

Analysing the impact of Internet based technologies implementation process on the relations in a supply chain: an explorative research design

Lelio Raffa¹

University of Lecce, Italy

Companies are using Internet technologies to manage their customers and their supply chain transactions, and find that these applications can offer a great return on investment. Companies realized that to build their own business globally, they had to find better ways to serve their customers, and had to work more efficiently with their suppliers. This is often the first step of a virtual integrated supply chain.

In order to reach this goal a new technology has to be implemented. In other words, a technology has to be absorbed by the organization that is involved in the implementation process. During internet based technologies implementation process users of information and communication technologies (ICT) systems are obliged to overcome the failures and the problems that inhibit the complete “absorption” of the technology, making it difficult to let it become part of the usual managerial routine. Therefore, there are two key entities that characterize the implementation process: the organizations involved and the technology implemented.

The purpose of this paper is to frame the analysis on the implementation process of an ICT in the context of a supply chain, to propose a research design useful to understand how an Internet-based technology implementation can shape and change the context.

Keywords: Internet-based technologies, implementation process, supply chain

1. Introduction

An important aspect of long-term competitiveness is the ability to adapt to a changing environment. Once new conditions are identified companies need to adapt to stay competitive. When changing conditions demand a shift of technology in important product lines, companies are likely to adopt this new technology.

The implementation of new technologies is an always-recurring process. This research aims at analysing how firms react in order to successfully manage the implementation of new technology so that the loss in productivity, incoherent behaviours, misalignments and the risk of institutionalising these situations is minimized.

The information and communication technologies (ICT) have the potential to transform the competitive landscape in many industries, while at the same time, creating whole new industries. Taking into consideration, as an example, the Internet: it is a low cost standard with fast interactivity that exhibits

network externalities, moderates time, has a universal reach, acts as a distribution channel, and reduces information asymmetries between transacting parties. Internet plays a critical and profound role in the way firm activities (internal or external) are coordinated, how commerce is conducted, how people and machines communicate, what defines communities and how they interact, and how and when goods are made and delivered.

2. The building blocks of the research

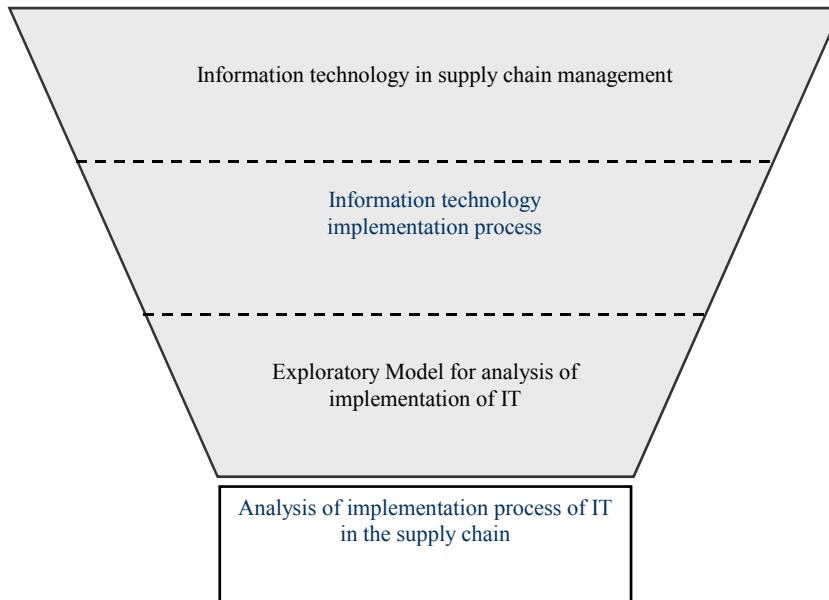
This research is a conceptual blending of two important research streams in the managerial studies, mainly the literature and research on technology and organization and the supply chain management (SCM) literature. When designing the research, and consequently, the aim of the research and the research questions and methods, both theoretical backgrounds were taken into consideration. As stated by scholars (Croom *et al.*, 2000) the supply chain

¹ e-Business Management School, ISUFI, Università di Lecce, Via per Monteroni, 73100 Lecce (Italy); Email: lelio.raffa@isufi.unile.it; L.Raffa@soton.ac.uk, phone +39 0832 421201 – fax +39 0832 323796

(SC) literature is a broader research field that encompasses different component bodies, and among them the object of this research is mostly the literature on relationships, the literature on

organizational behaviour and the literature on the information and communication technologies and their influence in the supply chain.

Figure 1 – The “top-down” approach of the research: from literature to the exploration



In the following brief review we will underline the main findings to which scholars agreed in the studies of information technology in supply chain management, and in the implementation process of IT, that are fundamental for developing the theoretical framework of this research. This framework is built also on the exploratory scheme developed to investigate the implementation process of ICT in a previous phase of the research activity (“the pilot study”). As shown in Figure 1 the theoretical basis of the research converged towards the final aim of building a framework for the analysis of an implementation process of an Information and communication technology by a firm. The framework should allow the evaluation of the effects of the implementation in the relations with the contiguous suppliers and buyers that operate in the supply chain.

2.1 Literature on information technology in supply chain management

The literature on IT in the SCM context has been growing rapidly in the last years, as summarized in

Table 1. From the review of the literature an assumption emerge clearly: information technology can help overcome the problems that plague many supply chains (Boyson, Corsi, & Verbraeck, 2003). In fact the electronic exchange of information leads to a reduction of the number of errors. Consequently this leads to an increased efficiency of the work processes. When companies that are part of a common supply chain can use the information of other companies in the chain, the negative effects of uncertainty can, in theory, be mitigated. The lower level of uncertainty is represented by a lower inventory level, more accurate forecasts since less are based on site-level observations and more on the whole chain condition, there will be less unfulfilled orders, less fragmented logistic services.

In practice the exchange of flows of knowledge, information or technology between companies is not easy, and it is not directly related to the availability of powerful technological tools. The first problems encountered regard the technology itself, many different systems and standards are used, but the number of peer-to-peer relationships with other actors

across the network is too big to manage each relationship in a specific way. Most ICT systems are not able for an easy exchange of flows with other

systems or are not open and flexible enough to fit in the organization without creating distortions (Patterson, Grimm, & Corsi, 2003).

Table 1 - - Literature on information technology in supply chain management

Research methods in P&S; Literature review in P&S.	(Ramsay, 1998; Zmud et al., 2001) (S. Croom, Romano, & Giannakis, 2000)
Purchasing and supply literature on the Information and communication technologies; The ICT impact on P&S activities.	(Akkermans, Bogerd, Yucesan, & van Wassenhove, 2003; Andersen & Rask, 2003; Brenner & Hamm, 1996; Croom, 2001; De Toni & Nassimbeni, 1995; Harland, Brenchley, & Walker, 2003; Laage-Hellman & Gadde, 1996; Plouffe, Vandenbosch, & Hulland, 2001; Rutner, Gibson, & Williams, 2003)
How e-business, practices and tools, implementation effects firms; E-business opportunities for supply chain management.	(Boyson, Corsi, & Verbraeck, 2003; Corsi & Boyson, 2003; Cross, 2000; Muffatto & Payaro, 2004; Pant, Sethi, & Bhandari, 2003; Patterson, Grimm, & Corsi, 2003)
SMEs and internet based technologies implementation in the SCM literature.	(Carbonara, ; Gonzalez-Benito & Dale, 2001; M. Levy, Powell, & Galliers, 1999; Margi Levy & Powell., 2003; Mehrrens, Cragg, & Mills, 2001; Olson & Boyer, 2003; Zheng et al., 2004)
ICT impact on supply chain relationship; Internet based technologies and supply chain relationship.	(Barut, Faisst, & Kanet, 2002; Garcia-Dastugue & Lambert, 2003; Forker & Stannack, 2000; Fürst & Schmidt, 2001; Hausman & Stock, 2003; Roberts & Mackay, 1998; Romano, 2003; Rubiano Ovalle & Crespo Marquez, 2003)

These are some of the many obstacles that have slowed the adoption, and the consequent implementation of supply chain management tools based on internet technologies (Muffatto & Payaro, 2004). A key barrier to full supply chain management has been the cost of communication with, and coordination among, the many independent suppliers in each supply chain. Internet, for many reasons, seems to be the first channel that makes it possible for information, data and any flows of codified knowledge to be available and visible to supply chain actors.

Supply chain management requires the integration of inter-organizational and intra-organizational relationships, in order to reach the coordination of the different types of flows that run along the entire supply chain (information, financial, material, knowledge), although there is high consensus on these ideas, there has been little investigation on the use of e-collaboration tools and opportunities and their impact on the SC performance (Rubiano Ovalle, Crespo Marquez, 2003); or on the issue of measuring the effectiveness of these tools and of the increase of information flows that they enhance (Barut et al., 2002).

How e-business, practices and tools, implementation effects firms and relations along the supply chain is in particular a subject that started to draw some attention in recent years (Garcia-Dastugue & Lambert, 2003), and some scholars have started to focus their attention on the so-called e-supply chain (Pant, Sethi, & Bhandari, 2003). The work on the effect of this new technology on the relationships already in place (Hausman & Stock, 2003) is particularly interesting for the research question proposed in this paper. This research proposal is different, compared to similar works, because it proposes a deeper and more qualitative understanding of the dynamics of the implementation and co-evolution of technology and organization using a structural approach.

In the following paragraphs the state of the art of the literature in this field will be summarized.

2.2 Literature review on the implementation process of information technology

Implementation is a technical and organizational issue with a scope varying from preparation of data, training and learning, to testing, and acceptance in the organizational structure of the newly implemented technology (Avgerou and Cornford 1998). The

narrative of implementation of a system is seen as problematic, sometimes conflictive, and bound up in a complex set of political actions and reactions, situated accommodations, and learning.

In the following paragraphs the structure of Orlikowski and Gash (1994) is used to analyse the different approach to the implementation process. Then the concept of frames and technological frames in order to set the basis for the Technological Frame Analysis will be introduced.

Various distinct theoretical positions characterize the interpretation of the implementation activities:

- The school of **technological determinism** assumes that these artefacts are potent external forces, technology is an objective factor, and is completely autonomous from humans and has an instrumental power over organizational and social properties (Sproull and Kiesler 1986; King 1991). Determinism holds that everything is "determined" by a sequence of previous conditions and events, operating with regularity and, in principle, predictability.
- The school of **organizational imperativism** sees the artefacts as equally potent but manageable, as a means to an end, with their power at the disposal of wise planners, managers or reformers. Implementation is defined as the introduction of changes through a choice of new artefacts with the purpose of creating strategic and sustainable links between the business environment, business processes, and organizational forms.
- In contrast to the above, the school of **socio-technical interactionism**, considers information artefacts as, to some degree, multivalent, as needing refinement, shaping, and situating within the social structures of the organization (Lin and Cornford 2000). Implementation is defined as an explicit, creative and contextual process of linked and mutually sustaining social and technological shaping negotiated within the organizational setting (Kling 1980; Markus 1983).
- More recent **structuralism** works suggest that the above approaches all provide an incomplete view of implementation and change and emphasize that changes in either organizational or technological properties are the consequences

of situated human actions (Orlikowski 1991; Walsham 1995). Structurationism gives a more prominent role to agency (human action) and the modalities (including information artefacts) through which agency influences, and is influenced by, organizational structures.

To follow the way suggested by Structurationism it is important to introduce concepts borrowed from psychologists. We can assess that a major premise of social cognitive research is that people act on the basis of their interpretations of the world, and in doing so enact particular social realities and endow them with meaning (Berger and Luckmann 1967). In particular the cognitive branch of psychology gives us some very important hints on the concept that we should use to enrich our analysis of agents behaviour in the organization. The *frames* of reference held by organizational members are implicit guidelines that serve to organize and shape their interpretations of events and organizational phenomena and give them meaning (Weick 1979).

By shaping individuals interpretations of organizational phenomena, frames implicitly guide them to make sense of and take action in organizations (Bartunek 1984). To the extent that technology constitutes a core element in organizations, aspects of its members' organizational frames will concern technology.

In accordance to the theories of social constructionists the misalignment is part of the more comprehensive problem of the relation between technology and organization (Berger e Luckmann, 1967), according to these theories human actions model the social structure. Human actions are also strongly influenced by this structure. Interaction between the two components of this system is then the fundamental actor in shaping the social systems. Social constructivism includes a conception of technological development as a contingent process, involving heterogeneous factors. Accordingly technological change is best explained by reference to a number of technological controversies, disagreements, and difficulties, that involve different actors (individuals or groups that are capable of acting) or relevant social groups, which are groups of actors that share a common conceptual framework and common interests. These actors or groups

engage in strategies to win from the opposition and to shape technology according to their own plan.

An important methodological contribution to analyse the specific features of an implementation process using a structural approach is supplied by the Technological Frames Analysis (TFA), a generic conceptual approach for examining cognition when a new technology is encountered (Bijker 1995; Orlikowski and Gash 1994). The underlying assumption behind TFA is essentially structural: people, or groups, act according to the meanings that technologies have for them, and their actions shape the meaning of technologies for others and for institutions. Frames, as such, can be both enabling and constraining.

When using the TFA the most important aspect of the procedure is to find and categorize the actors involved in the process, for example users, technologists, managers, and then take note of their different technological frames for each different domain. In the analysis the key concept to bear in mind is the congruency of the frames, this means that there is an alignment of the frames of the different actors on key elements or categories. As a matter of fact, "By congruent, we do not mean identical, but related in structure (i.e., common categories of frames) and content (i.e., similar values on the common categories)" (Orlikowski and Gash 1994). On the other side the implementation process is more likely to be less successful when there is a high degree of incongruence among the frames of the actors. Incongruence, clearly, brings along misalignments and this is the situation that is more interesting for our analysis.

2.3 Exploratory scheme for the analysis of the implementation process of information technology

In this paragraph the theoretical framework used by the authors is illustrated in order to analyse the implementation process of ICT technologies in the "pilot study".

The implementation process is not linear; i.e. introducing a new technology and taking some pre-determined steps does not guarantee that the new technology would be implemented as initially planned.

On the contrary, such process is characterized by an initial misalignment between the technological and the organizational dimensions. Such misalignment is progressively recomposed through adaptive circles involving both dimensions (Leonard-Barton, 1988; Capaldo et al., 1994).

In this respect, we look at the emergence of misalignments through an internal-organizational perspective. Drawing on the literature, it is possible to identify three main factors that contribute to the emergence of such misalignments among different organizational actors:

Management-expectations. Management perception of the *opportunities* given by ICT technologies: such expectations could span different fields (Esposito, Raffa, 2005)

Technological frames. The way new technologies are pictured by organizational agents is influenced by technological-frames (§ 2.2).

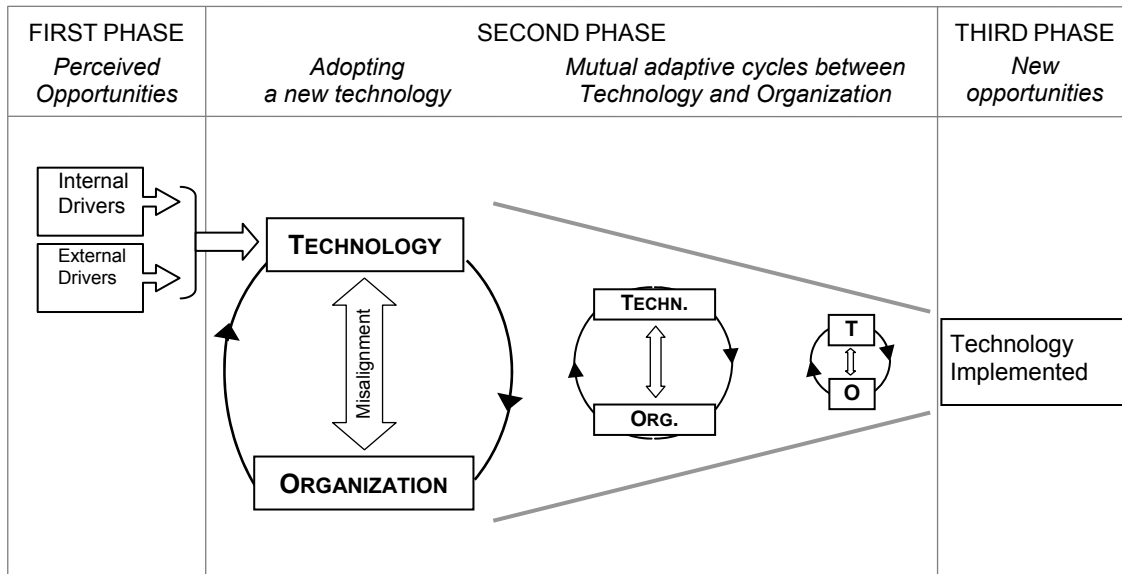
The implementation strategy. The deliberate implementation strategy of the firm is composed by a number and *variety of interventions* (such actions may include: providing incentives, implementing learning activities, promoting skill-building policies, training, changes in procedures, frames). (Majchrzack, Salzman 1989; Leonard-Barton, 1988; Esposito, Raffa, 2005).

Drawing on the theoretical framework presented above a descriptive scheme has been elaborated (Figure 2).

The new ICT can be seen as made up of two dimensions: one is objective and clearly defined, it is the technical hardware/software infrastructure (the so-called *technology*); the second dimension is the subjective representation that the different organizational actors involved in the process use to describe the *technology*, that directly affect the behaviour of the organization. For every factor analysed perception is different depending on the two organizational categories involved, the *management* and the *users* that are the actors involved in the implementation process everyday.

In the **first phase** the drivers boost the decision to adopt and consequently implement the new technology; they are classified according to their source in internal drivers, coming from within the organizational boundary of the firm, and the external

Figure 2 – The implementation process of ICT technologies (DIEG, 2003)



ones. The internal drivers are constituted mostly by perceived opportunities (Majchrzack and Salzman, 1989), perceived organisational problems (Weick, 1979), need to change by implementing a new ICT technology or upgrading antiquate information systems (Leonard-Barton, 1988; Capaldo et al., 1993). Normally the origin of these decisions can be attributed to the management and their consultants (Orlikowski and Gash, 1994).

External drivers normally are stimuli or requirements coming from actors that operate beyond the boundaries of the firm, they can be clients, suppliers or competitors; but they can also be the control commission or the regulator that modifies the operating standards, or the government that can change the legal framework.

In the **second phase** the cycles of adaptation take place, they have an impact on the technological as well as the organizational dimension. As long as it regards the first dimension, the scalability and flexibility of the systems, the decrease of the costs, the increasing standardization of programming languages, the interoperability among different informatics systems and the modularity of software, have dramatically reduced the purely technical problems. On the organizational level the interventions vary from the simple need of defining a single role in a new way, to the need of new

competencies for a role, to the re-definition of the key role in the organization of the firm.

In the **third phase** the interventions that reduce the width of the misalignments tend to minimize and normally using a trade-off between costs and benefits, the management assumes that no more interventions are necessary. They analyse the objectives reached, the resources employed and finally new opportunities are perceived.

3. The aim of the research

Going through the literature on the use of information technology in the supply chain management, and the recent literature on the so-called e-supply chain, it was observed that the interest for the topic is fast growing and different perspectives were adopted to study it. It seems however that a perspective based on the structural view of the co-evolution of technology and organization is still missing, and this consideration, together with the little investigation of the effects and feasibility of e-supply across the chain (Zheng et al., 2004), leads to the research question.

The completed research should permit to answer this question: what are the enablers and barriers faced during the implementation process of internet based technologies in firms that operate in a supply

chain? And how these enablers and barriers link to the management of relationship in firms that operate in a supply chain as purchasers and/or suppliers?

Directly related to this research question a few propositions emerged from the analysis of the literature and the "pilot study":

- In detail, a deep understanding of the past and present state of the relationship through a detailed analysis of the management of the implementation process and its effects on the relationship can help to investigate if the social process of acceptance of newly embedded technologies in the organization is an ongoing process, acting as an "invisible modifier" (hidden learning process), and to what extent. Or if it is possible to highlight a clear change or variation to the state of the relationships of the focus firm. It should be highlighted to what extent the new technologies influence the relationships of the firms in the SC, or if they adapt to the existing set of relationships and just add new potentiality to them. Internet will increase the use of information technology to distribute and restructure work practices, and the pace and rhythm of organizational processes. These changes may have an impact on the implementation of a new technology. Using internet-based technologies as a means of coordination and management of relationships in a supply chain should enable a more interactive approach to co-operation and partnering in the chain context. Is it true that employees with a higher technological know-how can accelerate learning processes and enable richer communication among the different groups involved in the process? On the other hand can employees with a lower level of technological know-how slow down the implementation process? The same effect on successful implementation can also be observed among different actors of the supply chain with different technological know-how?
- The technological frames of the actors involved in the processes are one of the basic variables to consider for determining the effective implementation strategy; a similar reasoning could be applied to the management's expectations. Starting from these considerations

it is interesting to investigate which is more influential in a supply chain: the focus firm' frames and expectations (and according to the previous proposition, its technological know-how level) or the ones of other actors of the chain that have already a leading role in the network.

- It could be more interesting to focus the attention on the implementation processes and problems of SMEs? Although a subject less analysed in implementation literature and e-supply literature it seems to be attracting an increasingly growing attention. The diffusion of modular and lighter technological solutions is finally giving many SMEs the possibility to adopt internet-based technologies that go towards the integration of their supply chain, giving them new opportunities.

It is important to try to answer these questions and propositions, to define the boundaries of the research; this imply stressing the object, the level and the unit of analysis and the nature of the exchange that is under investigation:

- *The object of the analysis*: The impact of the process of co-evolution of organization and technology on the relationships in a supply chain.
- *The level of the analysis*: Chain Level - it "encompasses a set of dyadic relationship including supplier and manufacturer or manufacturer and distributor/retailer" (Croom, 2001), considering the complex context of a supply chain where the inter-connectedness of the actors results in multiple relationships.
- *Nature of the exchange*: The influence of the product technology on supply chain relationships, "the element of exchange is about "what" is exchanged (material assets, financial assets, human resources assets, technological assets, information and knowledge) and "how" relationship between actors are conducted and managed" (Croom et al., 2000). It is necessary to consider in the exchange process, which takes place between the actors of the chain, both the material, or static, aspects and the dynamic aspects, which normally characterize the flows between actors. The focus is on the vertical dyadic relationship taking place within customer – supplier relationship, but at the same time the

other multiple relationships, including vertical secondary supplier and customers and horizontal competitive or co-operative relationships, have to be taken into account.

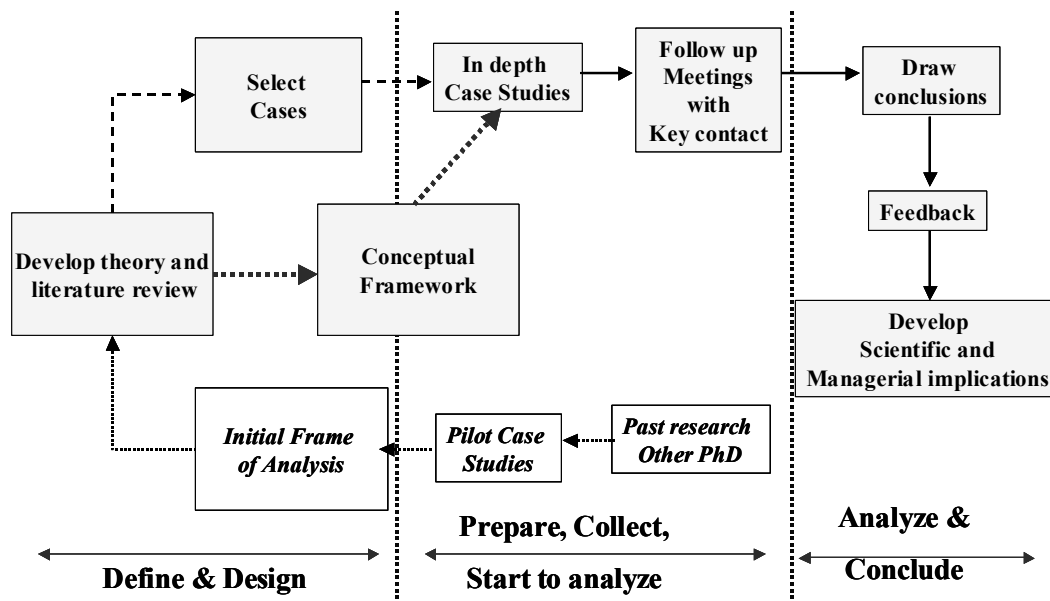
- *The unit of the analysis*: the implementation process of an internet-based product or system; to observe how the linkages that relate the actors in the supply chain evolve after an implementation process. An industry or sector should be studied in order to add both width and depth to the analysis through the comparison of more than one processes.

4. Research methods

Since this is an organizational study, and the unit of analysis is embedded and a “process” unit, the best fitting design seems to be an embedded case study (Figure 3). The research should be a multiple

case study because the evidence that can be obtained from this type of study is considered more compelling, and the results can be regarded as more robust. Taking in consideration that this is not considered in literature a field were unusual or rare case are often emerging and revelatory case should not be found during the research, the case study research method is considered fitting to the research proposal. Other reasons emerged from the “pilot study”, in detail: the boundary of the unit of analysis can be considered quite fuzzy; there is a large number of human actors involved in the process; the focus is on the co-evolution, which is a dynamic concept, with strong implication also at a social level; the methodology is used in the organizational studies for the analysis of the organization behaviour in the technology implementation process (Walsham, 1995).

Figure 3 – Research design of the PhD



The starting point of this research are the models, consolidated in literature, about the implementation processes of new technologies. This stable foundation collected through the literature review is the starting point for the *testing of existing theory*. This testing will be developed with the case study; for which the selection of the focus firms will be done with the sample selection technique of the “purposive sample” (Judd *et al.*, 2002). Furthermore a multiple case study is adopted and supported with the right logical rationale for the case choice, in order to externally validate the findings from the single case

study, to ensure that no case study is unique in any way (Eisenhardt, 1989). The case study includes an on field research with an *in-depth observation* of the different categories of actors (Management, Users) involved in the implementation. This observation will be done for a sustained, in comparison to the length of the PhD. Program, length of time.

The tools that will be used during the field analysis will be mainly semi-structured interviews (Table 2) with managers and key users at different levels and employed in different functions within the firm object of the case study.

Table 2 – TFA Framework for Semi-Structured interviews (adapted from Orlikowski, Gash 1994)

Domains	Management	Users
Implementation Strategy: incentives, learning processes, competence management, skills building, etc.		
Technological Frame: understandings of the process of change that brings technology into the organization		
Management Expectations: concerns about technology in use and impact on work activities related to the improvement of some specific processes such as procurement and sourcing, or the change in the supply-network strategies, etc.		

Furthermore interviews with selected suppliers and customers with a key role in the implementation process, and that are strongly related to the focus firm by relationships that emerged clearly from the previous interviews, will be realised.

In a second stage as many follow-up meetings with the contact that emerged as key within each case, should be put in place. These meetings and the secondary data that will be collected during the field research are planned to act as enhancer of the validity of the research. In the last stage of the research design a comparison of the case studies results with the theoretical propositions or the research questions will be developed in order to reach the managerial and academic implications from the research activity.

5. The scheme proposed for the research

The scheme of the analysis adopted for the research (Figure 2) is the result of the first phase of the research activities carried out in the last year by the research group. In Table 3 the variables and the parameters (*External and Internal drivers*) that constitute the scheme are briefly summarized. The final result of the research should permit to link the key factors influencing the studied process (Management Expectations, Technological Frames, and Implementation Strategy) to the managerial result of a firm (minimization of misalignments, successful implementation process), explaining which are the links between the two objects of the analysis and how their interaction works.

Table 3 – The Variables and Parameters considered in the scheme

Management expectation	Increase quality of the products; Process innovation; Product innovation; New product development; Market results (increase of the market share/turnover increase, etc.); Organizational innovation
Technological Frame	Non compatible individual skill; Misalignments with the methodologies in use; Organizational design
Implementation Strategy	Training; Organizational re-design of functions or tasks; Activities that support the organizational change (e.g. pilot project, research centre activities, etc.)
Internal Drivers	Skills (n° of degree/n° of employees); perceived organizational problems (type and n° of functions production, marketing, administration, distribution, ...); perceived opportunities (cost-cutting, improve information exchange, increase supplier base, improve supplier base, improve time use;); n° of employees
External Drivers	Stimuli or requirements suppliers (No of miscommunications, increase of the lead time, decrease of the available supplier base, etc.); stimuli or requirements from clients (ex. No of reclaims); stimuli from competitors (market shares variations, turnover variations, etc.); standards introduced by the control commission or regulators; governments changes of the legal frameworks

6. Conclusions

To sum up, the expected results of this research project are: the conceptual conclusion, derived from the synthesis of the case studies and the conceptual framework, will be the basis to produce the managerial policy implications and the contribution to the theory.

In particular for the next phases of this research we aim to: develop a taxonomy of the different typologies of misalignments that can be observed in different contexts; identify a scientifically rigorous methodology to measure the misalignments; test the scheme on a larger scale, as well as in different environmental and organizational contexts; and, finally, to underline the managerial and organizational implications that are useful to minimize the misalignments and speed up the cycles of adaptation, in order to prevent the continued existence of situation that prevent the technology to fully express its potential.

To be more accurate it should be possible to highlight the managerial and organizational implications that can help to reduce the degree of the misalignments and speed up the cycles of adaptation. This should lead to a minimization of the risk of institutionalising organizational situation that reduce the potential of the implemented ICT. Furthermore it should be possible to define factors that can help the choice of the right organizational variables, in order to ease the co-evolution of technologies and structural and organizational characteristics, focusing mainly on the incentives. And finally it should be explained how incentives and which types of incentives can help a successful implementation process and ease the co-evolution of technologies and structural and organizational characteristics.

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