large companies is more commonplace, the Internet use gap between large and small companies is quickly disappearing. In most OECD countries, with a few exceptions, the Internet penetration rate in medium-sized companies (50-249 employees) has reached, or exceeded, the levels observed in larger companies (250+ employees), with rates over 80%.

The arrival of ICT may play a role in restoring competitiveness, since these technologies are also a factor in relaxing the constraints specific to SMEs. ICT makes a number of services possible in a large range of processes and transactions within and between companies. Internally, ICT applications can improve knowledge and information management practices; they can also allow more rapid and more reliable transactions between businesses (B2B) and between businesses and consumers (B2C). They are equally quite effective in improving external business communications and service quality for both new and existing clients. They also appear to be a source of competitive advantage for SMEs under certain conditions.

Few studies in the literature have focused on the ways that SMEs can use ICT to improve and defend their competitive positions. This book provides a synthesis of the advantages of ICT for SMEs. Seven chapters illustrate the technologies used in such companies, often with concrete examples. Each of these chapters provides a theoretical and/or practical view of the way that SMEs can use ICT.

The first chapter, written by Sébastien Caisse, Sophie D'Amours, Benoit Montreuil and Diane Poulin, proposes a conceptual framework with a definition of ICT and a typology for various ICT found in the literature. Readers are invited to question what they know and assume about these ICT and SMEs. The framework proposed in this chapter plays a key role in questioning, categorizing and uncovering the broader undercurrents at work. The authors apply their framework to the Manufacturing Business Technology's 2007 Global 100, a compilation limited to a hundred entries, designed to encourage global players providing applications for the manufacturing and supply chain markets. They also propose a new way to categorize information technologies in the context of small and medium size manufacturing firms, with the aim of identifying emerging trends. Information and communication design may turn out to be the most crucial aspect of manufacturing.

In chapter two, Sophie D'Amours, Benoit Montreuil, Diane Poulin and Jean-François Rougès present a review of the literature about the links between SME performance and ICT use, as well as the variables that influence these links. Research has highlighted several advantages of ICT use in SMEs, but many questions remain, particularly regarding the systemic vision of performance improvements linked to other factors. Based on their literature review, the authors propose a 6-variable analysis framework that examines the links between ICT use and SME performance.

In chapter three, François Bergeron, Yan Cimon, Diane Poulin and Jean-François Rougès present their synthesis of the literature about the *strategic alignment* concept, which is an issue for companies seeking to improve their performance. Although many researchers have examined this concept, theoretical and methodological problems remain. After defining the concept of strategic alignment and presenting different methodological approaches for measuring this alignment, the authors demonstrate, through studies related to the strategic alignment of ICT and performance, that the results have been contradictory, revealing certain paradoxes.

In the fourth chapter, Luca Canetta, Naoufel Cheikhrouhou and Rémy Glardon identify the attributes influencing customer willingness to adopt e-purchasing practices and formalize the relationships between the attributes identified. They aim to provide a description of e-purchasing adoption characteristics by applying Diffusion of Innovation (DOI)

models. Identifying customer e-purchasing behavior is essential for companies thinking about introducing new e-sales channels, because this allows them to estimate the e-sales figures that can potentially be reached by targeting these customers.

With its origins in Web-based tools and other interorganizational information systems (IOISs) such as B2B e-commerce tools, e-collaboration now describes relationships that go beyond simple buy-and-sell transactions (Johnson and Whang 2002). Today, Web-based IOISs play a crucial role in the evolution of supply chain relationships, as because they can support a number of collaborative processes ranging from direct procurement, replenishment, delivery and design to more strategic processes such as capacity planning (Cassivi 2006). The importance of SMEs in the value chain in manufacturing sectors is such that it seems important to identify the factors that incite SMEs to collaborate electronically. In chapter 5, Pierre Hadaya and Robert Pellerin examine one of the key dimensions of supply chain collaboration: information sharing. By taking advantage of the technical capabilities of the Internet, manufacturing SMEs that are members of virtual enterprises may be able to skip the lengthy, incremental process generally required to participate in global markets. In this chapter, the authors weigh the influence of various determinants on manufacturing firms' intent to use Web-based interorganizational information systems to share inventory information with their key customers.

In the sixth chapter, Jean-Marc Frayret, Hedi Kaffel, Diane Poulin and Constance Van Horne present a concrete illustration of ICT use as a support tool for Research and Development (R&D) in SMEs. The challenges of the new global economy are numerous, and many SMEs simply do not have the necessary internal R&D capabilities to develop adequate responses to these challenges. To overcome these weaknesses, SMEs can look to universities or centers of expertise to help find solutions to these new challenges with innovative products, processes and business systems. After reviewing the literature about knowledge and technology transfers from academic-industrial research groups to industry, the authors present an exploratory case study of an example of such a research group working with the Quebec furniture industry. This case will investigate how an electronic forum was used and viewed by both researchers and members of SMEs.

In the last chapter, Rafa Kouki, Robert Pellerin and Diane Poulin focus on the antecedents of ERP assimilation. Enterprise resource planning (ERP) systems have been promoted as a critical technology in an increasingly complex and knowledge-intensive economy. Given the potential benefits that an ERP system can generate for a company and the large financial commitment that it requires, it is important to understand and investigate the determinants that facilitate the ERP assimilation process in SMEs. This chapter is based on the experience of two manufacturing companies, one large company and one SME, that have adopted an ERP system. The authors explain the different factors that facilitate or hamper ERP assimilation.

# CHAPTER ONE

# CONCEPTUAL POSITIONING FRAMEWORK FOR INFORMATION AND COMMUNICATION TECHNOLOGIES AIMED AT SMALL AND MEDIUM SIZED MANUFACTURERS

SÉBASTIEN CAISSE, DIANE POULIN, BENOIT MONTREUIL AND SOPHIE D'AMOURS

## Introduction

In Norse mythology, Thor the god of thunder slays Jormungandr, the world-serpent that encircles the Earth, by wielding his mighty hammer called Mjolnir. Think of it as a metaphor for what happened during the 20th century, when Man's mastery of electromagnetism blossomed into the Internet, information technology and the global village. The barriers which were inherent to distance were struck down.

Information technology, Man's Mjolnir, is nothing new. Books, after all, are a human technology, and deal mostly in information. But the information technology alluded to in this chapter is quite different. Its definition is elusive, though most people associate it with circuits and code, with hardware and software, rather than with paper and leather. It is different because it is implicitly bounded by a notion of novelty, which is itself bounded by cultural relativism.

In the context of small and medium manufacturing enterprises, things get a bit more complicated. Take the example of that small local manufacturer that does not manufacture at all, and instead designs its products over the Web and subcontracts the work offshore, Mjolnir firmly planted in Jormungandr's skull. Can that organization be considered a manufacturer even though it doesn't carry out any manufacturing internally?

Information technologies (IT), small and medium enterprises, manufacturers, these are concepts that are heard so often that we take their meaning for granted. And we do the same thing with expressions such as Enterprise Resource Planning, Supply Chain Management and Computer Aided Design. We even reduce them to acronyms to feel like we know and master them better: ERP, SCM, CAD—simple concepts, really. But they are not simple. They evolve. They mean different things to different industry stakeholders. Some acronyms will survive a few years in the market, others perhaps a bit longer. Information technologies transform one another ceaselessly, and buzzwords live and die short lives.

In the following sections, readers are invited to question what they know and assume about these concepts. The use of myth as metaphor was a prelude. A new way to categorize information technologies in the context of small and medium manufacturing firms is proposed. This new framework is interesting, but is not an end in itself. Yes, the proposed framework makes sense of information technologies in a different way. But more value lies in the journey towards this new framework and in the often uncomfortable process of questioning existing forms and categories.

## 1. A conceptual positioning framework

What are information and communication technologies (ICT)? The question is not as innocent as it looks. What constitutes an ICT is the object of much confusion in the scientific business management literature (Rougès et al. 2007). The Organization for Economic Cooperation and Development (OECD) provides an indirect answer in its Information Technology Outlook 2008, page 30, by looking at ICT activities rather than ICTs themselves[1]:

> "ICT activities are those that "process, deliver, and display information electronically". Hence, the ICT industries are those that produce the equipment, software and services that enable those activities. Each of the top 250 firms is classified by ICT industry sector: i) communication equipment and systems; ii) electronics; iii) specialist semiconductors; iv) IT equipment and systems; v) IT services; vi) software; vii) Internet; and viii) telecommunication services. Broadcast and cable media and content

[1] See Information Technology Outlook, 2008, Organization for Economic Cooperation and Development. Last visited March 9th, 2009: http://www.oecd.org/document/20/0,3343,en_2649_33757_41892820_1_1_1_1,00.html

are excluded."

It should be noted that this OECD survey was conducted in 2006. The ICT activities that were used to identify ICT industries were based on a 1998 definition from OECD's Working Party on Indicators for the Information Society (WPIIS), later complemented by an ICT goods definition in 2003 and an ICT services definition in 2006[2]. This definition was revised in 2007 by the WPIIS for the International Standard Industrial Classification (ISIC) Revision 4[3]:

> "The following general principle (definition) is used to identify ICT economic activities (industries): The production (goods and services) of a candidate industry must primarily be intended to fulfill or enable the function of information processing and communication by electronic means, including transmission and display."

Following this OECD WPIIS document, the ICT sector comprises ICT manufacturing industries, ICT repair industries, ICT trade industries and ICT services industries, but excludes the content and media sector, although both ICT and the content and media sectors belong to the broader concept of "information economy". This definition is evolving and remains problematic for some activities. For example, the case can be made that the publishing of productivity software belongs to the ICT services sector while the publishing of multimedia software is part of the content and media sector. However, both are part of the ICT services industries, notably because ISIC recognizes only one software publishing industry that produces both types of software.

In a less structured and coherent manner, ICT producers have also devised their own ICT classification schemes. They group and advertize the ICTs they sell under labels such as *Enterprise Resource Planning* (ERP) or *Supply Chain Management* (SCM), which reflect the intended fulfillment or enabling function of the ICTs they offer. Such labels and groupings can vary from one source to the next. Moreover, some ICT producers purposefully craft new labels and acronyms for their ICTs in a bid for market differentiation. Finally, some classification schemes

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[2] See Information Economy -- Sector Definitions Based on the International Standard Industry Classification (ISIC 4), DSTI/ICCP/IIS(2006)2/FINAL, Organisation for Economic Co-operation and Development. Last visited March 9th, 2009: http://www.oecd.org/dataoecd/49/17/38217340.pdf

[3] Idem, Annex 1.

originate from other ICT sector stakeholders. Some are industry specific, such as furniture manufacturing ICTs (Azouzi et al. 2007). Others are more inclusive, such as the five ICT families proposed by Reed Business Information's Manufacturing Business Technology magazine's Global 100 ICTs for small and medium manufacturers:

1. Product innovation (ICT meant to sustain innovation, such as computer assisted design, engineering or manufacturing software);
2. Computing infrastructure (ICT meant to enable other ICT families such as servers, computers, security software, and so forth);
3. Plant operations (ICT meant to digitize plants and equipment, such as robots and control software);
4. Enterprise/supply chain (ICT meant to enact the virtual value chain, such as radio frequency identification tags and software (RFID));
5. Business performance (ICT meant to yield business intelligence and value added knowledge).

A new way to conceptually position Enterprise Information and Communication Technologies ($ICT^E$s) is offered here. This classification scheme is presented as a complement to other approaches to ICT classification, and is based on making explicit certain assumptions commonly found in business management discourse. On the one hand, an enterprise is composed of ICT-using individuals. On the other hand, it is embedded in an environment providing an enabling infrastructure. As a result, it is assumed that $ICT^E$s exclude those ICTs which deal first and foremost with such individuals or are provided through the business's environment. If it were not so, the $ICT^E$ landscape would in fact be the global ICT landscape in its ever-changing entirety.

A first conceptual boundary can thus be found between ICTs intended for individuals and $ICT^E$s. This boundary is useful to determine which ICT is meaningful to the discourse at hand. For example, knowing how to use a telephone refers to an ICT which is common to firms of every size and trade, and which permeates the whole of modern society. This ICT is conceptually outside the boundaries of $ICT^E$s.

A second boundary refers to the environment, involving the notion of scale. Many ICTs essential or useful to enterprises are found upstream from those intended specifically for enterprises. These include computer operating systems, satellite networks, credit card systems, and the Internet – ICTs of general interest which enable ICTs of more specific intent. To

describe them all in the context of enterprises would be an exercise in futility. But at what point does the exercise cease to be futile and start to add meaning to the contextualized discourse? That is where the second boundary can be found, between ICTs presumed to be present in the business environment and useful to commerce in general, versus ICTs intended specifically for enterprises so that they may better interact with such an environment.

These two boundaries find their echo in the scientific business literature. In a contribution to knowledge-based theories of the firm, Sveiby (2001) proposed a tripartite view of a firm's knowledge transfers and conversions. Figure 1-1 adapts this view to represent an enterprise as an internal structure which encompasses conceptual spaces of knowledge transfer and conversion within itself, among competent individuals, with an external structure, and with both of these at once.

The enterprise's internal structure interacts with an external structure such as a market, an industry or an environment. It also interacts through, and among, competent individuals such as employees, investors and end users. Knowledge is transferred and transformed between and through these three poles. Prosperity lies in mastering the interactions of all three poles.

The definition of Enterprise Information and Communication Technology ($ICT^E$) adopted here is inspired by Figure 1-1 and the OEDC's definition:

> "A technology enabling knowledge transformation and transfer within the enterprise's internal structure and with its external structure and competent individual stakeholders."

By fixing the boundary of an enterprise along the dotted black line encircling the organization's internal structure in Figure 1-1, $ICT^E$s that are mainly relevant to individuals or external structures can find their place outside the Manufacturing Small & Medium Enterprise (MSME) discourse. $ICT^E$s relevant to both the external and internal structures, or for both competent individuals and internal structure, or for all three, can also find their own conceptual space. Telephones, fax machines, cell phones, email, instant messaging, desktop operating systems and word processors are ICTs which can thus be excluded from the enterprise discourse in modern society, as they are assumed to be mastered by competent individuals. In this contextualized discourse, these ICTs are positioned outside the enterprise's boundary and into the competent individual

conceptual space. This subjective view is linked to which ICTs are assumed to be mastered by individuals based on regular education and common experience, and which competencies cannot be assumed to exist before the enterprise gets involved.

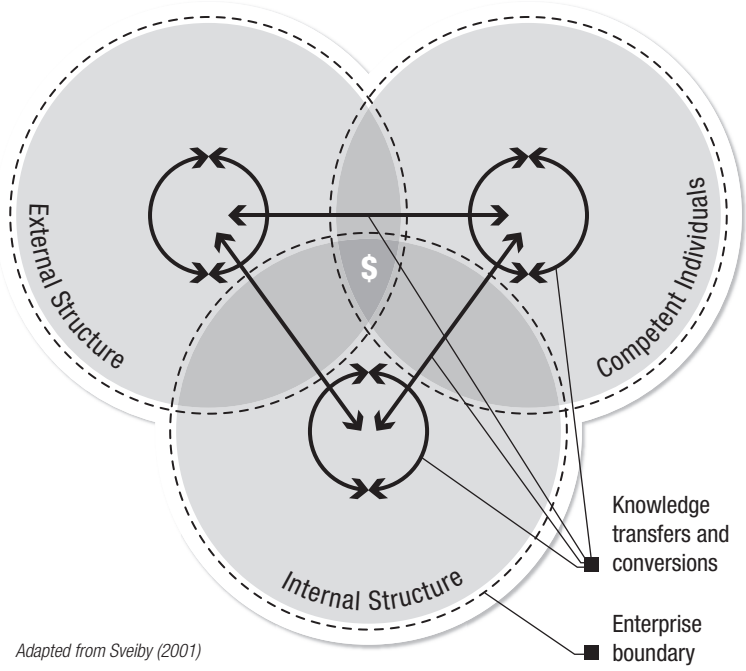



Figure 1-1 A knowledge-based view of an enterprise

ICT$^{E}$s that are too costly, too vast or simply impossible to access or create by individual enterprises can also be positioned outside the enterprise's boundary. Examples include the Internet's infrastructure (comprising fiber optic cables, satellites, routers and so forth), communication and information exchange standards (such as XML, PapiNet, RosettaNet), credit card networks, social networks, as well as other vast material or symbolic infrastructures. For this contextualized discourse, these are ICTs which are part of the enterprise's environment – they are part of its accessible resource toolkit and enterprises do not have to put them in place, though they may have to pay to access them.

Figure 1-1 does not imply that internal structures can be disconnected from the external world or from individuals. The enterprise's internal structure cannot exist without interacting with its external structure or the competent individuals which bring it to life. Likewise, the external structure cannot exist without firms with internal structures or without competent individuals. Competent individuals need an external structure to interact in, just as they need firms with internal structures to interact with. Figure 1-2 presents broad $ICT^E$ types for manufacturing enterprises and positions them in four conceptual spaces along their most commonly found intent:

- Internal Structure (IS) $ICT^E$s concern knowledge transfer and transformation within an enterprise's internal structure, such as ICT that deal with improving internal product design processes;

- External Structure – Internal Structure (ESIS) $ICT^E$s concern knowledge transfer and transformation between the enterprise's internal structure and its external structure, such as ICTs that deal with value chain logistics or customer relationships;

- Competent Individuals – Internal Structure (CIIS) $ICT^E$s concern knowledge transfer and transformation between the enterprise's internal structure and its competent individuals, such as ICTs that deal with virtual team communication or employee portals;

- Competent Individuals – External Structure – Internal Structure (CIESIS) $ICT^E$s concern holistic solutions which try to deal with knowledge transfer and transformation between an enterprise's internal structure, its external structure and its competent individuals, such as all-in-one ICTs which digitize enterprises and elevate them up to best industry practices with internal, external and people processes.

Knowing which $ICT^E$ belongs to which conceptual space in Figure 1-2 (IS, ESIS, CIIS or CEISIS) is a matter of judgment. $ICT^E$ types evolve over time. Many $ICT^E$s offered on the market can belong to more than one type or share an acronym for marketing purposes without sharing key characteristics once put in actual use. Note that the acronyms of common $ICT^E$ types are positioned in Figure 1-2 to illustrate the use of conceptual spaces and do not constitute an exhaustive categorization effort for these spaces.

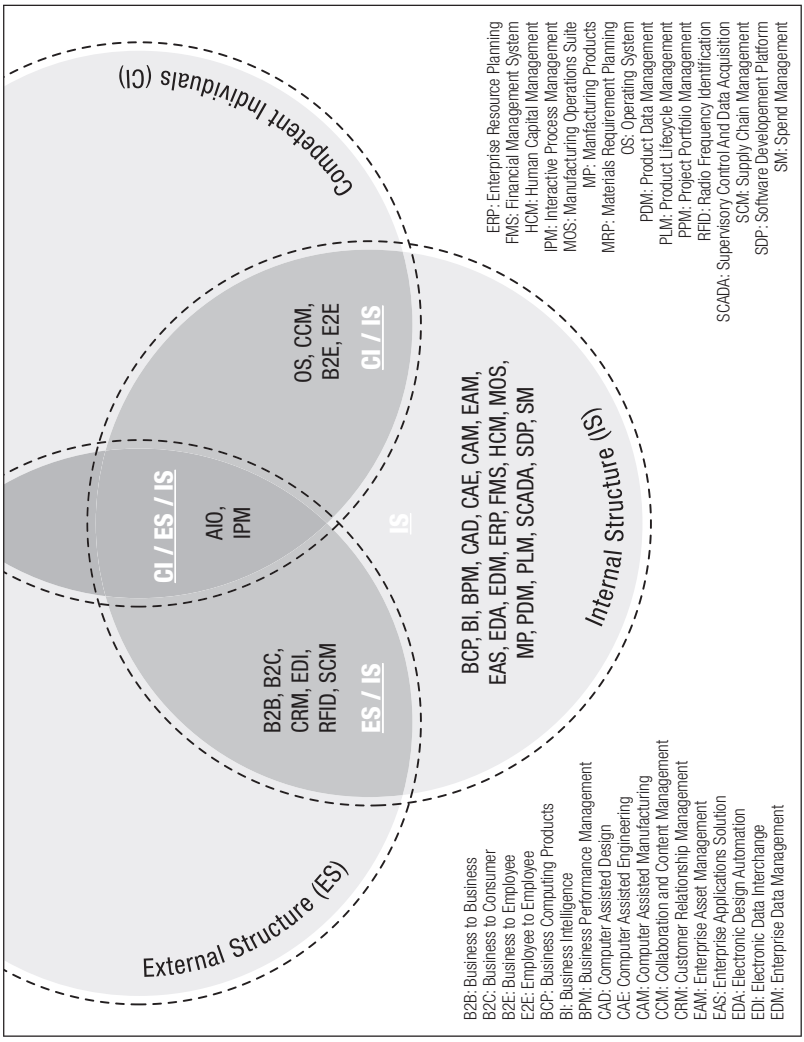



Figure 1-2 ICT conceptual positioning framework in the context of manufacturing enterprises

One could argue that all ICT$^{E}$s have an impact on external and internal structures, as well as competent individuals. For example, computer assisted design (CAD) software is part of the enterprise's internal structure as far as product creation and innovation are concerned, but is also part of the CIIS space when seen as a work interface between co-creating employees. Moreover, it is also part of the ESIS space when considered under the light of digital CAD files moving across the value web between various stakeholders. This type of reasoning discourages all classification attempts because it does not focus on the intended systemic effect sought by a given ICT$^{E}$. It is through such intent that classification may intelligibly take place. In this example, CAD software is primarily intended to assist in product design, and indirectly shapes work and value chain exchanges as more competent individuals start to use it. The acronym itself carries meaning which anchors CAD in the IS space of Figure 1-2.

How intended use is expressed varies, notably because ICT$^{E}$ usage varies amongst manufacturing enterprises. In addition, ever more complex ICT$^{E}$s are grouped into solutions which can be segmented into specialized modules. For example, Enterprise Resource Planning (ERP) solutions often have invoicing or inventory management modules, but are also part of larger All-in-One (AIO) solutions and may feature modules of other AIO components that have little to do with what an ERP system commonly does. Nevertheless, strong hints of an ICT$^{E}$'s intended use can be found in the label attached to it, such as *Product Lifecycle Management* (PLM) or *Supply Chain Management* (SCM). However, the definitions of these labels are evolving and sometimes contradictory between ICT makers.

## 2. Positioning of ICT$^{E}$s for manufacturing SMEs

An exhaustive catalog of ICT$^{E}$s aimed at Manufacturing SMEs (MSMEs) would be obsolete upon release. Aside from the huge amount of resources such a compilation would entail, one has to take into account that ICT$^{E}$s are created constantly and evolve over time. A critical catalog would likewise be impractical. The pros and cons of ICT$^{E}$s depend on each SME's business context. Choosing relevance over exhaustiveness is the only realistic option for a book discussion.

The ICT$^{E}$s presented here are taken from Manufacturing Business Technology's 2007 Global 100, a compilation limited to a hundred entries

which favors global players with manufacturing offers. Each is positioned in one of the four conceptual spaces presented in Figure 1-2. The Global 100's five groups are preserved to show how they are distributed through these spaces. The label or acronym used to market each $ICT^E$ is kept to show its developer's foreseen use, regardless of how MSMEs actually appropriate and adapt them. Each $ICT^E$ was verified through website visits made during the summer of 2007 using the Global 100's URL list.

$ICT^E$s were most often grouped along industry, size, or problem solving website navigation options. $ICT^E$s in industry specific navigation were often contextualized aggregates of wider solutions, with many industries getting their own dedicated bundles. Where firm size navigation was an option, different $ICT^E$ scopes were offered. SME solutions often turned out to be truncated versions of large firm solutions. Where industry or firm size navigation was not available, only $ICT^E$s with a substantial link to MSMEs were positioned. It should be understood that such substantial character was based on experience and context when dealing with all Global 100 entries. It should also be noted that some developers showcased a multitude of different products or services where others would aggregate them in comprehensive all-in-one (AIO) solutions. Offers too numerous and granular compared to similar Global 100 $ICT^E$s were positioned along their product or solution family line. Others were omitted in favor of more aggregate solutions originating from the same developer. Figure 1-3 synthesizes the Global 100 positioning exercise, presenting 29 $ICT^E$ acronyms commonly found during navigation. These do not form an exhaustive list of MSME $ICT^E$s acronyms.

As shown in Figure 1-3, the IS space comprises 122 $ICT^E$s, the ESIS, 66, the CIESIS, 14 and the CIIS, 11, for a total of 213. The five Global 100 ICT families are to be found in all conceptual spaces, except CIIS, home to and focus of collaborative tools, which only features three: product innovation, computer infrastructure and business performance. The five families are grayscale-coded for easier reading, from pale to dark: product innovation is palest, followed by computer infrastructure, plant operations, logistics and value chains, and finally business performance.

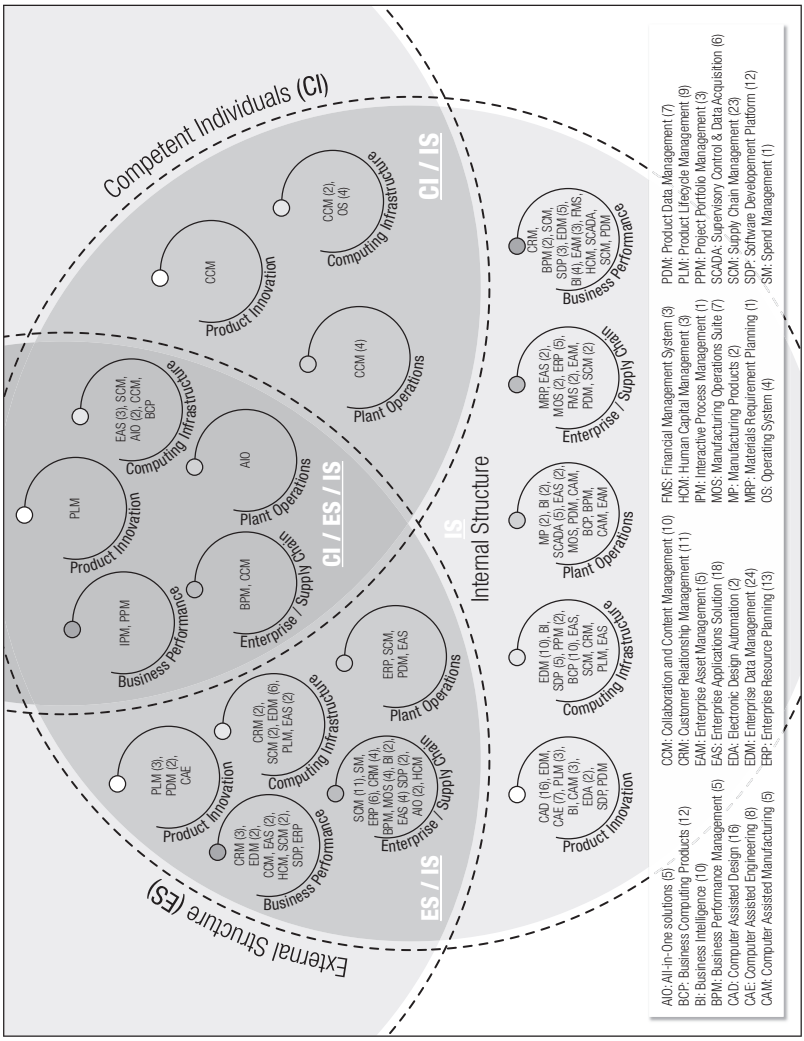



Figure 1-3 Conceptual map of Global 100 MSME ICT$^{E}$s

This conceptual map is much more nuanced and heterogeneous than what Figure 1-2 suggested. The five most frequent ICT$^{E}$ types were *Enterprise Data Management* (EDM), *Enterprise Applications Solution* (EAS), SCM, CAD and ERP, though one should not forget that many solutions are modular and may thus be included under more encompassing acronyms. For example, *Customer Relationship Management* (CRM) is sometimes presented as a stand-alone ICT$^{E}$ type, but is frequently included in AIO, EDM, SCM, EAS and ERP. This complicates any attempt to draw conclusions about the frequency of Global 100 ICT$^{E}$ type. It may be similarly tempting to conclude that there are fewer CIIS ICT$^{E}$s on the market, though it is far more likely the result of a web navigation bias in favor of SMEs and manufacturing as keywords and selected options.

Figure 1-3 showcases a wide variety of MSME ICT$^{E}$s that mesh into one another, many being modules of more aggregate ICT$^{E}$s or featuring modules of other ICT$^{E}$ types. This makes any clear-cut categorization effort suspect. The fact that new labels are constantly being created and that established ones keep evolving – as new modules are added and older ones disappear – complicates things further.

Global 100 navigation was complemented by visits to MSME ICT developer websites from Québec Chaudière-Appalaches region in the Canadian province of Quebec. A list was generated with the assistance of the administrators of Resautic.ca, a local ICT$^{E}$ directory. The goal was to look at MSME ICT$^{E}$s from a locally grounded perspective, with the objective of adding complementary insight for discussion in Section 3. Out of 10 developers identified in January 2008, 9 offered one or more ICT$^{E}$ to manufacturing SMEs: 14 ICT$^{E}$ types, comprising 4 ERPs, 2 *Collaboration and Content Management* (CCM) as well as 8 others : *Business Computing Products* (BCP), *Business Intelligence* (BI), CAM, *Enterprise Asset Management* (EAM), EDM, *Financial Management System* (FMS), *Human Capital Management* (HCM) and *Spend Management* (SM). All conceptual spaces were occupied by local developers, except CIESIS.

## 3. Emerging trends for MSME ICT$^{E}$s

Navigating the Global 100 revealed two major trends. First is consolidation: numerous websites featured news of fusions, acquisitions or partnerships. The result is widespread aggregation of ICT$^{E}$s around AIO solutions with industry-specific bundling of relevant modules. Few

developers advertize a single AIO. Most propose multiple industry verticals such as aerospace, healthcare, finance and so forth, with manufacturing being one of the more commonly found options. Such bundles can be sold as a whole or in parts, as required by MSMEs. Second is web-based online $ICT^E$ access where current bandwidth limitations make such an option viable. For example, most ERPs are operable through the web, while few CADs are. CAD interfaces need robust 3D manipulation, something which current bandwidth limitations make unavailable to most. Note that such limitations recede ceaselessly, so this trend is likely to continue until all $ICT^E$s are available and operable online. Such "anytime-anywhere" access also feeds mobile solutions, though more acutely limited by bandwidth, memory and processing power. *Business Intelligence* $ICT^E$s are the most frequent examples of mobile MSME $ICT^E$s.

These two trends are also found at the non-Global 100, local $ICT^E$ developing SME scale solutions, although they find a different expression; where consolidation goes hand-in-hand with large scale AIO aggregation, local developers instead focus on compatibility and interoperability. This is likely a reflection of who owns industry standards; larger firms have the resources to fight a format war, while smaller firms hedge their bets by advertizing compatibility with a major standard solution. Choosing which global format holder to align themselves with is likely a major strategic decision for developers, since other stakeholders in the format are likely to become their main growth enablers and clients. The trend toward web deployed $ICT^E$ is also present for local developers, which enables competition at a global scale. Interestingly, the computing infrastructure which allows ubiquitous $ICT^E$ access worldwide is itself partly crafted from locally developed $ICT^E$s sold throughout the world.

These two trends feed upon a common source: the ubiquitous availability of intelligible information. Intelligibility should be understood here as a quality which enables $ICT^E$ modularity and aggregation, while ubiquity refers to real-time, anytime, anywhere access to relevant technologies. The challenge posed to manufacturing SMEs is thus to design ubiquitous and intelligible information in a manner as, if not more, robust than the way in which they design products. This means information designed for the manufactured product, the manufacturer, as well as its entire value web, from supplier to end user.

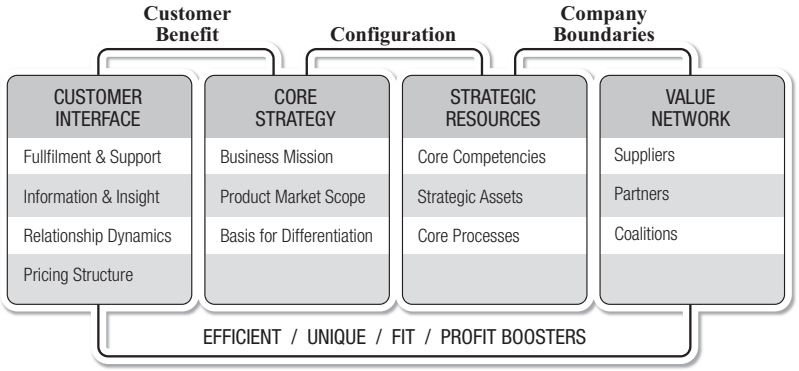
From a high conceptual standpoint, each $ICT^E$ developer implicitly proposes information designs through its offers, with the most holistic ones found in AIO solutions. A manufacturing SME must choose between three options: (1) to adopt a developer's information design as offered through third party $ICT^E$; (2) to create its own information design; or (3) to adapt a developer's design by taking what fits and by creating what it can do better than a third party. For all three options, the goal is to find what works best to enact a prosperous business design in a new economy context. In this sense, the challenge posed above can only be met if a manufacturing SME can leverage its mastery of information design to innovate not only in operational terms, but also in terms of business design.

Business design seeks to holistically represent a firm and the sum of its actions. Table 1-1, Figure 1-4 and Figure 1-5 present three conceptual frameworks meant to better enable business design and business modeling. It can be affirmed that $ICT^E$s should be conceptualized around such representations rather than around commercial acronyms, so that their impact on the design of a business be adequately grasped. Each of the frameworks is based on four interlaced key elements.

Simply stated, according to Table 1-1, an $ICT^E$ can have a potential impact on the enterprise's products, its customer interface, its management infrastructure and its finances. According to Figure 1-4, an $ICT^E$ can potentially impact on a business's customer interface, its core strategy, its strategic resources and its value network. Alternatively, according to Figure 1-5, an $ICT^E$ can potentially impact on an enterprise's character, its creation system, its offer of products and services, and its stakeholders.

| Pillar | Business Model Building Block | Description |
|---|---|---|
| Product | Value Proposition | Gives an overall view of a company's bundle of products and services. |
| Customer Interface | Target Customer | Describes the segments of customers a company wants to offer value to. |
| | Distribution Channel | Describes the various means the company uses to get in touch with its customers. |
| | Relationship | Explains the kinds of links a company establishes between itself and its different customer segments. |
| Infrastructure Management | Value Configuration | Describes the arrangement of activities and resources. |
| | Core Competency | Outlines the competencies necessary to execute the company's business model. |
| | Partner Network | Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value. |
| Financial Aspects | Cost Structure | Sums up the monetary consequences of the means employed in the business model. |
| | Revenue Model | Describes the way a company makes money through a variety of revenue flows. |

Table 1-1 Osterwalder et al.'s business model framework




*Source: Hamel. 2000. Leading the Revolution. p. 96*

Figure 1-4 Hamel's business model framework

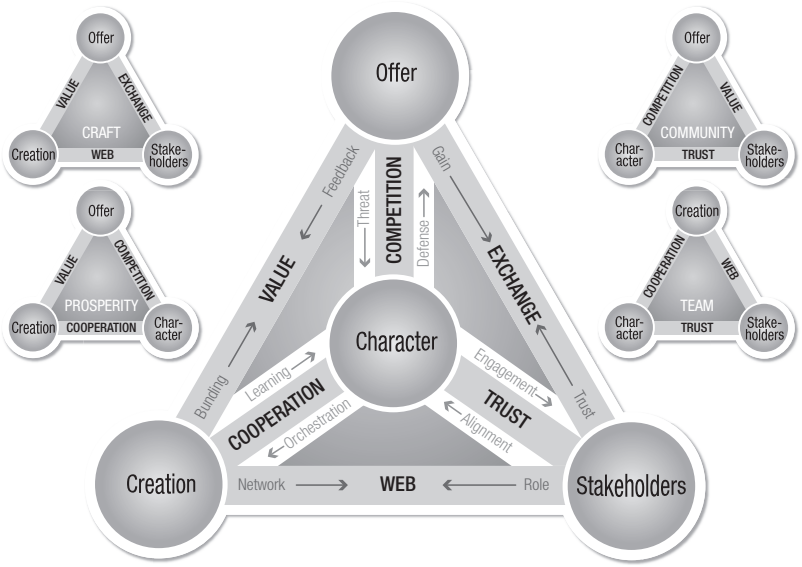



Figure 1-5 Caisse & Montreuil's Tetrahedral business design framework

Relationships between each of these three frameworks and ICT$^{E}$s are rich in nuances that are much more profound and subtle than is possible to highlight here. Careful study of these relationships can be most revealing for SME managers as well as for ICT$^{E}$ developers, vendors and integrators.

Considering the impact of ICT$^{E}$s as implicit embodiments of information designs on overall business design, it appears opportune to question what it means to be a manufacturing SME. The megatrends identified above foreshadow a future where numerous SMEs would mostly be nervous systems capable of doing business with subcontractors and partners around the globe. In other words, even if the value creation web as a whole maintains the manufacturing character which is central to the manufacturing SME in this chapter, it is far from obvious that the SME which evolves into a manufacturing web orchestrator will maintain such a manufacturing character itself. It is more likely that it could be conceptualized as a piloting or orchestrating SME, with or without internal manufacturing capacity. This questioning is already pertinent at a time when numerous enterprises increasingly source their products from foreign countries.