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What attracts decision makers' attention? Managerial allocation of time at new product development portfolio meetings*

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***** This is the third paper on decision making at portfolio and gate meetings by two of the present authors. The first paper focused on how decisions makers in some situations seemed to make appropriate decisions rather than rational ones (Christiansen and Varnes, 2008) based on the PhD thesis of Claus Varnes (2005). The second focused on the relationship between decision making at meetings and the project level based on network theory (Christiansen and Varnes, 2007). The present analysis uses another theoretical perspective, an expanded set of data, and a quantitative research method to analyze what factors influence decision makers' attention.

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WHAT ATTRACTS DECISION MAKERS' ATTENTION? MANAGERIAL ALLOCATION OF TIME AT NEW PRODUCT DEVELOPMENT PORTFOLIO MEETINGS

ABSTRACT

Managers' attention is a scarce resource in complex NPD settings. The present explorative study addresses the need for more knowledge about the actual behavior of decision makers when they discuss new product development (NPD) projects and especially the role of different factors for their attention. Thus, how managers allocate their attention while facing difficult decisions in NPD projects infused with ambiguities provides new insights into how decision making related to NPD actually happens. Prior NPD research has examined criteria for decision making and management systems design and has proposed innovative ways to improve decision making. However, research is sparse on the factors that actually attract decision makers' attention or the role information plays at NPD management meetings. Prior research is mostly based on surveys, and ethnographic-inspired research from meeting observations is rare. The present analysis draws on insights from previous research into decision making in NPD and studies on organizational decision making. Based on prior NPD research and organizational studies on decision making, the present study identifies six potential factors that could explain decision makers' attention: (1) the quality of information on projects; (2) the phase of projects; (3) project progression (on time or delayed); (4) the value of projects; (5) decision makers' prior knowledge of projects; and (6) organizational politics. Data for this study were collected through direct observation, other sources, data from a portfolio management system, and an information quality measurement system in an internationally operating petrochemical company. The analysis produced some surprising results. The quality of information was not significant for explaining variations of decision makers' attention; even more surprisingly, differences in project status did not explain variations in attention. Delayed projects did not get significantly more attention than those delivered on time. By controlling for other project characteristics, the newness of projects to the corporate portfolio was found to be the most important parameter. This contradicts prior NPD research, which argues that decision makers should pay special attention to certain phases. Implications and possible explanations for the observed behavior are discussed.

INTRODUCTION

Decision making regarding new product development (NPD) projects and portfolios encompasses many facets and dimensions (Krishnan and Ulrich, 2001; Griffin, 1996); however, only very limited ethnographic-inspired research has attempted to uncover the

processes decision makers actually follow when they make NPD decisions. The present analysis tries to fill this gap: what factors attract decision makers' attention, based on an ethnographic-inspired study of decision making in a large petrochemical company? Drawing on prior organization studies and research on decision making in NPD, the attention of decision makers at two combined gate- and portfolio-meetings is analyzed.

The remainder of the paper is structured as follows. First, prior research on decision making related to NPD is presented. Second, some observations from research on organizational decision making are presented, underscoring that decision making in situations characterized by ambiguity, fluidity, and complexity should limit our expectations for rational decision making and that decisions might better be understood by investigating how decision makers allocate their attention. Third, six identified factors are used to design a conceptual model to examine what attracts decision makers' attention at combined gate–portfolio meetings. There are six factors: (1) the quality of information on projects; (2) the phase of projects; (3) project progression (on time or delayed); (4) the value of projects; (5) decision makers' prior knowledge of projects; and (6) organizational politics; they cover four different critical areas. Next, the research questions and method are presented, followed by analysis of the results. Finally, the findings are discussed, with implications for NPD research and managers.

We know of only two ethnographic studies on decision making and innovation. The first study, by Hansen (2006), showed that many different criteria are mobilized in new product development processes and that the decision criteria change over time in a dynamic interplay influenced by many different organizational factors. The second study (Bower, 1970), which was originally concerned among other things with portfolio management decisions, found that these decisions are much more than the application of

one or another method and that the context and organizational processes and politics must be taken into consideration, thus pointing to the relevance of understanding what attracts decision makers' attention. The findings from the present study seem to contradict some of the prior assumptions about how decision makers should allocate their attention and give insights into how various factors influence the attention. The observations add to the present body of knowledge on decision making at gate and portfolio meetings and suggest an interesting avenue for further research.

PRIOR RESEARCH ON NPD DECISION MAKING

Prior empirical studies on decision making in NPD have often been based on surveys. Schmidt and Calantone (1998) examined criteria for go/no-go decisions. Multiple studies have investigated how criteria change over the decision-making process (Carbonell-Foulquié, Munuera-Aleman, and Rodriguez-Escudero, 2004; Saunders et al., 2005; Hart et al., 2003, Ronkainen, 1985). Hultink and Robben (1995) looked into decision makers' long- and short-term focus. Griffin and Page (1996) suggest that decision makers should apply different criteria for project and program-level success measurement and found by surveys that criteria applied differed accordingly to company strategy; Hart et al. (2003) conducted a survey involving 166 Dutch- and U.K.-based companies, confirming Griffin and Page's list of criteria and adding five more. Hart et al. found that criteria on market acceptance, financial performance, and product performance were applied differently over time but that a market orientation was dominant throughout the different stages. In a study by Balachandra, Brockhoff, and Pearson (1996), variables used for research and development (R&D) project termination decisions were time, technical success, probability of technical success,

costs, market information, and staff motivation. Based on a review of prior research, Krishnan and Ulrich (2001) identified more than 30 different types of decisions related to product development, although they were not “concerned about how these decisions are made” (ibid. p. 3). Ozer (2003) investigated how to improve the accuracy of new product evaluation decisions and identified four factors that influence the quality of decision making: (1) the nature of the task; (2) the type of individuals; (3) the way the individual's opinions are elicited; and (4) the way opinions are aggregated. Haque et al. (2000) suggest improving computational capabilities by training managers to use case-based reasoning.

Calantone, Di Benedetto, and Schmidt (1999) researched the role of the team and experimented with the analytic hierarchy process using a decision-making simulation. They suggested that increased teamwork among the formal decision makers benefit them in making decisions. Also, Englund and Graham (1999) highlighted teamwork among decision makers with diverse competencies and knowledge as being expected to improve decision making as groups have a larger pool of information to draw from than any individual group member, and therefore decisions will be of higher quality (Griffith and Neale, 2001), e. g. in cross-functional teams (Griffin & Hauser, 1996). Moreover, Schmidt, Montoya, and Massey (2001) indicated that both face-to-face and virtual teams make NPD project review decisions more effectively than do individuals acting alone.

Another stream of research is more prescriptive in its focus and advocates for the use of structured approaches and decision aids. Through the NewProd studies, Cooper (1975, 1979) derived eight key lessons related to organizational structures, a structured approach, and well-informed decision-making processes. Information is to be integrated

through a "process model" (Cooper, 1983, p. 3) that provides structure and presents requirements for information. Cooper gives an example of a chemical company undertaking go/kill decisions through "precise information requirements" (p. 8) with the help of computerized evaluation. Different sets of checklists, guidelines, and criteria are to be applied by decision makers during the different phases (Cooper, 2001), and indicators to assess a project's likelihood of success are established (Hart et al., 2003). Others propose decision support systems with refined cost-benefit analyses (Krishnan and Bhattacharya, 2002; Loch and Kavidas, 2002; Ulrich and Ellison, 1999; Blau, Pekny, Varma, and Bunch, 2004). Similarly, Calantone, Di Benedetto, and Schmidt (1999) advocate for improving decision making with increased information dissemination between decision makers since decisions "often are taken informally or unsystematically" (p. 65).

As companies integrate project meetings with portfolio meetings, project decisions are intertwined with portfolio decisions and vice versa. Prior decision-oriented NPD studies have addressed this in different ways. Different models have been proposed to improve NPD portfolio management using a dynamic portfolio selection model (Loch and Kavadias, 2002). Others address the potential interrelatedness among projects and recommend dividing the portfolio into clusters before decisions are made (Chien, 2002) or analyzing the portfolio by considering potential competitive advantages along with customer benefits (Mikkola, 2001). Some suggest automating decision making for accepted and rejected projects and analyzing only those classified as "consider further" (Linton, Walsk, and Morabito, 2002). Cooper, Edgett and Kleinschmidt (1999) and Heidenberger and Stummer (1999) identified the use of multiple methods and approaches, and Cooper and associates found that those most

satisfied with their portfolio management processes and outcomes used a mix of both calculative methods (i.e., financial and other decision criteria) and a strategic evaluation.

Overall, within this line of NPD research the collection of information is considered of paramount importance to management and new product success. The project level of the NPD process produces information that is the prerequisite for managerial decision making. Mullins et al. (1999) examined the link between risk taking and decision making and found that individuals' previous experiences and whether survival or outperforming competitors motivated their goals had an influence on the decisions made. Decisions made in early phases of the NPD were found to be sometimes based on very limited information—using only personal knowledge and experience gained during past problem-solving processes—and thus were prone to bias (Haque et al., 2000).

In sum, the prior studies on NPD decision making seem to fall into two camps. One advocates for the design and use of improved information systems to provide more relevant, timely, or high-quality information to decision makers. The other emphasizes different factors that seem to be relevant for decision makers; these factors shift over the progression of projects, possibly causing decision makers' attention to shift over time and between projects. The present study tries to apply knowledge from both views by studying how six particular factors influence decision makers' attention and considering the quality of information as one of these factors. Furthermore, the present study proposes that decision making in NPD should also be studied in action— that is, based on empirical observations of managers trying to make decisions.

Since NPD and portfolio management is a highly complex process affected by many elements that cause uncertainty, the decision maker can be confused in the process of reaching targeted performance (Büyüközkan and Feyzioğlu, 2004). Thus, decision makers are faced with the challenge of trying to make intelligent decisions on difficult matters; in complex ecologies, with ambiguity about means–ends relationships and multiple and dynamic environments and technologies, this makes their allocation of attention among different issues a critical issue (Seshadri and Shapira, 2001; Langley et al., 1995; Cohen, March, and Olsen, 1972; March and Simon, 1958, 1993).

DECISION MAKING AND DECISION MAKERS' ATTENTION

Decision making is studied by many different disciplines and in different ways. Economics and operations researchers focus on constructing axiomatic models and attempt to produce prescriptive theory; within behavior theory, others study decision makers' actual behavior based on cognitive studies or investigate the different options generated and choices made. Presenting paradigms within decision research, Beach and Connolly (2005) label research that investigates deviations between prescriptive decision models and decision makers' behavior as *first-generation research.*
The present research is what Beach and Connolly describe as *second-generation research,* because it is based on observing professional decision makers and analyzing the cognitive processes in which they engage when trying to make decisions (p. 12).

Research on judgment and decision making, spurred among other things by the works of Tversky and Kahneman (1974), has explored issues on judgment (i.e., how well does someone's judgment relate to the real world) and the internal consistency and logic of decision making (Hammond, 1996) or has tried to refine the decision models,

for example, by introducing multi-attribute evaluation techniques (Edwards and Newman, 2000; Connolly, Arkes, and Hammon, 2000). Basically, this line of research come either from a pessimistic view, in which problems with making sound decisions comes from the humans involved, or from an optimistic view, in which the models and approaches need to be improved (Jungeman, 1983).

The present study adopts neither a pessimistic view on the capabilities of managers nor an optimistic belief in designing yet another model. Instead, this study departs from prior research that explores some of the challenges in organizational decision making. The sections below discusses how the attention of decision makers comes into focus when we relax the assumptions about purely rational calculative decision making.

Beyond Rational Decision Making

As companies and organizations pursue intelligence, they are, among other things, collecting and processing information and making decisions (March, 1999, p. 1). Ideally, the process by which decisions are made is often expected to be according to the "rational choice model" (ibid., p. 14), which is based on identifying alternatives and consequences (Simon, 1976, pp. 66–68). Thus, the logic of consequentiality and its rational choice model are based on four things (March, p. 14):

- Knowledge of alternatives.
- Knowledge of consequences.
- Consistent preference ordering (over time and space and among decision makers).
- Decision rules.

Starting with the seminal work of Herbert Simon (1976, first published in 1945) researchers on decision making and organizations have on numerous occasions pointed to the challenges of actually applying the rational decision-making model or the logic of

consequentiality (March, 1999). Simon pointed especially to how decision makers and organizations are limited due to restrictions in knowledge, time, and resources (pp. 67–68). Tversky and Kahneman (1974) analyzed decision makers' difficulty with judgment in uncertain circumstances and said that decisions makers' cognitive abilities and biases are limited because of factors such as insensitivity to probability of outcomes and to sample size, misconceptions of chances, illusions of validity, misconceptions of regression, and illusory correlations (pp. 35–38).

Simon (1976) also pointed out that preferences might not be given per se but may be explored and identified during the decision-making processes (p. 68). In product development regarding new cars, Jönsson, Edström, and Ask (2001) found that actions often came before decisions or that action and decisions were different (p. 254). Simon further suggested that group membership or different units of a company might bias the decision-making processes (pp. 70–71). Simon (p. 82) concluded that humans often lack sufficient knowledge and that memory is limited: "The human being striving for rationality and restricted within the limits of his knowledge has developed some working procedures that partially overcome these difficulties. These procedures consist in assuming that he can isolate from the rest of the world a closed system containing a limited number of variables and a limited range of consequences." Simon coined this *bounded rationality,* a decision-making behavior that seeks to satisfy rather than to find an optimal solution. For Simon, rationality had many meanings (pp. 75–77). March (1994) pointed out that two different types of rationality—focusing on either the best outcome or the optimal process—are often confused when we evaluate decision making either as outcome intelligence or in terms of process reliability (pp. 222–224).

Research on judgment and decision making points to additional ways of understanding the psychology behind making decisions (Beach and Connolly, 2005), such as framing (Kahneman, 2003; Tversky and Kahneman, 1981), the use of cues to reduce complexity, standard operational procedures (SOPs), policies (e.g., the Lens model; Brunswick, 1947), prescriptive choice and game models, introduction of prescriptive models to aid decision makers with probabilities, and utility calculations or the role of emotions (Beach and Connolly, pp. 97–114).

Early studies on decision making pointed to a variety of complexities, such as different stakeholder goals and coalitions (Cyert and March, 1963), ambiguities and loose couplings in organizations and decision making (March and Olsen, 1979), the influence of politics and institutional settings on decision making (Allison, 1971; March and Olsen, 1989), and the relevance of understanding the process of attention direction as allocation of energy and time toward different issues in a turbulent and complex world (March and Simon, 1958; March, 1994, pp. 23–35). Decision makers might consider their own situation, the context, the behavior of peers, and their expectations on them; March called this *decision making following a logic of appropriateness* (March, 1999; March and Olsen, 1989). This model has been found to explain decision making on product development in some instances (Christiansen and Varnes, 2008).

Rather than regarding decision making as a computational challenge or a matter of cognitive limitations, other studies focus on its creative aspects (Allwoood and Selart, 2001; Boland and Collopy, 2004; Zong, Dijksterhuis, and Galinsky, 2008). Studies within this view emphasize that we should not focus just on the visible elements and processes of the decision processes (Zong, Dijksterhuis, and Galinsky, 2008), as the unconscious processes might be of greater importance than the conscious ones.

Allwoood and Selart present research based on cross-disciplinary approaches and empirically and theoretically demonstrate that human decision making is inherently social and more or less creative. Boland and Collopy (2004) urge managers to think about decision making as a matter of design (e.g., how managers identify "problems," frame decision making, and use aspirations to navigate) and to get inspiration from the way designers work.

Decision Makers' Attention as Important in Complex, Dynamic, and Ambiguous Settings

Faced not only with uncertainty (which might be calculated) but also with ambiguity about mean–ends relations (March and Simon, 1993) and incomplete learning (Cohen, March, and Olsen, 1972), the focus or attention of decision makers becomes of interest. Simon actually regarded organizational design as mainly a matter of attention direction: "Organizations and institutions provide the general stimuli and attention-directors that channelize the behaviors of the members of the group, and that provide those members with the intermediate objectives that stimulate action" (Simon, 1976, pp. 100–101). Furthermore, "the scarce resource is not information; it is processing capacity to attend to information. Attention is the chief bottleneck in organizational activity" (Simon, 1973, p. 270).

In his landmark study on managerial work, Mintzberg (1973) observed managers' behavior when they had to allocate their attention among numerous different tasks in a fragmented and time-limited working situation (p. 173). In this situation, one of the most critical decisions a manager makes is the allocation of time and energy to tasks (Seshadri and Shapira, 2001). Using planned variation in attention focus, managers might be able to successfully devote energy to both exploration and exploitation (Helgesen, 1990). Experiments with stochastic models seem to confirm that optimal

attention strategies favor the development of different sets of rules and sequential rather than simultaneous attention (Seshadri and Shapira, 2001).

Recently, studies within social psychology and decision making have further explored the relationship among calculative managed decision-making processes, decision makers' attention, and the perceived quality of decisions (Dijksterhuis and Nordgren, 2006). Drawing on an range of different experiments, Dijksterhuis (2004), Dijksterhuis and Olden (2006), and Dijksterhuis, Bos, Nordgren and Van Bararen (2006) present a unconscious-thought theory, which proposes that "conscious thought is better at making linear, analytical decisions, but unconscious thought is especially effective at solving complex problems" (Zhong, Dijksterhuis, and Galinsky, 2008, p. 917) and leads to a higher ex post decision-making satisfaction (Dijksterhuis and Olden, 2006). For example, one experiment demonstrated that, for consumers faced with making decisions on which products to choose, a deliberate explicitly analytical decision process provided the best outcomes for simple products, whereas more complex product decisions benefited from an unconscious unstructured decision process (Dijksterhuis, 2004; Dijksterhuis and Olden, 2006). Thus, the quality and satisfaction of decision-making processes in this perspective is more the outcome of the amount of attention devoted to the issue at hand (e.g., "sleep on it") rather than the amount of available information or the use of some analytical technique.

Studying Managerial Decision Making

Over the years, studies have discussed how to examine and understand decisions. Simon (1976) noted that our aim should not be to understand or analyze a single decision (p. 272-273), since organizational decision making often involves a series of decisions that

are distributed among organizational units and decisions makers in time and space. Langley, Mintzberg, Pitcher, Posada and Saint-Macary (1995) conducted a meta-analysis of patterns of decision making and identified a number of different patterns that decisions follow, consisting of a number of micro- or sub-decisions. Similarly, Chuna and Gomes (2003) identified five structures for NPD processes, each of which has unique decision-making patterns.

Thus, it seems relevant to analyze decision making as a series of decisions (Simon, 1976), where decision makers allocate different amounts of attention to various issues and projects (March and Simon, 1993, p. 4). In 1954, Simon et al. had already published work on the use of management systems and had identified different uses of information systems. Among their observations was that management systems are used for attention direction (ibid.). Other studies have indicated that the allocation of managers' attention and time toward different issues has important implications for decision making and what is considered relevant in an organization (Mintzberg, 1973; Cohen & March, 1971). Furthermore, some behavior can be regulated by structural constraints such as organizational rules, organizational hierarchy, and specialization, but individual personal choices influence the attention patterns (March & Olsen, 1976, pp. 38–53). More recently, these early findings have been reformulated by Boland and Collopy (2004), who call for a design perspective on managing: that is, we need to show an interest in the design of the premises, conditions, and framing of decision making rather than to focus on the individual decision. The attention of decision makers is part of such a design focus.

FACTORS THAT INFLUENCE THE ATTENTION

Drawing on prior research on product development and decision-making, the present study identifies six factors that might explain the pattern of attention direction of decision makers on NPD. These factors are selected to analyze how aspects of information, project characteristics, and organizational politics influence managers' attention.

Information Quality

Robert G. Cooper is one of the strongest proponents for the need to improve information quality but as mentioned previously, many others have also suggested innovative models and approaches toward this end. Cooper (2001) advocates for "completeness" of information (p. 116), and, among the three key tasks of gatekeepers, the first one is a check of the given information: "Are the data presented based on solid work?" (Cooper, 2008, p. 229). Throughout his works, Cooper stresses the need to evaluate information quality. He points out that "good … information is absolutely essential for more successful industrial products (Cooper, 1979, p. 134) and also that "stages consist of activities …, whose purpose … is to provide the additional information needed to proceed to the next stage" (ibid., p. 165). Cooper (1983) provides an example of a chemical company that is undertaking go/kill decisions though "precise information requirements" (p. 8) with the help of computerized evaluation. In the most elaborate version of these models, Cooper (2001) advances decision criteria covering the market, technical, and financial/business information domains. Company use of these domains is confirmed by other studies (e.g., Griffin and Page, 1996).

As resources and time for the search of information are limited (Simon, 1948, 1975), it might be expected that decision makers give more attention to projects for

which there is sparse information than to those with rich information. Following Cooper (1975, 1979, 2001), sparse and low quality of information could suggest that the project team has not carried out the necessary activities. Hence, projects with low levels of information might be expected to be scrutinized more thoroughly and consequently to attract more attention; however, high levels of information could also attract more attention and spur further questions.

Project Status: Which Phase?

One of the central premises of structuring the product development process is to carefully manage the increased use of resources as projects progress by reducing uncertainty through increased information: "View each stage as a means of reducing uncertainty. Remember that information is the key to uncertainty reduction" (Cooper, 2001, p. 127). As the "amounts at stake" (Cooper, 2001, p. 127) rise during subsequent phases, especially the product development stage, production start-up and market launch phases are expected to attract more attention (Cooper, 2001; Cooper and Kleinschmidt, 1988). In prior survey studies, decision makers have indicated that criteria might change (Carbonell-Foulquie, Munuera-Aleman, and Rodriguez-Escudero, 2004; Saunders et al., 2005; Hart et al., 2003; Ronkainen, 1985), but this has not been confirmed with observational data.

Project Status: One Time or Delayed?

Decision makers are expected to allocate more attention to projects not meeting targets (i.e., delayed) than those that are meeting targets (March and Simon, 1993, p. 4). Cooper (2001) is concerned with time and timelines. He remarks, "Speed is

everything!" (Cooper, 2001, p. 258). Additionally, he says that "deadlines must be regarded as sacred: Time-based innovation is impossible without a disciplined adherence to deadlines" (ibid., p. 259). Furthermore, he urges companies to check the progress of NPD projects and to constantly watch out for delays and "check to make sure that you're on schedule and on budget. One rule of thumb that some firms employ is that if several milestones in a row are missed, the project is flagged. The project is clearly in some sort of trouble …" (ibid., p. 261). Cooper observes that milestones are "important metrics in the time line" (p. 261) and are "quantifiable" (p. 261). Plans and budgets are often used as diagnostic control systems that set financial and nonfinancial reference points managers need to meet (Davila, Foster, and Oyon, 2009). Furthermore, in portfolio meetings managers are expected to pay special attention to problematic projects, i.e., the delayed ones (Cooper et al., 1999).

Project Value

Within a rational model of decision making, one might expect larger projects to attract more attention than others because organizations tend to focus on targets (March and Simon, 1993, p. 4) and because product development management is expected to consider the total value of projects in the portfolio and to pay attention to those most likely to generate the biggest future income (i.e., the larger ones; Cooper, 2001; Cooper, Edgett, and Kleinschmidt 1999). Since most companies use some type of financial evaluation with their portfolio (Cooper, Edgett, and Kleinschmidt, 1999; Hertenstein and Platt, 2000), a greater interest toward larger and more profitable projects is implied.

Prior Knowledge of Project: Existing or New Project?

Based on an experiment, Mullins et al. (1999) concluded that experienced decision makers' previous training and knowledge have an influence on NPD decision making. Research on organizational decision making has demonstrated how "decisions" often unfold as a series of micro- or sub-decisions (Simon, 1976; Langley et al., 1995). Thus project and portfolio meetings might not be the centre for decision making related to NPD, but represent one decision arena among several (Christiansen & Varnes, 2007). Well-designed structured approaches and management systems are expected to facilitate a better and smoother management process (Cooper, 2001) across the company and its different units, which should make it possible to spend less time on ongoing projects since they have already been evaluated in the management system and discussed before.

Organizational Politics and Power: Influence of Project Ownership?

Eisenhardt and Zbaracki (1992) found that strategic decision makers have partially conflicting objectives and limited cognitive capability. Further, strategic decision making is best described by an interweaving of both bounded rational and political processes, because the most powerful among them determine the decision. Bower (1970) raised the question about the role of organizational politics in decision making on investment portfolios in large North American corporations. He found that organizational politics influences decision making and that certain business units for various reasons might be more influential than others and thus receive or require more attention. Cooper et al. (1999) found that organizational politics and vested interests influenced the portfolio management practices. Early on, Cyert and March (1963) raised the issue of whether different stakeholders (e.g., business units) might be more or less powerful depending on different locations within the functional structure (Hickson et

al., 1971); and product development was later addressed by Jönsson (2004). He found that some units exercised more power than others in a car-development project.

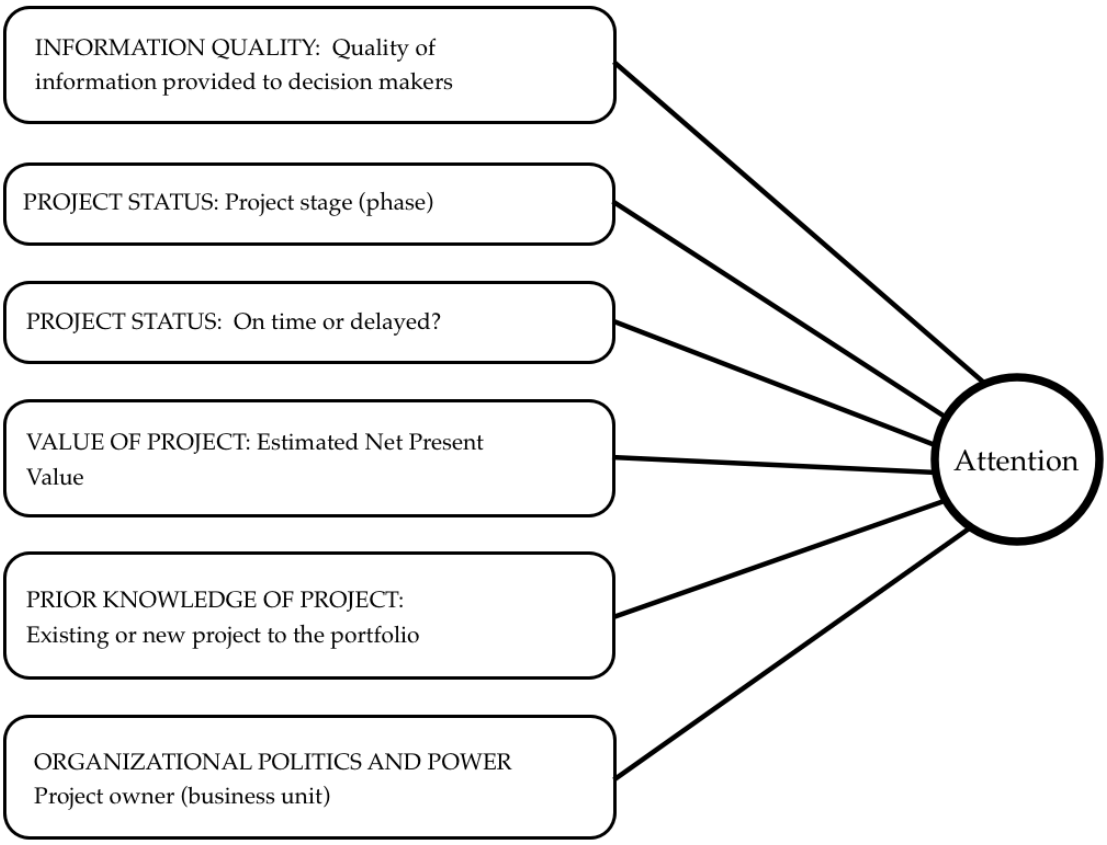


Figure 1: Conceptual model

RESEARCH QUESTIONS

From the previous review on NPD decision making as well as the examination of organizational studies, three sets of questions are derived regarding the effect of information; project characteristics; and the role of cognition and politics.

Related to the effect information has on decision making, consider the first research question:

RQ1: Do decision makers' pay more attention to projects for which there is more and richer information than to those where information is sparse? Or do decision makers scrutinize projects that have low quality of information, ask more questions about them, and thus allocate more attention to them?

Concerning project characteristics and decision making, consider the following:

RQ2: How do projects features influence decision makers' attention? How does project stage, timeliness of projects, and project value influence attention?

Related to RQ2, within the prescriptive model of decision making, one expects that larger projects might attract more attention than others, so are larger projects given more attention than smaller ones? Within the framework of the structured approaches, some expect that decision makers' attention is to be the highest before detailed development, production start-up, and market launch (Cooper, 2001). So, does the phase of a project explain the variations of attention? From a project management view (Meredit and Mantel, 2006) late projects should be closely monitored and scrutinized.

RQ3: Do organizational politics or decision makers' prior knowledge about the projects influence how much attention is devoted to them?

Related to RQ3, within prescriptive project management research new projects to the portfolio would require more attention, as project plans and analysis need to be prepared and carefully tested before launch (Cooper, 1975; Meredith and Mantel, 2006). Thus, are new projects drawing more attention than are ongoing ones?

METHOD

Sample and Data

The sample of this study is drawn from two gate and corporate portfolio management meetings held three months apart in the same international petrochemical company. The company employs a structured approach for managing the product development process in six stages (Figure 2). The first two stages—idea generation and opportunity

assessment—are the responsibility of one of the five business units as indicated in Figure 2. The next four stages— entering the portfolio through the concept development, the detailed development, the launch, and the review stage—are the responsibility of the gate and portfolio management meeting. Portfolio management is at a corporate level (Cooper, Edgett, and Kleinschmidt, 2001, p. 154) in these four phases. Besides guidelines and checklists for the projects and the business units and for conducting the gate and portfolio meetings, the company has two databases with information and a quality measurement system to evaluate the data delivered from projects to the databases and to the decision makers.

TS: Figure 2 about here

In the first two stages (i.e., idea generation and business assessment), it is the responsibility of the business unit vice presidents to update information; in the remaining four stages this is left up to the project managers. The business units' vice presidents are therefore responsible for documenting project ideas, using an "idea communicator" (simply a text document), and, in the second stage, for securing information in the form of a project description (e.g., a business case and health, safety, and environmental [HSE] check registered in the innovation database as well as links in the archive database). In the following phases, the project manager assumes responsibility for documenting a market and launch plan as well as a project plan and other issues. Different templates are available for the project managers to use for their work and reporting. The documentation must be updated "continually" and "checked at least in milestone review" (company guidelines).

Quality of information here refers to the quality of the data in the information system, as automatically calculated by the computing system in the company itself, based on the data the system receives from the product development projects. The information requirements the company uses to calculate the information quality index fall into five categories (Table 1). First, information on the project including objectives, target objectives, and the selected technology platform (drop-down menu) is registered. Second, *project assessment metrics* is done, including the probability of success (calculated as an average between market and technical probability of success), the estimated net present value (NPV) of the project (business case), and the estimated cost. Third, the project is to be documented with the business case, market plan, killer variables, and project plan (including end date). Finally, the specific innovation tasks are described in operational terms, and the formal stage and status of the project on a continual basis are reported.

Measurement of information quality has been researched within the area of information systems (e.g., Wang and Strong, 1996; Kahn, Strong, and Wang, 2002; Lee, Strong, Kahn, and Wang, 2002; Pipino, Lee, and Wang, 2002). To measure quality of information, Pipino et al. recommend a mix of three types of calculations: (1) simple ratio; (2) min or max operation; and (3) weighted average for objective assessment of information quality. The case company uses a mix of these three methods to compute its information quality index. The simple ratio form includes various types of measures, but the company has chosen to measure on the completeness dimension where "… one can define column completeness as a function of the missing values in a column of a table" (Pipino, 2002, p. 213). This is similar to Table 1 in this study, where "0" indicates incomplete information. The second element (i.e., min or max operation) can be either a

minimum or maximum value as an aggregation of the data quality indicators. Here the case company has the maximum value of 46 (Table 1) to indicate "accessibility" of information by the decision makers (ibid., p. 215). The third element (i.e., weighted average for objective assessment of information quality) involves weighting *Objective*, *Target*, *Description*, *Task Member Insert, Task Bottleneck Resources Insert*, *Allocation*, and *Cost*/*SAP* (management system) *Order No.* double that of other factors in Table 1. An exception is *Tasks Specified*, which has a weight of 5. These information variables are weighted because the company historically had too many projects for the quantity of available manpower and resources and thus focused meticulously on these issues when the information quality measurement system was designed four years ago.

How well the information requirements are fulfilled is measured by the company's quality index (QI), which is available for each project. Quality check is "done by allocation of quality points to each input field …. Some of the input fields have more Q-points than others to emphasize the importance, e.g. 2 points can be gained by filling in the Innovation objective …. The total number of points to gain per project is 46" (from company guidelines). The weights are shown in Table 1 and exemplified with a QI of 61% (= 28*46/100) for Project 20, where 28 is the total of the input fields. Quality indexes are reported for each project but are also averaged for each business unit and submitted with the agenda for the meetings.

Dependent Variable

The role of attention has been discussed in decision sciences (Seshadri and Shapira, 2001) and in organizational studies (Cohen and March, 1974, Simon, 1992) and has been explicitly modeled in the garbage can model on decision making (Cohen, March,

and Olsen, 1972), which is used to explain how the time and energy decision makers put into a given process will likely influence the outcomes of these. Kingdon (1984) and Dutton and Duncan (1987) pointed to the fact that issues in organizations compete for participants' time and energy. Psychology studies have followed the observation that "however alert or responsive we may be, there is a limit to the number of things we can attend at any one time" (Deutch and Deutsch, 1963, p.1). Simon (1992) regarded attention as the bottleneck for connecting thought with motivation. Within psychology there is an ongoing debate on the cognitive aspects and measurements of attention, noted by William James (1890, pp. 403–404):

> Everyone knows what attention is. It is the taking possession by the mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalizations, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal effectively with others, and is a condition, which has a real opposite in the confused, dazed, scatterbrained state, which in French is called distraction and Zerstreutheit in German.

Psychologists and neuropsychologist have debated attention. Some argue for different types of attention: Sohlberg and Mateer (1989) created a clinical hierarchic model with five levels of attention based on studies of recovering processes of brain-damaged patients after experiencing a coma. However, Ylvisaker (2003) questioned this perspective and argued that knowledge is dynamic in relation to ongoing experience; that study pointed to a contextual perspective on attention. Thus, attention might be difficult to classify. Following prior studies on organizational decision making (Cohen, March, and Olsen, 1972; Cohen and March, 1972, Seshadri and Shapira, 2001), the present study uses participants' time allocation to a certain subject (e.g., projects) as a proxy measurement for their allocation of attention toward certain projects and issues.

Dijksterhuis et al. (2006, p.1006) also used consumers' time spent on a certain decision as a proxy for consumers' attention to product analysis.

Descriptive Statistics

There are 62 projects in the portfolio with a total value of more than €250 million. All vice presidents from the business units took part in the meetings along with the two chief scientists, the portfolio manager, and the general managers. In the second meeting, one vice president was represented by the development manager. Quarterly meetings are the norm. The first meeting was September 1 and the second by the end of November. Plastic is part of a large conglomerate and is a manufacturer of plastic as raw material (polymers) in the form of granulates. The business units cover different market applications including Molding, Film and Fiber, Wire and Cable, and Pipe. Moreover, cross-business unit projects can be managed by Multi (a separate cross-business function) or by the Engineering and Application Departments, focusing on cost-saving projects or by Assets. The latter manages the production plants and investments in new production machinery and is divided into a polypropylene and a polyethylene unit. The September and November meetings each lasted 5.5 hours, mainly to accommodate to participants' flight schedules. Of these, 1 hour and 1.2 hours, respectively, were allocated to debating ongoing projects, and 1.5 hours and 0.5 hour, respectively, were allocated to evaluating new projects requesting to enter the portfolio. At the September meeting, the average time spent on a project was 4.5 minutes, and the standard variation was 4.5 minutes. At the November meeting, the average time spent on a project was 2.5 minutes, and the standard variation was 6 minutes.

Table 2 around here: **TABLE 2: Descriptive statistics**

Regression Model

The independent variables follow from the previous discussion. A simple regression model explaining attention patterns is as follows:

$$\begin{aligned}\text{Duration}_j = \quad & \text{Constant} + a_1 O_{1j} + a_2 O_{2j} + a_3 O_{3j} + a_4 O_{4j} + a_5 O_{5j} + a_6 O_{6j} + a_7 O_{7j} + a_8 O_{8j} + \\ & \theta_1 S_{1j} + \theta_2 S_{2j} + \theta_3 S_{3j} + \delta N_j + \beta_1 NPV_j + \beta_2 QI_j + \kappa_1 C_{1j} + \kappa_2 C_{2j} + \kappa_3 C_{3j} + \varepsilon_j\end{aligned}$$

where

ownership, $O_1 - O_8$, is given by the eight divisions in the company (Asset PP = 1, Molding = 2, EA = 3, Film&Fiber = 4, W&C = 5, Pipe = 6, Asset PE = 7, Multi = 8).

$a_1 - a_8$ is equal to duration due to ownership.

Stage, $S_1 - S_3$, is given by Launch = 1, DD = 2, CD = 3. Only 3 of the 62 projects are in the review phase and are removed from the analysis.

$\theta_1 - \theta_3$ is equal to the duration due to stage of the formal NPD process (Figure 2).

δ is equal to the effect if the project is new, *N,* to the corporate portfolio.

β_1 is equal to the effect of the *NPV*.

β_2 is equal to the effect of the QI index.

Delays are measured in months ($C_1 - C_3$) where $\kappa_1 - \kappa_3$ is equal to the duration due to delays in the project. On time = 1, 0 < delay < 2 months = 2, > 2 months = 3.

Unexplained errors are equal to ε described as a Weibull-distributed (Cox and Oakes, 1984) with shape parameter $\gamma > 0$ and scale parameter $\lambda > 0$.

RESULTS

The Proc Lifereg procedure in SAS was used to estimate the parameters of the model. By successive reduction, the full model was reduced to the following estimated parameters reported in Table 3 for the two portfolio meetings.

[TS: Table 3 about here.]

RQ1

The quality of information, β_2, was an insignificant parameter in both meetings, as it was estimated to 0.02 in September and 0.01 in November, as indicated in Table 3. Table 3 reports the value of individual variables identified through the regression analysis, but subsequently a variance analysis (Box, Hunter, and Hunter, 2005) was added to analyze the relative role of these variables (Table 4). Thus, a variable can prove significant but still fail to be important in explaining the total variance of duration. The analysis of variance reported in Table 4 shows that the quality of information explains only approximately 6% of the total variation in September and mere 0.01% in November. Better information does not make any difference to decision makers; neither does lack of information.

[TS: Table 4 about here.]

RQ2

Duration due to delays, $\kappa_1 - \kappa_3$ was removed as it proved to have no effect on duration and is not reported in Table 3. Delayed projects did not have a significant impact on the variation of allocated time and attention.

In the September meeting it can be observed that NPV is significant whereas the effect from *Stage* is insignificant (Table 3); Table 4 shows that NPV explains only 0.01% of the total variation and that the effect on duration is disappearing.

In the November meeting, the *Stage* variable is significant while now NPV is insignificant (Table 3); however, *Stage* explains only 0.3% of the total variation, and the effect on duration is disappearing.

RQ3

The effect from *Newproject*, δ, is the most important issue in both meetings. This means that the attention of a new project extends the amount of time spent in the September meeting with 8-9 times and approximately 20 times at the November meeting. *Newproject* explains 72.6% and 98.3% (Table 4), respectively, of the total variation and therefore is considered the only main effect in both September and November. *Owner* was also significant in both meetings. *Owner* explains 9.2% of the total variation in September but only 0.3% in November.

The scale parameter, λ, clearly shows that the distribution is spread out and is not concentrated at both meetings. Thus, the three main effects in September are *Newproject, Owner*, and *Stage*, in descending order. In November, the main effect is *Newproject*.

[TS: Figure 3 about here.]

Finally, the shape parameter is above 1 for both meetings. This means that the effect from the parameters under investigation behaves in the same way. The duration of issues behaves as a bell-shaped curve for both meetings (Figure 3). There is a positive dependence in September as the shape parameter is equal to 2.30 > 1, which indicates that the probability of terminating a project discussion increases as the duration of the

discussion lengthens. A positive dependence (shape parameter = 1.52 > 1) is also identified for November, but the level of the parameter indicates that the probability of terminating a project debate (i.e., close the project discussion) is not as abrupt as it was at the September meeting. Duration of issues takes up more space in September than in November. Moreover, the November meeting shows longer project debates than the September meeting does.

DISCUSSION

Quality of information cannot explain the discernable differences in decision makers' attention to various projects, nor can delayed projects explain variations in attention patterns. Based on prior positive research in product development, it was assumed that rich information would produce a smoother process and less attention to ongoing and well-known projects (Cooper, 2001). This was not the case here. Instead, other factors were responsible for the variation of attention.

New projects entering the corporate portfolio provided the single most significant and important effect on attention. The second most important parameter was project ownership. Depending on whether a project is new or already exists in the corporate portfolio, the duration of the discussion could be prolonged with a factor between 8 and 20. It was seen that new projects attract more attention than any other project feature analyzed here. Decision makers might allocate attention to new projects since they might be aware that early criticism is both more influential and easier to deliver than are questions to projects already accepted and in need of tough decisions (Cooper, 2001; Balachandra, 1984; Balachandra, Brockhoff, and Pearon, 1996).

This high attention toward new projects may prove to be beneficial to decision makers since dealing with tough questions early in the process might reduce the need to close projects later on, which would demotivate employees (Balachandra, 1984); Balachandra, Brockhoff, and Pearson, 1996). If the decision makers wait until the projects are under way, their decisions might really stress project team members. Although prior research has indicated shifting criteria over phases and at different gates (Hart et al., 2003; Cooper, 2001), only Cooper (2001) stresses that decision makers should spend more time on some specific gates than on others.

Ownership was the second most important parameter. Certain business units and their managers attract more attention than others, which indicates organizational politics and power plays (Cyert and March, 1963; Jönsson, 2004; and Hickson et al., 1971).

Another interpretation of the observations could be drawn from March's (1994, 1999) findings that objectives are discovered and formulated during action, which might explain the high attention on new projects: here, potential solutions, customers, markets, and technologies are open for debate and fabrication. Within NPD Jönsson (2004) found that organizational narratives and visions were more important for the shaping of new cars than were formal structures and systems and that the visions were developed simultaneous with the development activities. The observations in the present study might indicate that managers are spending more energy on the new projects, as these can be tested and challenged before they are finally formulated, while ongoing ones are less manageable and beyond their reach. These findings might support the assumptions that projects presented for the portfolio management meeting are going through a continuously more and more detailed formulation.

Methodological Issues

The present paper thus represents something new, analyzing decision makers attention in real-life settings and should be considered an experiment in itself. Experiments of this sort not only leave room for discussion and improvement but also provide an opportunity to learn. Making it possible to conduct this research required work with and for the company in question for more than 18 months, and later managerial changes put the research project on hold. However, strong single (case) observations might in some instances produce more interesting results than large scale surveys (Flyvbjerg, 2001) and within ethnographic inspired research many has demonstrated this (Angrosino, 2007; Glaser & Strauss, 1999; Latour, 1987). Each method and approach has it's merits, and following the statement of John Law "we need to ask whether we are willing and able to recognize that our methods also craft realities" (Law, p. 151) we present the present study as a possible interpretation of decision making.

One of the difficulties we faced—well known to all who has attended meetings—is that the demarcation of shift from one issue on the agenda to the next is seldom clear. In the analysis the measurement of duration included triangulating the general agenda with the tracked debate, observations and notes, and data (from full transcripts and listening to the recordings), identifying breaks in the discussions, and tracking the project titles referred to in the content of the discussion. Furthermore, in addition to the first researcher, two others did a control coding of both the recorded and the transcribed material. The pauses in the discussion at the meetings, often four to five seconds long, were divided equally between the projects.

Would the use of video recordings (Jönsson, Edström, and Ask, 2001) or eye-movement tracking devices (Strayer, Drews, and Johnston, 2003; Feiereisen, Wong, and

Broderick, 2008) improve the present study? Empirical research in psychology has typically examined attention using techniques such as listening to different sounds from different sources, recording electric signals from the brain, using magnetic resonance (MR) scanning to track brain waves, and tracking eye movements (Strayer, Drews, and Johnston, 2003). Though eye-tracking devices have been used for quite some time in various experiments, the technology would be difficult to apply in a real-life setting. Sanfey et al. (2003) represents another experimental approach—using brain scanners to identify the active parts of decision makers' brains—but, again, we doubt that this approach with the present known technology is adaptable to real company meetings. Video recordings have been used as part of an research method on product development of cars where selected rather small sequences (a few minutes) have been shown to meeting participants for clarification of content in the meeting dialogue (Jönsson, Edström, and Ask, 2001). However, it seems that these methods are difficult to apply in a real-life corporate product and portfolio meeting. For the present study it was found sufficient and relevant to combine direct observations, interviews, and secondary sources with dialogue recordings (which seems to be the least distracting approach).

Implications

The results are significant, as they appear contrary to some recommendations within prior NPD research regarding the allocation of attention and the role of information quality. Is it a drawback that managers put so much attention on the new projects? Does it indicate that ongoing projects are indeed hard to kill and that managers instead focus their attention on where they think they can make a bigger difference? Does it indicate a managerial gridlock, where managers are reluctant to openly criticize and ask questions

on the ongoing projects? Or do the results actually indicate a special intelligent behavior, since the initial NPD stage is where the promising projects must be scrutinized and differentiated from the less relevant ones? Even with heavy investments in terms of structured approaches, meeting facilitators, resources, and top-management backup, decision makers' attention still seems to depend on the decision of the individual manager.

As the role of the quality of information is not significant for the distribution of attention, does it indicate that we should not ask projects and companies to do their homework and prepare reports on their NPD projects? Or does it indicate that managers are not significantly dependent on the produced information and can make their own preparations and judgments across different levels and types of information? We are not able to explain the shift in the role of organizational politics at the two meetings, but such observations call for longitudinal types of studies that could investigate such processes over several years.

A speculative more radical interpretation of the findings is offered: Throughout research on decision making in NPD and in organizations, it is mostly assumed that there is—or should be—a close link between information and decision making, and a form of analytical process is assumed to follow from the data provided. However, if we relax that premise, it might be possible to understand the design and use of structured approaches as potential sources for inspiration (March, 1987) but not as the sole sources for managers' actual decision making. Structured approaches and information systems might be important signals and symbols for rational analytical behavior, but, as Dijksterhuis and Nordgren (2006) and Dijksterhuis and van Olden (2006) found, deliberate analytical thinking was most useful for simple decisions.

From the information collated in this study, managers involved in NPD and companies might learn that they should regularly analyze how they are allocating their attention and time toward different types of issues and NPD projects, and consider how they design their management (Boland and Collopy, 2004). The results of this study indicate that the allocation of attention can be different in practice from what is described in the standard agenda for the NPD meetings. Furthermore, responsible NPD managers and decision makers should be aware if their present distribution of attention toward projects, issues, and phases is the best possible and if they should try to develop alternative meeting designs to stimulate a deliberate focus on certain aspects of projects.

FIGURE 2

Company new product development process in six stages **.**

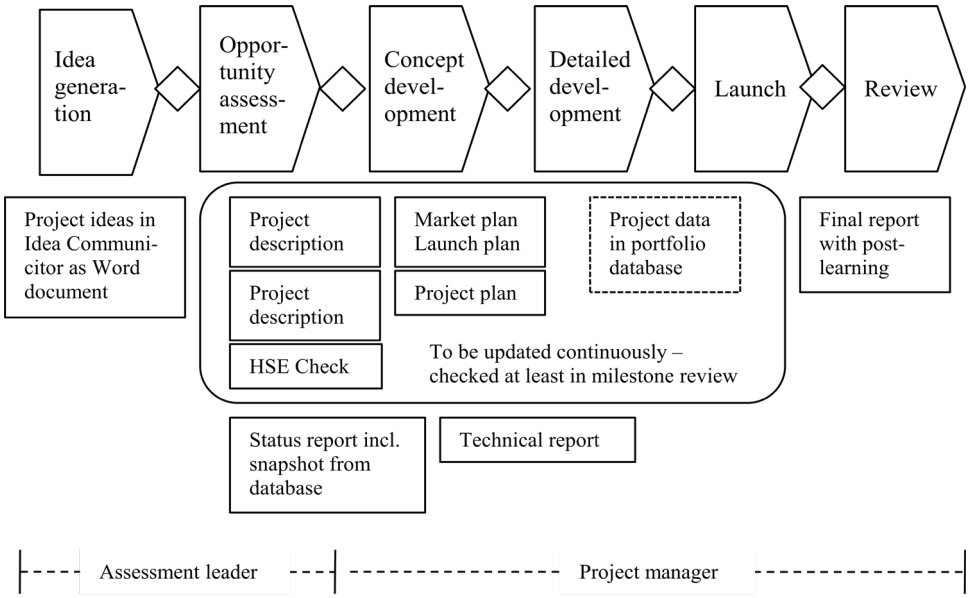
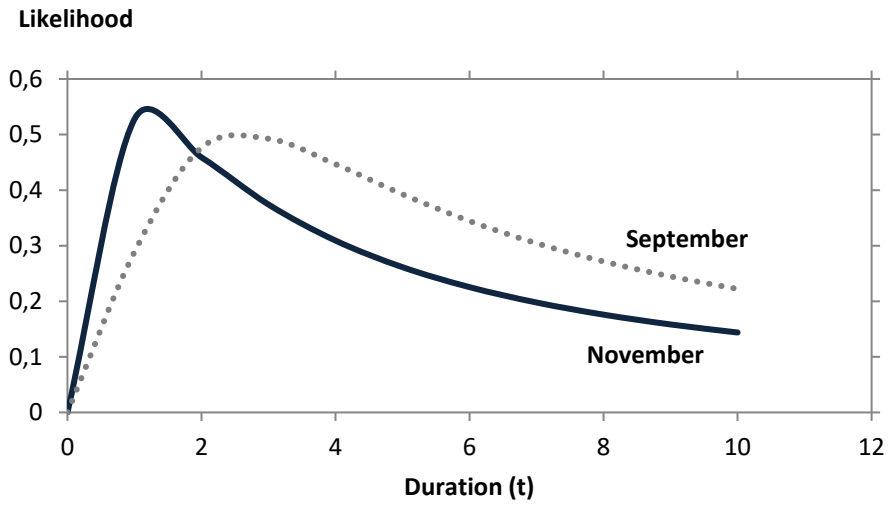


FIGURE 3



The Weibull distribution of meetings

Innovation project	*Weight*	*Project no. 20**
Innovation objective in archival database	2 pts	0 pts
Description	1 pts	0 pts
Innovation objective keeper	1 pts	1 pts
URL for further reading	1 pts	0 pts
Project characteristics		
Project in innovation database	1 pts	1 pts
Target	2 pts	2 pts
Description	2 pts	0 pts
Project category	1 pts	1 pts
Technology platform	1 pts	1 pts
Proprietary platform	1 pts	1 pts
Business owner	1 pts	1 pts
Chairman steering committee	1 pts	1 pts
Project manager	1 pts	1 pts
Decision forum	1 pts	1 pts
Archival project file	2 pts	2 pts
Project dates	1 pts	1 pts
Tasks specified	5 pts	1 pts
Allocation and cost /SAP order no.	2 pts	2 pts
Project assessment metrics		
Probability of success	1 pts	1 pts
Business case	1 pts	1 pts
Cost and FTE	1 pts	1 pts
Documentation in archival database		
Business case	1 pts	1 pts
Market plan	1 pts	1 pts
Killer variables status in market plan	1 pts	0 pts
Project plan	1 pts	0 pts
IPR evaluation/status	1 pts	0 pts
Innovation tasks		
Description	1 pts	0 pts
Stage	1 pts	1 pts
Status	1 pts	1 pts
Task leader	1 pts	1 pts
Task time and cost	1 pts	1 pts
HSE Evaluation: check status	1 pts	0 pts
HSE check document URL	1 pts	0 pts
Task member insert	2 pts	2 pts
Task bottleneck resources insert	2 pts	0 pts

Table 1: Information required to calculate quality index by the company and example*: Project no. 20 calculated to have an QI of 61 percent.

TABLE 2: Descriptive statistics

Variable	Mean	Std.Dev.
Duration September	4.56	4.57
NPV September	4.57	4.00
Quality Index September	61.42	18.45
Duration November	2.56	6.09
NPV November	5.21	4.24
Quality Index November	61.42	18.45

TABLE 3: Regression analysis

	September		November	
	Estimate	Std. Err.	Estimate	Std. Err.
Constant	-1.26	1.35	-2.12*	0.44
Newproject (δ)	2.25*	0.46	3.15*	0.74
Stage (θ)	-0.19	0.15	0.35*	0.17
Owner (α)	0.35*	0.15	0.15*	0.08
NPV (β_1)	-0.15*	0.04	0.04	0.04
QI (β_2)	0.02	0.01	0.01	0.01
Scale (σ)	2.27		1.51	
Shape (λ)	2.30		1.52	

*Significant at 5%

TABLE 4: Analysis of variance

Source	September Sum of Squares %	November Sum of Squares %
Model	99.5	99.0
-Newproject	72.6	98.3
-Stage	9.2	0.3
-Owner	11.5	0.3
-NPV	0.1	0.0
-QI	6.0	0.1
Residual	0.1	1.0
Total	100	100

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