Explaining factors affecting technological change adoption

A survival analysis of an information system implementation

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Abstract

Purpose – The purpose of this paper is to explore how drivers differentially speed up the change process adoption in the perspective of a technological change. More specifically, the paper aims to answer the following question: "Which factors impact the technological change adoption speed of an information system?" Based on an empirical study, our results identify three factors that have a direct influence on the speed of technological change adoption.

Design/methodology/approach – Using the Unified Theory of Acceptance and Use of Technology model as a point of departure, the paper analyzes the impact of eight variables grouped in four categories: the perceived attributes of change (performance expectancy and effort expectancy), social influence (peer influence and supervisor influence), facilitating conditions (initial training and helpdesk) and individual characteristics (receptivity to change and self-efficacy). To evaluate which factors accelerate or inhibit change adoption, the paper uses a statistical model of survival analysis.

Findings – Based on a 15-month longitudinal study of a workflow system implementation in a telecommunications firm, the results highlight that performance expectancy, supervisor influence and self-efficacy have a direct influence on the speed of technological change adoption.

Research limitations/implications – As a case study, the research findings may only be valid in the particular organization in which it is developed. Indeed, the organizational culture, the company's internal rules, and the history of the organization are factors which significantly influence the speed of change.

Practical implications – The results may help project leaders to be aware of the elements that must be dealt with effectively if a change process is to succeed within the allotted time.

Originality/value – The statistical model of survival analysis allows analyzing change adoption from a dynamic perspective. This statistical approach is quite new and complementary with most of the studies which are qualitative in the field.

Keywords Case studies, Change management, Unified Theory of Acceptance and Use of Technology, Management information systems, Technological change, Drivers of adoption

Paper type Research paper

1. Introduction

While IT investments are very substantial in many companies (Peppard *et al.*, 2007), technological change management research suggests that the potential benefits of such IT systems within organizations often remain unrealized (Hitt and Brynjolfsson, 1996). According to Neufeld *et al.* (2007), less than one-half of IT project initiatives ever come close to achieving the anticipated results. Aiman-Smith and Green (2002) explained these failures by the fact that the cost of the project exceeds the initial budget due to time overruns. While companies must react quickly to changes in business

Management Decision
Vol. 52 No. 6, 2014
pp. 1082-1100

0025-1747
DOI 10.1108/MD-10-2013-0540

environment (Umble *et al.*, 2003), implementation delays may be very harmful for organizations. The contribution of a new technology to a firm performance can only be realized when and if the new technology is widely adopted (Hall and Khan, 2003).

Adoption itself results of a series of individual decisions based on the basis of various factors. The understanding of the factors affecting these decisions is essential to the technological change management. In the literature, many research articles have sought to determine what factors inhibit the acceptance of new technologies by workers (Nah *et al.*, 2001; Nicolaou, 2004; Bradley, 2008) but to the best of our knowledge, none of them have explored the influence of these factors over time. To answer this gap, our key question here is to differentially answer factors that have an impact on the speed of end-users adoption. This perspective aims to develop a more nuanced approach on levers that managers can use to accelerate the adoption of the IT system. In line with Venkatesh *et al.* (2003), we focus on the four critical factors related to technological use in organizational context: perceived attributes of change, social influence, facilitating conditions and individual characteristics. For empirical analysis we use a statistical model of survival analysis. We present empirical evidence from a 15-month longitudinal study of a workflow system implementation in a telecommunications firm.

The paper is organized as follows. First, we justify our decision to focus on technological change. Second, the theoretical background is introduced. Then, before presenting our findings, the research methodology is explained. Finally, the paper outlines the implications for practitioners and researchers.

2. Background and hypotheses

2.1 The emphasis on technological change

According to Umble *et al.* (2003, p. 241), "companies today face the challenge of increasing competition, expanding markets, and rising customer expectations. This increases the pressure on companies to lower total costs in the entire supply chain, shorten throughput times, drastically reduce inventories, expand product choice, provide more reliable delivery dates and better customer service, improve quality, and efficiently coordinate global demand, supply, and production." To accomplish these objectives many firms have changed their information system (IS) strategies, adopting application software packages instead of in-house IT development (Hong and Kim, 2002). Bradley (2008) adds that ISs are often used as a tool to improve customer service, shorten cycle times and reduce costs. The uncontested advantages of IT systems explain why so many large firms have already completed their IT implementations and that demand from small and mid-sized organizations is increasing.

However, despite the perceived importance of such IT systems, many studies have demonstrated that IT projects are very risky (Nelson, 2005; Muscatello and Parente, 2006; Aiman-Smith and Green, 2002). Specifically, Nelson (2005) indicates that due to cost and time overruns only 34 percent of IT projects are judged to be successful. This failure rate may be explained by the fact that the full effects of Enterprise Resource Planning adoptions for firms do not surface until after a considerable time lag (Poston and Grabski, 2001; Hunton *et al.*, 2003; Nicolaou, 2004). In particular, Nicolaou and Bhattacharya (2006) reported that a period of at least two years was necessary before adopters would begin to demonstrate positive differential financial performance in comparison to their non-adopting peers.

Most researchers have overwhelmingly focussed on the critical success factors of IT implementation projects (Nah *et al.*, 2001; Nicolaou, 2004; Bradley, 2008;

Michel *et al.*, 2013). As a case in point, Nah *et al.* (2001) highlighted 11 critical factors in a comprehensive literature review:

(1) ERP team work;
(2) change management program and culture;
(3) top management support;
(4) business plan and vision;
(5) business process reengineering;
(6) project management;
(7) monitoring and evaluation of performance;
(8) effective communication;
(9) software development and testing;
(10) project champion; and
(11) appropriate business and IT legacy systems.

Nicolaou (2004) reported that ERP implementation success relies on user participation and involvement in system development, assessment of business needs, and data integration into the new system. More recently, Bradley (2008) showed that choosing the right full time project manager, training personnel and the presence of a champion all affect project success. He added that successful managers must focus their scarcest resource – their time – on those things that make a difference between success and failure. Lately, Michel *et al.* (2013) argued that the predisposition of individuals toward a specific change project will be influenced by the way the change is managed.

While most studies have analyzed why end-users adopt or reject a technology at a point in time, only a few have been oriented toward the influence of technological and social factors on adoption over time. As a case in point, Vas (2005) and Bruque and Moyano (2007) investigated through case studies the factors that reduce the time lag necessary before end-users would adopt the new IT system. Knowing the factors which influence the speed of adoption would indicate which characteristics new technologies should possess and how it should be implemented to become quickly and widely adopted. As a complement to these qualitative studies, the objective of our study is to prioritize the factors that have an impact on the speed of end-users adoption. Specifically, this research aims to explore how drivers differentially speed up the change adoption process in a perspective of a technological change, in the case of a top-down change imposed by top managers on field employees.

2.2 The drivers of adoption

When a technological change is implemented, end-users may decide to adopt it or resist it based on the evaluation of the features of the IT introduction (Kim and Kankanhalli, 2009). By analyzing the technology acceptance literature, it appears that several theoretical models have searched to explain technology acceptance and use: the theory of reasoned action, the technology acceptance model, the motivational model, the theory of planned behavior, a model combining the technology acceptance model and the theory of planned behavior, the model of PC utilization, the innovation diffusion theory, and the social cognitive theory (Venkatesh *et al.*, 2003). By synthesizing these eight theories/models of technology use, the Unified Theory of

Acceptance and Use of Technology (UTAUT) was formulated, with four core determinants of intention and usage of information technology: *performance expectancy*, *effort expectancy*, *social influence* and *facilitating conditions*. *Attitude toward using technology* and *self-efficacy* were theorized within the model not to be direct determinants of intention. This unified model was tested empirically and found to outperform the eight individual models. As previous models explain between 17 and 53 percent of the variance in user intentions to use information technology, the UTAUT model explains about 70 percent of the variance in behavioral intention to use a technology and about 50 percent of the variance in technology use (Venkatesh *et al.*, 2012). In this perspective, Venkatesh *et al.* (2003, p. 425) argued that "UTAUT provides a useful tool for managers needing to assess the likelihood of success for new technology introduction and helps them understand the drivers of acceptance in order to proactively design interventions." In line with the UTAUT (Venkatesh *et al.*, 2003, 2012), our model consists of four dimensions that may affect the speed of change adoption:

(1) perceived attributes of change (performance expectancy and effort expectancy);

(2) social influence (peer influence and supervisor influence);

(3) facilitating conditions (initial training and helpdesk support); and

(4) individual characteristics (self-efficacy and personal receptivity).

Although self-efficacy and personal receptivity to change were considered as indirect determinants in the UTAUT model, we want to analyze whether these two variables may affect the speed of adoption.

2.2.1 Perceived attributes of change. Concerning the perceived attributes of change, the UTAUT theorizes that individual technology acceptance is determined by two distinct but interrelated beliefs: *performance expectancy* and *effort expectancy*. *Performance expectancy* is defined as the degree to which an individual believes that using the system will help him or her to attain gains in job performance (Venkatesh *et al.*, 2003). This concept was first proposed under the term "perceived usefulness" in the Technology Acceptance Model (Davis *et al.*, 1989) before being reformulated as "job-fit" in the model of PC utilization (Thompson *et al.*, 1994), as "outcome expectations" in the social cognitive theory (Compeau and Higgins, 1995) and as "relative advantage" in the innovation diffusion theory (Rogers, 1995). *Effort expectancy* is defined as the degree of ease associated with the use of the system (Venkatesh *et al.*, 2003). Three constructs from previous studies capture this concept: "perceived ease of use" (TAM), "complexity" (model of PC utilization) and "ease of use" (innovation diffusion theory).

2.2.2 Social influence. Social influence is defined as the degree to which an individual perceives that important people believe he or she should use the new system (Venkatesh *et al.*, 2003). According to Kets de Vries and Balazs (1998), this social support is one of the most important factors in helping an individual overcome the barriers to change. Following this line of reasoning, they suggest that "people who decide to embark on a journey of transformation often seek out people who can give them the support they need" (Kets de Vries and Balazs, 1998). Given that the subjects in our study have no subordinates, social influence is limited to peer influence and supervisor influence.

Peer influence. As teams have become the basic unit through which work is carried out in organizations (Balkundi and Harrisson, 2006), it seems crucial to incorporate the interactions that take place within these teams in our analysis. In fact, Eby *et al.* (2000) point out that interpersonal and social dynamics within one's work group may impact organizational readiness for change. Specifically, they add that "if an employee has trust and confidence in his or her peers then he or she may be more likely to report that the organization is ready for change to a team-based structure" (Eby *et al.*, 2000, p. 426). As Tenkasi and Chesmore (2003, p. 288) remark, "for successful on-time change implementation, learning has to occur organization wide as the whole system assumes a new architecture, and for effective use of the change, there has to be learning within the units of a network as they craft local approaches." To ensure that people will use the new IS, new shared meanings and understandings have to be developed through local sensemaking and learning processes. As early as 1987 Burtshowed that the adoption behavior of change recipients can be influenced by the advice of co-workers and how many others have already adopted. The interaction, in terms of frequency and richness, between members of a social group can enhance the speed of innovation adoption (Zaltman *et al.*, 1973; Zmud, 1984).

Supervisor influence. A number of studies (Gomez and Rosen, 2001) address the importance of a trusting relationship between managers and employees as the basis for organizational change initiatives (Oreg, 2006). In this regard, Oreg (2006) observes that supervisors who are able to inspire employees and instill in them a sense of trust appear to be most effective in circumventing resistance to change. Along the same lines, Oxtoby *et al.* (2002) add that each supervisor would be expected to play the role of "key player" to cascade the vision embedded in the corporate strategy. Considered as effective leaders in their particular part of the organization, direct supervisors are responsible for communicating an inspirational vision of the change project (Neufeld *et al.*, 2007). In fact, the supervisor's support may play a central role in mobilizing and motivating employees toward change. Specifically, the leadership relationship they have with their employees may be associated with employees feeling that they are operating in a context in which change is supported. In this line, Pardo-del-Val *et al.* (2012) suggested that supervisors should give their employees the opportunity to question aspects that could endanger changes.

2.2.3 Facilitating conditions. Facilitating conditions are defined as the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system (Venkatesh *et al.*, 2003). In other words, this perceived organizational support refers to an employee's perception that the organization cares about his or her concerns (Eisenberger *et al.*, 1986). According to Eby *et al.* (2000), this support may impact an individual's reaction to the impending change such that it is perceived as less threatening (Rush *et al.*, 1994), and may influence his or her overall schema for organizational change such that the change is viewed more favorably (Lau and Woodman, 1995). In the IS context, we refer to service efforts targeted to end-users such as initial training or the helpdesk, which are resources invested in organizational learning (Davis *et al.*, 1989).

2.2.4 Individual characteristics. The issue here is to analyze whether individual traits, viewed as indirect determinants of user acceptance in the UTAUT model, may have an impact on the speed of change adoption.

Personal receptivity to change. Change receptivity is recognized as an important factor in successfully implementing organizational change strategies (Frahm and Brown, 2007). Specifically, change receptivity has to be considered as a persistent personal propensity to innovate and change (Midgley and Dowling, 1978). This notion can be associated with the construct of Personal Innovativeness in the Domain of Information Technology (PIIT) which is defined as "the willingness of an individual to try out any new information technology" (Agarwal and Prasad, 1998a, p. 206). In any given population, some people are more willing than others to try new things and will precede their peers in adoption. According to Agarwal *et al.* (1998b), individuals with high PIIT are likely to be impulsive by nature and may not think through the reasons and implications for their actions. In other words, they may "dive in" and try the technology due to their curious and risk-taking nature. Consequently, PIIT seems as important as other factors in accelerating the speed of change adoption.

Self-efficacy. It has recently been proposed that the concept of self-efficacy is important to the study of individual behavior toward information technology (Agarwal, 2000). Social Learning Theory (Bandura, 1977, 1986) claims that self-efficacy, a belief in one's capability to perform certain actions, is a major determinant of choice of activities, degree of effort, period of persistence, and level of performance in the face of challenging situations. According to Armenakis *et al.* (2007), self-efficacy can be defined in the context of organizational change as the perceived capability to implement a change initiative (Bandura, 1986). They add that employees must believe they are capable of performing actions required by the change initiative. Otherwise the outcome of the change initiative may be less than expected. In the IS literature, it is expected that an individual who has a strong sense of her or his computer capabilities (a self-efficient agent) will be more willing to accept and use the new system. More precisely, Compeau and Higgins (1995, p. 191) define computer self-efficacy as "an individual's perceptions of his/her ability to use computer (software) in the accomplishment of a task."

2.3 The speed of change adoption

A literature review reveals several indicators of technological change adoption. Among them we find: the frequency of use (Davis *et al.*, 1989), the decision whether to adopt or reject (Rogers and Shoemaker, 1971; Gatignon and Robertson, 1989), and the number of people who adopt the innovation during one period of time (Rogers, 1995). These indicators constitute discrete and dichotomous measures that are static and that ignore variations over time in terms of the degree of adoption by the targeted population. Lately, Hall and Khan (2003) suggested considering the diffusion of a technology as a continuous process. According to them, "diffusion can be seen as the cumulative or aggregate result of a series of individual calculations that weight the incremental benefits of adopting a new technology against the cost of change. The resulting diffusion rate is then determined by summing over these individual decisions." In this contribution, we analyze how technological and social drivers influence the speed of adoption. While adoption has generally been studied from a static view, the longitudinal nature of our research enables us to move toward a dynamic perspective through four moments of observation during the adoption process.

3. Method

3.1 Research setting

The research reported in this paper pertains to a major change project at a large European telecommunications company that we shall call Technico (invented name). The "Work Force Management System" (WFMS) is an integrated management system whose purpose is to optimize the distribution of field technicians' work by selecting those who are the closest to the intervention and the most competent to perform the work (Figure 1). This project aims to implement an IT system handling technical and commercial information and generating work orders that are directly sent to field technicians. Practically, instead of being faxed to local offices, data is directly sent to the laptop of every field technician. While field technicians were used to receive from their local responsible all the work orders for the day, they now receive their work orders via their laptop based on what they have already done during the day. In this perspective, field technicians have constantly to encode into the system what they are busy with. To familiarize technicians with the new system, three-day training was organized for each of them. An important element to highlight about this kind of project is that at any point in time the choice being made is not a choice between adopting and not adopting but a choice between adopting now or deferring the decision later (Hall and Khan, 2003).

Thanks to frequent contact with the organization, the researcher benefited from full access to end-users. As the researcher was in regular contact with end-users (interviews, meetings), he took advantage of these opportunities to administer the questionnaire. In order to avoid any bias related to cultural differences, we decided to restrict our sample to French-speaking workers. Based on this criterion, our sample consists of nine local services located in Wallonia and Brussels, for a total of 63 field technicians. It should be noted that these field technicians are fairly homogeneous in terms of age and seniority (Table I). Empirically, data were collected four times over a period of 15 months, i.e. one month before implementation ($T-1$), one month after implementation ($T+1$), five months after implementation ($T+5$) and 15 months after implementation ($T+15$).

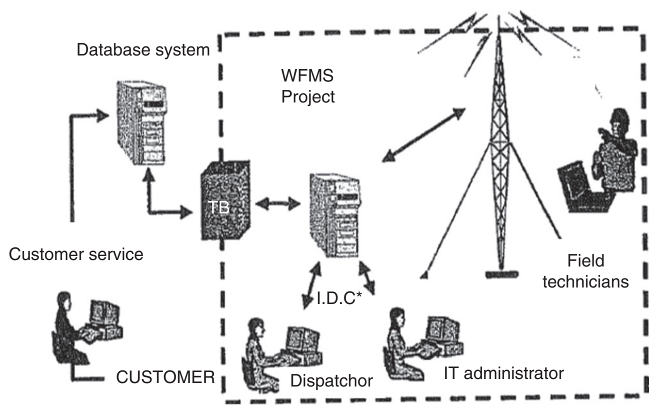

Figure 1.
The Work Force Management System

Table I.
Descriptive statistics of the sampling

Variable	Obs	Mean	SD	Min	Max
Age	63	47.46	3.69	39	54
Seniority	63	26.70	4.2	18	37

3.2 Dependent variable
As it is never easy to define indicators that can capture the time dimension in change, the difficulty in our study lies in the choice of a dependent variable able to operationalize the speed of change adoption. Typical dependent variables for studying adoption process include binary adoption/non adoption, time of adoption and frequency of use (Fichman, 2000). These indicators constitute discrete and dichotomous variables that ignore all possible variations in the degree of adoption by members of the target population. In this study, adoption is analyzed in terms of the relative speed with which a change is adopted by members of a social system. The most common approach to measuring adoption is to ask adopters to express judgments about their own adoption behavior by comparing several proposals (Evrard *et al.*, 1997). Specifically, participants estimated the degree of their adoption on a four-point ordinal scale: 1 = opponent: "I am against the new system"; 2 = skeptic: "I am not convinced by the new system"; 3 = supporter: "I am convinced by the new system"; 4 = champion: "I am ready to defend the new system in front of my colleagues." This metric captures the opinion of adopters four times over a period of 15 months.

To test the reliability of our indicator, we compare the self-assessment by respondents with their direct supervisor's assessment of adoption behavior. As it was difficult for the supervisor to detect through the behavior of his employee the nuances between "opponent" and "skeptic" and between "supporter" and "champion," we decided to aggregate the four initial categories into two generic categories: the categories "opponent" and "skeptic" formed a generic category called "against change" and the categories "supporter" and "champion" formed a generic category called "for change." For the four periods studied, we have convergence coefficients of 0.94; 0.94; 0.84 and 0.81, respectively (Appendix). Self-assessment by respondents seems to fully capture their degree of willingness to change.

3.3 Independent variable
3.3.1 Perceived attributes of change. *Performance expectancy* and *effort expectancy* were treated as separate items and they were not combined, since they were assumed to present different dimensions. These variables were measured with two statements using seven-point Likert-type scales, from (1) strongly disagree to (7) strongly agree. The statements were: "My work is easier with the introduction of the new system" and "It is hard to use the new system in my work."

3.3.2 Social influence. Social influence was evaluated from peer and supervisor perspectives. *Peer influence* and *supervisor influence* on the adoption of the new system by the adopters were measured with two statements using seven-point Likert-type scales, from (1) strongly disagree to (7) strongly agree. The statements were: "I was frequently in touch with my colleagues concerning the new system" and "I was frequently in touch with my direct supervisor concerning the new system."

3.3.3 Organizational supports. *Initial training* was measured with one item. The participants expressed their opinion on a statement using a seven-point Likert-type scale, from (1) strongly disagree to (7) strongly agree. This statement was as follows: "The initial training session was effective in learning how to use the new system."

Helpdesk support was measured with one item. The participants expressed their opinion on a statement using a seven-point Likert-type scale, from (1) strongly disagree to (7) strongly agree. This statement was as follows: "I was frequently in touch with the national helpdesk center concerning WFMS."

3.3.4 Individual characteristics. The characteristics of change recipients were captured through *personal receptivity to change* and *self-efficacy*. We measure the responses to two statements using a seven-point Likert-type scale, from (1) strongly disagree to (7) strongly agree: "I like change in my job" and "I feel skilled enough to work efficiently with the new system."

3.4 Statistical analysis

We used "event history analysis" to determine the speed of change adoption, measured over time from the start-up of the WFMS to the acceptance decision by employees. Event history analysis is a term commonly used to describe a variety of statistical methods that are designed to explain or predict the occurrence of events (Hardy and Bryman, 2004). This method, often called "survival analysis," is widely used in the life sciences field but also in economics and management, especially in research on firm survival (Durand and Obadia, 1998; Manigart *et al.*, 2002). Survival analysis concerns analyzing the time to the occurrence of an event. Compared with standard statistical methods, the survival model works on the assumption that when the study ends and the analysis begins, one will typically find that the event in question has occurred for some individuals but not for others (Aalen *et al.*, 2008). One major advantage of this kind of model is its ability to deal with missing information, called censored information. In our study, if the subject did not accept the change at the end of the observation phase, the subject was censored "on the right," that is, his time adoption is only known to exceed 15 months. For "right-censored" people, i.e. not yet adopting, we cannot observe this event but we can record the time since they were initially polled.

Among the families of the parametric time distributions, we chose an exponential distribution, based upon the survival function $F(t) = 1 - exp(-\lambda t)$ where λ consists in a constant rate of change over time. The underlying property of the exponential distribution is the specification of a constant hazard rate. In other words, this approach assumes that the chance of accepting change is constant over the lifetime of the process. We also tried to relax this constraint with a Weibull distribution within which the hazard function was increasing or decreasing over time, but without improving the quality of estimations.

In presenting our findings, we display the hazard ratios rather than the conventional coefficients (as in familiar regression models). They are simpler to read and understand; hazard ratios indicate the effect of a one-unit change in the covariate on the risk of adopting change. More specifically, the hazard ratio is the ratio of the hazard rates corresponding to the conditions described by two levels of an explanatory variable. For example, a hazard ratio of 2 is thought to mean that a person has twice the chance of adopting the new system than another person. Hazard ratios in one model are directly comparable with each other. Consequently, the higher the positive hazard ratio, the more effective the covariate (the explanatory variable) on the adoption process.

4. Comments on the findings

4.1 Descriptive findings

Table II reports the descriptive statistics of independent and dependent variables, and Table III presents the correlation matrix.

It is interesting to note that only one third of the subjects had accepted the change at the end of the observation phase. In other words, 42 out of 63 people have been censored on the right. This seems consistent with the studies of Poston and Grabski

Dependent variable	Proportion	SE	(95% Conf. Interval)	
Adoption				
0	0.667	0.0599	0.547	0.786
1	0.333	0.0599	0.214	0.453
Time				
t–1	0.032	0.022	−0.013	0.076
$t+1$	0.063	0.031	0.001	0.125
$t+5$	0.048	0.027	−0.006	0.102
$T+15$	0.857	0.044	0.768	0.946
Independent variables	Min	Max	Mean	SD
Performance expectancy	1	7	3.540	1.740
Effort expectancy	1	7	4.206	1.780
Peer influence	1	7	4.127	1.800
Supervisor influence	1	7	4.254	1.731
Initial training	1	7	4.603	1.571
Helpdesk	1	7	3.762	2.241
Receptivity to change	1	7	3.746	1.402
Self-efficacy	1	7	4.619	1.745
Age	1	7	4.746	3.693

Table II.
Descriptive statistics

	Performance expectancy	*Effort expectancy*	*Initial training*	*Helpdesk*	*Peer influence*	*Supervisor influence*	*Self-efficacy*	*Receptivity to change*
Performance expectancy	1.000							
Effort expectancy	−0.229*	1.000						
Initial training	−0.097	0.030	1.000					
Helpdesk	−0.062	0.247*	−0.100	1.000				
Peer influence	0.354***	−0.028	0.280**	−0.100	1.000			
Supervisor influence	0.414***	−0.132	0.198	−0.204	0.362***	1.000		
Self-efficacy	−0.101	−0.052	0.497***	−0.143	0.298**	0.032	1.000	
Receptivity to change	−0.016	−0.095	0.202	−0.297**	0.166	0.200	0.072	1.000

Notes: $^{*}p<0.10$; $^{**}p<0.05$; $^{***}p<0.01$

Table III.
Correlation matrix

(2001), Hunton *et al.* (2003) and Nicolaou (2004) which suggest that the full effects of IT adoptions for firms do not surface until after a two-year time lag.

4.2 General findings

Our findings are presented in Table IV. We analyze our findings in relation to the four categories – perceived attributes of change, social influence, facilitating conditions and individual characteristics – that we introduced in the background section.

4.2.1 Perceived attributes of change. As the perceived attributes of change are concerned, the results report that the *performance expectancy* speeds up the processes of change whereas the *effort expectancy* does not seem to impact on the speed of adoption of the new technology. Our findings are partially consistent with the literature

Table IV. Hazard function results for the speed of adoption

Covariates	Haz. Ratio	SE	*z*	*p* > *z*
Performance expectancy	1.668	0.228	3.740	0.000
Effort expectancy	0.958	0.122	−0.340	0.734
Peer influence	1.125	0.189	0.700	0.485
Supervisor influence	1.878	0.285	4.150	0.000
Initial training	0.558	0.115	−2.820	0.005
Helpdesk	0.726	0.104	−2.230	0.026
Receptivity to change	1.171	0.171	1.080	0.279
Self-efficacy	2.247	0.488	3.730	0.000
Age	1.037	0.071	0.530	0.599

Notes: $n = 63$ case (21 events), Log likelihood = −31.709, $\chi^2 = 179.34$

(Thompson *et al.*, 1994; Venkatesh and Davis, 2000). Given the characteristics of the change studied, it is unsurprising that the complexity of the new system is statistically insignificant to explain the speed of adoption. In fact, as it seems quite simple to encode data within the system, the effort expectancy for field technicians is limited to the use of a laptop.

4.2.2 Social influence. The results for social variables are uneven. On one hand, the coefficient for the *peer influence* variable does not have a significant value. These results are not surprising given our research context. Indeed, field technicians are not organized on a team-based working arrangement but are each assigned to specific places according to their work orders. In this specific organizational context, opportunities to interact are few. In this perspective, this study calls for additional research that would clarify the precise role of interactions among peers during the change process. Recently, Balogun (2003) states that change recipients need to communicate with their colleagues, to gather information, ask questions, swap experiences and exchange gossip and stories as they try to interpret what is expected of them in the changed organization. Balogun (2006) even adds that lateral and informal communications between peers are just as important, if not more important, than formal and vertical communications in the development of what change is about. In this perspective, we believe that these interactions among peers may alter change processes in different ways, both positive, (knowledge sharing) and negative (more powerful refusal by group than by individuals) social pressures. However, since these conversations often take place informally, we may assume that it would be difficult for end-users to be aware that they are making sense of the new system during these interactions.

On the other hand, the role of the direct supervisor appears to be one of the most decisive factors. Managerial commitment and support have received consistent attention in the literature as an important influence on technological change adoption in organizations (Agarwal, 1998c). Brown and Vessey (2003) state that top management being committed to the project, not just involved, is a success factor. Liang *et al.* (2007) found that management participation positively affects the degree of ERP usage. In general, deliberate managerial action from the direct supervisor and from the project change managers can have a profound impact on individual adoption of change. Managers can provide appropriate, decentralized support through local communication channels; they can ensure adequate resource availability through the provision of dedicated training and other means of support.

4.2.3 Facilitating conditions. The organizational side of the change process also produces striking results.

First, it appears that *initial training* has an influence, but a negative one. Such a result is surprising considering the literature on IS management. Most studies highlight the fact that the full benefits of an IT system cannot be realized until end-users are using it properly. In this perspective, it has been suggested that reserving 10-15 percent of the total IT implementation budget for training will give an organization an 80 percent chance of successful implementation (Umble *et al.*, 2003). On that basis, we expected the initial training to have a positive impact on the adoption of the system by users. Although training seems essential, the results may be explained by the fact that training was not suited to the specific needs of each end-user. Indeed, Leonard-Barton and Deschamps (1988) found that support was significant only for individuals who reported little interest in experimenting with the technology in question. To find out who needs to be trained and what kind of training is required, the organization should perform a skills analysis by evaluating the qualifications and experience of each operator.

Second, we observe that the implementation of centralized helpdesk solutions do not speed up the process. The covariate *helpdesk* is significant, but with a negative sign. This result is less surprising given that it appears that people being frequently in touch with the national helpdesk tend to adopt a passive behavior and seem to use the support in an opposite way. Moreover, it seems that users would prefer to ask their questions to someone within the company who knows the specificities of their company and who will provide a solution suited to the circumstances. In this regard, Umble *et al.* (2003) suggest that periodic meetings of system users should help identify problems with the system and encourage the exchange of information gained through experience and increasing familiarity with the new system.

4.2.4 Individual characteristics. A striking result is the influence of the self-efficacy dimension on the speed of adoption. This variable seems to be the most influential. In social cognitive theory self-efficacy is defined as employees' belief in their ability to mobilize the motivation, cognitive resources, and courses of action needed to exercise control over events in their lives (Wood and Bandura, 1989). Social cognitive theory has demonstrated the importance of self-efficacy in behavioral change. Individuals with high self-efficacy perform new tasks at much higher levels than do individuals with lower self-efficacy (Bandura, 1997). This explains why two individuals with exactly the same skills will often produce different organizational results. It is one thing to have the skills and another to use them consistently under difficult conditions such as the circumstances typically created during major change. The success of organizational change implementation depends on recipients having the required skills, high confidence and a positive belief in their ability to apply their skills to adopt the new behavior. It therefore seems necessary to better understand the factors that contribute to increased self-efficacy under major change circumstances.

By contrast, being *receptive to change* does not produce the same effect. Note also that age is without any influence in our study. The speed of change adoption is not a generational issue. We do not introduce variables for education levels because the subjects basically had the same background. The results can be explained by the fact that when a change is imposed by management, employees have no choice but to accept it. Under these circumstances, individual differences, such as personal predisposition to change, cannot significantly influence the individual adoption of the new system.

5. Discussion

5.1 Implications for practice

In this study, we developed a model explaining the factors that affect the speed of adoption of a technological top-down change. Choosing to work with a statistical survival analysis, we studied the speed of change adoption from a dynamic perspective, as opposed to static research concerning adoption or non-adoption models. The results of this survival analysis show that performance expectancy, supervisor influence and self-efficacy significantly accelerate the speed of technological change adoption (Table V).

Based on these results, the study has implications for professionals in that it provides some explanations of the factors that could be considered as "best practices" to speed up the adoption of a new IT system.

First, the results for performance expectancy emphasize the importance of communicating with employees at the earliest opportunity about the benefits of the new system in order to facilitate its adoption. In this regard, Balogun and Jenkins (2003) suggest using two levels of communication. First, project leaders should explain the concepts of the changed organization and second, they should allow individuals to work out the implications for themselves. According to them, this second aspect of the communication is necessary to generate new knowledge and make change recipients aware of the benefits of the new system (Balogun and Jenkins, 2003). As soon change recipients are aware of the usefulness of the new system, as soon they will adopt it.

Second, our findings suggest that deliberate managerial action by the direct supervisor and the project change managers can have a profound impact on individual adoption of change. Managers should provide appropriate decentralized support through local communication channels; they should ensure the availability of adequate resources through the provision of dedicated training and other means of support.

Finally, we suggest that building self-efficacy should become a primary focus of management. Especially in a context of a technological change, employees should feel skilled enough to work efficiently with the new system. As a case in point, supervisors and change agents should support a coaching environment and provide positive verbal statements that bring about high levels of self-efficacy.

To address these three factors and counteract the negative impact of an initial standardized training, we suggest the organization to replace its three-day initial training by a program combining videotaped training and on-the-job coaching. The advantages of this program are threefold. First, the videotaped training allows highlighting the usefulness of the new system by showing examples in real situations.

Covariates	Haz. Ratio
Self-efficacy	2.247
Supervisor influence	1.878
Performance expectancy	1.668
Receptivity to change	1.171
Peer influence	1.125
Age	1.037
Effort expectancy	0.958
Helpdesk	0.726
Initial training	0.558

Table V.
Prioritization of the factors affecting the speed of adoption

Second, this type of training allows each field technician to advance at his own pace and go back if necessary. In this way, the training meets the needs of each technician, so that each of them will feel skilled enough to adopt the new system. Third, the on-the-job coaching provides employees with informative feedbacks about how they are using the new system. These feedbacks further increase their self-efficacy by making corrective adjustment to get their behavior to fit the new IT requirements. To be fully effective, this combined program needs to get the support from the direct supervisor. The latest is responsible for encouraging his employees to go through the videotaped training and to express at their coach the difficulties encountered with the new system. Globally speaking, this research is in line with the work of Maguire and Redman (2007) which states that IS lag time is often associated with a lack of attention to softer management practices such as organization development or user involvement.

5.2 Further research

However, there are several limitations to this study that should be addressed. The most serious concern is related to opportunities for generalizing results. As a case study, our research findings may only be valid in Technico's organizational context. Indeed, the organizational culture, the company's internal rules, and the history of the organization are factors which significantly influence the speed of change. However, while the capacity for change is always idiosyncratic to the particular organization in which it is developed, our results may help project leaders to be aware of the elements that must be dealt with effectively if a change process is to succeed within the allotted time.

In addition, the evaluation of our constructs could be strengthened by using multiple items. Although we might argue that indicator interchangeability enables researchers to measure the reflective construct by sampling a single item (Nunnally and Bernstein, 1994), future research could reinforce the results by translating each construct into several indicators. This would allow researchers to identify and eliminate measurement error for each indicator using common factor analysis. Coltman *et al.* (2008) argue, for instance, that using a multi-item indicator, the factor score contains only that part of the indicator that is shared with other indicators and excludes the error in the items used to compute the scale score.

A final limitation is related to how we measure adoption. As we used the opinion of end-users as the dependent variable, it could be interesting to round out our results by focussing future research on the use of the system by change recipients. In a manner similar to Argyris and Schön's (1978) contrast between espoused theories and theories in use, Orlikowski and Hofman (1997, p. 11) suggest that there is a discrepancy between how people think about technological change and how they implement it. Moreover, they add that "this discrepancy significantly contributes to the difficulties and challenges that contemporary organizations face as they attempt to introduce and effectively implement technology-based change."

Because few empirical studies have examined the speed of change adoption, there are numerous avenues for future research and extensions of this study. First, future research could take the analysis further by checking whether the factors that accelerate the "cognitive" adoption of the new system also quicken its effective implementation. Second, researchers could further refine the survival analysis by using a design that would enable researchers to test moderator variables such as age, seniority or experience. In line with the UTAUT model that considers these three factors as moderating variables, future research should explore how age, seniority and experience affect the strength of the relation between independent variables and the speed of adoption. On a different tack, future research could explore whether change being imposed or voluntary has an impact on the factors that speed up change adoption.

Most IS studies have concentrated on the critical success factors of IT implementation projects without taking into account the time lag necessary before change recipients adopt the new system. Using a survival analysis, our study contributes to both the IS and technological change literature by studying the speed of adoption from a dynamic perspective. Following this approach, the study shows that the speed of adoption of a technological change depends on its own terms of implementation.

6. Conclusion

To the best of our knowledge the present research paper is the first to study change adoption through a survival analysis. It gives evidence on the fact that the process is not only dynamic but much more entails different dynamics in the process on a whole. The characteristics of the new IT system, the organizational culture, the group norms as well as the profile of end-users are all factors that may differentially influence the speed of technological change adoption.

Of course, the results presented in this study are limited to the specific context of a telecommunications company. However, the benefit of this research is to highlight the need to consider the IT change in a broader context. Concretely, top managers no longer have to focus their attention only on the specificities of the system but must also examine the elements of the context in which it is implemented. In particular, research has highlighted three elements (performance expectancy, supervisor influence and self-efficacy) top managers must take into account, even if they are not directly connected to the system implemented. This should help us improve the efficiency of IT system implementation and in many cases enhance the customer satisfaction.

In terms of future research, we hope that this paper will open new research avenues in that direction. It would be indeed worthwhile to explore more in-depth theses dynamics in action throughout such processes and to generalize and refine our first empirical outcomes.

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Appendix

T − 1	*Assessment of the supervisor*	
Self- assessment	For	Against
For	1 observation	1 observation
Against	3 observations	58 observations

$$T-1 \text{ Convergence coefficient} = \frac{1+58}{63} = 0.94$$

T + 1	*Assessment of the supervisor*	
Self- assessment	For	Against
For	5 observations	2 observations
Against	2 observations	54 observations

$$T+1 \text{ Convergence coefficient} = \frac{5+54}{63} = 0.94$$

T + 5	*Assessment of the supervisor*	
Self- assessment	For	Against
For	9 observations	2 observations
Against	8 observations	44 observations

$$T+5 \text{ Convergence coefficient} = \frac{9+44}{63} = 0.84$$

T + 15	*Assessment of the supervisor*	
Self- assessment	For	Against
For	25 observations	2 observations
Against	10 observations	26 observations

$$T+15 \text{ Convergence coefficient} = \frac{25+26}{63} = 0.81$$

Figure A1.
Convergence coefficients

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