

## Survey on productivity, information and communications technologies (ICT) and business strategy

**Even though ICT are now an integral part of the day-to-day operations of many enterprises, the assessment of the benefits extracted from these investments remains an important issue and requires further investigation. Can ICT really increase the productivity of an enterprise? Are they essential for an enterprise to remain competitive?**

In many cases, the answer to these two questions is affirmative. However, while we accept the fact that investing in ICT can improve the efficiency of an enterprise, the mechanism through which the investments will be transformed into financial benefits too often remains poorly understood. Consequently, an ICT investment plan can rapidly become a failure if not well conceived to begin with.

A survey conducted by the Centre has evaluated to what extent ICT enhance productivity for Canadian enterprises. Among other things, the data collected allowed us to determine that investing in isolated components has very little impact on productivity. In fact, the results show that to realize the full potential of ICT investments, enterprises need to improve their ICT infrastructure as a whole, simultaneously.

The following fact sheets offer a snapshot of the survey and its main conclusions. Grouped into 10 themes, this overview will give readers a better understanding of the issues surrounding ICT and productivity.

Before plunging into the core of the subject, the rest of this first fact sheet will give a brief portrait of Canada's and Quebec's situations in terms of ICT investments.

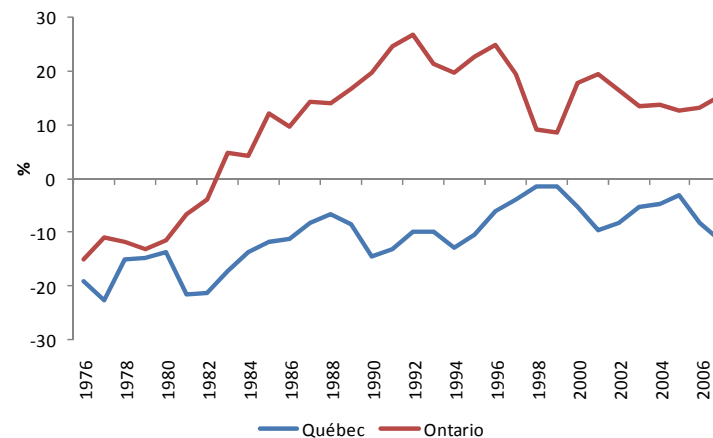
### ICT investments in Quebec and Canada

In Canada, ICT investments represent a smaller share of total investments made by enterprises than in the United States:

- 16.2% of total investments in the Canadian business sector in 2006;
- 27.9% of total investments in the business sector in the United States in 2006;
- In 2007, the United States spent 33% more on ICT investments per capita than Canada.

Furthermore, for the past 30 years Quebec has invested less in ICT than the rest of Canada. As presented in the following graph, the level of investment in Quebec was weaker than in Canada between 1976 and 2007.

### ICT per worker, Difference from the national average, in per cent, 1976-2007



The data presented in this document originate from a survey conducted in 2010.

Total number: 429 respondents

- 88 in Quebec
- 88 in Canada (excluding Quebec)
- 253 in New Zealand

There are no significant differences between the jurisdictions studied.

The sample consists of small and medium-size enterprises:

- Fewer than 50 employees: 14.8%;
- Between 51 and 100 employees: 27.5%;
- Between 101 and 250 employees: 29.9%;
- More than 250 employees: 27.8%

## Governance of information and communications technologies (ICT)

This fact sheet focuses on two basic aspects of ICT governance:

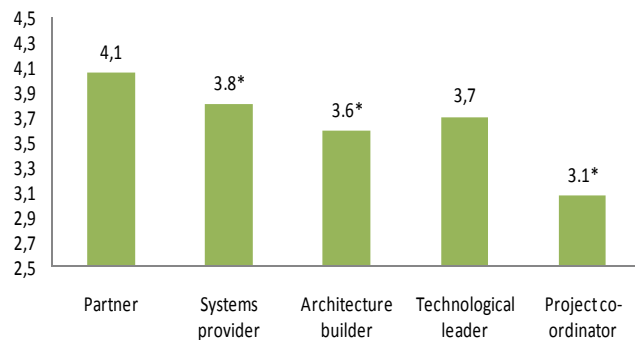
- Governance is a fundamental requirement for the optimal use of ICT in a company.**
- Companies with the lowest level of governance are those in which the ICT department handles outsourcing (*project co-ordination*) and integration (*architecture building*).**

Governance plays a fundamental role in the optimal use of ICT in a company. To make the most of ICT, the company must have a clear vision of the technologies' role and a well-designed game plan.

### Planning for information technology

Planning for ICT is one of the governance measures that makes it possible to estimate the level of oversight of ICT in the company.

The first figure shows that this varies depending on the role of the ICT function in the company. For *systems providers*, *architecture builders* and *project co-ordinators* the level of planning for ICT is lower than for *partners*.

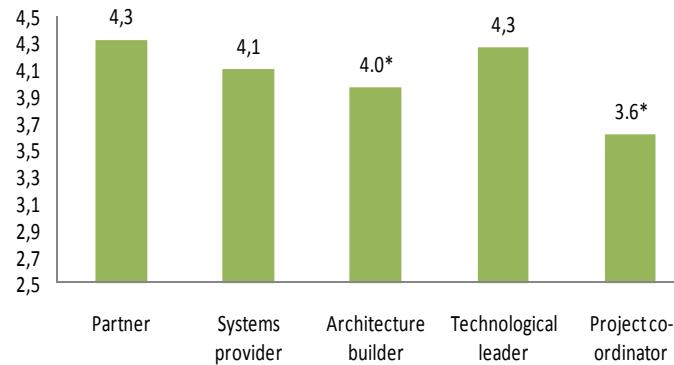


\*Significantly less than *Partner* at a 95% confidence level.

### Responsibility for information technology

Responsibility for managing ICT is the second aspect of ICT governance in companies.

The second figure shows that, once again, *architecture builders* and *project co-ordinators* are far behind when it comes to defining responsibilities relating to ICT management.



\*Significantly less than *Partner* at a 95% confidence level

The ICT function is classified on the basis of the technologies' role in the organization. There are five types of classification:

**Partner:** Creates ICT-enabled business capabilities to support the organization's current business strategies.

**Systems provider:** Provides the organization with quality information systems at the lowest possible cost.

**Architecture builder:** Links the firm's various business units by integrating computerized systems, data and technological platforms.

**Technological leader:** Uses change and innovation to transform the organization's strategy.

**Project co-ordinator:** Co-ordinates ICT activities between the organization and outsourcers.

Adapted from Guillemette, Paré and Smith (2008)

### 5 elements can improve ICT planning :

- 1 Implementing an overall plan laying out the role of ICT in the organization.
- 2 Implement a plan incorporating the deployment of computer systems and user stations.
- 3 Implement ICT reflecting the organization's business objectives.
- 4 Continually assess the potential of new technologies.
- 5 Take user needs into account in planning ICT implementation.

### 4 elements define responsibility for ICT :

- 1 Clearly identify the individual or group responsible for ICT policy.
- 2 Clearly identify the individual or group responsible for computer procurement.
- 3 Clearly identify the individual or group responsible for technology distribution in the organization.
- 4 Maintain a constant link between ICT and strategic planning.

## Information and communications technology (ICT) infrastructure

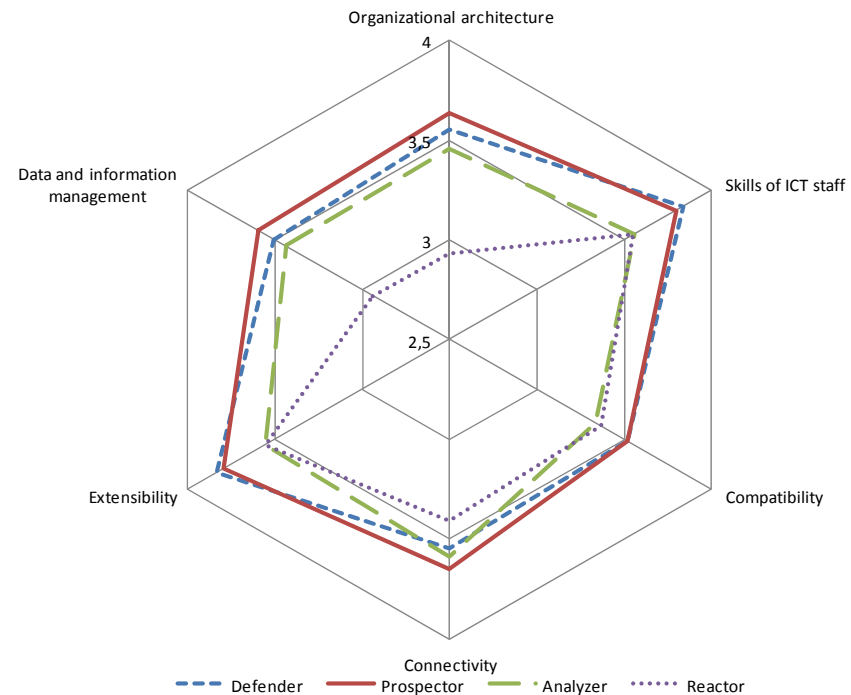
In recent years, investments in ICT have skyrocketed. In Canada alone, ICT investment per worker has risen from \$385 in 1980 to \$2,338 in 2008, for growth of more than 507% (source: CSLS). Information and communications technologies are much more than investment in physical hardware, however.

ICT infrastructure is a set of tools used to support internal and external communications, share information and carry out planning in an organization.

In concrete terms it consists of two elements: the first combines technical infrastructure, i.e. software, hardware, networks and all other tangible ICT resources. This element is determined by the extensibility, connectivity and compatibility of ICT infrastructure.

The second element comprises the business infrastructure: the organization's knowledge and skills when it comes to managing its ICT. This second component of ICT infrastructure refers to the management of data and information, the organizational architecture and skills of its ICT staff.

The figure shows the positioning of different companies in terms of ICT infrastructure, according to their business strategy. It clearly shows that *Reactors* are those with the weakest infrastructure. At the other end of the scale, *Prospectors* and *Defenders* have the strongest positioning. *Analyzers* fall between *Prospectors* and *Defenders* for almost all ICT infrastructure components, but are still ahead of *Reactors*.



### Organizations' product/market strategies are classified as follows:

**Defender:** A more limited range of products than the competition, in a stable market, offering superior quality and services. Not necessarily on the cutting edge, but does the best possible job.

**Prospector:** Constantly redefines products and markets. Efforts are directed at being the leader and taking advantage of business opportunities as they arise.

**Analyzer:** Maintains a product line that is updated to keep pace with industry trends. Rarely the leader, but generally in second place with a more affordable product or service.

**Reactor:** No coherent product/market orientation. Not able to act as aggressively as competitors, and forced to respond to external pressures to survive.

The data presented in this fact sheet were drawn from a survey of 429 companies (88 in Quebec, 88 in the rest of Canada, and 253 in New Zealand). Answers are based on a scale of 1 to 5, with 1 being "strongly disagree" and 5 being "strongly agree" with the statement.

## Information and communications technology (ICT) infrastructure: Connectivity

This fact sheet looks at two fundamental aspects of connectivity:

1. **Connectivity is a key factor in increasing an organization's flexibility.**
2. **Business strategy does not change the level of connectivity observed in organizations.**

The fact that an organization has ICT is not enough to assess the organization's level of technological expertise. Without proper connectivity, ICT can only partially fulfill the potential for value creation.

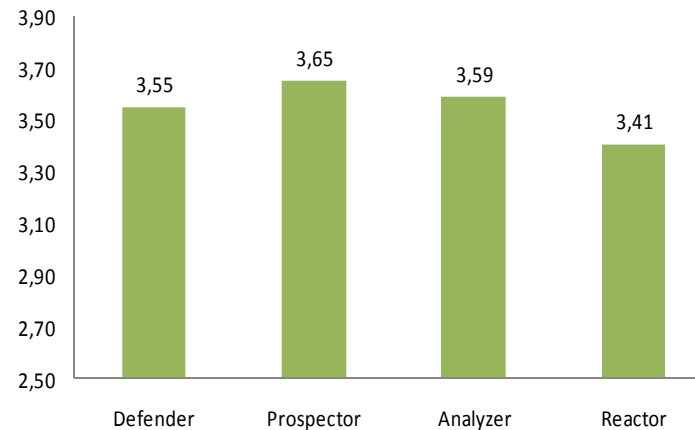
Connectivity simplifies exchanges with the organization's business partners. Greater connectivity means it can share information in all formats, beyond simple traditional business communications (orders, invoices, etc.).

In a world shaped by the Internet and Web 2.0, this kind of connectivity is essential. It lets the organization remain in contact with its customers and suppliers, to exchange ideas with them on new products and all kinds of potential innovations.

### Connectivity vs. business strategy

The figure shows the connectivity of computer systems according to business strategy. Despite small differences in connectivity levels between the four types of corporate strategy, it seems that the level of connectivity is not really influenced by the type of strategy.

The rapid development of compatibility, accessibility and innovations in ICT networks has allowed most organizations to acquire easily interconnected technology. This connectivity has become a prerequisite for remaining competitive: many customers will deal only with companies with which they can interact electronically.



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### 5 criteria for assessing an organization's connectivity:

- 1 Using ICT networks, external partners can access authorized data from anywhere.
- 2 Using ICT networks, internal users can access public data.
- 3 All partners (customers, suppliers) are linked electronically to the organization through ICT networks.
- 4 The organization can hold conferences with participants located anywhere, through the organization's ICT networks.
- 5 All departments and branches are linked electronically through ICT networks.

## Information and communications technology (ICT) infrastructure: Compatibility of computer systems

This fact sheet looks at two fundamental aspects of data management:

1. **Compatibility is one of the key factors in increased flexibility in the organization.**
2. **All organizational strategies call for similar levels of system compatibility.**

Implementing ICT in organizations is never painless. The complexity and diversity of the ICT available call for advanced technical knowledge in order to transform this technological bounty into a coherent whole.

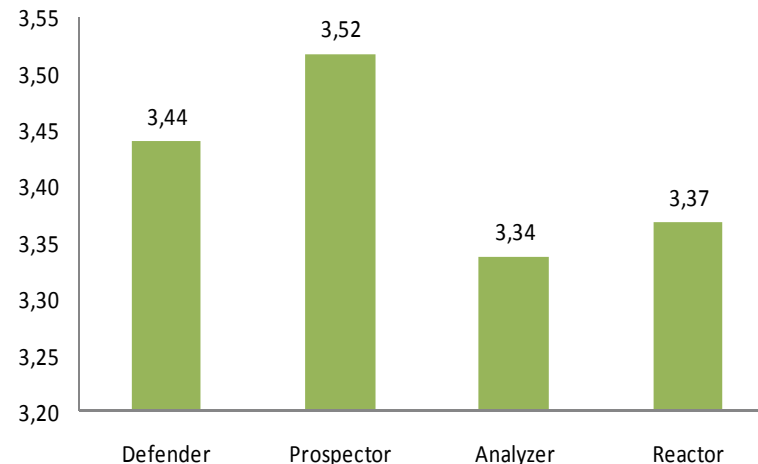
Computer systems must be compatible if they are to make the most of the potential synergies between technologies. This compatibility means greater flexibility for users, leading to optimal use and better sharing of information.

### Compatibility vs. business strategy

The figure shows the degree of compatibility of computer systems according to business strategy. There are only slight differences in compatibility among the four types of corporate strategy. *Prospector*-type organizations have the highest degree of compatibility.

In recent years, efforts to standardize ICT have led to greater compatibility within organizations. This explains why there are so few differences in this component of ICT infrastructure from one type of organization to another.

System compatibility is essential to allow managers to track all the organization's operations.



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### 4 criteria for assessing computer system compatibility:

- 1 Software can easily be transferred between and used on many different platforms.
- 2 The organization offers users a large variety of types of information.
- 3 Users can use all platforms and applications.
- 4 The organization offers many different ways of accessing corporate information.

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## Information and communications technology (ICT) infrastructure: Extensibility

This fact sheet looks at two fundamental aspects of extensibility:

1. **How easy it is to upgrade and improve the organization's ICT infrastructure is a key factor in the organization's competitiveness.**
2. **Business strategy does not drastically change the level of extensibility observed in organizations.**

Information and communications technologies are evolving quickly, and it is often necessary to upgrade existing technology to keep pace with technological innovations or the organization's growth.

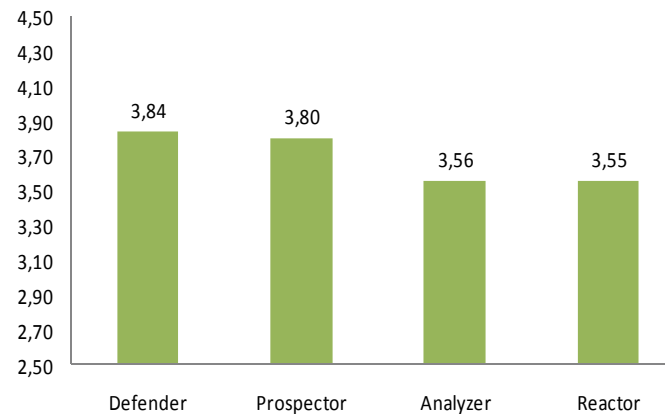
If upgrades are too difficult, they may be put off or even ignored altogether. Then it becomes difficult to remain competitive, and there is a quickly growing risk of losing market share.

The ability to easily upgrade and improve existing ICT infrastructure is essential for the organization, and allows it to be more flexible in a changing competitive environment. That improves the organization's agility and its ability to quickly adapt its strategy.

### Extensibility vs. business strategy

The figure shows the extensibility of computer systems according to business strategy. There are slight differences in extensibility among the four types of corporate strategy. *Prospector*- and *Defender*-type organizations have the most extensible infrastructures.

The constant renewal of ICT has forced ICT producers to design products that are easy to upgrade and replace, so as to allow organizations to transition more easily. Thus most organizations have been able to acquire technology that can be easily upgraded.



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### 5 criteria for assessing an organization's extensibility:

- 1 Hardware and software can easily be upgraded with the existing ICT infrastructure.
- 2 Hardware and software capacity can easily be increased with the existing ICT infrastructure.
- 3 Hardware and software can quickly and easily be adapted to meet changing needs.
- 4 Hardware and software can support future business growth.
- 5 Hardware and software can be added to, changed or removed from the existing infrastructure with no major disturbances.

## Information and communications technology (ICT) infrastructure:

### Data management

This fact sheet looks at two fundamental aspects of data management:

1. **Efficient data management makes it possible to make the most of the flow of data in any organization in the ICT era.**
2. **Reactor-type organizations are poorest at managing data and information.**

As new information and communications technologies are introduced in organizations, a greater amount and variety of information becomes available. Consequently, organizations must have a clear image of their data. The data must be accessible, reliable and understood by all.

It is easy to lose one's bearings in such a complex environment, however. Too often, organizations simply drown in the deluge of information to be processed, and the technologies then become a costly burden. Given the abundance of information to be handled, information management is a key element in an effective and productive ICT infrastructure.

An efficient organization will have a formal process for managing its data, and data quality will be measured formally and regularly. The people responsible for the data (owners) will be clearly defined. Data are a valuable resource for the organization.

#### Data management vs. business strategy

The figure shows the level of data management according to business strategy. It seems that organizations with a *Reactor*-type strategy have poor data management. The figure also shows that the other types of strategy have relatively similar levels of data management, although somewhat better for *Prospectors*.



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### 7 criteria for effective data and information management:

- 1 Systematic data management (policies, standards, supervision).
- 2 An organizational data architecture (structure, framework, philosophy).
- 3 A quality assurance program for ICT systems.
- 4 An organizational policy regarding data ownership.
- 5 Development of a data dictionary and user guide.
- 6 Integration of data between applications.
- 7 Sharing of data between users and between departments.

## Information and communications technologies (ICT) infrastructure: Business architecture

This fact sheet looks at two fundamental aspects of business architecture:

1. **Business architecture, by establishing standards and a precise structure, forms the basis for reliable ICT use in organizations.**
2. **Reactor-type organizations have poorer business architecture than the other types of organization.**

As information and communications technologies develop, become more complex and multiply, they are playing an increasingly large role in organizations. They are occupying more and more space in daily operations. An organization's success or failure thus depends on the reliability of its ICT. Consequently, it is essential that ICT be properly coordinated with business processes and, in particular, be well supported by a robust ICT infrastructure. Like physical buildings, ICT must have solid foundations. In other words, the business architecture must be able to support the weight and complexity of its ICT structure.

A solid business architecture is based on planning, analysis, design and careful analysis of ICT in the organization. It calls for specific methodology and official, recognized techniques. The use of proven methods and tools guarantees the reliability of ICT in the organization, by offering a rigorous framework for implementation and use. By standardizing the use of ICT, a good business architecture makes it possible to make the most of ICT strengths and provides users with more tools for reaching the organization's business objectives.

### Business architecture vs. business strategy

The figure shows business architecture according to business strategy. It seems that *Reactor*-type organizations have a weaker business architecture than others. The figure also shows that the other types of strategies have relatively similar levels of business architecture. *Defender*- and *Analyzer*-type organizations have slightly weaker business architectures than do *Prospector*-type organizations, however.



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### 6 criteria for a strong business architecture:

- 1 Documentation describing information flows in the organization.
- 2 An inventory of the organization's data and information.
- 3 An inventory of the organization's ICT facilities.
- 4 A systematic methodology for system development.
- 5 Organization-wide compliance with technological and ICT standards.
- 6 Data exchange between centralized and distributed (PC) equipment.



## Information and communications technology (ICT) infrastructure: Skills of ICT staff

This fact sheet looks at two fundamental aspects relating to the skills of ICT staff:

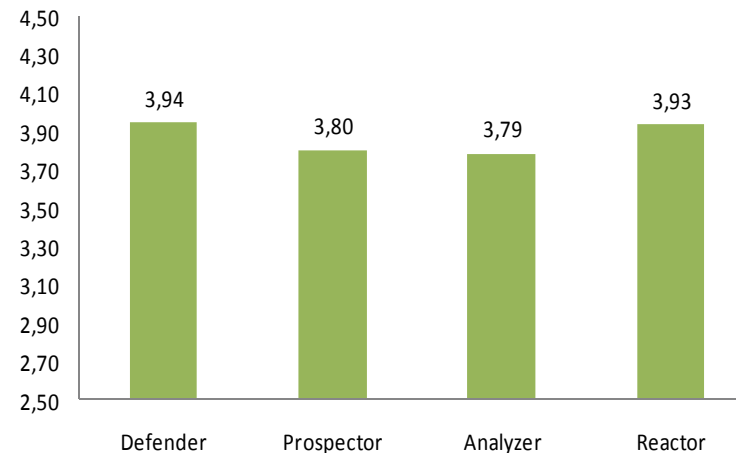
1. **The skills of ICT staff are an essential element of an organization's overall ICT infrastructure, as important as its hardware, software, networks, etc.**
2. **Business strategy does not alter an organization's need for competent ICT staff.**

Although physical investments in ICT are essential to maintaining an organization's competitiveness, managing ICT involves major challenges. An ICT team capable of understanding and properly managing ICT is essential to reach an organization's objectives. No matter how much an organization invests in ICT, the money will be wasted if the staff supporting the infrastructure does not have the skills necessary to realize its potential.

This is why these technologies very often have positive impacts in organizations where experience is recognized and ICT staff have the appropriate skills. Consequently, the skills of ICT staff become an asset as important as the ICT itself.

### Skills of ICT staff vs. business strategy

The figure shows the skills of ICT staff according to business strategy. Despite small differences among the four different types of corporate strategy, it seems that the skill level is relatively similar.



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### 9 criteria for assessing ICT staff skills:

- 1 The person responsible for ICT understands the organization's policies and objectives.
- 2 The person responsible for ICT can plan for future technological challenges.
- 3 The person in charge of ICT is able to act as a leader in ICT projects.
- 4 The person in charge of ICT can quickly learn and apply new technology.
- 5 The person in charge of ICT is interested in learning about new technology.
- 6 The person in charge of ICT is able to identify business challenges and find the appropriate technical solutions.
- 7 The person in charge of ICT is aware of market limitations.
- 8 The person in charge of ICT can work in co-operation with other teams.
- 9 ICT staff have skills related to many different technologies and tools (programming languages, operating systems).

## Complementary investment

Information technology is a powerful agent of change and innovation. Yet too often, major investments in ICT fail to meet expectations regarding efficiency gains and growth.

Accordingly, it is increasingly clear that complementary investment is required to get the most out of ICT. Such investment in continuing education, organizational change and upgrading the skills of non-ICT staff will lead to better management of existing ICT, and help to catalyze the changes underway.

If no changes are made to the organization and none of its staff are trained to use ICT properly, it will not be possible to realize the benefits of ICT.

In many cases, a lack of complementary investment could explain the uneven results in terms of productivity gains as a result of the introduction of ICT.

### Complementary investment vs. geographic region

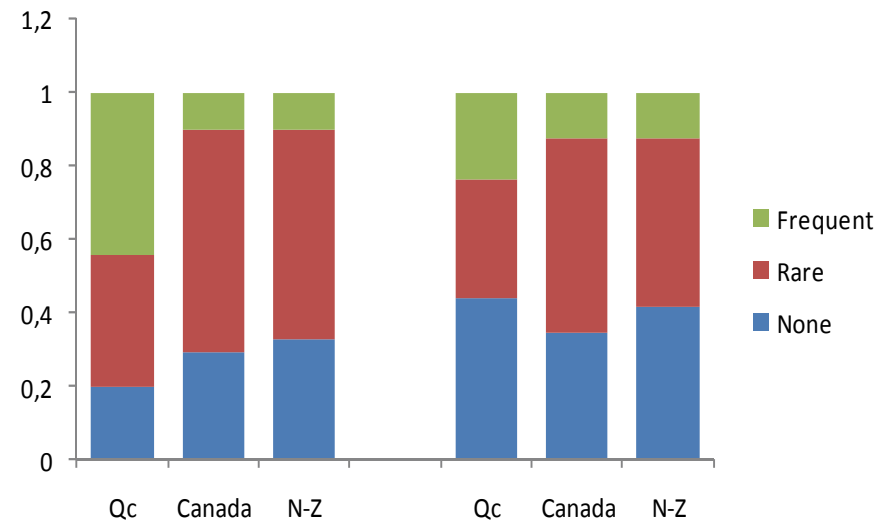
#### *Skills of non-ICT staff*

There are few differences between the skill levels of non-ICT staff in the different jurisdictions surveyed. On a performance scale of 1 to 5, Quebec firms showed an average of 3.39 while those in the rest of Canada had a level of 3.44. The average score of New Zealand firms was 3.21, slightly lower than their Canadian counterparts.

#### *Training and organizational change*

The figure shows that Quebec does fairly well in terms of continuing education. More firms regularly provide on-the-job training than in the other two jurisdictions surveyed. It can be seen, however, that from 20 to 30% of firms in Quebec do not offer any training for their employees. In a knowledge economy, this is hardly reassuring.

There are few differences among these jurisdictions when it comes to organizational change. However, Quebec has more firms that regularly undertake organizational change, and a higher number of firms that do not make any organizational changes. There are few firms in between. In the rest of Canada and in New Zealand, there are more firms that make changes occasionally. Lastly, it can be seen that New Zealand firms make fewer efforts than Canadian firms, on the whole, in terms of complementary investment.



Complementary investment can be divided into three categories:

**Organizational change:** Any change in the way work is organized within the organization (e.g. decentralization, re-engineering, flatter structure, etc.)

**Training:** Any continuing education offered within the company. This may be in the form of job rotation, apprenticeship, training apprentices, courses, group discussions, role playing, on-line training, simulation, videos, classroom training, etc.

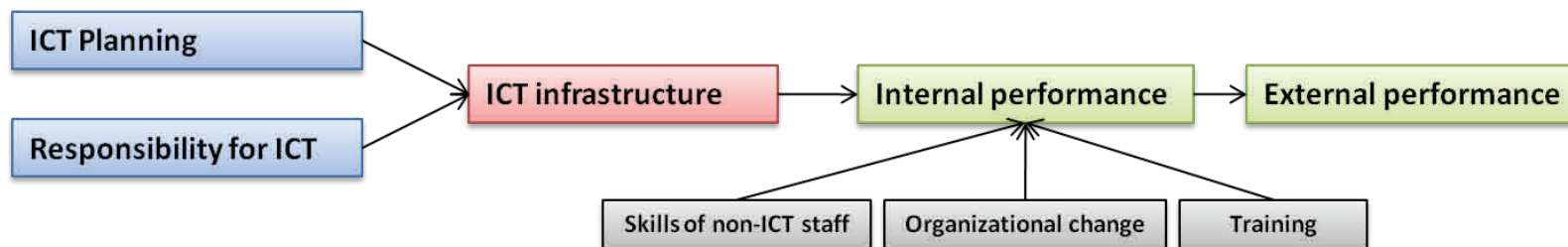
**Skills of non-ICT staff:** The level of skills and experience among non-ICT staff enabling them to master, learn and work efficiently with ICT.

## What about productivity ?

**This fact sheet looks at the effects of information and communications technologies (ICT) on organizations' business processes and efficiency. It draws a simple portrait of the role of ICT in determining organizations' performance.**

In today's technological era, it is easy to advocate the adoption of technology in any organization; high-tech firms often have a better reputation. Yet investments in ICT make no sense unless they produce value added for the organization, in terms of productivity, profit, quality, speed or otherwise.

In practical terms, a number of observations can be made. First of all, information and communications technologies are difficult to implement. Their benefits are difficult to identify. Yet organizations continue to invest massively in such technology. So it is clear that the relationship between ICT and performance is not simple, and involves external factors with the potential to influence this relationship. The illustration below shows how ICT can affect an organization's performance.



First of all, it can be seen that planning for ICT and responsibility for ICT, referred to as ICT governance, influence the quality of the ICT infrastructure. In other words, an organization that carefully plans the implementation and management of its ICT and gives these responsibilities to a clearly defined individual or group should see an improvement in the quality of its ICT infrastructure.

Governance must structure ICT in the organization, in accordance with the organization's business objectives. This gives meaning and purpose to the introduction of such technologies.

Secondly, these ICT infrastructures will have a beneficial effect on the organization's internal performance. More specifically, ICT will provide better support for internal and external communication and better sharing of information and better planning within the organization. This will make it possible to improve the organization's internal performance in terms of quality, failure rates, delivery lead times, etc.

This internal performance will also be influenced by complementary investments made to support the implementation of ICT infrastructures:

**7 criteria for assessing an organization's internal performance:**

- 1 Quality of products/services.
- 2 Process quality.
- 3 Failure rate.
- 4 Quality of suppliers' and partners' products.
- 5 Fluidity of work processes.
- 6 Delivery lead times.
- 7 The fact that the person in charge of ICT is aware of market limitations.

## What about productivity (Cont'd) ?

training, skills of non-ICT staff and organizational change. They act as catalysts for improved performance by the organization thanks to ICT. First of all, training and improving the skills of non-ICT staff will ease the transition when new technologies are implemented. They help enhance staff skills and overcome human resistance to change. Second, organizational change makes it possible to align ICT capabilities with business processes, to improve the fit between business objectives and ICT in the organization.

These elements allow the organization to use ICT rapidly and as efficiently as possible.

Lastly, improving the organization's internal performance will lead to better external performance. In concrete terms, this improvement will mean increased sales, profit and return on investment, better market share, etc.

So there are two fundamental aspects of the relationship between ICT and efficiency to be remembered. First of all, without well-defined governance, it will not be possible to implement top-quality ICT infrastructure.

Second, quality ICT infrastructure combined with complementary investment in training, organizational change and improving the skills of non-ICT staff will improve the organization's performance. It is important to mention that it is improving the overall infrastructure that leads to these benefits. Improving only one dimension without improving the others will not produce any significant benefits.

The relationship between ICT and performance must be seen as a chain, in which each link depends on the quality of the preceding one.

The question to be asked, then, is not how much to invest in ICT, but rather how to go about it. Investing in ICT cannot be an isolated act, with no consideration given to the changes it will produce in the organization. It must be an effort made by the organization as a whole.



### 8 criteria for assessing an organization's external performance:

- 1 Growth in sales as compared with main competitors.
- 2 Return on investment as compared with main competitors.
- 3 Gains in terms of market share as compared with main competitors.
- 4 Net profits as compared with main competitors.
- 5 Cash flow as compared with main competitors.
- 6 Satisfaction with sales growth rate.
- 7 Satisfaction with return on investment.
- 8 Satisfaction with return on sales.

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