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The make-or-buy decision in ICT services: Evidence from Luxembourg

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Abstract

In this paper, we seek to analyse the characteristics of firms located in Luxembourg that choose to outsource and/or offshore Information and Communication Technologies (ICT) services. Outsourcing occurs when firms choose to 'buy' rather than 'make' in-house. It involves greater specialisation as firms switch from sourcing inputs internally to sourcing them from external suppliers. Offshoring occurs when firms move production overseas, either its own foreign affiliates or outsourced suppliers.

As globalization is a new way firms choose to organize their activities, a broad literature focuses on the outsourcing and the offshoring of activities (Grossman and Helpman, 2005; Marin and Verdier, 2003). Even if a lot of papers consider the outsourcing of materials (Antras and Helpman, 2004; Hubbard and Baker, 2003), firms resort more and more to the outsourcing of business services. Indeed, technological changes favour the compatibility and tradability of many services across the world (Goodman and Steadman, 2002; Abramovsky, Griffith and Sako, 2004). Consequently, a lot of firms outsource, for example, their call centre or invoice and payroll services.

A literature review shows that outsourcing is extensively documented concerning the adoption factors of outsourcing, in particular, the benefits (*i.e.* cost reduction, the ability to focus on core competencies, technological leadership, etc.) and the risks (*i.e.* vendor opportunism, lock-ins, contractual difficulties, etc.).

Because information systems (IS) outsourcing is a growing phenomenon, in this study, we focus on ICT services outsourcing. The ICT services we investigate are notably the management of the ICT system, the development of software, database, website and the administration of the internal and external communication networks. These ICT services can be easily transferred across firms, especially the programming and network needs of the firm. Consequently, the costs of transaction between the firm and its supplier are reduced and beyond the cost of outsourcing.

As firms are cost minimising, the demand for outsourced services depends on the relative cost of producing the services in-house compared to outsourcing. This cost may vary across firms depending on notably the size of the firm and its investment in ICT. Concerning ICT investment an ambivalent hypothesis can be formulated. First, according to Abramovsky and Griffith (2006), we can suppose that firm's investment in ICT can diminish the cost of outsourcing and favour this phenomenon. Second, conversely if the firm has skilled workers it can reduce the cost of managing in-house ICT services.

We conduct our analyses on a large and nationally representative dataset at the firm unit level. The dataset comes from the Luxembourg part of the "ICT Usage and e-Commerce in Enterprises" survey collected in 2007. We try to determine the main important profiles of firms that resort to outsourcing and/or offshoring of their ICT services.

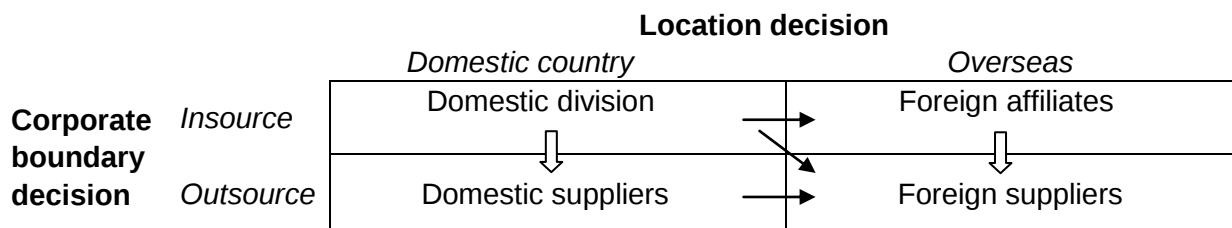
Keywords: ICT services, outsourcing, offshoring.

1. Introduction

In the context of economic globalisation, firms need to increase their adaptability and flexibility to assure their competitiveness on their market. To manage effectively their activities, firms choose to resort increasingly to outsourcing and/or offshoring of activities both for the manufacture of products and for the inputs included in the production process. Outsourcing has been called “*one of the greatest organizational and industry structure shifts of the century*” with the potential to transform the way firms organize their activities (Drucker, 1998).

The number of articles dedicated to these phenomena has increased in recent years (Gonzalez, Gasco, Llopis, 2006ⁱ; Grossman and Helpman, 2005; Marin and Verdier, 2003). A lot of papers considers the outsourcing of materials (Antras and Helpman, 2004; Hubbard and Baker, 2003) but also there is a large literature on the outsourcing of different business services (Abramovsky and Griffith, 2006; Arnett and Jones, 1994; Barthélemy and Geyer, 2005).

The concepts of outsourcing and offshoring suffer from the lack of a common definition as underlined by Loh and Venkatraman (1992) on outsourcing and by the literature review of Jahns (2006) on offshoring. The definitions retain in this paper are the same as Abramovsky and Griffith (2006).



Source: Abramovsky and Griffith (2006, p.595)

The outsourcing decision occurs when firms choose to ‘buy’ rather than ‘make’ in-house. It involves greater specialisation as firms switch from sourcing inputs internally to sourcing them from external suppliers. The offshoring decision occurs when firms move production overseas, either made by their own foreign affiliates or purchased from outsourced suppliers.

The broad areas of research conducted on outsourcing and offshoring decisions concern mostly four topics. The first topic is related to the drivers of firm’s choice (Abramovsky and Griffith, 2006; Arnett and Jones, 1994; Barthélemy and Geyer, 2001, 2005; Diaz-Mora, 2007). The second topic focuses on the characteristics of the products delivered by outsourcers and the management of the relationship between the firm and the outsourcer or the firm located abroad (Bhatnagar and Madon, 1997; Currie and Seltsikas, 2001). The third most important topic concerns the effect on firm success in terms of productivity (Altinkemer, Chaturvedi and Gulati, 1994; Heshmati, 2003; Holger, Hanley and Strobl, 2008; Ohnemus, 2007). Finally, the fourth main topic discussed in the literature is the macroeconomics

ⁱThey provide a review of the literature considering specifically Information Systems outsourcing in journals of management and business like *MIT Sloan Management Review*, *Harvard Business Review*, etc.

consequences of the phenomena (Amiti and Wei, 2005; Chongvilaivan, Hur and Riyanto, 2008; Chongvilaivan and Hur, 2008). The literature both in the field of economics and of management provides theoretical background (Chalos and Sung, 1998; Antras and Helpman, 2004) and/or empirical studies (Abramovsky and Griffith, 2006; Diaz-Mora, 2007).

In this paper we focus on firms that decide to outsource and/or offshore activities related to Information and Communication Technologies (ICT) needs. In most firms ICT do not belong to the core competencies of the firm, so the phenomena of outsource and/or offshore have grown during the last decade. In 2006, 44% of firms located in the European Union (EU with 27 countries) choose to outsource a part or all of their ICT services (Ohnemus, 2007). The Economist has published a survey of outsourcing, in which the growing development of IT outsourcing especially in Asia is pointed out (The Economist, 2004).

As underlined by several papers, the phenomena have undergone a lot of transformations. Ketler and Walstrom (1993), Vassiliadis, Stefani, Tsaknaki and Tsakalidis (2006), Yang and Huang (2000) provide a history of these changes. As underlined by Watjatrakul (2005), the last decade has brought new changes to the phenomena. Indeed, with the e-commerce revolution, the outsourcing of ICT services like Internet service outsourcing, application service outsourcing, and business process outsourcing as appeared. The outsourcing (or offshoring) activities studied in this paper covers three types of ICT services the firm used in the production process. In accordance with Arnett and Jones (1994), these ICT activities can be classified into: hardware, software and "comprehensive management activities". Hardware covers ICT systems integration, installation, development and administration of firm's networks and technical support. Software activities include software development, programming and user help and support. "Comprehensive management activities" concerns e-business, database, website, ICT systems management and administration.

Moreover, technological changes favour the compatibility and tradability of many services across the world (Goodman and Steadman, 2002; Abramovsky, Griffith and Sako, 2004). Many service processes can be performed thousands of miles away from the customer. Consequently, a lot of firms outsource abroad, for example, their call centre or invoice and payroll services. With a quick skimming over of the literature we can observe that outsourcing is extensively documented concerning the motivations behind outsourcing, in particular, the benefits (*i.e.* cost reduction, the ability to focus on core competencies, technological leadership, etc.) and the risks (*i.e.* vendor opportunism, lock-ins, contractual difficulties, etc.).

The ICT services studied in our analysis can be easily transferred across firms, especially the programming and network needs of the firm. Consequently, the costs of transaction between the firm and its supplier are reduced and beyond the cost of outsourcing. As firms are cost minimising, the demand for outsourced services depends on the relative cost of producing the services in-house compared to outsourcing. This cost may vary across firms depending on notably the size of the firm and its investment in ICT. Concerning ICT investment we formulate an ambivalent hypothesis. First, according to Abramovsky and Griffith (2006), we can suppose that firm's investment in ICT can diminish the cost of outsourcing and favour this phenomenon. Second, conversely, if the firm has internal ICT competencies it can reduce the cost of managing in-house ICT services and thus reduce the resort to outsourcing.

We conduct our statistical analysis using a large and nationally representative dataset at the firm unit level. The dataset comes from the Luxembourg part of the “ICT Usage and e-Commerce in Enterprises” survey collected in 2007. It gives some information about the characteristics of the firm surveyed and covers: computers and communication technologies use; Internet access and use; purchases via the Internet or other computer networks. Thanks to a specific topic included in 2007 in the survey we have information on ICT competence in the firm unit and the demand for ICT services produced by external suppliers and abroad the country. We look at the profiles of firms that have decided to outsource and/or offshore at least a part of their ICT activities during 2006.

The main observations we can do show, notably, a wide proximity of firms’ characteristics that resort to outsourcing and to offshoring. It appears that firms with the highest specific ICT needs choose to find these services from external suppliers or firms located abroad. However, these firms are not at the same time those with the lowest ICT investment, quite the reverse. Indeed, in order to control the execution of the contract and to assure the compatibility of services produced externally with the internal system of the firm, firms that choose to outsource or offshore have large ICT competencies measured by ICT investment and by the employment of ICT/IT specialists.

The remainder of this article is organised as follows. In the next section we present both theoretical and empirical literatures concerning the outsourcing and offshoring of ICT services in order to formulate our research hypotheses. After a detailed description of the database, we present the variables used in our statistical analyses based on two methods, a multiple correspondence analysis and a hierarchical cluster analysis. Then we present our statistical evidences and discuss the main findings.

2. Research hypotheses

The objective of our study is to explore the characteristics of the firms which decide to outsource and/or offshore ICT services. As underlined by Diaz-Mora (2008), Curzon Price (2001) or Kimura and Ando (2005), the first phenomenon concerns the ownership dimension of the production of ICT services and the second, the geographical dimension of the choice.

As firms are cost minimising, their decisions depend on the relative costs to produce in-house or to purchase services on the market for the first dimension. The second dimension concerns the location of the production of the services: the firm has to choose between the production by an abroad subsidiary or by an independent foreign firm.

Built on Abramovsky and Griffith (2006) and Grossman and Helpman (2005), we can make clear the various costs firms need to evaluate before taking their decisions to insource or outsource their activities and the relative costs of a resident production against a foreign production.

The costs of the firm when it chooses to produce in-house depend on drivers such as its resources, its needs, its competencies, its productivity and its size.

The cost of purchasing goods or services on the market includes the market price and other costs of outsourcing that are firm-specific. These costs cover the cost to identify the needs,

the adjustment costs of the services to the real needs of the firm, the costs of finding the best provider on the market, the transaction costs on market and the costs of writing contracts and monitoring its execution. These costs can be diminished by the bargaining power of the firms for negotiation and renegotiation of contracts. Transaction cost theory developed by Coase (1937) assumes that the market is always the lowest-cost producer of a good or a service. However, factors like internal competencies can conduct firms to choose an internal governance mode.

The specificity of ICT activities can modify the decision of firm compared with the outsourcing of the manufacturing process. Focusing on ICT activities outsourcing, we analyse both services inducing short-term or long-term contracts. If the ICT activity the firm wants to outsource concerns software without maintenance, spot transaction on the market can be used. However, for other activities such as network maintenance the relationship has to be a long-term one. Consequently, market transaction costs can be high if the relationship between firms has a long-term nature and if it concerns a very specific need. Moreover, if the need is very specific, it induces a great quantity of information to give to the outsourcer, such as detailed instructions and specifications.

Furthermore, as underlined by Willcocks, Lacity and Fitzgerald (1995), firms need to retain sufficient in-house capability in order to be able to manage the outsourcer and the measurement systems to make sure that the contract goes smoothly. ICT activities induce, indeed, hidden cost and uncertainty about the quality of the services provided by the outsourcer. So, it is not surprising that some firms choose to retain in-house a part of their ICT activities.

The trade-off between in-house production of ICT needs and outsourcing depends on the characteristics of the firm. In accordance with its business activities firms have more or less needs of software sophistication, of security of data management, etc.

Large firms have more available resources to produce internally but at the same time their needs are bigger than small ones. Furthermore, largest are the resources and competencies of the firm highest is its bargaining power. Consequently, transaction costs are reduced for negotiation and renegotiation of contracts. Thus, we can formulate the following hypothesis concerning resources and needs.

Hypothesis 1. Firms with large resources and needs should choose more than others the outsourcing of business activities.

Moreover, the choice between in-house and outsource can vary in accordance with firm's investment in ICT. Following Abramovsky and Griffith (2006) and Magnani (2006), we can suppose that technologies affect the cost of outsourcing.

Technological diffusion in firms seems to facilitate outsourcing because it "induces convergence of firm-specific skill to general skill over time" (Magnani, 2006, p. 618). So it increases the transferability of services across firms and reduces the specificity of the transaction. Moreover, investments and usages of ICT like those around Internet should influence others costs of outsourcing such as the search costs of the best outsourcer on the market and the costs of monitoring the execution of the contract. ICT competencies and skills should also reduce the adjustment costs of the services purchased to firm's needs.

But if the firms have enough internal ICT competencies the costs of producing in-house can be lower than those induced by outsourcing. However, ICT competencies can affect the needs of the firm. When the firm accumulates ICT competencies, it can develop new needs that are more specific and that induce the resort to an external service provider. We can therefore formulate an ambivalent hypothesis.

Hypothesis 2. *As firm's investment in ICT seems to diminish the cost of outsourcing it can favour the phenomenon. Conversely, if the firm has ICT competencies it can reduce the cost of managing in-house ICT services.*

3. Data

The data used to analyze the characteristics of enterprises which have decided to outsource and/or offshore ICT activities in 2006 have been collected by the CEPS/INSTEAD in collaboration with STATEC. The survey was conducted by post mail during the second quarter of 2007 from firms employing 10 persons and more and operating in all sectors of the economy. Among the 3144 firms surveyed, 1955 have responded, that is to say a response rate of 62%. The data collected give information about the characteristics of the firm and its business and about the investment and use of different ICT (computer, Internet, etc.). The data used do not apply to firms that are not computerized (50 firms) because without this tool they can not adopt any ICT. Our sample consists of 1905 enterprises computerized and employing 10 persons or more.

3.1. Main characteristics of the firms sampled

The characteristics of the establishments surveyed are available in the Appendix 1. We have information on the business in which the firm operates. The sectors surveyed are: industry, construct, trade, tourismⁱⁱ, transport (of merchandises), financeⁱⁱⁱ and services. The most represented sectors in our sample are trade and construct with each one 25% of the firms. We also know the size of the firms. We use the classification of the European Union concerning small (10-49 employees), medium-sized (50-249) and large firms (250 and more). The large majority (76%) of the firms surveyed are small ones. In order to capture the organizational structure, we introduce two dummy variables: the first equals one when the firm has more than one legal unit in its organization, and the second equals one when the firm is a subsidiary of a group. 13% of the firms in the sample are multi-establishments firms.

Moreover, we have information on ICT use in the establishment. We know the current ICT use of the firm. Our first measure is based on the number of common communicant ICT deployed in the firm. We compute the total number of common ICT used in the firm: local computer network (wireless or not), Intranet, Extranet, electronic mail service, video conference, electronic forum, electronic working group calendar and group project scheduler. And we reduce the score to five levels: 1) no or just one ICT, 2) two ICT, 3) three ICT, 4) four ICT and 5) five and more ICT. The average in the population surveyed is three ICT. In details, we can see that 22% of the sample use five ICT or more.

ⁱⁱ The tourism sector includes hotels, restaurants, travel agencies and companies operating in the market for passenger transport (by train, by car, by boat and by plane).

ⁱⁱⁱ This sector includes both financial and insurance activities.

Our second measure is based on the number of management ICT adopted by the firm. The management ICT are systems adopted to manage placement and reception of orders. The score is composed of internal systems for re-ordering replacement supplies, systems of invoices and payment, systems for managing, logistics or services operations, ICT linked with suppliers' business systems or with customers' business systems, the use of software for CRM^{iv}, the use of ERP^v and finally the automatic processing of the reception or the sending of invoices in digital format. As for the common ICT score, we reduce the score to six levels: 0) no management ICT, 1) one management ICT 2) two management ICT, 3) third management ICT, 4) four management ICT and 5) five management ICT and more. The average in the sample is two management ICT. In details, we can see that 17% of the firms use five management ICT or more.

We also create a score concerning the trust of the firm in the security of the data transfer on Internet. The score includes the resort to e-government, that is to say the use of Internet for interaction with public authorities, the fact of sailing and/or of doing purchases on Internet or on external computer networks. The average in the sample is one, that is to say a medium trust. In details, we can see that 38% of the firms have a high or a very high trust in data transfer on the Internet or other networks.

To capture information on the skills of the workforce, we introduce a proxy for the fact that firm employs or not ICT/IT specialists. We can observe that 21% of firms employ one or more ICT/IT specialists.

3.2. *Outsourcing and offshoring by the firms surveyed*

As we said before, the ICT/IT activities outsourced or produced abroad we want to analyze concerns hardware, software and “comprehensive management activities” defined by Arnett and Jones (1994). Hardware covers ICT systems integration, installation, development and administration of firm's networks and technical support. Software activities include software development, programming and user help and support. “Comprehensive management activities” concerns e-business, database, website, ICT systems management and administration. The proportion of firms that choose to outsource a part or all their IT activities is 45% and of offshoring is 21%.

4. Statistical evidence

In order to define the most important enterprises profiles of those who choose and of those who don't choose to outsource and/or to offshore at least a part of their ICT services, we conduct for each one phenomenon a multiple correspondence analysis (MCA) and after a hierarchical cluster analysis.

^{iv} Software application for Customer Relationship Management (CRM) concerns the management of information about clients especially for marketing purposes.

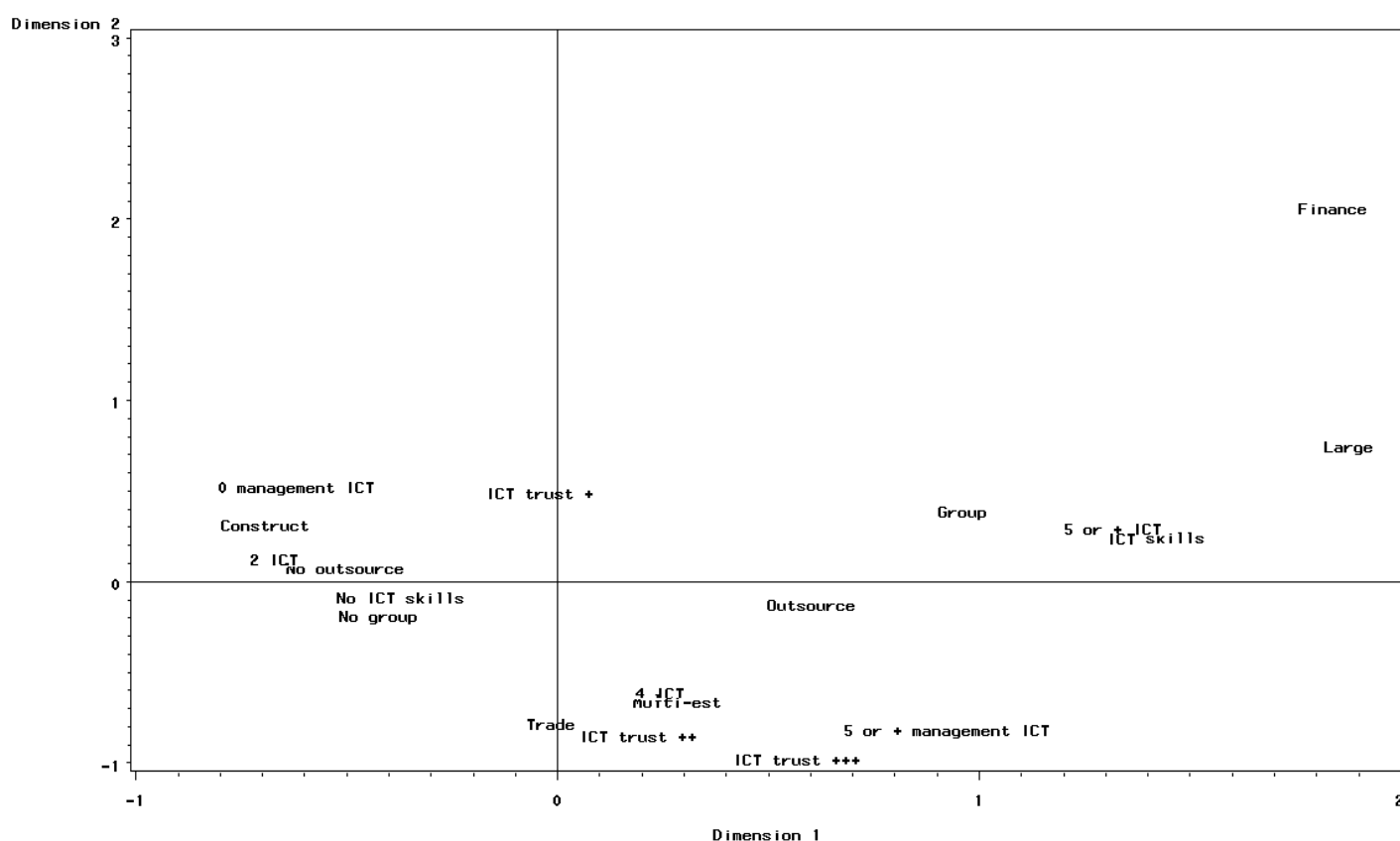
^v Enterprise Ressources Planning (ERP) software permits to share information on sales and purchases with other internal functions areas like finance, marketing...

All the variables which characterize the firm and its ICT use outlined above are introduced into our MCA in order to interpret the proximity between individuals. As our data are qualitative data, our cluster analysis is conducted in the continuity of the MCA. So, we achieve our classification from the details of individuals' coordinates computed by the MCA on the two dimensions we retain.

4.1. *Firms that choose to outsource ICT activities*

The Figure 1 shows the results of the MCA. We report only the modalities of the significant variables, that is to say variables with a contribution on at least one dimension highest than $1/m$ with m the number of modalities introduced in the model ($m=33$, cf. appendix 1 and $1/m=0.03030$).

Fig 1. *Projection of contributed variables for the analyze of firms that choose outsourcing*



In accordance with the partial contributions of variables computed with the MCA, the modalities that contribute most to the dimension 1 are presented in the table below.

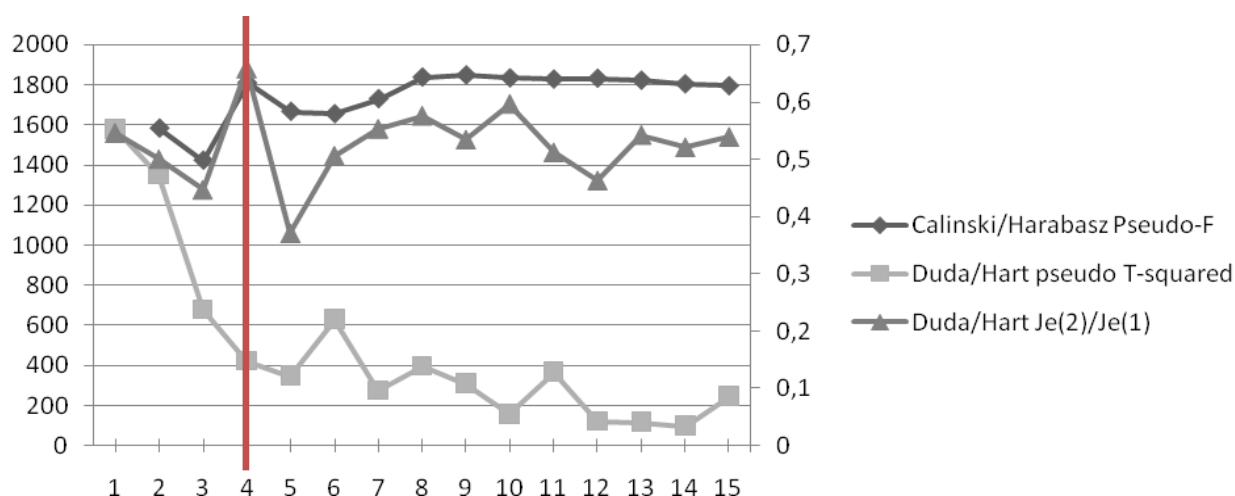
Negative part of the dimension 1	Positive part of the dimension 1
Construct	Finance
No group	Group
0 management ICT	Large
4 management ICT	5 or + management ICT
2 ICT	5 or + ICT
No ICT skills	ICT skills
No outsource	Outsource

The dimension 1 opposes firms that outsource against firms that produce in-house the ICT services they need. On the positive part of the dimension 1, we find firms with large resources because of the belonging to a group and of their size (large) and firms doing financial or insurance activities. Moreover, these firms use a lot of ICT both common ones and management ones and employ ICT/IT specialists. Conversely, on the negative part we find firms with a little use of ICT and that have no ICT/IT specialists.

As there is a parabolic shape of ICT variables on the Figure 1 we can observe what is commonly known as a "Guttman effect". Consequently, all the information of our MCA is almost given by the dimension 1. Information given by the dimensions of subsequent ranking reflects the same phenomenon that the first dimension. Because of the presence of such a specific effect, it seems that ICT variables have a great importance in our analyses.

As we said before, we conduct our cluster analysis on the coordinates of individuals computed by the MCA. In order to determine the number of cluster, we use "stopping rules" evaluated by Milligan and Cooper (1985) as ones of the best existing rules. These rules are the Calinski and Harabasz (1974) pseudo-F and Duda and Hart (1973) Je(2)/Je(1) and pseudo-T-squared. Figure 2 shows the distribution of theses rules between 1 and 15 clusters.

Fig 2. Values of the criteria to choose the number of clusters^{vi}



Large values of the Calinski and Harabasz (1974) pseudo-F stopping-rule index indicate distinct cluster structure. And a large value of the Duda and Hart (1973) Je(2)/Je(1) index value and a small associated pseudo-T-squared value indicate distinct clustering. At least two of the three criteria favour a four classes clustering (the red line on Figure 2), the number of clusters we retain.

The four classes identified are composed of two classes with a large number of firms which choose to insource their production of ICT needs and of two other classes with a large proportion of firms which choose to outsource.

^{vi} The scale on the left side of Figure 2 corresponds to the values of Calinski/Harabasz Pseudo-F and of the Duda/Hart pseudo T-squared. And the scale on the right side corresponds to the values of Duda/Hart Je(2)/Je(1).

We present the identified clusters with a ranking from the cluster with a little number of firms which use outsourcing to the cluster with the large proportion of firms which use this governance mode.

The first class we identify concerns 28% of the sample. This class includes a large proportion of firms that choose to insource the ICT services they need (84% of the establishments in this part of the clustering don't outsource). The business sector which is the most represented here is construct (52% of the firms in this class evolved in this sector). Practically all the firms in this class are small ones and are independent of a group (88% of the class and 89% respectively)^{vii}.

Concerning ICT use, this class is characterized by a low resort to ICT:

- 58% of the establishment in this class don't use management ICT^{viii};
- 80% use at most two common ICT amongst local computer network (wireless or not), Intranet, Extranet, electronic mail service, video conference, electronic forum, electronic working group calendar and group project scheduler;
- 98% have a low or a medium trust in data transfer on the Internet;
- Near 100% don't employ ICT/IT specialists.

In conclusion, this class doesn't seem to use outsourcing, *a priori*, simply because the need for ICT of firms in this class is low and so they don't need to require to external service providers.

The second class we identify includes 43% of the firms sampled. The majority of firms in this part of the clustering insource the ICT they need (56% of the establishments in class 2). The business sector which is the most represented here is trade (36% of the firms in this class evolved in trade). The large majority of firms in this class are small ones and are independent of a group (83% of the class and 84% respectively).

This second class is characterized by a medium use of ICT highest compared with the low ICT use of the firms in the first class:

- 60% of the establishments in this class use at the most two management ICT;
- 70% use at most three common ICT;
- 96% don't employ ICT/IT specialists.

Nevertheless they have trust in data transfer on the Internet: 40% use at least one of the Internet or network possibility we study (e-government, online sales or online purchases) and 44% use two of these network possibilities.

Concerning this class, we can conclude that the firms belonging to this class have ICT needs, but they are not very specific and so firms don't have to require to outsourcers.

The third class identified includes 18% of the firms sampled. The majority of firms in this part of the clustering choose to outsource their ICT activities (75% of the establishments in class 3). Two business sectors are widely represented: trade and services (36% and 37% of the

^{vii} We must notice here that for all classes the biggest proportion of firms concerns firms organised with only one establishment.

^{viii} The management ICT studied here are internal systems for re-ordering replacement supplies, systems of invoices and payment, systems for managing, logistics or services operations, ICT linked with suppliers' business systems or with customers' business systems, the use of software for CRM, the use of ERP and finally the automatic processing of the reception or the sending of invoices in digital format.

firms in this class respectively). 57% of the firms are small, 34% are medium-sized and the large majority belongs to a group (60% of the class) so have financial and human resources available at the group level.

This class is characterized by a large use of ICT:

- 71% of the establishments in this class use at least four management ICT;
- 60% use five or more common ICT;
- 62% employ ICT/IT specialist;
- 79% have a high or a very high trust in data transfer on the Internet.

In conclusion the firms belonging to this class use a lot of ICT, employ ICT/IT specialists, but choose to require to outsourcers because of, *a priori*, wide and very specific needs of ICT services. This statistical evidence is consistent with the observations of Willcocks, Lacity and Fitzgerald (1995). It seems, indeed, that those firms choose to retain in-house a part of their ICT competencies to facilitate the adjustment of purchase services on the market and to control the good execution of contracts with external services providers.

The fourth class of our clustering analysis includes 11% of the firms surveyed. 76% of the establishments in this part of the clustering choose outsourcing for their ICT activities. One business sector is largely represented: 63% of the firms of this final class evolve in finance (and insurance) (except 1 firm, the entire financial establishments surveyed are in this class). 52% of the firms are small, 29% are medium-sized and 19% are large firms. 91% belongs to a group.

This class is characterized by a large use of common ICT but a little use of management ICT:

- 58% of the establishments in this class use at most two management ICT;
- 69% use five or more common ICT;
- 70% have ICT/IT specialist among employees;
- 93% have a medium trust in data transfer on the Internet.

This class is somewhat special because it concerns a specific part of the sample, that is to say, firms evolving on the financial and insurance markets. Consequently, their ICT needs are very specific and as the data they handle are confidential they require a lot of security that is very costly to developed internally. Like the firms of the third class they retain large ICT competencies internally to manage their contracts with external service providers (Willcocks, Lacity and Fitzgerald, 1995).

In conclusion of our analysis, the size doesn't appear as a discriminating variable to distinguish between firms that insource and those that outsource. However, the resources that can be given by the group they belong to, seem to discriminate the two populations of firms. Moreover, it seems that firms with specific and/or wide needs choose more than others the outsourcing of ICT activities. Our observations seems, indeed, to support our hypothesis 1 concerning internal resources and needs.

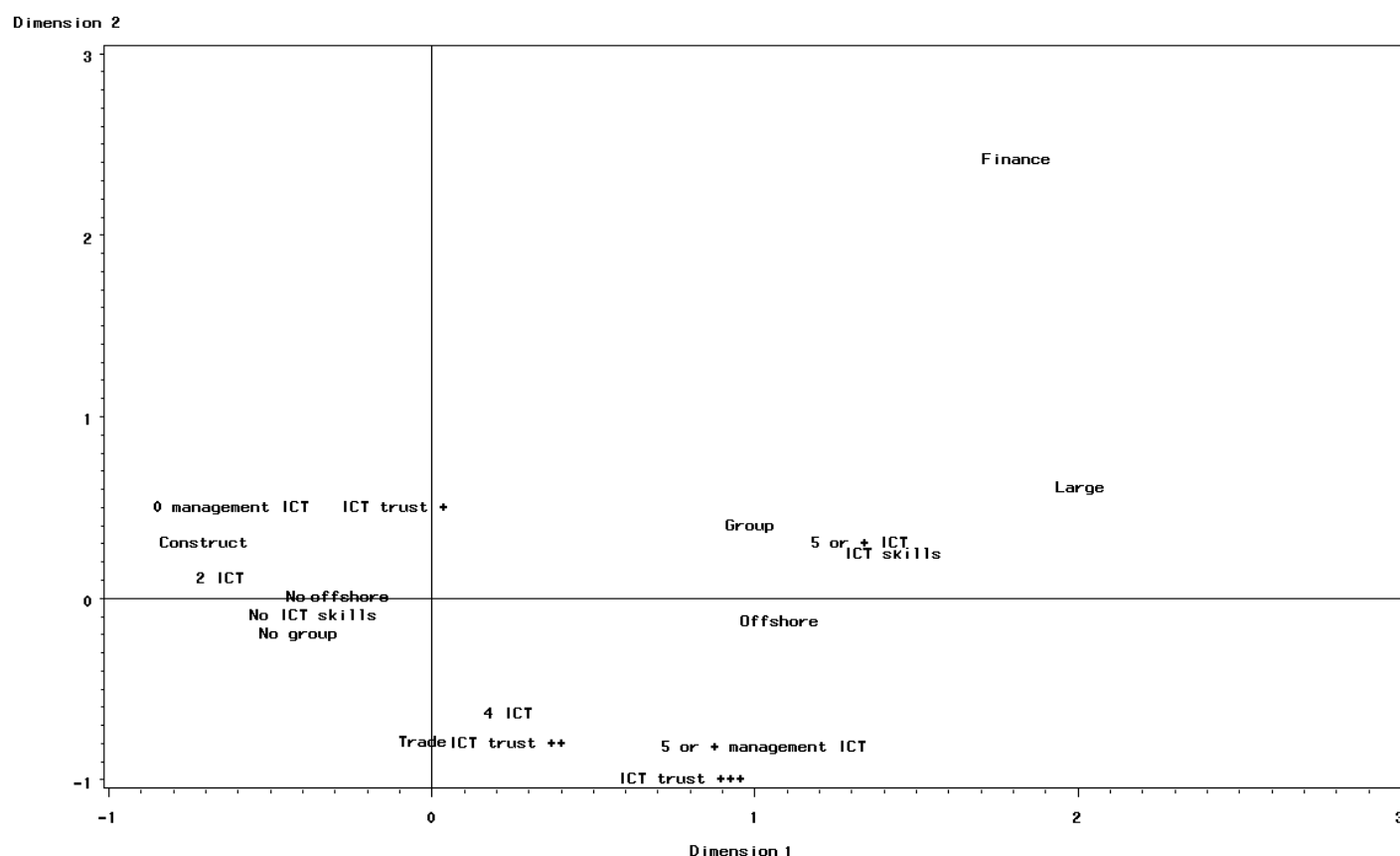
Concerning our ambivalent hypothesis 2 linked with ICT investments, our observations, especially about the class 3, give support to the fact that ICT investments favour the phenomenon of outsourcing. Observations especially about the class 2 seems to give support to the second part of the hypothesis 2 for which the fact of having large ICT competencies can reduce the cost of managing in-house ICT services and will curb the

phenomenon of outsourcing. However if we measure ICT competencies with the fact of employing ICT/IT specialist, our evidences are not really be consistent with this second part of the hypothesis 2. Our observations are for this point close to the conclusions of Willcocks, Lacity and Fitzgerald (1995) who underline the importance of ICT capabilities in-house when the firm choose to outsource at least a part of its ICT activities.

4.2. *Firms that choose to offshore ICT activities*

The Figure 3 shows the results of the MCA concerning offshoring decisions. Like our first analysis about outsourcing decisions, we report only the modalities of the significant variables ($m=33$, cf. appendix 1 and $1/m=0.03030$).

Fig 3. *Projection of contributed variables for the analyze of firms that choose offshoring*



The first observation we can formulate with the Figure 3 is that there is a large proximity of this MCA with the one conducted on outsourcing decisions.

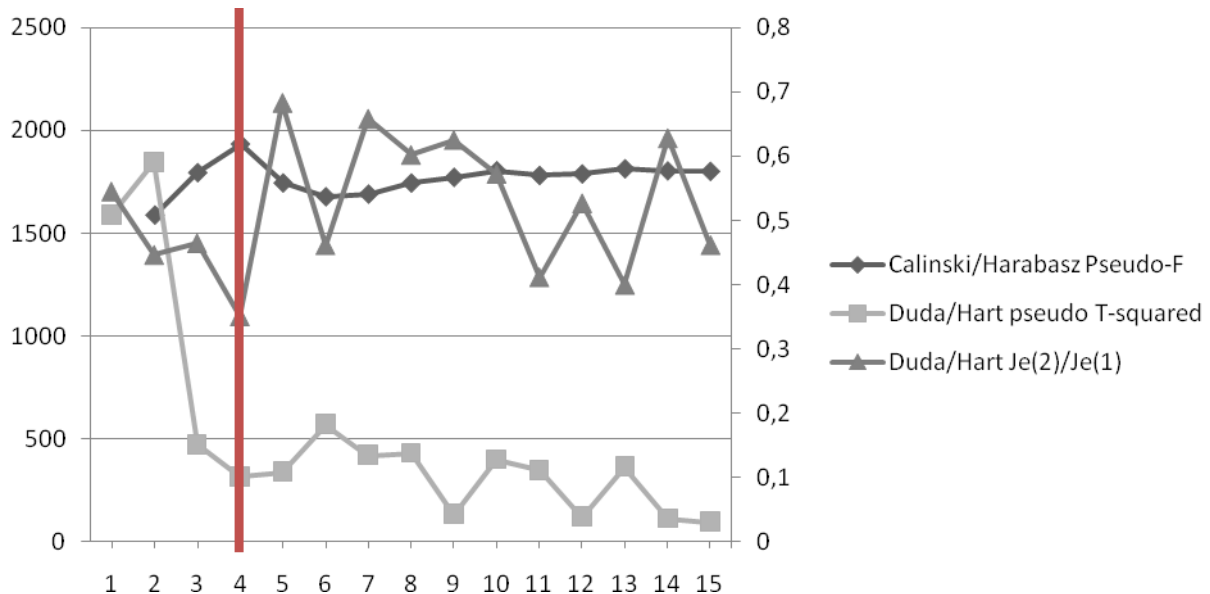
Like for the first MCA, in accordance with the partial contributions of variables computed with the MCA, the modalities that contribute most to the dimension 1 are presented in the table below.

Negative part of the dimension 1	Positive part of the dimension 1
Construct	Finance
No group	Group
0 management ICT	Large
2 ICT	5 or + management ICT
No ICT skills	5 or + ICT
No offshore	ICT skills
	Offshore

Again, the results of the MCA on offshoring are very close to those of outsourcing decisions. The dimension 1 opposes firms that offshore against firms that use ICT services produced in-house in Luxembourg or bought services produced locally. On the positive part of the dimension 1, we find firms with large resources (belonging to a group and large size) and firms doing financial or insurance activities. Moreover, these firms use a lot of ICT both common and management ICT and employ ICT/IT specialists. Conversely, on the negative part we find firms that little use ICT and have no ICT/IT specialists. We also find, as in our first analysis, a "Guttman effect". Thus we can observe a parabolic shape concerning ICT variables. This particular effect underlies the importance of ICT investment in our analyses.

Then, we conduct our cluster analysis on the coordinates of individuals (*i.e.* establishments surveyed) computed by the MCA. In order to determine the number of cluster, we use the "stopping rules" developed by Calinski and Harabasz (1974) and Duda and Hart (1973). Figure 4 shows the distribution of these rules between 1 and 15 clusters.

Fig 4. Values of the criteria to choose the number of clusters^{ix}



Taking into account these indicators we selected 4 classes. The four classes identified include three classes with firms which, in majority, don't choose to offshore at least a part of their ICT activities and one class with a large proportion of firms which choose to offshore.

^{ix} The scale on the left side represents the values of the Calinski/Harabasz Pseudo-F and the Duda/Hart pseudo T-squared and the scale on the right side the values of the Duda/Hart Je(2)/Je(1).

We rank the identified clusters from the cluster including the smallest number of firms that use offshoring to the cluster including a large proportion of firms that widely use abroad production of ICT.

Our first class includes 42% of the firms sampled. 96% of the establishments in this part of the clustering don't offshore ICT activities. The characteristics of the firm belonging to the first class are close to those of the first class in our analysis of outsourcing decisions. The business sector the most represented here is construct (44% of the firms in this class). Firms are small and in majority independent of a group (85% of the class and 88% respectively)^x. Moreover they have a low use of ICT^{xi} that induce no need of outsourcing and thus of offshoring.

Our second class includes 36% of the firms sampled. 78% of the establishments in this part of the clustering don't offshore. Like the second class in outsourcing, the business sector which is the most represented in this cluster is trade (40% of the firms in this class) and practically all the firms are small ones and are independent of a group (83% of the class and 79% respectively). However, this class is somewhat different in terms of ICT usage. Indeed, 24% of the establishment in this class use five management ICT or more, 30% use three common ICT, 30% four common ICT and 58% have a high trust in data transfer on the Internet. But the number of firms employing at least one ICT/IT specialist is low: only 11%.

Our conclusion about this class is close to the one formulated for the nearest class in the outsourcing analysis. Firms in this class have ICT needs but these needs are met by the use of management and common ICT. Thus they don't really need to outsource or offshore their ICT activities.

Our third class includes 10% of the firms sampled. This class is close to the fourth class in the analysis of outsourcing in terms of firms' characteristics and ICT investment or use. 70% of the firms evolve, indeed, in finance (and/or insurance) (again except 1 firm, all the financial establishments surveyed are in this class). 51% of the firms are small, 29% are medium-sized, 20% are large firms and 90% belongs to a group. 40% of the establishment in this class use at most two management ICT; 70% use five or more common ICT; 71% employ ICT/IT specialist and 93% have a medium trust in data transfer on the Internet.

Even if the characteristics of this class are close to those of the fourth cluster in outsourcing, there is an important difference between this cluster and its "neighbour" in outsourcing. 59% of the establishments in this cluster don't offshore. In conclusion, the firms doing financial and/or insurance activities are a lot to choose the outsourcing of ICT activities but a little to includes offshored services in their production process. Thus, it seems that the ICT activities use by these firms are produced by external service providers located in Luxembourg.

The fourth class includes 12% of the sample. This cluster is close to the third cluster in the outsourcing analysis: it includes mostly two sectors trade and services (30% and 39% of the firms in this class respectively). 46% of the firms are small, 40% are medium-sized, 14% are large and the large majority belongs to a group (74% of the class). Concerning ICT use, 71%

^x Again the variable multi-establishment is not a discriminating variable.

^{xi} 76% of the establishment in this class use at most one management ICT; 72% use at most two common ICT; 91% have a low or a medium trust in data transfer on the Internet. Near 100% have no ICT/IT specialists.

of the establishments in this class use at least four management ICT, 75% use five or more common ICT and 76% employ ICT/IT specialist.

Moreover, the majority of firms in this cluster and its “neighbour” in the outsourcing analysis use ICT services produced by outsourcer and 62% of these firms resort to ICT services produced abroad. Another observation we can noticed here is the large number of firms employing ICT/IT specialists. It seems that more monitoring is needed when the firm decides to offshore its ICT operations. Moreover, problems of language (wide use of English in the ICT/IT industry) can appear, requiring internal skills to make external services compatible with the current system of the enterprise.

In conclusion, the statistical evidences we can formulate here are quite close to those formulated for outsourcing. However we can add one or two things to distinguish the two decisions. It seems that financial and insurance firms choose to use the ICT services of firms located in Luxembourg. For firms which choose to resort to offshoring, the presence of ICT/IT specialists is more frequent than for firms that choose to resort to outsourcing, at least for firms of trade and services. This observation may emphasize the fact that monitoring and compatibility of services requires the presence of internal ICT competencies.

5. Conclusion

In this paper, we seek to analyse the characteristics of firms located in Luxembourg that choose to outsource and/or offshore ICT activities. As underlined by Watjatrakul (2005), the 2000 decade has induced large evolutions in the phenomena with, notably, the e-commerce revolution. At present, the outsourcing of ICT services is quite large. The outsourcing (and/or offshoring) ICT activities studied in this paper covers three types of ICT services the firm can use in its production process. In accordance with Arnett and Jones (1994), these ICT activities can be classified into: hardware, software and “comprehensive management activities”. Hardware covers ICT systems integration, installation, development and administration of firm’s networks and technical support. Software activities include software development, programming and user help and support. “Comprehensive management activities” concerns e-business, database, website, ICT systems management and administration.

As underlined by Diaz-Mora (2008), Curzon Price (2001) or Kimura and Ando (2005), the outsourcing phenomenon concerns the ownership dimension of the production of ICT services and the offshoring phenomenon concerns the geographical dimension of the production of these services. As firms are cost minimising, their decisions depend on the relative costs to produce in-house or to purchase services on the market for the first dimension. The second dimension concerns the location of the production of the services: the firm has to choose between the production by an abroad subsidiary or by an independent outside firm.

First, we try to find in the theoretical and the empirical existing literature the drivers that can modify the cost of producing in-house and those of purchasing the services on the market and beyond the drivers that sustain the choice of outsourcing and/or offshoring. It permits us to formulate research hypotheses that we confront to a database collected in 2007 in Luxembourg.

Second, we conduct our statistical analyses of the data based on two methods: a multiple correspondence analysis and a hierarchical cluster analysis. The main observations we can do show, notably, a wide proximity of firms' characteristics that resort to outsourcing and to offshoring. It appears that firms with the highest specific ICT needs choose to find these services from external suppliers or firms located abroad. While we can think that having large ICT competencies can reduce the cost of managing in-house ICT services and will curb the phenomenon of outsourcing our observations are in opposite direction. Firms with the highest ICT investment, are also firms which choose to resort a lot to outsourcing. As underlined by Willcocks, Lacity and Fitzgerald (1995), in order to control the execution of the contract and to assure the compatibility of services produced externally with the internal system of the firm, firms that choose to outsource or offshore choose to develop in the same time large ICT competencies.

One limitation of our study lies in the measure of the outsourcing and offshoring phenomena. Indeed, we have global information on the fact of using these possibilities to obtain ICT services. Further researches have to address this limitation by finding precise information on the degree or the number of ICT functions outsourced or offshored by firms.

Appendix 1. Descriptive statistics of the whole sample (1905 observations)

Modalities	Mean	Std. Dev.	Nb of modalities
Industry	10.08%	0.3011	1
Construct	24.93%	0.4327	1
Trade	24.57%	0.4306	1
Tourism	3.99%	0.1958	1
Finance	6.88%	0.2531	1
Transports	9.71%	0.2962	1
Services	19.84%	0.3989	1
Small	76.38%	0.4249	1
Medium	19.69%	0.3977	1
Large	3.94%	0.1945	1
Multi-establishment	12.60%	0.3319	2
Group	30.39%	0.4601	2
Score ICT :	3.12	1.2728	5
0-1 ICT	6.61		
2 ICT	34.17		
3 ICT	21.52		
4 ICT	16.01		
5 ICT and more	21.68		
Score management ICT :	2.07	1.8173	6
0 management ICT	27.30		
1 management ICT	20.68		
2 management ICT	12.23		
3 management ICT	13.70		
4 management ICT	9.55		
5 management ICT and more	16.54		
ICT trust :	1.36	0.7660	4
- Low trust	9.50		
+ Medium trust	52.81		
++ High trust	29.45		
+++ Very high trust	8.24		
ICT Specialists	20.58%	0.4044	2
Outsource	45.25%	0.4979	2
Offshore	21.26%	0.4093	2

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