IT INVESTMENT DECISION-MAKING: PRACTICAL USABILITY OF A NORMATIVE MODEL

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Abstract

This article analyzes the usability of a multi-criteria decision analysis based on a real options AHP (ROAHP) method for IT-investment decisions. The study presents ROAHP to Chief Information Officers (CIO's) and collects their opinions on prerequisites for usability, strengths and weaknesses. To understand these opinions, the opinions are put in an organizational context by profiling their organization's strategic decision making process. The study concludes that CIO's recognize the potential and need of ROAHP but that organizations need much investments in data collection and decision models to make this method useful for its purpose, i.e. increasing IT investment decision rationality. ROAHP lacks usability. Furthermore, this study recommends future research focus on the usability rather than the validity of the method.

Keywords: IT-investments, Strategic Decision Making; MCDA; ROAHP; IT-investment decision making

1 Introduction

Despite the importance of IT for businesses, there are many problems concerning determining the value of an IT investment. The question whether IT adds value has been addressed in multiple studies, whether it be financial (e.g., return on investment), intermediate (e.g., process-related) or affective (e.g., perception related) (Kohli & Grover, 2008). There are still questions that remain: how does IT influence aspects of a business (like effectiveness and customer satisfaction)? Who should be involved in the decision making progress? What information is required by the management to make proper and grounded IT-investment decisions? How should these IT-investment decisions be made for optimal results? This article focusses on the last two questions. For answering these questions, one could argue from a normative rational perspective that an investment decision requires that the problem is

unambiguously stated, different solutions are available, requirements for solutions can be quantified and used as selection criteria, and that the best solution is unambiguously mathematically determined. Such an approach, however, does pose certain problems in organizational decisions. First, it requires the decision maker to be able to quantify requirements of a solution for the investment problem. Second, the decision maker also has to be able to rank the importance of each criterion for the solution. The extensive literature on bounded rationality states that people in organizational contexts are not fully able to meet these requirements of normative rationality (Lindblom, 1959)(Simon, 1955)(Gigerenzer & Goldstein, 1996)(Kahneman, 2003). Our position is that in the world of more advanced computing and decision support systems, trying to make normative rationality applicable may be worth the effort and not doing so when it could would result in a harmful neglect (Althuizen, Reichel, & Wierenga, 2012). More precisely, we state that since the development of the theory of bounded rationality, two developments require an update of this theory. First, IT investment decisions have become portfolio decisions with interrelated investment options. This is so because organizations nowadays have many interrelated systems as part of enterprise systems or as networked systems (Panetto & Cecil, 2013)(John Ward, Hemingway, & Daniel, 2005)(Garikar, Marakarkandy, & Dasgupta, 2015). This requires that project proposals have to consider the project in its broader context of the organization's systems architecture (Ross, Weill, & Robertson, 2006)(Winter & Fischer, 2006), which means that the valuation of an IT project proposal requires the inclusion of values and costs from the broader impact of the project. Second, the increase in computing and networking power enables the collection and computation of data as never before, resulting in substantial reductions in search and decision costs. These search and decision costs were important limitations to human rationality and required bounded rationality as a method for handling complex decision problems (Gurbaxani & Whang, 1991)(March & Simon, 1993). This is not to say that bounded rationality does not exist anymore, but we say that some limitations to human rationality in decision making can be mitigated. However, at the same time, for IT investment decision making complexity has increased as a consequence of higher levels of integration and linkage of (sub)systems.

Angelou and Economides (2008) present an attempt of developing a method for prioritizing a portfolio of ICT infrastructure projects that follows the ambition of a fully normatively rational approach, which is built on more fundamental economic research of Benaroch & Kauffman (1999) and Bardhan, Sougstad, & Sougstad (2004). They present a multi-criteria decision analysis model called ROAHP (Real Options Analytical Hierarchy Process). This model uses a mathematical technique for combining real options to value projects within a portfolio of projects, taking into account possible subsequent projects that the initial projects can enable, which might add value in the future. AHP is used in their method to value intangible factors and by combining these with real options. An important challenge of such a model is that it assumes that the relative weights of the criteria are known *ex-ante*, while this is not (always) the case in real-life scenarios (Sarasvathy, 2001). Another limitation is that it does not take into account the organizational reality of decision making, i.e. in real-life scenarios of IT-investment decision making, the processes are highly influenced by politics (Eisenhardt & Bourgeois, 1988), uncertainty and ambiguity (Denis, Dompierre, Langley, & Rouleau, 2011)(Schrader, Riggs, & Smith, 1993)(Pich, Loch, & Meyer, 2002), limited time and limited information (March, 1987)(Smith & Brynjolfsson, 2001). The real life process of decision making is far from a normative rational process and therefore a rationalistic approach, such as the ROAHP model, might not be fully usable in practice. This is also true for IT decision and policy making (Weill & Ross, 2005). However, in defense of rationalism, we argue that IT-investment decision making could benefit from a more rationalistic approach such as a multi-criteria decision analysis (MCDA), if the tools for it have become better suited to their organizational contexts. Therefore, the key research question in this article is:

- *What is the usability of normative decision making method ROAHP for IT-investment decision making?*

To further study the usability of normative models for IT-investment decision making, specifically ROAHP, we aim at finding insights from practitioners, especially CIO's, as feedback on the idea of using ROAHP for their decision making. We are aware that CIO's have to make these decisions not only on basis of their expertise, data and models but also in the context of their organizations (Weill &

Ross, 2005)(J Ward, Daniel, & Peppard, 2008)(De Haes, Gemke, Thorp, & Van Grembergen, 2011). Therefore, we split the research question in two subquestions:

- *What do IT-investment decision makers think of ROAHP's potential to increase the quality of IT-investment decision making?*
- *How do IT-investment decision makers think the IT-investment decision making process in their organization can benefit from ROAHP?*

In order to answer these questions, an explanation of ROAHP will be presented to CIO's for collecting their opinions on this method. To understand these opinions, these CIO's will be asked about characteristics of the organizational context they have face for their decisions. The results of both their opinions on the ROAHP method and on their strategic decision making context are examined for finding missed opportunities of ROAHP within these organizations. The result of this analysis will provide information for further research on increasing the usability of MCDA models as decision support tool for IT-investment decisions.

This article is structured as follows. The next chapter gives a literature review on behavioural and normative models for decision making. In order to profile an organization's decision making, these models are operationalized into assessment questions. In the next chapter, the ROAHP model is explained, reviewed and improved where necessary. Before asking CIO's to review the ROAHO model, we first execute a few case studies for checking its practical validity. These case study results are next formalized in explicit statements that could indicate ROAHP success and are used in a panel with IT investment experts (mainly CIO's) for checking their validity. Finally, the results are presented and discussed, the conclusions and limitations summarized and recommendations for further research are given.

2 Behavioural and normative models of strategic decision making

IT investment decisions are strategic decision. Strategic decisions are "important, in terms of the actions taken, the resources committed, or the precedents set" (Mintzberg, Raisinghani, & Theoret, 1976).

Eisenhardt and Zbaracki (1992) present a review of three dominant paradigms in strategic decision making. These three paradigms are rationality and bounded rationality, politics and power, and the garbage can model.

2.1 Rationality and bounded rationality

The rational model of choice assumes that an actor enters a decision-making situation with known objectives. The actor defines the value of those objectives, gathers information and develops a set of alternative actions. Then the optimal alternative is selected based on that information. This approach assumes that the goal is completely known, all information about the alternatives is known (information problem), and that all the relative weights are known *ex-ante* (reliability problem). Several empirical studies show that there are limitations on this model. For example Cyert and March (1963) presented theory and case studies that show "that goals can be inconsistent across people and time, search behaviour is often local and standard operating procedures guide much organizational behaviour" (Eisenhardt & Zbaracki, 1992). An adaptation of the bounded rationality model by Mintzberg et al. (1976) poses that decisions have unique patterns of solutions. They present strategic decision making as unstructured, i.e., their model consists of three basis phases: the identification phase, the development phase, and the selection phase and differs from the classic rational model in that the phases do not have a sequential relationship and may occur in any order with repetitions.

Folowing Mintzberg et al (1976), the identification phase consist of two routines: decision recognition and diagnosis. First the opportunity or problem has to be recognized by the management. In the diagnosis phase the management tries to gain understanding about the problem or opportunity and its possible causes and effects. The development phase consists of two routines: search and design. The search routine represents the activity of searching for ready-made alternatives for the decision problem. The design phase is used to modify or create a new solution for the decision problem. The selection phase consists of three routines: screening, evaluation, and authorization. In the screen routine, management tries to reduce the number of alternatives in order to allow for a more intense evaluation. This routine is more concerned with eliminating infeasible alternatives rather than selecting the

appropriate ones (Mintzberg et al., 1976). The next routine is the evaluation-choice, which consists of selecting the best alternative based on the selection criteria. The evaluation-choice routine uses three modes: judgment, bargaining and analysis. In judgment, each individual makes a choice in her or his own mind with procedures that s/he does not, perhaps cannot, explain. In bargaining, a selection is made by a group of decision makers with conflicting goal systems, each exercising judgment. In analysis, factual evaluation is carried out, generally by technocrats, followed by managerial choice (Mintzberg et al., 1976). Mintzberg et al. (1976) find that judgement is a favourable mode of selection, most likely due to the fact that it is fastest, most convenient and least stressful. The analytic mode clearly distinguishes fact and value in the selection phase. "It postulates that alternatives are carefully and objectively evaluated, their factual consequences explicitly determined along various goal, or value, dimensions and then combined according to some predetermined utility function – a choice finally made to maximize utility" (Mintzberg et al., 1976). The authorization routine occurs when the individual making the decision needs to gather approval of all parties that have that authority or have the power to block the decision.

This three stage model acknowledges that decision processes are often boundedly rational. More recent research breaks from the assumption that rationality and bounded rationality are a continuum but poses that rationality is multidimensional. This means that decision makers are rational in some ways, but not others (Eisenhardt & Zbaracki, 1992). A review of this paradigm by Eisenhardt and Zbaracki (1992) shows that there is sufficient empirical evidence that 1) cognitive limits to the rational model exist, decision makers do not always optimize but rather satisfice, 2) decisions follow the basic phases of problem identification, development and selection, but do not follow each other sequentially but rather cycle through and repeat these phases, and 3) the decision path is influenced by the complexity of the situation and the conflict that exists among the decision makers.

Although less formally-rational processes seems to be important in organizations, Elbanna (2006) presents the procedural rationality view of Dean, Jr. and Sharfman (1996) as: "the extent to which the decision process involves the collection of information relevant to the decision and the reliance upon analysis of this information in making the choice" (Elbanna, 2006). Their study on 52 strategic decisions

shows a positive relation between procedural rationality and decision effectiveness. Dean, Jr. and Sharfman's (1996) scale for measuring procedural rationality in strategic decision making processes contains a 5 item ($\alpha = .80$) 7-point Likert scale (see table 1).

Procedural rationality item	Response
How extensively did the group look for information in making this decision?	(1= not at all, 7 = extensively)
How extensively did the group analyse relevant information before making a decision?	(1= not at all, 7 = extensively)
How important were quantitative analytic techniques in making the decision?	(1 = not at all important, 7 = very important)
How would you describe the process that had the most influence on the group's decision?	(1 = mostly analytical, 7 = mostly intuitive)
In general how effective was the group at focusing its attention on crucial information and ignoring irrelevant information?	(1 = not at all effective, 7 = very effective)

Table 1. Procedural rationality items as formulated by Dean, Jr. and Sharfman (1996)

The ROAHP IT investment decision models of Benaroch and Kaufman (1999), Bardhan et al (2004) and Angelou and Economides (2008) are evolutions of a procedural rationality perspective.

2.2 Politics and power

Another view on strategic decision making that is closer to Mintberg et al's "routines" has roots in political science. In this view, decisions are the result of a process where the "decision makers have different goals, they come together through coalitions, and the preferences of the most powerful triumph" (Eisenhardt & Zbaracki, 1992). The notion that organizations can be seen as political systems is supported by empirical evidence. For example Baldridge (1971) studied New York University (NYU)'s shift from an open enrolment school to a research-oriented university. This was in line with the general view of the university but different stakeholders (such as the students, faculties, and alumni), while sharing the common interest of the wellbeing of the university, had different interests. For example, the implication to increase the tuition fee co-aligned groups of students against the university's plans. Another study of universities by Pfeffer and Salancik (1974) found that the share of the budget of each department was not determined by a rational criterion such as student units taught but by the

power of the department. The act of engaging in politics is another important feature of the political model. Eisenhardt and Zbaracki (1992) define this as follows: "By politics, we mean those observable but often covert, actions by which people enhance their power to influence a decision. Examples of politics include coalition formation, lobbying, co-optation, withholding agendas, and control of agendas." Empirical research on political behaviour within organizations shows that political behaviour is mostly negatively related to organizational performance (Gandz & Murray, 1980) and decision effectiveness (Dean, Jr. & Sharfman, 1996; Eisenhardt & Bourgeois, 1988). This negative relation can be explained by Dean, Jr. and Sharfman (1996)'s insights that political behaviour can lead to decision makers making decisions on incomplete information, this being due to political behaviour distorting information (Pfeffer, 1992) and often restricting the information flow (Pettigrew, 2001). Another reason could be that political behaviour is often time-consuming and therefore causes a delay in the decision, possibly causing loss of opportunities (Pfeffer, 1992). Dean, Jr. and Sharfman (1996) also argue that "political behaviour may lead to incomplete understanding of the environmental constraints, resulting in the undermining of strategic decision effectiveness in two ways. First, political tactics are directed towards the interests, power bases and positions inside the organization rather than towards what is feasible, given the present environmental forces. Hence, decisions which result from such processes are less likely to consider environmental constraints. Second, political processes may exclude some feasible alternatives because they are in conflict with powerful individuals' interests, undermining the likely success of strategic decisions" (Elbanna, 2006). Dean, Jr. and Sharfman (1996) have also developed a scale for measuring the extend of political behaviour in a decision making process (see table 2).

Political behaviour item	**Response**
Were group members primarily concerned with their own goals, or with the goals of the organization?	(1 = own goals completely, 7 = organizational goals completely)
To what extent were people open with each other about their interests and preferences in the decision?	(1 = not at all, 7 = completely)
To what extent was the decision affected by the use of power and influence among group members?	(1 = not at all, 7 = completely)
To what extent was the decision affected by negotiation among group members?	(1 = not at all, 7 = completely)

Table 2. Political behaviour items as formulated by Dean, Jr. and Sharfman (1996)

The political view on IT investment decision making has been extensively researched and debated in the management information systems field. For example, Kling (1980) has described how a dominant coalition makes IT decisions, possibly resulting in counter-implementation if not wel done in a democratic way. Markus (1983) has described how IT initiatives do not pay off by a clear technical advantage or organizational goal, but by a complex interaction of stakeholders in context. More recent work of Galliers and Leidner (2014) and Walsham (2005) emphasize the cultural and political nature of IT investments, as they can fundamentally change the structure and nature of work. Kettinger et al (2011) describe that given an internal power balance, a CIO may be leading the IT innovations or have to leave this leading role to business executives. De Haes et al (2011) describe the case of Dutch airline company KLM, where the newly appointed CIO has been given the role to better align IT investments with the business needs through generating higher involvement of business leaders in the IT investment decision making process.

Dean and Sharfman (1993) found that political behaviour and rationality are not mutually exclusive: an organization's decision making process can both be rational and political in nature. It is, however, reasonable to assume that political behaviour does limit the extent of rationality in an organization's decision making process, as it can lead to decision-makers making decisions based on incomplete information, loss of opportunities as a result of delay in the decision making and the exclusion of feasible alternatives, which are all effects that decrease the extent of rationality in the decision making process. From the statements above, we can identify what a decision making method like ROAHP should bring to the table: the capabilities to identify all feasible or relevant options, to assess the direct and indirect consequences of all relevant combinations of these options by means of explicit and measurable criteria, and to establish the relative importance of these criteria.

3 Description and Adaptation of ROAHP

After this description of rationality and decision making, we present a concrete method for rationalist IT investment decision making. This method, ROAHP, has been inspired by financial decision making, but needs some adjustments. In finance, in order to evaluate an investment decision a discounted cash flow (DCF) approach is used. This means an investment decision is based on the calculated present value of expected cash flows by using a discount rate based on the corresponding risk involved. This approach, however, does not take into account the needed flexibility for most IT-investment decisions (Bardhan et al., 2004). Bardhan et al. (2004) present a RO approach for valuating a portfolio of IT-investment decisions. They argue that previous RO approaches for valuating IT investment decisions ignore project interdependencies because they only look at one project at a time. Their model of nested RO considers positive and negative dependencies of projects within a portfolio. They also state that IT investments are characterized by uncertainty, long pay-back times and the changing nature of a business (Bardhan et al., 2004). An IT-investment thus can have a negative net present value (NPV) but still provide a foundation for other services that might increase profitability in the future. Another reason why a DCF approach to IT investment decisions is not sufficient for IT investments is that these can hold qualitative factors that cannot be quantified easily. Benaroch and Kauffman (1999) present a MCDA model for valuating IT-investments using a real options (RO) approach. A real option is an option to purchase an asset in the future. Following Angelou and Economides (2008) this implies that when more information becomes available about a past IT investment, decisions can be made to either expand, downsize or abandon other future projects, therefore taking into account the flexibility of IT-investment decisions (Angelou & Economides, 2008).

The research by Angelou and Economides (2008) extends on the idea of using a nested RO model by adding the analytical hierarchy process (AHP) to the existing RO model. The nested real options approach helps to include the interdependencies between projects during the valuation of the projects. This will allow not only to calculate the NPV of one project at one moment, but also to add the value of other projects that are enabled by this project. Angelou and Economides distinguish here between hard project dependencies which indicate projects that without their completion will not allow another

projects to be possible and soft dependenices which indicates that projects results may make other projects easier to accomplish. For example, an investment in IT security and customer privacy is a hard dependency for customer relationship management systems, whereas a corporate database may make integrated client processing easier and thus is a soft dependency for the customer relationship management system.

Angelou and Economides (2008)'s method starts by calculating the extended net present value (ENPV). Their value calculations incude the following steps and parameters. An initial project k is defined as P[1,k]. Where P[1,*k*] may be an initial "infrastructure project" *k* (*k* = 1,2,…,K) in phase 1 with K being the total amount of initial infrastructure projects. Angelou and Economides (2008) define subsequent projects as P[*i,j*], where *i* = 1, . . ., n phases and *j* = K+1, K,+2, …,M. M is the total number of ICT projects. Considering P[1,1], if implemented in phase 1 it may hold one future investment opportunity P[2,2] in phase 2. If P[2,2] is successful, the total value of P[1,1] may increase by the extra value enables via the cluster of projects. This results in an extended NPV for P[1,1]: ENPV(P1*,*1)= NPV(P1*,*1)+OV[P2, 2], where OV is the option value of project 2,2 that is enabled by project 1,1.

This formula can be extended to a more complex situation by adding more phases and the options that each project embeds. Hard and soft dependencies, however, have different impacts on ENPV. Hard dependencies between projects exist if project P[2,2] cannot exist when project P[1,1] is not implemented. Because without project P[1,1], project P[2,2] cannot exist the overall option value should be the contribution of P[2,2] to the ENPV of P[1,1], defined as OV[P*1,j,k*] = max (V[P*2,j*]–C[P*2,j*], 0), where V is the present value of operating revenues of the project and C the one time implementation costs. The maximum potential ENPV for P[1,1] therefore can be calculated by the following formula: ENPV(P1,1)= NPV(P1,1)+OV[P2,2,1], where OV[P2,2,1]= max(V[P2,2]–C[P2,2] ,0)

Soft dependencies can exist in both negative and positive form. A positive soft dependency exists when project 1 is not a prerequisite for project 2 but enhances the benefits of the latter. The same goes for a negative soft dependency but instead of project 1 enhancing project 2's value it decreases project 2's

value. The maximum potential ENPV for P[1,1] with soft dependencies can be calculated as follows: ENPV'(P1,1)= NPV(P1,1)+OVA'[P2,2,1]

In order to estimate how much P[2,2] enhances P[1,1] you have to calculate OVA'[P2,2,1]. OVA'[P2,2,1]= OV'[P2,2,1]–OV'[P2,2], where OV'[P2,2,1] is the option value for P[2,2] when P[1,1] is implemented and OV'[P2,2] is the option value for P[2,2] when P[1,1] is not implemented. S*k,j* = the percentage of reduction of operating revenues of project *j* if it is not preceded by project P1,k. This can be calculated as follows: OV'[P2,2,1]= max ([V2,2]–C[2,2],0) and OV'[P2,2]= max(([S,1,2])*([V2,2]–C[2,2],0). For negative soft dependencies the same formula can be used by negating [S2,2]: -OV'[P2,2,1]= max([V2,2]–C[2,2],0) and -OV'[P2,2]= max((1-[S1,2])*([V2,2]–C[2,2],0)

After calculating the ENPV of each project, Analytical Hierarchy Process (AHP) determines each factors' relative weight. AHP is a MCDA technique for choosing from a given set of alternatives. It helps to tackle complex decisions and allows to structure the alternatives hierarchically (Saaty, 2004). AHP allows for different criteria with different units of measure to be transformed into one compatible unit of measure. A nine-point scale (extreme, very strong, strong, moderate and equal, and intermediate values) can be used to score the projects on each factor. Using pairwise comparison matrices all relative weights can be determined and all criteria can be hierarchized.

The decision making method as formulated by Angelou and Economides (2008) follows five steps, which we compliment with a sixth step:

1) Recognize the overall portfolio's projects as well as the initial infrastructure projects as chains of investment opportunities.
2) Identify all hard and soft dependencies between all combinations of projects P1,k and P2,j, where k = 1, 2, 3,. . ., K and j = K+1, K+2,. . .,M.
3) Identify the option presence and type for all projects.
4) Apply the AHP methodology by steps a and b:
    a) Estimate the maximum or minimum potential ENPV values for the infrastructure projects P1,k including the options attributes of subsequent investment opportunities.

b) According to the options presence, perform pairwise comparisons for the estimation of values resulting from ROs thinking.

5) Perform sensitivity analysis to understand the contribution of each factor.

In order to ultimately prioritize the portfolio, the projects have to be arranged based on their total utility factor.

6) Calculate overall ICT utility factor of each project

4 Research Methodology

Although the ROAHP is formal and precise, the actual understanding of how people will use it is unclear. Consequently, we follow an analytic inductive grounded theory approach, in which we aim at finding the reasons for satisfaction and use from direct practical observation (Glaser & Strauss, 2009). For this goal, preliminary interviews were held with CIOs to gather qualitative information about ROAHP's usability, strengths and weaknesses and how it could benefit the current decision making routines within the organization. This structure is useful as the relevant criteria for measuring decision makers' evaluation of a method such as ROAHP are not yet known (Creswell, 2013). This qualitative information thus gained is used to formulate formal statements about ROAHP for more rigoros testing with a panel of experts, i.e. CIO's. These statements are next integrated with Dean, Jr. and Sharfman (1996) scales on decision making contexts, as addressed before, for rating the agreement with these statements.

The selection of CIO's is done in collaboration with the Dutch CIO platform, an association of CIO's of larger Dutch companies. As such it is a convience sample. An ad random sample is hardly feasible in such contexts, given the general difficulties of accessing senior executives. The CIO's are selected on their ability to deliver their expertise for criticizing the method proposed and providing insights that will enable us to develop ideas for the improvement of the method for practical purposes. Consequently, the motivation of CIO's to spend time on our project is more important than a guarantee of having approached the full population of CIO's. Hence, this is a panel study, not a survey, and part of a method

development study, not a finished product. We do not aim to establish the distribution of views and ideas across our subjects, we merely want to identify as many views and ideas as possible that will aid in improving the ROAHP method.

The next section gives the results of the preliminary grounded interviews and the results of the formal panel are given in the section after that.

5 Qualitative Interviews

Participants were given an introduction and explanation of ROAHP per step. The data is gathered by visiting three organizations and asking a mix of questions to IT-portfolio managers, IT architects, CIO's and senior project managers closely involved in the IT-investment decision making process in their organization. All three organizations are commercial organizations with a yearly gross revenue of at least €500 million and/or an IT budget of at least €25 million. The names of the organizations have been changed for the sake of confidentiality. The first organization is a large brewing company founded in the Netherlands, which we will refer to as "Beer". The second organization is a Dutch airport company, named "Airplane" and the last organization is a manufacturer of confectionary and gum, which we will call "Candy". The participants were given an introduction to the ROAHP method. The questions and answers about ROAHP will now be discussed and the statements derived from the answers will be presented.

The first question about the method is: *"What do you think is of importance in order to make the use of the described method feasible?"*

Both Beer and Airplane stressed the importance of the acceptation of the method by stakeholders. Candy mentioned that the benefits of the method must be clear, while Beer stated that there must be a proof of concept. This resulted in the following two statements:

Statement 1: *"In order for this method to work, the business stakeholders have to accept it"*.

Statement 2: *"The benefits of this model must be clear"*.

All three organizations agreed that the method must not be too much effort and easy to perform. Beer and Airplane also mentioned that it should be easy to explain the method to (also business) decision makers involved. This resulted in the next two statements:

Statement 3: *"The method must be easy to explain to non-IT executives".*

Statement 4: *"The method must be easy to perform".*

Airplane explained that it was very important that the data needed for the method must already be available and no additional data has to be collected.

Statement 5: *"The data needed for this method must already be available"*

Furthermore, both Beer and Airplane said that the model, and especially the results must be presented in a visually attractive manner.

Statement 6*: "The results of the analysis must be presented in a visually attractive manner"*

The second question about the method is:

"What are potential strengths and/or weaknesses of the described method?"

All three organizations mentioned several strengths and/or weaknesses and this resulted in 5 statements about the strengths of ROAHP and 4 about the weaknesses:

Statement 7:*"A potential strength of this method is that it can quantify decision factors"*

Statement 8:*"A potential strength of this method is that it helps to identify the interdependencies between projects within the portfolio"*

Statement 9:*"A potential strength of this method is that it can compare tangible and intangible factors and weigh their importance relative to each other"*

Statement 10:*"A potential strength of this method is that it provides a clear prioritization of projects"*

Statement 11:*"A potential strength of this method is that it can help improve the quality of decisions"*

Statement 12: "*The method is too theoretical, it will not work in real life decision making"*

Statement 13: "*The method is too much of an administrative burden"*

Statement 14: "*There is too much information to deal with to make use of this method"*

Statement 15: "*The benefits of the method are not clear"*

The last question is about how current decision making routines could benefit from ROAHP:

"Of the aforementioned routines, which (one) could benefit from the use of the presented model?"

Airplane and Candy both said that the screen routine could benefit from ROAHP, as it could help decrease the initial amount of potential projects.

Statement 16: *"The method can potentially help with decreasing the initial amount of potential projects"*

All three organiziations believed the evaluation choice routine could benefit from ROAHP. Beer added that only the highest management layer would benefit from this and Candy thought it would help increase the transparency of the portfolio. The evaluation choice routine consists of evaluating the selected alternatives and making a prioritization based on this evaluation. Therefore, the following two statements have been added:

Statement 17: *"The method can potentially help with comparing the costs and benefits of different projects"*

Statement 18: *"The method can potentially help prioritizing projects within a portfolio of projects"*

These 18 statements about ROAHP will be used to quantitatively collect opinions of CIO's on ROAHP.

6 Panel study

6.1 Introduction

In the interviews, participants will at first be introduced to the topic and asked to answer the questions corresponding to the scales for procedural rationality and political behaviour. The answers to these questions will create a profile of the strategic decision making process in an organization as either more political or more rationalist. This profile can then be used to identify possible missed opportunities within the organization. For example, an organization with a profile that has political behaviour as dominating characteristic has the opportunity to become more rationalistic, and therefore has an opportunity to improve the quality of the decision making process (see table 3). In order to calculate the value of each construct for each organization, all items have the same relative weight.

Political behaviour items	Procedural rationality items
Individual vs. organizational goals	Use of analysis
Open about preferences	Information search
Use of negotiation	Quantitative methods
Use of power	Intuitive vs. analytic
	Information focusing

Table 3: Items for decision making profile based on Dean, Jr. and Sharfman (1996)

The goal of the panel study is to test the practical usability of ROAHP by IT-investment decision makers. In order to check whether the participants understood the explanation of the method, a first and second item were added to the list of 18 statements from the previous section. This makes for a total of 20 statements (see table 4): 2 statements about the understanding of ROAHP, 6 statements about prerequisites to make ROAHP usable, 5 statements about the strengths, 4 statements about the weaknesses of ROAHP, and 3 statements about how their current decision making routines could benefit from ROAHP.

In order to put the panel members' opinions in an organizational context, the participants are first asked about the decision making process in their organization using Dean, Jr. and Sharfman's (1996) items (see tables 1 and 2). Next, the CIO's were presented an explanation of ROAHP and asked to rate the statements on a 7-point Likert-type scale, ranging from 1 (strongly disagree) to 7 (strongly agree).

Question	Category
Q1. The explanation of the method is clear to me	Understanding of method
Q2. I understand what problem the method is trying to solve	Understanding of method
Q3. In order for this method to work, the business stakeholders have to accept it	Prerequisite to make the model usable
Q4. The benefits of this model must be clear	Prerequisite to make the model usable
Q5. The method must be easy to explain	Prerequisite to make the model usable
Q6. The method must be easy to perform	Prerequisite to make the model usable

Q7. The data needed for this method must already be available	Prerequisite to make the model usable
Q8. The results of the analysis must be presented in a visually attractive manner	Prerequisite to make the model usable
Q9. A potential strength of this method is that it can quantify intangible factors	Potential strength
Q10. A potential strength of this method is that it helps to identify the interdependencies between projects within the portfolio	Potential strength
Q11. A potential strength of this method is that it can compare tangible and intangible factors and weigh their importance relative to each other	Potential strength
Q12. A potential strength of this method is that it provides a clear prioritization of projects	Potential strength
Q13. A potential strength of this method is that it can help improve the quality of decisions	Potential strength
Q14. The method is too theoretical, it will not work in real life decision making	Potential weakness
Q15. The method is too much of an administrative burden	Potential weakness
Q16. There is too much information to deal with to make use of this method	Potential weakness
Q17. The benefits of the method are not clear	Potential weakness
Q18. The method can potentially help with decreasing the initial amount of potential projects	Benefit to current routines
Q19. The method can potentially help me with comparing the costs and benefits of different projects	Benefit to current routines
Q20. The method can potentially help me prioritize projects within a portfolio of projects	Benefit to current routines

Table 4: Questions about ROAHP

The data are gathered by sending a questionnaire to 106 CIO's operating within the Netherlands. 15 CIO's responded, whose responses have been anonymized for the sake of confidentiality, resulting in a response rate of 14%. A total of 26 CIO's actually responded, however, only 15 surveys were answered and usable. The reasons for this low response can be the fact that the role of CIO is very time-consuming and, even though confidentiality was guaranteed, some organizations consider insight on their decision making process to be confidential.

6.2 Strategic decision making process

In order to calculate the value of each construct for each organization, the Dean, Jr. and Sharfman (1996) item means are calculated. In order to compare both scales, the scale scores are divided by the total number of items per construct, 5 and 4 for procedural rationality and political behaviour respectively (see table 5). The strategic decision making process in the majority of organizations (60%) is mainly driven by procedural rationality and in 40% of the organizations driven by political behaviour. In order to classify each decision making process, the Likert-type item scores have been divided in two categories: 1) low —a score between 1 and 4—, and 2) high —a score between 4 and 7. This means there are four possible combinations of politics and procedural rationality (high politics/low rationality, high politics/high rationality, low politics/high rationality and low politics/low rationality). It is noteworthy that almost all (14 out of 15) strategic decision making processes of the organizations scored high in both procedural rationality and political behaviour.

Organization	Procedural rationality	Political	Rationality vs politics
1	4.4	2	high/low
2	5	5.5	high/high
3	5.4	4.75	high/high
4	4.4	4.75	high/high
5	4.4	4.75	high/high
6	6	4.75	high/high
7	4.8	5.5	high/high
8	4.6	4.5	high/high
9	4.8	5	high/high
10	5.6	4.75	high/high
11	5.6	4.25	high/high
12	5	4.75	high/high
13	5.4	4.5	high/high
14	4.8	5	high/high
15	4.8	4.5	high/high
Mean	5	4.62	high/high

Table 5: Results of the Dean, Jr. and Sharfman (1996) items

6.3 Results of ROAHP items

The first two statements after the explanation of ROAHP are about the understanding of the method. While 12 CIO's (80%) either agree or mildly agree that the explanation was clear, two CIO's indicate that they thought the explanation of the method wasn't clear. Most CIO's did understand what problem the method was trying to solve and 80% either agreed or strongly agreed with this statement. It can be concluded that the explanation and intention of the method was understood by the majority of CIO's. This validates the assumption that our panel participants understand the method and are able to answer the questions in the other four categories.

	The explanation of the method is clear to me	I understand what problem the method is trying to solve
Strongly disagree	0.0%	0.0%
Disagree	0.0%	0.0%
Mildly disagree	13.3%	6.7%
Neutral	6.7%	6.7%
Mildly agree	33.3%	6.7%
Agree	46.7%	46.7%
Strongly agree	0.0%	33.3%

Table 6: The understanding of ROAHP

The following statements are about prerequisites to make ROAHP usable. Almost all CIO's (93.3%) agreed that in order to make ROAHP work, the business stakeholders have to accept it. One CIO mildly disagreed with this statement. This CIO also did not agree with the statement that the method must be easy to perform or that the results must be presented in a visually attractive manner. The other CIO's were in agreement about almost all statements (see table 7).

	For this method to work, the business stakeholders have to accept it	The benefits of this model must be clear	The method must be easy to explain	The method must be easy to perform	The data needed for this method must already be available	The results must be presented in a visually attractive manner
Strongly disagree	0.0%	0.0%	0.0%	0.0%	0.0%	6.7%
Disagree	0.0%	0.0%	0.0%	6.7%	0.0%	0.0%

Mildly disagree	6.7%	0.0%	0.0%	0.0%	13.3%	0.0%
Neutral	0.0%	0.0%	6.7%	6.7%	13.3%	0.0%
Mildly agree	13.3%	13.3%	13.3%	20.0%	26.7%	0.0%
Agree	33.3%	40.0%	46.7%	40.0%	33.3%	53.3%
Strongly agree	46.7%	46.7%	33.3%	26.7%	13.3%	40.0%

Table 7: Prerequisites to make ROAHP usable

Multiple strengths of ROAHP were mentioned in the interview and received agreement by the majority of panel members (see table 8), while the statements about the weaknesses received less agreement. The opinions on the weaknesses of ROAHP are divided (see table 12). More CIO's disagreed than agreed with the statement about ROAHP being too much of an administrative burden (46.7% against 40%, respectively). The statement about whether there is too much information to deal with to make use of the method was agreed upon by 40% of the CIO's, while 33.3% have a neutral opinion on the matter.

	A potential strength of this method is that it can quantify intangible factors	A potential strength of this method is that it helps identifying inter-dependencies among projects	A potential strength of this method is that it can compare tangible & intangible factors and weigh their importance	A potential strength of this method is that it provides a clear prioritization of projects	A potential strength of this method is that it can help improve the quality of decisions
Strongly disagree	6.7%	6.7%	0.0%	0.0%	0.0%
Disagree	0.0%	0.0%	0.0%	6.7%	13.3%
Mildly disagree	0.0%	6.7%	0.0%	0.0%	0.0%
Neutral	20.0%	6.7%	13.3%	6.7%	13.3%
Mildly agree	20.0%	20.0%	26.7%	40.0%	26.7%
Agree	40.0%	40.0%	40.0%	46.7%	26.7%
Strongly agree	13.3%	20.0%	20.0%	0.0%	20.0%

Table 8: Strengths of ROAHP

The results show that 86.7% of the CIO's think that ROAHP can help them with comparing the costs and benefits of projects. The majority of CIO's (53.4%) also think that ROAHP can decrease the number of initial projects but 26.7% either disagrees or strongly disagrees with this statement. 73.3% indicate that ROAHP can potentially help to prioritize projects within a portfolio of projects.

	The method is too theoretical, it will not work in real life decision making	The method is too much of an administrative burden	There is too much information to deal with to make use of this method	The benefits of the method are not clear
Strongly disagree	0.0%	0.0%	0.0%	13.3%
Disagree	6.7%	20.0%	13.3%	46.7%
Mildly disagree	20.0%	26.7%	13.3%	13.3%
Neutral	26.7%	13.3%	33.3%	13.3%
Mildly agree	33.3%	40.0%	26.7%	6.7%
Agree	6.7%	0.0%	13.3%	6.7%
Strongly agree	6.7%	0.0%	0.0%	0.0%

Table 9: Weaknesses of ROAHP

	The method can potentially help with decreasing the initial amount of potential projects	The method can potentially help me with comparing the costs and benefits of different projects	The method can potentially help me prioritize projects within a portfolio of projects
Strongly disagree	6.7%	0.0%	0.0%
Disagree	20.0%	13.3%	13.3%
Mildly disagree	0.0%	0.0%	6.7%
Neutral	20.0%	0,0%	6.7%
Mildly agree	20.0%	46.7%	40.0%
Agree	26.7%	40.0%	13.3%
Strongly agree	6.7%	0.0%	20.0%

Table 10: Benefit to current decision making routines

In the next chapter, these results are discussed and interpreted.

7 Conclusions and Discussion

In the beginning of this article, we argued that current research on normative models for IT-investment decision making lacks a focus on the usability for the end-users: IT-investment decision makers.

The results indicate that political behaviour is almost equally apparent as rationality in the decision making process of our studied organizations. Literature shows substantial evidence that, within a

strategic decision making process, political behaviour is negatively related and rationality is positively related to organizational performance. This shows a potential for organizations to improve their decision making process by finding a better balance between their political behaviour and rationality in their IT-investment decision making process.

Results of this study show that the our panel members (who were all CIO's) recognize the potential of ROAHP to increase the quality of their current routines of decision making by decreasing the number of potential projects to consider, comparing the costs and benefits of individual projects, and prioritizing projects within a portfolio of projects. Furthermore, our panel members recognize the benefits of ROAHP. In fact, they were quite positive about ROAHP. The method's potential to quantify intangible factors and the ability to compare these with tangible factors, the ability to identify interdependencies between projects within a portfolio of projects, and the potential to provide a clear prioritization of projects are seen as strengths of ROAHP. Results from the qualitative interviews and the panel study show that there is agreement among CIO's about prerequisites that are essential to make ROAHP usable in practice. All panel members agreed with the prerequisite that the benefits of the method must be clear. Furthermore, the business stakeholders have to accept the method and therefore the method must be easy to explain, easy to perform, the data required for the method should be available, and the results should be presented in a visually attractive manner. Opinions on the potential weaknesses of ROAHP are less strong, but a considerable number of panel members agreed that ROAHP is too theoretical and that it will not work in practice. Angelou and Economides (2008) state that ROAHP "provides a better understanding of interdependencies and various intangible factors of projects extracted by the ROs analysis, enabling these projects to be valued and prioritized with higher accuracy". The results of this research reveal a gap between this statement and practice. CIO's, the end-users of ROAHP, do not doubt the potential benefits of the method if it is able to meet its prerequisites.

To answer our key research question, we argue that ROAHP does not meet these prerequisites and is not easy enough to explain, to perform and the data required is often not available and thus results in high decision and search costs that are hard to compensate with measurable benefits. ROAHP requires a significant amount of mathematical know-how and data about costs and benefits, and dependencies

between projects that are often not known and this impedes the practical usability of a normative model such as ROAHP.

While current research on normative models for IT-investment focuses on the validity and accuracy of the model, this study shows that the end-users are already convinced of the potential of these methods. However, the use of normative models is still not widespread because they are not found usable in practice. This study shows a need for change in research on normative models for IT-investment decision making and, given these observations, IT-investment decision making research is ready to shift its attention to the end-users. To let good academic ideas land in practice, systematic research is needed to fill the gap between theory (and the well-designed method) and actual adaptation and use. These types of implementation studies have been done before on for example ERP implementations (Ward et al., 2005), competence management system implementation (Lindgren, Henfridsson, & Schultze, 2004), knowledge management systems (Markus, Majchrzak, & Gasser, 2002), and data quality method implementation (Wijnhoven, Boelens, Middel, & Louissen, 2007). Such studies require intense case studies, in which implementation hypotheses are tested in multiple suggestive trials during action research cycles. For IT investments methods it seems that it is now time to proceed in a similar way.

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