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Technology-based Service Proposal Screening: Decision Making Effectiveness and Innovation Success

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Abstract

Purpose - Technology-based services (TBS) create substantial value for providers and customers alike. Increasingly short life cycles and high innovation failure rates have turned superior innovation competences into a fundamental source of sustainable competitive advantage. In TBS innovation projects, decision-making in pre-development stages (e.g., in the screening or innovation proposal evaluation stage) is challenging, because TBS proposals are difficult to assess. Decision-makers deal with intangible and often highly complex products, making the decision task very complex. Furthermore, screening decisions are made under conditions of uncertainty and ambiguity. Enhancing decision-making in the screening stage of the innovation process could substantially increase success rates. This article identifies information processing-related antecedents of effective TBS screening decision-making.

Design/methodology/approach - Combining the literatures on service innovation, new product screening and decision-making under uncertainty, we identify antecedents of decision-making effectiveness in the TBS proposal screening stage. We develop a range of hypotheses and test them with data from 251 TBS innovation projects.

Findings - The study demonstrates the importance of decision-making team composition, information use and decision perspective for three dimensions of innovation success. Decision-maker experience and perspective mediate the effects of the composition of the decision team.

Research limitations/implications – Further research is needed to investigate the screening decision-making process. We provide a research agenda based on our findings.

Practical implications - The study helps screening committees enhance their decision-making process, by optimizing committee composition, and making better use of decision maker experience and information.

Originality/value - Little is known about how decision makers exploit previous experience as well as select and process information to deal with the high levels of ambiguity, complexity and uncertainty in a TBS proposal screening setting. This study is the first article to approach the problem from an information processing perspective.

Keywords - Screening, Technology-based services, Service innovation management, Decision-making under uncertainty.

Paper type – Research paper

1. Introduction

Recent developments in information and communication technologies (ICT) and the globalization of markets have created tremendous opportunities for service innovation and the introduction of entirely new technology-based services (TBS). TBS are developed, produced and/or distributed with intensive use of ICT. Successful TBS create substantial value for their providers as well as for their users (Van den Ende and Wijnberg, 2001). However, as a consequence of rapid technological change and volatile consumption trends, product life cycles in high technology industries have become increasingly short. Continuous innovation has thus become essential for firm survival (Edvardsson *et al.*, 1995; Kelly and Storey, 2000; Lehmann, 1997; Schilling, 2008; Storey and Easingwood, 1993).

As a consequence, new services are constantly introduced (Boulding *et al.*, 1997; Johne and Storey, 1998), yet a substantial percentage of these offerings fail to produce a reasonable return on investment (Schilling and Hill, 1998). The investments required and the high rates of failure make TBS innovation very risky (De Brentani, 2000). A substantial research effort exists to identify factors that increase the efficiency and effectiveness of the service innovation process (Boulding *et al.*, 1997; Cooper, 1996; De Jong and Vermeulen, 2003; Droege *et al.*, 2009).

To reduce risk and make the innovation process more manageable, innovation projects are typically subdivided into six or seven stages, separated by more or less rigid go-no-go decision gates (Booz, Allen & Hamilton, 1982; Cooper, 1983). In service innovation, decisions made in the initial phases of the innovation project, the so-called pre-development stages, appear to have a particularly great impact upon innovation success due to the sequential way in which new services are developed (Lievens *et al.*, 1999). In this article, the focus will be on enhancing decision-

making in the screening stage, i.e. to reduce the possibility of making errors in selecting service innovation projects.

Screening, or the process in which a management committee decides whether or not to invest in the development of a new product or service, is an early go-no-go decision in the stage gate process (Cooper, 1994; Schmidt *et al.*, 2001; Schmidt *et al.*, 2009). Enhancing the screening decision-making process could have a substantial effect on service innovation success (Alam, 2003; Calantone *et al.*, 1999; Cooper and Kleinschmidt, 1986; De Brentani, 1986; De Brentani and Dröge, 1988; Johne and Snelson, 1988; Verganti, 1997).

This initial screening decision is considered to be challenging for a number of reasons: as a result of its intangibility, little information is available about the new service itself (i.e., services can only be evaluated when produced) and the market for the service. It is also difficult to predict competitive actions, by the time the new service will be launched. In this respect, there is fundamental uncertainty, since much relevant information about the service, the market and the competition simply does not exist at the time of the decision (Dequech, 2001; Froehle *et al.*, 2000). A second issue is the problem of the complexity of the decision task, i.e. the fact that there are many factors to consider, which are interrelated and interdependent (Simon, 1996). Specifically complicating the evaluation and screening of TBS proposals is the fact that information from a range of business disciplines is needed to assess the interrelated potential strategic, financial, and marketing benefits of the new service proposal (NSP). Due to the specialization and bounded rationality of the decision makers (Simon, 1997), there is also a problem of ambiguity - the subjective feeling of missing information (Frisch and Baron, 1988) - with respect to the information that *is* present to the decision makers. Consequently, new product screening is generally considered very risky and fuzzy (Alam, 2006; Reid and De Brentani, 2004; Veldhuizen

et al., 2006) and is recognized one of senior management's most challenging tasks (Barczak *et al.*, 2009; Cooper, 2009).

The extent to which organizations are able to solve complex problems, such as investment decisions, by effectively managing and processing information cues from the environment as well as using knowledge and available experience (cf. Simon, 1962) is considered to play an important role in determining service innovation success (Lievens, 1996; Lievens and Moenaert, 2000; Moorman, 1995; Van Riel *et al.*, 2004; Van Riel and Lievens, 2004). In a meta-analysis, managerial attitude towards change and innovation, and their tenure and professionalism were found to affect innovation success positively (Damanpour, 1991). However, the potentially crucial roles that information and experience play in solving complex problems (Simon, 1962) have not been studied extensively in the NSP screening stage of the innovation process (Hammedi *et al.*, 2011). The organizational competence to manage and exploit information and experience appears especially relevant in the screening stage due to the relatively high levels of uncertainty and complexity, and inherent ambiguity associated with the unique, intangible, and highly customizable nature of services. Services are difficult to evaluate before production, and it is nearly impossible to use standardized evaluation criteria (Fisk *et al.*, 1993). A screening committee thus evaluates relatively ill-defined proposals. Screening decisions are based on little explicitly available information and are made under substantial time pressure.

In the present study, we therefore investigate the effects of information availability and utilization during screening on innovation success. Specifically, we formulate the following research questions:

Research Question 1: What is the effect on innovation success of information usage in the TBS screening process?

Research Question 2: What is the effect on innovation success of the decision-making perspective - or attitude - used in the TBS screening process?

Research Question 3: What is the effect on innovation success of the position and experience of decision makers participating in the TBS screening process?

By providing at least partial answers to the above research questions, this study contributes to a better understanding of the roles of information and information use in the screening of TBS innovation proposals. The remainder of the article is structured as follows. First, the screening process[i] is discussed in some detail. Based on this discussion, antecedents of effective screening decision-making are identified. Hypotheses are formulated regarding the effects of these antecedents on the probability of innovation success. We then present findings from a survey designed to obtain empirical support for the hypotheses. Furthermore, we discuss the findings and provide managerial implications. Finally, the limitations of the current study and a research agenda are presented.

2. Literature review and hypothesis development

The objective of the screening process is to ensure that scarce firm resources are allocated to those projects that (i) best fit the firm's objectives and strategies and (ii) are most likely to be successful (De Brentani, 2000).

Screening effectiveness depends on the extent to which decision makers succeed in minimizing two types of potential errors: (i) Type I errors, which occur when the company's scarce resources are spent on 'failures' (De Brentani, 2000), and (ii) Type II errors, which occur when ideas that might be successful are overlooked (Baker and Albaum, 1986). An effective screening

process should reduce the risks of Type I and Type II errors and must therefore strike a balance between using criteria and methods that are either too feeble or too rigid (Cooper, 1985). Decision makers should select projects that fit the firm's strategy and strike the right balance between value and risk (Cooper and Edgett, 1997; Cooper *et al.*, 2001).

Some companies use "*ad hoc*" selection methods or select projects based on the "*gut feelings*" of senior managers. Formal selection procedures or screening models are generally considered to help to increase uniformity, to ensure that all projects are evaluated according to the same or similar criteria and to facilitate communication and project prioritization (Boag and Rinholm, 1989). That said, too much formalization could hinder the selection of breakthrough innovations (Sethi and Iqbal, 2008). Cooper (1985) identified different categories of screening models, including financial, scoring and ranking models.

At first sight, financial screening models based on an estimation of return on investment (ROI) in terms of discounted cash flows (DCF) or net present value (NPV) appear to be attractive options. They force decision makers to apply a structured approach. However, as these models are solely based on quantifiable factors that can be forecast, their reliability in the case of innovation projects (especially breakthrough or radical projects) is very limited. During the screening process, limited information is available about the precise nature and costs of the product and its market potential, and thus the uncertainty is very high. At the same time, financial models generally do not take into account considerations of a more strategic nature, such as the extent to which a product contributes to the realization of strategic objectives. They are generally used to deselect projects that do not reach certain minimal financial objectives.

Scoring and ranking models, which involve many factors that are essentially difficult to quantify, have been quite popular (Cooper and Kleinschmidt, 1986). In such models, proposals

are evaluated according to a range of screening criteria (Carbonell *et al.*, 2004; Hart *et al.*, 2003; Tzokas *et al.*, 2004). During screening, criteria such as fit with company strategy and capabilities, and with available human, technological and financial resources are assessed. Market screening can imply an estimate of the market size and evolution, while consumer screening criteria can include product superiority and perceived value for money (Anschuetz, 1996).

Having discussed screening models and objectives in general, we will now develop hypotheses regarding the role of information, the decision-making perspective, and the contribution of the decision-maker.

2.1 The role of information use in the screening process

The evaluation of new service proposals against a background of strategic company objectives and environmental factors is very complex and involves high levels of uncertainty. The level of uncertainty can –to a certain extent- be mitigated by using relevant and up-to-date information during the evaluation process (Schilling and Hill, 1998). The use of relevant and up-to-date information, by providing detailed evidence about the organization, its strategy, its market and its competitive environment, may prevent mistakes, enable intuitive leaps, and help to anticipate important problems in the development of the new service (Cooper and Schindler, 2003). The service innovation process forces decision makers to be engaged in permanent interaction with internal and external contexts (Markus *et al.*, 2002). The extent to which various sources of information are used is by no means standardized and depends on the organizational routines that implicitly or explicitly prescribe the acquisition of information prior to these decisions.

We distinguish two categories of information in the context of innovation decision-making (Kelly and Storey, 2000): 1) Information that is readily available within the organization, and that

helps decision makers to create a realistic mental image of the firm (Van Riel and Lievens, 2004) and 2) information that is externally collected in a proactive manner, explicitly regarding the innovation project under consideration. Internal information, such as information pertaining to the long-term strategy of the company (i.e., business plans), may contribute to a better understanding of the positioning of the new service within the existing product portfolio, while financial information could create a more balanced perspective of the resources available and needed, thus contributing to the quality of the decision. Therefore, we propose the following hypothesis:

Hypothesis 1a: The use of internal information in the TBS proposal screening process improves screening effectiveness.

The second type of information, which is collected externally in a proactive manner, enables decision makers to judge the TBS proposal on its commercial value and technical merits. Consumer screens, market screens and technological screens are among the most common screening criteria that service companies use to evaluate proposals (Ambler and Styles, 1997; Davis, 1997; Langerak *et al.*, 2004). In the high technology service industry, measures of customer acceptance and market potential were found to be more important for innovation performance than strictly financial information (Pavia, 1991). Through market, competitive and technological intelligence, companies gather external information about (changes in) customer needs, market opportunities and potential competitive threats. Therefore, we propose the following hypothesis:

Hypothesis 1b: The use of externally gathered information in the TBS proposal screening process improves screening effectiveness.

2.2 Decision-making perspective

NSP screening decision-making effectiveness depends not only on which information is presented to the decision makers but also on the interpretation of that information in relation to the proposal,

the calculated risk decision makers are prepared to take, and their understanding of the organization (Van Riel *et al.*, 2004). In an organizational setting, the way decision makers perceive, organize, and process information, as well as how these interpretations are used for guiding actions, affect the quality of collective decision-making (Hayes and Allison, 1988). The perspective within which decision makers consider a proposal may, for example, vary in terms of time horizon. Operational decisions are generally made within a relatively short-term perspective (hours, days, weeks), whereas decisions in which strategic issues play a role require a more long-term perspective (years, decennia, depending on industry, firm and project). When NSPs are explicitly viewed as investment opportunities, a long-term view will be prevalent during the decision-making process. Since innovation projects often run over several years, we expect there to be a positive relationship between innovation success and the extent to which decision makers take a long-term perspective - corresponding to the extent of the project - while evaluating the proposal:

Hypothesis 2a: A long-term perspective in the TBS proposal screening process improves screening effectiveness.

The perspective can also vary with how innovative or risk-averse the decision makers are. In operational decision-making, risk is generally reduced as much as possible, whereas in innovation related decision-making a certain amount of risk is not only acceptable, but even desirable and often inspired by an entrepreneurial desire to achieve success. During the screening process, an entrepreneurial attitude (cf. Robinson *et al.*, 1991), reflecting this innovative, risk seeking mind-set, will likely contribute to the amount of information that will be used and thus to the quality of the screening process. Therefore, we propose the following hypothesis:

Hypothesis 2b: An entrepreneurial attitude in the TBS proposal screening process improves screening effectiveness.

2.3 The contribution of decision maker level and the role of experience

The skill with which decision makers select relevant cues from available information and their success in processing them affect screening decision-making effectiveness. How well information is processed and used during the screening process depends on the decision makers' ability to make complex decisions under important uncertainty. The possession of these skills is related to their expertise and experience. These skills and capabilities are not equally distributed over all echelons in the firm (Bartlett and Ghoshal, 1993). For an appropriate evaluation of new service proposals, sufficient insight into a firm's strategic options and choices also appears to be a necessary condition. As they are the originators of the company's strategy, senior management is most knowledgeable with respect to strategic options (Hambrick and Snow, 1977; Harrison and Pelletier, 1998). Thus, we expect that innovation success may be increased by having senior management involved in the screening process (Kelly and Storey, 2000; Lukas and Brodowsky, 1998):

Hypothesis 3a: The involvement in the TBS proposal screening process of senior managers improves screening effectiveness.

The involvement of middle managers in the screening process could make the allocation of resources more realistic. These managers, active at a more operational level, are likely to have a more accurate and realistic view of available organizational resources and capabilities (Bartlett and Ghoshal, 1993), and technological possibilities (Kolb *et al.*, 2000; Smulders, 2004). We therefore expect that:

Hypothesis 3b: The involvement of middle managers in the TBS screening process improves screening effectiveness.

Baker and Albaum (1986) tested different scoring procedures and recommended a mathematical approach, calculating a total score for each NSP evaluated. This method is based on scoring each proposal according to a range of criteria, then assigning weights to each of the criteria in order of their relative importance for the firm. Although the calculation is (or at least can be) highly rational, the input for these models is essentially judgmental in nature. This implies that the experience of the members of the management team involved in the screening decisions is crucial. We therefore expect:

Hypothesis 4: The level of experience of the decision makers involved in the TBS screening process improves screening effectiveness.

3. Methods

An empirical study was designed to test these hypotheses. Data were collected by means of an online survey made available on a university website. Participants were asked explicitly to focus on one specific recent technology-based service innovation project and to indicate the extent to which they agreed with a range of statements on seven-point Likert scales ranging from 'strongly disagree' to 'strongly agree'. The questionnaire was pre-tested for intelligibility on a limited sample. The electronic questionnaire contained undisguised, topically organized statements (Judd *et al.*, 1991).

3.1 Sampling

To obtain a representative sample, the Association for Services Management International (AFSMI) was approached. AFSMI is a professional organization dedicated to furthering the knowledge, understanding, and career development of executives, managers, and professionals in the technology-based services and support industry. An invitation to participate in the survey,

including a short motivational segment and an endorsement from an AFSMI official (the Vice President of Europe, Middle East and Africa) was sent via email to senior executives and managers of approximately 1500 companies active in the technology-based service sector. The email clearly stated the purpose and relevance of the study and included a hyperlink directing the participants to the online survey. We asked participants to reflect on a successful or non-successful service innovation project, the result of which had been introduced to the market in the recent past. To avoid any kind of social desirability bias, we stressed that reports about successful and unsuccessful projects were equally important for our study. This was reflected in our data, since a substantial part of the reported data (35%) concerned unsuccessful projects. As an incentive to participate, we offered a summary of the results to all participants.

3.2 Sample characteristics

A total of 251 usable questionnaires were received within two weeks of the mailing of the initial invitation. Nearly all participating companies operated internationally. Respondents from various parts of the world, mainly US, Europe and Japan, participated in the survey. Occasionally multiple respondents within one company reported on different projects. According to an AFSMI official who regularly organizes such web-based surveys, the response rate in our study (17 %) did not deviate significantly from response rates in earlier studies they facilitated. Since no information was available about the precise composition of the population, the most adequate way to assess non-response bias was deemed to be an examination of differences between early and late respondents. The results were non-significant. Non-response bias does not appear to play a role in the present investigation, and the homogeneity of the sample supports the external validity of the study (Armstrong and Overton, 1977). Due to the design of the web-based survey, the number of missing values was negligible (<.1 %). All participants were employed in companies providing

technology-based services either as a core business or as supporting services for other core products. The functions of the participants ranged from corporate positions (approximately 15 % of the sample) and high-level management (approximately 20 %) to middle management (approximately 65 %). Figure 2 shows the distribution of the survey participants over the various industry sectors. This distribution shows that technology-based services play a role in many major industries. In general, the innovation projects concerned value-added services linked to tangible high-technology products. Detailed information about the nature of the innovation projects was not collected, except for the relative radicalness of the innovation. We used this variable as a control factor in the analysis. However, no significant effect was observed.

Insert Figure 2 Here

Figure 3 presents an overview of the percentages of innovation projects in which specific information sources were used during the screening process. Figure 3 shows that most companies use reports containing information about the company and its strategy. However, only in one third of the observed cases did decision makers make use of external information.

Insert Figure 3 Here

Figure 4 presents an overview of the relative involvement of various types of managers in the initial screening process. Apparently, the screening process is mainly the domain of decision

makers at an operational level, while the CEO and other senior managers are involved in slightly more than half of the screening decisions.

Insert Figure 4 Here

3.3 Measures

No single measure of innovation success is adequate in isolation (Cordero, 1990; Griffin and Page, 1996). The operationalization of success and the relative weights of various indicators depend on the service category studied. To avoid treating new service success as a single dimension (Cooper and Kleinschmidt, 2000), a composite measure was developed (Di Benedetto, 1999) using a balanced set of success indicators (Easingwood and Percival, 1990; Easingwood and Storey, 1993). Based on a literature review, thirteen items were included in the questionnaire. An exploratory principal components factor analysis was carried out. A Scree test and cutoff value of one for the initial Eigenvalues helped to determine the dimensionality. Comparable to the results of a similar study (Alam, 2003), a three-factor solution was obtained, explaining 67 % of the total variance. The interpretation of the three factors was based on the presence of different components in each factor (Hair *et al.*, 1998). Short-term success (STS) represents the most salient aspects of innovation success. Long-term success (LTS) represents factors associated with sustained competitive advantage. Indirect success (IS) reflects the creation of (potentially very long-term) preconditions for future success. All success factors are ultimately important for firm survival, and their relative importance mainly depends on the time horizon used. Note that short- and long-term success are relative concepts, introduced to better interpret the results of the factor analysis.

To obtain measurements of the independent variables, we used single item categorical measures. Respondents were asked whether a specific type of manager was involved, a type of information was used, or a specific attitude was adopted in the screening decision process.

4. Analyses

Internal consistency, reported in Table 1 in the form of composite reliabilities (α), is good as it exceeds .70 - which is generally considered the lower limit - for all factors (Nunnally and Bernstein, 1994). Convergent validity of the factors appears excellent as all AVE (ρ) levels exceed .50 (Fornell and Larcker, 1981). Discriminant validity among the three dimensions is good as correlations between STS, LTS, and IS do not exceed the square root of the average variance extracted (AVE) for any single factor. Confirmatory factor analysis (CFA) performed in LISREL produced acceptable fit statistics: GFI = .96; AGFI= .94; NFI = .96; Chi-Square = 61.62 (df. = 47); P = .12 and RMSEA = .031. Full details of the CFA are reported in Table 1.

Insert Table 1 Here

Categorical items were included in the questionnaire about the use of specific information sources, the involvement of specific types of decision makers and the adoption of a strategic stance. The categorical variables were transformed into dummy variables. These were subjected to hierarchical regressions on the three innovation success variables. Since categorical items were used to measure most independent variables, measurement bias due to common method variance is deemed very low (Malhotra *et al.*, 2006).

Because our focus was on identifying potentially significant relationships rather than confirming relationships supported by prior research, a test for statistical power was crucial (Henseler *et al.*, 2009). The f^2 is the effect size (ES) index, which reflects whether a predictor latent variable has a weak, medium or strong effect on the structural model (Henseler *et al.*, 2009). f^2-values of 0.02, 0.15 and 0.35 are conventional for low-, medium- and high-level effects (Cohen, 1992). f^2-values for the hypotheses are reported in Figure 5. The formula below was used to calculate them:

$$f^2 = \frac{(R^2_{included} - R^2_{excluded})}{1 - R^2_{included}}$$

5. Results and discussion

Insert Tables 2, 3, 4 Here

In Tables 2, 3 and 4, we present the results of the hierarchical regressions on the different success measures. From these tables, it becomes clear that the use of external information, such as market research, and a marketing plan positively affect long-term innovation success, while a business plan affects short-term innovation success. The use of external or internal information does not affect indirect innovation success. Therefore, Hypotheses 1a and 1b are both partially supported by our data. These tables also show that the adoption of both a long-term vision and an entrepreneurial

stance affects the probability of success in nearly all success dimensions. Hypothesis 2 is therefore supported by the data.

The tables further show that, contrary to our expectations (Hypothesis 3b), no significant effects of involving any of the operational managers on innovation success were observed. The participation of senior managers (Hypothesis 3a), however, appears to make a difference with respect to the chief executive officer (CEO) in terms of long-term success and the chief information officer (CIO) in terms of indirect success. The effects in both cases are significant for one dimension of success and close to significant for another. The involvement of the chief operations officer (COO) has a significant effect on all three dimensions of success. This implies that Hypothesis 3a is largely confirmed by our data, while Hypothesis 3b is not confirmed. The presence of a chief financial officer (CFO) does not appear to affect innovation success. At the same time, the experience and decision perspective variables mediate the effect of the involvement of decision makers. The involvement of *experienced* senior decision makers, taking a *long-term* and *entrepreneurial perspective*, leads to the strongest positive effect on success. This provides support for Hypothesis 4. The results are graphically represented in Figure 5. We have included the f^2 values in the model.

Insert Figure 5 Here

The effects of the involved decision-makers on short-term and long-term success are mediated by the decision perspective and by the decision makers' experience. Interestingly, the participation of the CIO has a direct and unmediated effect on indirect innovation success.

6. Summary and conclusion

This study was conducted to investigate the role information use and managerial information processing competencies play in the new service proposal screening stage of innovation projects. Several antecedents of screening decision-making effectiveness were identified, as evidenced by the likelihood of innovation success. Hypotheses were formulated based on theories of decision-making effectiveness. These hypotheses were summarized in a theoretical model, which was empirically tested.

An information processing perspective appears to be appropriate and productive for the study of technology-based service innovation success. The research has demonstrated that it matters which information is used during the screening decision and that it matters who is involved in the decision process. Selection and acquisition of information plays a major role in dealing with uncertainty and increases the probability of success of a selected new service project proposal. However, not all information is equally relevant. Use of a business plan, a marketing plan and financial information during the screening process each influence innovation success in different ways. In spite of its current limited usage, gathering information about the external environment for use in the screening process must be considered especially important. External information was found to contribute significantly to two out of three innovation success dimensions. Furthermore, a strategic perspective consisting of an entrepreneurial attitude of the decision makers and a long-term perspective makes a clear difference during the screening process, as does the participation of certain senior, experienced, managers in the decision process.

In conclusion, the present study has contributed to a number of different strands of research. Several antecedents of technology-based service innovation success have been identified as factors that enhance decision-making during the screening stage of the innovation process.

6.1 Managerial implications

A number of recommendations can be made to high technology service firms. To enhance decision-making in the screening process, companies should consider using both information gathered about the external environment as well as traditionally used sources, such as internal company documents and reports. Strategic intelligence regarding political, legal and economic developments, societal trends, technological progress, market structure and competitive strategies could contribute substantially to the likelihood of innovation projects to succeed. Few companies currently use both sources. External information is currently used by one third of the firms in our sample, and we expect that much can be gained by its increased use.

Second, we recommend that the decision team explicitly take a long-term perspective and an entrepreneurial, innovative, and non risk-averse attitude during the screening decision-making process. Third, we found significant differences in new service success between companies in which the CEO and COO participate in the screening process and those in which this is not the case. These strategic experts and experienced individuals currently participate in the screening process in only a relatively small percentage of high technology service firms. Considering the involvement of senior management in screening decisions seems worthwhile. Involving only operational managers does not appear to lead to the selection of more successful projects. Companies may, however, prefer to keep operational managers involved in the screening process for other reasons.

6.2 Study limitations and suggestions for further research

The identification of information processing-related antecedents of decision-making effectiveness should receive high priority in service innovation research. Uncertainty, complexity and ambiguity occur in different forms and at different levels during the various stages of the innovation process.

The unique nature of the complexity and uncertainty and the way in which decision makers address them affect the performance of the screening and evaluation phase of the innovation process.

Screening decision-making should be studied in more detail, allowing for the identification of other factors that might play a role in the process but are at present difficult to determine. To develop a more detailed model of the screening decision process, we suggest that case studies be conducted so that the intricacies of the relations between different factors can be uncovered

During the screening decision-making process, a high level of residual uncertainty is acceptable, as much of the uncertainty seems to be reduced precisely by making the decision. There are also more creative aspects of innovation-related decision-making that are not based on external information but rather on information that is internal to the decision makers (Kahneman and Tversky, 1982). It is still unclear how uncertainty is reduced by making the decision rather than by collecting and processing information. More conceptual research seems to be needed here. The purpose of the present research was essentially exploratory. A number of factors have been identified that play a role in creating an organizational atmosphere that is favorable to innovation and to the diffusion of information and knowledge throughout the firm.

We expect various dynamic reciprocal and self-enforcing effects between collection, diffusion and processing of information in screening decision-making. Research is needed to study these issues in more detail.

The categorical variables used in the study do not explain unique variance. Clearly, some overlap exists between the contributions of different information sources and between the strategic capabilities of different managers. Research is needed to further develop the constructs pioneered in this study, and multi-item scales to measure them with higher levels of construct and discriminant validity.

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Table 1: Composition of the dependent variables

Constructs / Measurement items	Std. load.	*T*-value	Mean	Std. dev.
Short-term success (□□□□□ρ□□□□□ V = 3.375; VE =				
The new service is an overall success	.70	12.17	4.93	1.483
Success exceeds expectations	.83	15.42	4.23	1.652
The new service adds substantial value to other products & services	.56	9.22	5.10	1.520
The new service was a good idea to invest in	.80	14.76	5.70	1.316
The new service contributed to financial success	.68	11.65	4.45	1.506
Long-term success (□□□□□ρ□□□□□ V = 3.161; VE =				
The new service contributed to commercial success	.56	8.54	4.22	1.416
The new service improved our competitive position	.54	8.87	5.02	1.406
The new service improved brand equity & reputation	.55	9.13	4.43	1.521
The new service enabled expansion into new markets	.88	16.98	4.37	1.596
The new service increased customer satisfaction and loyalty	.86	16.49	5.11	1.322
Indirect success (□□□□□ρ□□□□□ V = 2.179; VE = 1				

The new service increased in-house technological knowledge	.84	15.81	4.70	1.529
The new service increased employee satisfaction	.78	14.09	4.32	1.612
The new service created innovation opportunities	.71	12.40	4.38	1.517

Table 2: Results of the hierarchical regression with long-term success as the dependent variable.

Dependent variable:	Long-term success	Model			
		1	2	3	4
Standardized coefficients (Beta)	Product manager (involved decision maker)	.039	-.004	-.004	.008
	Service manager (involved decision maker)	.038	.024	-.007	.008
	Other managers (involved decision maker)	-.002	-.034	-.069	-.053
	CEO (involved decision maker)	.160**	.119*	.076	.048
	CIO (involved decision maker)	.031	.037	.026	.029
	CFO (involved decision maker)	-.026	-.035	-.037	-.038
	COO (involved decision maker)	.149**	.120*	.052	.046
	Business plan		.017	.048	.021
	Marketing plan		.124*	.124*	.139**
	Financial analysis		.012	.042	.014
	External information		.154**	.146**	.127**
	Long-term vision			.179***	.169***
	Entrepreneurship			.209***	.165***
	Experience				.192***
R squared		.053	.101	.179	.210
Adjusted R squared		.026	.060	.134	.163
Change statistics	R squared change	.053	.048	.078	.031
	Sig. F change	.062*	.015**	.000***	.003***

Significance levels (two-sided): * = p < .10; ** = p < .05; *** = p < .01

Table 3: Results of the hierarchical regression with short-term success as the dependent variable.

Dependent variable:	Short-term success	Model			
		1	2	3	4
Standardized coefficients (Beta)	Product manager (involved decision maker)	-.008	-.032	-.032	-.015
	Service manager (involved decision maker)	.021	-.005	-.039	-.020
	Other managers (involved decision maker)	.044	.011	-.025	-.002
	CEO (involved decision maker)	.005	-.007	-.052	-.090
	CIO (involved decision maker)	.084	.085	.073	.077
	CFO (involved decision maker)	-.019	-.033	-.035	-.036
	COO (involved decision maker)	.153**	.101	.030	.021
	Business plan		.118*	.151**	.114*
	Marketing plan		.010	.010	.030
	Financial analysis		.048	.080	.042
	External information		.119*	.110*	.083
	Long-term vision			.196***	.181***
	Entrepreneurship			.212***	.152**
	Experience				.267***
R squared		.031	.067	.153	.213
Adjusted R squared		.003	.024	.106	.166
Change statistics	R squared change	.031	.036	.086	.060
	Sig. F change	.358	.057*	.000***	.000***

Significance levels (two-sided): * = p < .10; ** = p < .05; *** = p < .01

Table 4: Results of the hierarchical regression with indirect success as the dependent variable.

Dependent variable:	Indirect success	Model			
		1	2	3	4
Standardized coefficients (Beta)	Product manager (involved decision maker)	-.049	-.044	-.051	-.043
	Service manager (involved decision maker)	.045	.040	.004	.013
	Other managers (involved decision maker)	.036	.026	.008	.019
	CEO (involved decision maker)	.084	.079	.049	.031
	CIO (involved decision maker)	.156**	.160**	.147**	.149**
	CFO (involved decision maker)	-.029	-.028	-.027	-.028
	COO (involved decision maker)	.130**	.111	.067	.062
	Business plan		.054	.078	.060
	Marketing plan		-.071	-.074	-.064
	Financial analysis		-.001	.025	.007
	External information		.085	.070	.057
	Long-term vision			.180***	.173***
	Entrepreneurship			.079	.050
	Experience				.128*
R squared		.054	.065	.103	.116
Adjusted R squared		.026	.022	.053	.064
Change statistics	R squared change	.054	.011	.038	.014
	Sig. F change	.060**	.576	.008***	.057*

Significance levels (two-sided): * = p < .10; ** = p < .05; *** = p < .01

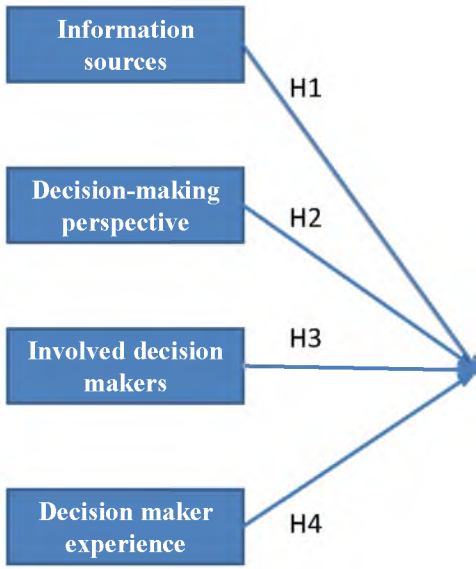

Figure 1: Conceptual model with hypotheses


Likelihood of
success

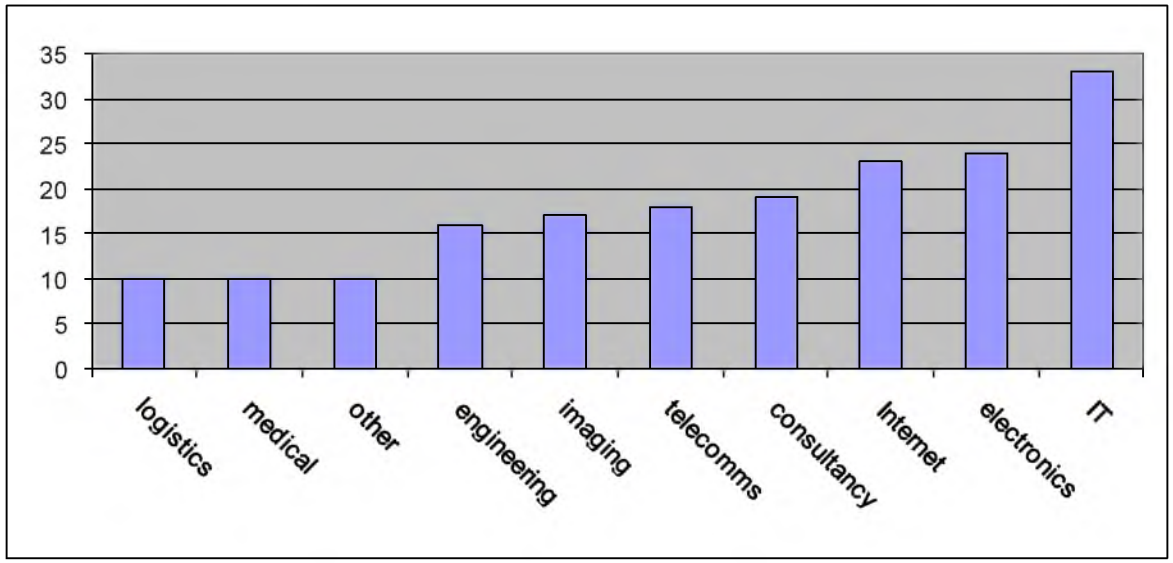

Figure 2: Industry origins of survey participants

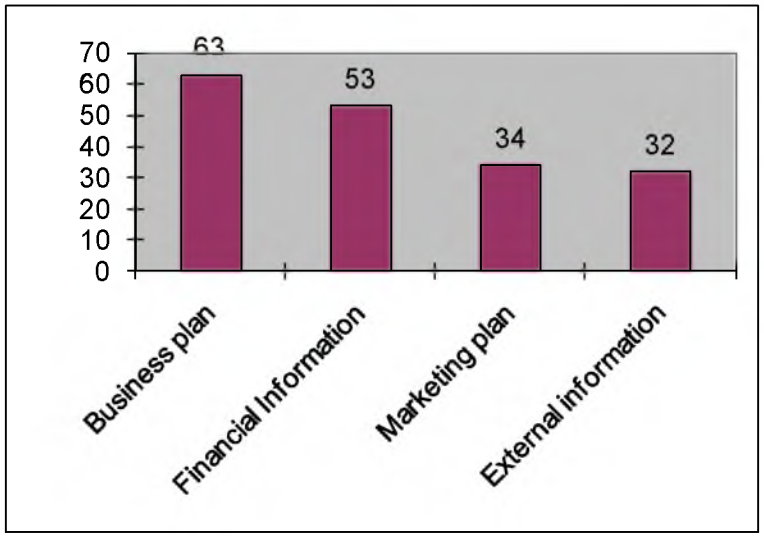

Figure 3: Information used in screening decisions, in percentages

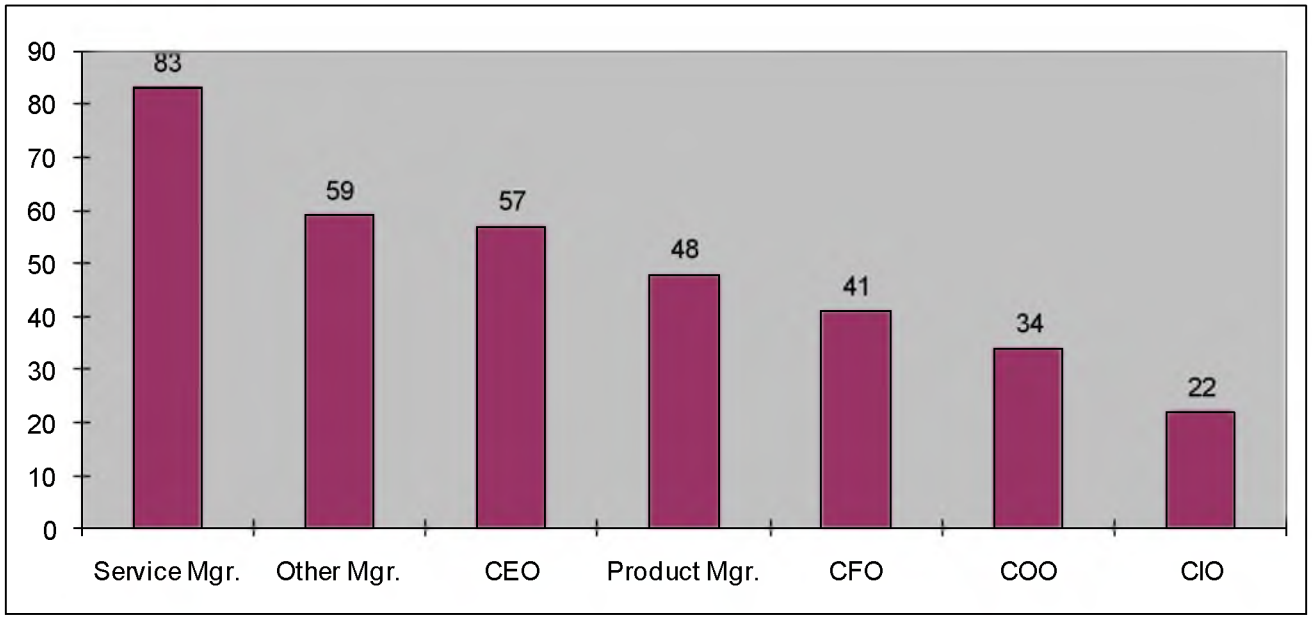

Figure 4: Involvement in the screening process in percentages

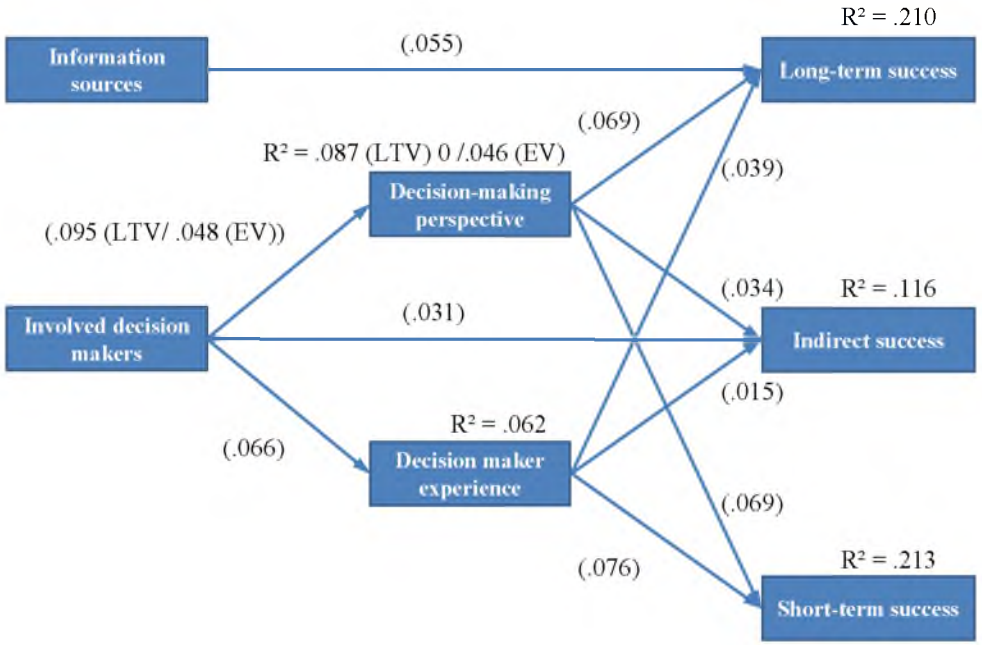

Figure 5: Results of the hierarchical regressions. Values in parentheses are f-squared.

[1] Although some literature refers to the screening stage as if it were a well-defined stage of the innovation project, we regard it instead as a process that may occur in different forms and places and at different times in different firms.