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Information Systems and Innovation Capacity

A Crossindustry Interpretive Study

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Abstract: Innovation is one of the many challenges raised by the digitalization of business and economy. In the current competitive environment, businesses are characterized by radical transformations through digitalization of services and products and their ability to innovate is increasingly linked to the exploration and exploitation of information and communication technologies (ICTs). This paper investigates the role of information systems (IS) as a key factor to innovation capacity. Starting from these issues, the paper explores through an interpretative study of the IS innovation practices as well as perceptions by managers within a sample of 7 French based companies from various industries. The interviews have been conducted on with a guide built based on a framework on IS innovation capacity maturity. Consistently with the framework, the interview guide addresses process areas and practices related to three core categories: management, innovation engineering, and support. The study reveals 7 fundamental contradictions that can explain the main tendencies observed across the companies, out of which the most striking is a generalized lack of maturity when it comes to exploiting their Information Systems to foster innovation.

1 INTRODUCTION

This paper investigates innovation capacity, particularly with regard to the actual challenges by the digitalization of business. We start from the observation that many businesses undergo radical transformations through digitalization of services and products, and the commonly accepted intuition that their innovation capacity is increasingly linked to the exploration and exploitation of information and communication technologies (ICTs).

Yet, besides well known success cases (Google, Apple, Facebook, Amazon), there is not yet – to the best of our knowledge- a repository of best practices structured according to an innovation model that explicitly consider IS related innovation capacity dimensions. The main goal of this paper is to draw a map of IS-based innovation practices as well as perceptions by managers within companies of various industries.

Our observations and conclusions are drawn from an interpretative study that was conducted with an interview guide constructed based on the framework proposed in (Achi and Salinesi, 2015).

The rest of the paper is structured as follows: section 2 discusses definition of innovation capacity and the role of IS in innovation capacity throughout literature. Section 3 presents the method used to build and conduct the interviews. Section 4 presents the qualitative interview guide and the framework that was used to build it. Section 5 reports the case study results. The paper is finally closed with a summary of the 7 contradictions revealed by the study, and our perspective on the topic of IS based innovation.

2 INNOVATION CAPACITY

Literature reveals that a wide range of factors impact the capacity for innovation of a organizations (Koc, 2007; Sharma and Rai, 2003). Based on the literature on dynamic capabilities (Teece et al., 1997), Lawson and Samson (Lawson and Samson, 2001) point out that seven elements are relevant: (i) vision and strategy, (ii) harnessing the competence base, (iii) organizational intelligence, (iv) creativity and idea management, (v) organizational structures

and systems, (vi) culture and climate, and (vii) management of technology. Other works have attempted to address the topic of innovation capacity with generic maturity models (Essmann and Preez, 2009; Esterhuizen et al., 2012; Müller-Prothmann and Stein, 2011; Toole et al., 2012), with relatively similar elements to the ones of the Capacity Maturity Model Integration (CMMI) (Carnegie Mellon University, 2002). However, even though we can daily observe the role of IT in business innovation, none of these works really raise the question of what are the key factors of innovation led by the use of IS. IS-based innovation capacity remains a topic worth investigating, with still a relatively few number of specific contributions.

This paper focuses on the use of ICTs to enforce the logic of services and the exploitation of network externalities at the business level. The ideal situation of interest here is when the IS constitutes the fundamental infrastructure for open innovation as a complement to traditional R and D, thus allowing companies to work both with internal and external stakeholders for new ideas and expertise (Chesbrough, 2003; Chesbrough and Bogers, 2014; Chesbrough and Rosenbloom, 2002; Chesbrough and Spohrer, 2006; Chesbrough, 2003). However, IS actually covers a wider field than ICTs (Avison and Fitzgerald, 2006; Hirschheim and Klein, 2012), encompassing, among others, the interactions between the different stakeholders.

Besides this, the role of IT has evolved (Guillemette and Paré, 2012; Morabito et al., 2015) from a traditional role of support activity to the key instrument of the business strategy (Applegate and Elam, 1992). As a result, the outcome of innovation depends on a combination of factors that span from the organization of the company activities and on the management of interactions with stakeholders, to the IS itself, thus requiring a kind of systematic approach or “innovation engineering” that instantiates a specific and integrated innovation model.

Innovation can take many forms such as for instance new products, processes, organizational forms, and business models (Chesbrough and Rosenbloom, 2002; Link and Siegel, 2007; Nambisan et al., 1999; Orlikowski, 1991). Taking the above issues into account, this paper defines IS-

based innovation capacity (“innovation capacity” in short) as the ability of an organization exploit its IS to elaborate new products or create new markets by combining strategic direction with innovative processes.

3 METHODOLOGY

The method used in this work is the interpretive approach to information systems research (Klein and Myers, 1999; Walsham, 2006, 1993). The research involves both researchers and practitioners, with the aim to understand (a) how innovation capacity is developed in different industries and (b) how IS are considered part of innovation process either influencing or influenced by it (Walsham, 1993).

To this end we adopt the framework which backbone structure is shown in Table 1. The framework is built as an interpretative tool to investigate on real cases (a) the means provided by IT managers involved in innovation initiatives (b) the meaning they give to innovation capacity, (c) the diverse maturity level, and (d) the role of IS. Mostly interviews were used as for sources of evidence, as discussed below.

The study was carried out following the 3 stages discussed below: (i) building the sample, (ii) performing the interviews, and (iii) analysis.

At the *first stage* each candidate company was contacted to arrange a meeting for presenting the research project with different stakeholders, mostly decision makers or responsible of innovation projects. The goal of this first 2 hours meeting was to allow them to understand the purpose of the research and identify the right people for the interviews. 100 companies were contacted at this stage, either directly, or during an event organized in association with the French club of CIOs (Club Urba-EA). Only 20 companies declared their interest, and agreed to meet us. At the end of the stage, the study could be carried on with 7 of these companies. Table 2 shows the characteristics of these companies. As the table shows it, all these companies are based in France, face an uncertain environment, and they operate in various business sectors.

Table 1: Interpretive framework for innovation capacity maturity driven by IS.

Categories	Process areas			
Management	Innovation Strategy		IS Governance	
Innovation engineering	Ideation	Demonstration and Evaluation	Project management	Market launch
Support	Human capital	Culture of Innovation	Waking	Knowledge management

Table 2: Characteristics of the study companies.

Company	Business sector	Function of the interviewees	Number of employees
A	Software	-Senior Regional Marketing Manager Southern EMEA	1 300
B	Software	-France and Southern Europe Marketing Manager	2 400
C	Bank	-IT Architect -Technology Driven Innovation manager	188 000
D	Industry of cosmetics and well-being	-Digital IT Manager -Responsible of Corporate Architecture	15 000
E	Marketing studies	-President	25
F	Automotive industry	-Responsible of innovation	184 804
G	Public employment agency	-Director of digital program	54 000

At the *second stage*, interviews were carried out with 9 innovation leaders from the 7 participating companies. This was achieved from 8th December 2014 to 22nd July 2015. The 9 interviews last in average 1 hour and 30 minutes, and the topics followed the framework in Table 1, as discussed in the next Section. In general, the focus of the interviews was on innovation and digital transformation. During this stage, each interviewee (usually an IT manager responsible or involved in innovation activities) was asked to specifying the scope of the intervention and innovation process she was involved in with regard to the business goals. The interviews combined open and closed questions, as defined in the interview guide presented below. It is worth noting that during the interviews, the researcher has left each interviewee the chance to deal with new themes or practices and when asked to disclose his/her views on the interview itself.

The *third stage* of the study was dedicated to the transcription, coding and analysis of the data collected during the interviews. At this stage, all the results were shared with the interviewees to avoid mistakes such as misunderstandings, poor interpretations, or coding errors. Interviewees were asked to return the data collected with their comments, which were used by the researcher to develop a further assessment summary that was also

systematically provided to each company involved. The analysis of interview material was conducted by process area, and for the sake of consistency, the answers of all the interviewees were grouped by company.

Once all the interviews achieved and the analysis of all the results done for all companies, a global maturity analysis for the identified innovation practices has been performed. This was done by the researchers directly involved in the interview process study, and by one external researcher to consolidate the analysis and develop an outside-in perspective.

The identification of the level of maturity of innovation practices of each company formed an inventory at the time of the interviews, thus facilitating the implementation of an improvement plan for every context.

The interpretive framework shown in Table 1 that was used to guide the interview process is inspired by the CMMI model because it is a globally recognized reference for practitioners, giving rise to new variants in other areas such as 4, e.g., systems engineering, purchasing, service, among others (Cross, 2002). Each process area is further decomposed down to questions. Table 3 illustrates this decomposition structure for the process areas of "Culture of Innovation".

Table 3: Practices and Questions in the process area "Culture of Innovation".

Process area: <i>Culture of innovation</i>
Best Practice 1: <i>To be open for experimentation</i>
Question: Do you think your company encourages the collaborators to experiment new ideas?
Best Practice 2: <i>Agree to take risks</i>
Question: In your opinion, does your company tolerate the risk-taking?
Best Practice 3: <i>Authorize the possible failure without stigmatizing the collaborators</i>
Question: Does your company encourage innovation initiatives even if they may fail or produce errors?

The process areas are grouped in three categories: management, innovation engineering, and support. Each process area relies on a collection of so-called "best practices" that are expected to allow companies increase their innovation capacity.

In order to investigate the innovation practices of companies in a systematic way, a series of question is defined for each and every practice of all the innovation process area. These questions were designed for managers in charge or involved in

innovation initiatives in each of the considered companies. Their purpose is to learn more about each practice, its implementation and also explore whether they have other best practices that we did not initially identified in the framework.

The example shown in Table 3 presents 3 questions for the process area *culture of innovation*, each corresponding to a particular best practice in the process area. In summary, in order to explore the different dimensions of innovation by IS in a systematic way, the interview guide was created starting from the collection of all questions attached to all best practices from all the process area covered by the framework. The interview guide (see Appendix 1 for the details) gathers structured questions around the process areas of the framework, based on the six main issues identified in both the management of IS and innovation management literature:

1. *Innovation strategy and IS governance practices* (innovation strategy, role of IT in innovation, communication)
2. *Organizational practices of innovation engineering process* (formalization of the process, collaboration of internal and external actors, methods and tools to develop the capacity for innovation, the creativity-related practices for employees and management)
3. *Knowledge management practices* (the skills development, knowledge sharing to enhance creativity and innovation)
4. *Human capital management practices* (assessment of contributions, valuing employees, and the creation of organizational trust)
5. *Culture of innovation practices* (identity, standards, habits, and the system of prohibitions and obligations shared within the organization, risk-taking, the right to make mistakes, and experimentation culture)
6. *Foresight practices* (knowledge of customer expectations and their evolutions, technology trends watch).

4 RESULTS ANALYSIS

Overall, the interpretive study has showed an increasing interest of both IT and business managers, especially in the innovation process through the use of IS. In particular, there is a clear interest in implementing an IT innovation unit within the Department of Information Systems (DIS) and/or launching dedicated projects for innovation

and digital transformation.

Another initial observation is that often the interviewees wondered about the methods, techniques and tools allowing to innovate faster and meet the challenges of an increasingly uncertain and complex environment.

Our analysis of the results is presented under two forms (a) a summary for each company, and (b) by process area, for all the companies from the sample.

4.1 Analysis of Innovation Practices by Company

Innovation practices driven by IS in the various companies are quite varied, as the summary below, for each company in the sample, show it.

Company A: IS occupies an important place in the innovation strategy. The innovation process is simplified into three phases (*ideation, validation and implementation*) and a key indicator of innovation is *generated turnover*. Organizational practices of the firm show a high level of maturity compared to the rest of the sample (considering: culture of innovation, diversity of profiles, small project teams, partnerships with actors of the ecosystem, strong commitment to develop the internal human capital, organizational environment of trust, management style adapted). The interviewee points out that European regulations are a constraint to innovation for her company.

Company B: The DIS and the marketing drive Innovation. Emerging technologies and IS are at the heart of the innovation process. The company operates in startup style to facilitate interaction of internal and external stakeholders (e.g., customers, research chairs, suppliers) to manage innovation. The internal environment increases motivation, curiosity and entrepreneurship, relying on multiple methods and techniques to innovate.

Company C: The organization does not have a proper process for innovation through the use of IT/IS. The organizational structure is highly hierarchical, and the process of decision-making is very long with a low confidence level. The adopted model of innovation is closed, exception made for some innovative products exploiting external cooperation. Internal communication on innovation is very weak, while the company communicates intensively on innovation outside (through newspaper communication, advertisement, sponsoring of innovation events, etc). It is worth noting that this organization does not have a culture

of innovation and does not invest in the development of its human capital to strengthen the innovation capacity.

Company D: There is no formalized process of innovation, recognized and implemented by all stakeholders (CIO, Business - or other- units), whereas IT is perceived as a profit center. The control and decision-making mechanisms are little adapted to the process of innovation despite the existence of a 2 year old budget dedicated to IT innovation. However, the company recognizes the existence of best practices of innovation notwithstanding the difficulties related to the lack of internal sponsorship.

Company E: The emerging technologies and IS are at the heart of the innovation strategy and the company's offer. Information system is a key factor in the innovation strategy and best practices in the treatment of human capital, and it is explicitly the basis for a culture of innovation are for its implementation. As the company is a marketing service provider, the outcome of the innovation process ultimately depends on interventions related to customer management.

Company F: The business is aware of the importance of emerging technologies in the process of innovation. It has no dedicated IT/ IS strategy despite the support of the top management to innovation initiatives. However, the company has implemented projects that meet the processing needs (e.g., connected car), even if the current regulation is not yet in line with the innovations provided. The human capital is at the heart of the innovation strategy. In fact, the organization has the expertise to set the necessary conditions for employees dedicated to innovation; however, the setting cannot be generalized to all staff because of the high cost. Thus, the company fosters innovation by investing on the human capital mainly in dedicated projects. The maturity level of the innovation practices is high but concentrated only in the limited area of some innovation projects.

Company G: The organization does not have an IT-based strategy of innovation. However, in the last three years, the company has carried out projects of digital transformation, sponsored by the top management. Thus, within the scope of these transformation projects, the company has an average level of maturity of the innovation practices, with a short-term organizational mode. Indeed, there is no formalized process of innovation, recognized and implemented by all stakeholders (DIS-business-

Others units). Furthermore, because of an internal organizational culture unsuited to the requirements of innovation, the management in charge of digital transformation relies on external actors by selecting a small internal team (5 people) to carry out the projects and avoid lead change within the organization.

4.2 Analysis of Innovation Practices by Process Area

Innovation Strategy and IS Governance Practices

The analysis conducted on the sample shows that none of the considered companies has a formally defined innovation strategy dedicated to innovation through the use of IS; while at the same time the majority of interviewees notify the importance of having a strategy and a clear vision for innovation in an uncertain environment. The governance of innovation within DIS is characterized in most of the cases by less formalized control, communication and sponsoring. In general, it is worth noting the development of IT innovation units within DIS or small entities dedicated to IT innovation or digital transformation. The DIS recognizes the existence of difficulties to collaborate with businesses for innovation. Furthermore, the DIS defines the means and actions to be implemented to make the IS an innovation lever for business value. Yet, the governance of the IT/Business ecosystem becomes a relevant predominant requirement in most the industries considered. In summary, the innovation process by the IS results as being at an early stage with companies not having feedbacks or indicators on the related activities.

Organizational Practices of Innovation Engineering Process

The majority of the companies in our sample does not have a formalized innovation process, recognized and implemented by all stakeholders. Some companies have simplified the process into three phases (ideation team, validation, and implementation). Others focus on the management of innovation projects without giving the required attention and importance to the process itself since the initial stages. The interviewees expressed the need to support the activities as a standard and recognized process for all stakeholders.

All interviewees recognized the importance of multidisciplinary teams in innovation activities. As for partnerships, the implementation of open innovation practices start being adopted and broadcast despite the persistence of mistrust inherent to the risks related to openness.

Knowledge Management Practices

The knowledge management dedicated to innovation is often poorly understood and generally equated with knowledge bases that are difficult to exploit in practice. Crowdsourcing practices, knowledge sharing within communities and organizational learning are very present in most of the DIS, the majority of companies have infrastructures supporting these practices but the appropriate level of familiarity with the required technologies is not consistent across business units.

Human Capital Management Practices

The interviewees agree that their companies offer talents the freedom to express themselves and promote the development of expertise; however, the social climate, the well-being of employees and adoption of a human capital management adapted to innovation remain weak. The synergy between internal and external human capital is non-existent except for structures in which prevails a startup spirit. It is worth noting that companies in the sample having an Anglo-Saxon origin (A, B) note a step ahead in terms of innovation practices related to human capital management through the development of training systems, recognition and creation of an enabling environment for innovation.

Culture of Innovation Practices

Culture innovation practices are present or in progress in small-scale structures. In large size companies (in terms of number of employees and units), the hierarchical structure represents a major constraint to develop a suitable culture that enables innovation practices (Companies G and C). The companies of the sample that have an Anglo-Saxon culture (Companies A and B), encourage employees to take initiatives, accept risk taking and give time to develop innovations.

Practices of the Foresight

Technology trends watch and business practices are implemented in all the firms in the sample. However not systematically involved, the DIS guarantees coverage of the technological watch in all strategic areas. Nevertheless, the results of trends analyses are often not used systematically or only by a small part of the staff of the companies in the sample. An exception is Company A, where the results are systematically sent to all employees. Finally, we found a high level of maturity of foresight practices in the companies operating in the ICT (company A and B) or in nearby industries (company E).

5 CONCLUSIONS

CIOs and people in charge of IS who engage in innovation and in the digital transformation of their businesses have only this magic word in mouth: "innovate!".

We are witnessing a renewal of organizational and managerial practices that results -to a very large extent- from the perceived benefits of a technology-driven innovation. In particular ICT and information systems has played a critical role in the rise of new open innovation systems. Companies have never had so many opportunities and strong demands of increasingly sophisticated products and services in their ecosystems.

Innovation is in the DNA of digital natives. But for older companies and businesses, for administrations, implementing good innovation practices cannot be commanded in a snap of a finger. This is a permanent improvement issue that takes all the business dimensions (cultural, organizational, human, etc). Where to begin? What is the effectiveness of the various practices? How to evaluate the strengths and places of improvement of companies in terms of ICT based innovation?

This paper reports an exploratory study that was conducted among 6 large French companies and 1 small French company (E) from different sectors. The study was built as an interpretative study based on interviews. The interview guide was a questionnaire developed from a CMMI-like innovation framework. Through this study, we observed a change in the vision of managers on organizational innovation process. Table 4 shows the Fundamental contradictions emerging from the analysis of the interviews. It was often seen as a black box without the need to define a standard process. The study also demonstrates that innovation units or services innovation within directions of information systems emerged only in the last five years. In fact, we noticed that the majority of interviewees raised the problematic of organizing the innovation process internally and with the ecosystems of different companies (see, e.g. Contradiction 2, 4, 5 in Table 4). As soon as this idea emerges, managers are faced with the lack of reference or model of best practices easy to implement in order to support the transformation of business and to federate all stakeholders to innovate and they have little to return 'experience (see, e.g. Contradiction 2 and 4 in Table 4).

The study shows that despite the dispersion of their maturity levels, companies (at least within the sample) mostly agree on good practices.

Table 4: Fundamental contradictions.

Contradictions	Evidence	Process areas	Companies
1. Formalize the innovation strategy! But: innovation is the strategy (sic).	- No formal innovation strategy - Development of IT innovation units within DIS or small entities dedicated to IT innovation or digital transformation	- Innovation Strategy - IS Governance	A, B, C, D, E, F, G
2. Standardize the innovation processes! But: innovation processes are not even documented.	- There is no formalized process of innovation	Innovation process : - Ideation - Demonstration and Evaluation -Project Management - Market launch	C, D, E, G
3. Create networks of multidisciplinary teams! But innovation stays centralized.	- Develop innovative projects without standard approach	Innovation process : - Ideation - Demonstration and Evaluation -Project Management - Market launch	C
4. Foster open innovation! But sensible information cannot be disclosed.	- The organizational structure is highly hierarchical, and the process of decision-making is very long with a low confidence level	Innovation process : - Ideation - Demonstration and Evaluation -Project Management - Market launch	A, B, C, D, E, F, G
5. Exploit the knowledge management tool! But: people don't understand it and how to overcome the barrier of rigidity.	- Innovation process with different opening levels	Knowledge management	C, D, F, G
6. Take a risk by betting on talents! But do not give them right to fail.	- Management wants all initiatives conclude with innovations and does not accept to take risks (D) - Managers do not allow the eventual failure and employees are at risk of being stigmatized on failure (C)	Culture of Innovation	C, D
7. Keep up to date with trends! But maintain stability.	- This organization does not have a culture of innovation and does not invest in the development of its human capital to strengthen the innovation capacity.	Waking	A, B, C, D, E, F, G

What is the role of Information Systems in handling these contradictions? Of course IS can participate to innovation in the sense of embedding new technology, or delivering services through new technologies. But also, interestingly, they can be used to build and deliver innovative services, they can be shaped to create networks of innovators

within, outside and across companies, they can be built in a way that let actors and customers participate to innovation. Last, IS government bodies can use the design thinking methodology usually employed to develop IS to shape the innovation strategy, and document and standardize innovation processes – just like any other business

or engineering process.

More evidence needs to be gathered, cases documented, techniques experimented and replicated. We wonder if sharing experiences between researchers and practitioners could fuel this process of continuous improvement of practices and help finding the levers adapted to each business context to strengthen the capacity for innovation.

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APPENDIX 1

<i>Qualitative interview guide</i>
<p>Introduction: presentation by the researcher of the research project, presented by the respondent of his company and of its function, concepts of innovation and maturity model (What is innovation? What are the different forms of innovation? What is a maturity model, and why use it?).</p>
<p><i>Innovation strategy and IS governance practices</i> What is the place of innovation in your business strategy? Do you have you an innovation strategy? How important are IS do in your innovation strategy / innovation processes? What are your current strategic priorities in innovation? In your opinion, does the IT management sponsor innovation and promote creative and innovative practices? Does your company use IS to obtain a competitive advantage? In your business, what are currently the IS priority? Is your strategy / approach to innovation communicated to all collaborators?</p>
<p>Organizational practices of innovation engineering process What is the unit that brings innovation within the company? What type of organization your company set up to lead the innovation process? Do you have an IS/IT Innovation unit? Do you have a clearly formalized innovation process? In your opinion, has your company a relationship with customers close enough to enable a strong ability to anticipate their needs and innovation in products/services? Are your processes depending/relying on your ecosystem (customers, suppliers, competitors, communities, experts, universities)? In your company, is it important that the innovation teams are composed mainly: the IT staff, people with business skills and/or multidisciplinary skills? Do you have a unit dedicated to innovation within the IT department? Are your managerial practices adapted to innovation (delay in decision-making, autonomy, etc.)? What techniques and tools do you use to innovate? How do you assess your innovation projects? Is your innovation process based on control within the boundaries of the enterprise since the emergence of the idea until the placing on the market or else do you favor openness? Have you done innovations? Over the past four years, has your IT unit worked on innovation issues? What is the average number of ideas generated / innovation projects every year? What were your innovations over the last four years? What is the number of employees working on innovation projects or the number day man / year?</p>
<p>Knowledge management practices Does your management encourage the sharing of knowledge? Do you have a knowledge management process? Do you use that knowledge to innovate? Do you combine internal and external ideas to innovate? Do you promote your internal ideas outside the</p>

<p>company? Do you use the crowd to produce knowledge or innovate? Has your company or IT unit developed practices / tools to promote knowledge sharing?</p>
<p>Human capital management practices Does your company implement devices for employees to learn, train and develop their skills to innovate? How do you judge the mood of your teams? Do you assess the contributions of employees on innovation? Do you have a compensation system to motivate employees to propose creative ideas? How do you staff your innovation teams within your company? In your opinion, does your company ensure that the internal environment is encouraging intellectual curiosity and motivation of employees?</p>
<p>Culture of innovation practices Do you think your company encourages employees to experiment with new ideas? In your opinion, does your company tolerate risk taking? Does your company encourage innovation initiatives even if that results in failure or errors? Does your company gives you the freedom to use some of your time to develop creative ideas? Is your corporate culture based on continuous improvement and ambition? Do you think there is a synergy between the culture of innovation and your company's cultural model?</p>
<p>Foresight practices Do you think the objectives of technological and business intelligence are clearly defined? Does you organization continuously/regularly watch technological/innovation trends to identify opportunities and threats? Is your IT department responsible for the technological intelligence within your company? Do you organize joint discussions with business on the development of ICT-Business processes to develop new products/services offering?</p>