UP-FRONT DECISION MAKING BASED ON SCANT INFORMATION

Kjell Sunnevaag [1], Knut Samset [2]

ABSTRACT

Major public investment projects emerge as the result of perceived problems or needs. Experience suggests that the preferred answer to the problem usually originates in isolation as a single idea, without systematic scrutiny of possible alternatives. The initial choice of project concept is essential, also because this often turns out to be the final choice - even when the initial choice subsequently prove to be the wrong choice. What happens apparently is that the more fundamental questions regarding the initial choice are drowned in a subsequent abundance of detailed quantitative information about the project as planning proceed.

This paper presents some preliminary findings from a research project undertaken by the Norwegian Institute for Research in Economics and Business Administration, commissioned by the Concept research program on front-end management of major public projects. The project, which is in its infancy, is designed to explore the quality and importance of the initial choice of project concept, what information and analysis it is based upon and what it would take to increase the chances to make the right choice.

Clearly, available information in the earliest stages is restricted, particularly reliable quantitative information. Analysis and decisions will therefore to a large extent rely on qualitative information and judgment. It is essential to explore how analysis and decisions are made up front, by whom and at what time, and the quality of available information. The front-end phase of major projects commonly lasts for a decade or more. Another vital issue is therefore how rapid various types of information become invalid over time during this period. The paper raises some questions regarding how to strengthen the information basis, and improve information quality in order to make better decisions up front. It further discusses the usefulness and limitations of applying various analytic techniques such as Bayesian and fuzzy logic. Finally, it looks at the importance of maintaining flexibility of choice during the initial years, when the option of making fundamental changes to improve future performance may be one of the main assets.

KEY WORDS

decision making, front-end, scant information, information quality.

1 Research Director, Institute for Research in Economics and Business Administration, Breiviksveien 40, N-5045 Bergen, Norway, Phone: +47 55 95 95 00, Fax: +47 55 95 94 39, kjell.sunnevag@snf.no

2 Professor, Director of the Concept research program, Dept. of Civil Engineering and Transport, Norwegian University of Science and Technology, N-7491 NTNU, Trondheim, Norway, Phone +47 73 59 46 41, +47 90 08 48 11, knut.samset@ntnu.no,

THE IMPORTANCE OF THE FRONT END PHASE

There are numerous examples of projects that have caused high additional cost for society both during and after they have been implemented. Overruns are common. Many projects appear as failures, particularly in the public view. However, in reality, most projects attain their objectives in one way or another. While media tend to focus on cost overrun and delays, these problems are often insignificant if seen in a wider time perspective. For instance, a 10 per cent cost overrun for the new Norwegian national university hospital which was completed 2003, was equivalent to only about one year operating costs. The real proof of success is therefore not the delivery of the project's outputs but its immediate and long term effect. Clearly, such more fundamental issues rely to a lesser degree on the management of the project during planning and implementation, but more on the selection of project concept and its initial design.

The importance of *quality at entry*, as measured by quality of project identification, preparation and appraisal, has been explored and emphasized in several studies, more recently in the IMEC study *Miller and Lessard (2000)*. The World Bank came out with the same message in a study based on a review of 1125 of its projects that were evaluated between 1991 and 1994, *World Bank (1996)* The study concluded that projects with adequate or better identification, preparation and appraisal had an 80 per cent satisfactory rate, versus 25 per cent for projects that were deficient in all these aspects. Of the projects with deficient appraisal but adequate identification and preparation, 46 per cent had satisfactory outcomes, nearly half the rate of those with adequate appraisal. The report concluded that the quality of preparation and of appraisal had significantly more influence on satisfactory performance, than key country macro-economic variables, external factors, or government considerations.

Because projects are unique undertakings, they involve a degree of uncertainty. Uncertainty characterises situations where the actual outcome of a particular event or activity is likely to deviate from the estimate or forecast value. It follows that decision-making becomes more difficult as uncertainty grows. Further, that the availability of relevant information increases predictability and reduces uncertainty seen from the decision maker's point of view.

Uncertainty is highest in the outset and reduces progressively as information is generated. Therefore, the potential for affecting the end result is highest in the outset. Amendment costs will normally increase as the project moves on. Experience as well as logic suggests that time and resources spent up front might be worth while. We would add that funds spent in the initial phase before the initial choice of concept and before the project is being planned might be an even more cost effective use of resources.

THE IMPORTANCE OF INFORMATION

There is a widespread belief that success and uncertainty is related. Projects therefore go to great length to explore, understand, reduce or overcome uncertainty in decision-making. To this end, the most common means is to:

- Generate and analyse as much essential information as possible
- Take a broad view to understand the factors that affect the project

- Reduce the level of ambition
- Reduce the planning perspective in time, etc.
- Improve planning, for instance by using stochastic analysis, etc.

However, reality, at least outside the physical laboratory, is in constant change, and therefore more or less unpredictable. The reason for this is the in-built dynamism in social and administrative systems, particularly their self-adjusting abilities. There are obvious limitations to what can be achieved in terms of reducing uncertainty. As the result, minute plans developed at an early stage may be less effective in achieving objectives than successive interventions to influence the dynamic process as it unfolds. Systematic assessment of uncertainty at different stages could therefore be seen as an alternative or supplement to planning. It would also be an essential part of evaluation, both in the front-end when the viability of basic project concepts are assessed, and later when performance and effect are scrutinised.

ACCESS TO INFORMATION

Uncertainty is commonly defined in terms of absence of information to make the right decision. Although this is a useful definition in operational terms, it is also very limited: it suggests that uncertainty can be eliminated when the necessary information is available. However, projects are dynamic processes operating in societal environments where plans are frequently overtaken by events. Such an assumption is therefore naive, to say the least. It may nevertheless be useful to consider the linkage between uncertainty and information along the dimension of time. What type of information is available at the earliest stage when a project is formulated and appraised? What type of information can not be produced? What is the limit to the usefulness of additional information? What is most important: contextual information or operational information?

In general, future events are predictable only to a limited extent. Some events can be predicted in quantitative terms on the basis of assessments of past trends. Other events occur more spontaneously and represent qualitative changes or discontinuities. Sudden changes in the economy, a new technological breakthrough, an act of terrorism, a change of government or management may suddenly change the general picture altogether. Often, neither the timing nor the effect of such events can be predicted or even understood before they occur. Uncertainty therefore depends not only on the amount of information which is actually available to the decision-maker, but also on the nature of the process studied. In many cases vital information is by definition not available forehand to shed light on development before it actually happens.[3]

Our main concern is the type of information that is critical to the success of the project. A study of 249 projects looked into their success rates, the main problems associated with the projects, what caused these problems and the extent to which the problems could have been foreseen, *Samset (1998).* The study concluded that as much as 70 per cent of the main

[3] For a further discussion see Annex 3

problems were caused by uncertainties that were largely predictable. It was found that also contextual uncertainties to some extent were largely predictable as indicated in figure 1. While this may be surprising, an explanation might be that successes and failures are largely repeatable in projects with similar purpose and characteristic. Taking the accumulated lessons of success and failure from these projects as the lead when looking for information relevant to the design and appraisal of an anticipated project may therefore be less demanding and expensive than imagined.

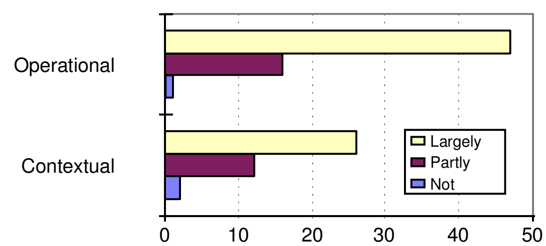

Figure 1 Assessment of predictability of operational and contextual uncertainties causing major problems in 249 projects. (N=334)

UP FRONT ANALYSIS AND DECISION

Projects should ideally be planned within the context of a long-term strategy, where objectives are established and formally agreed. Hence a need to analyze causality both in terms of expected achievements and probability of occurrence. In addition, an initial overview of the complexity of the strategy, which in many cases will reveal a picture of confounding, even conflicting, objectives.

The quality of design was explored further in a sample of 30 larger development projects that had been designed using a common format[4], *Samset (1998).* The distinction was made between the project's *operational* objectives (its outputs), *tactical* (immediate objective), and *strategic* (long-term effect). It was found that the strategies did not meet the planning requirements by far. Most of the projects had design faults at all levels and no projects were without faults.

In two third of the projects objectives had been swapped between the three ambition levels. About half of the projects had between two and six tactical objectives, instead of one, as required. Only 10 per cent of the projects were found to be well designed at the operational level, seven per cent at the tactical level, and seven per cent at the strategic level, see table 1. The study concluded that the weakest part of the design was the description of contextual uncertainties associated with the perceived project.

[4] The logical framework methodology

Table 1. Realism of objectives at three ambition levels, and the number of objectives defined in verifiable terms

	Strategic level	Tactical level	Operational level	Total	
				No.	%
Total number of objectives	49	63	104	216	*100*
Too ambitious objectives	12	3	26	41	*19*
Realistic objectives	15	18	75	108	*50*
Too limited objectives	23	42	3	68	*31*
Number of verifiable objectives	16	35	49	100	*46*

Clearly, this leaves much to be desired in terms of getting the picture right. Now, the question is what does it take to fill the analytical framework with the information the ensure the project is relevant in relation to the problem it is intended to solve, economically viable, end effective in fulfilling its objectives.

STRENGTHENING THE INFORMATION BASIS

The issue of strengthening the information basis leads instinctively to the questions *how* and *to what extent*. Before attempting to answer these questions, let us take a look at the traditional approach to estimating values relevant to the project. Very often this is to assess a 50/50 estimate, supported by a low and a high estimate.

As already mentioned, uncertainty is highest when the process of assessing project values commences, but will gradually be reduced as existing information is processed and new information is collected. In a report which i.a. evaluates reasons for cost overruns on the Norwegian Continental Shelf, NOU 1999:11[5], it is mentioned that when the oil companies present their plan for development and operations of an oil field to the Ministry of Petroleum and Energy for approval, i.e. at the end of the early phase, the total standard deviation for the project will have been reduced to 20%. For some components, however, the standard deviation will still be around 40%. As planning commences, this span will obviously be much higher, but as the project 'matures', the project will be more detailed, and more precise estimates will be enabled.

This process of gradual reduction of uncertainty, and the corresponding increase in estimate precision, can be attributed to several factors. Firstly, the project as such gets more detailed. This enables more precise use of existing data sources. Secondly, as time passes, more information of relevance to the project will be revealed, in other words; uncertainty is gradually unveiled. This will have a potential impact on prior estimates. We will, however, focus on the particular challenges faced in relation to up-front decision making. As illustrated in figure 2, a distinction is made between two decision points. We will define the front-end phase as the period leading up to a decision between at least one realistic investment

[5] Report from a Committee appointed by the Norwegian Ministry of Petroleum and Energy.

alternative to the zero alternative (doing nothing). If a decision is taken to proceed with a given project different from the zero alternative, the project will have to be detailed to such an extent that the final investment decision can be made, and building commence.

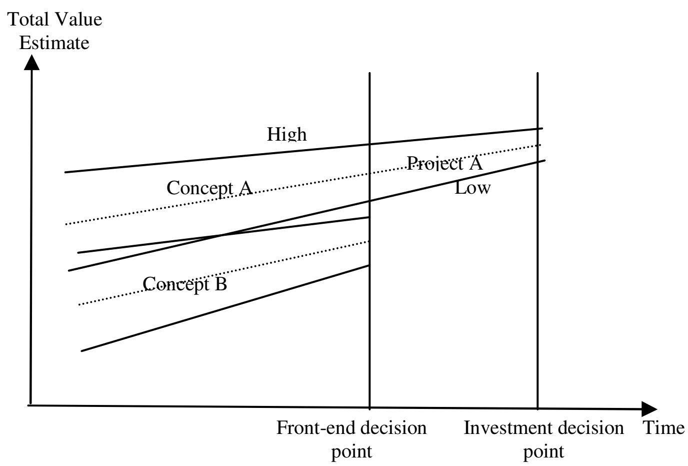

Figure 2. Challenges in making a choice between two concepts where estimates overlap

Here we have put the front-end decision point at a point in time where it is relatively clear-cut which alternative realizes the highest total value, measured for instance as net present value (NPV). There is obviously still room for surprises, but even more so had the decision point been earlier at a point in time where the high estimate for project B intersects the low estimate for project B.

In the earliest phase, with scant information and one or more project alternatives that only exist as a rough drawing on 'the paper napkin', it is obviously meaningless to use very sophisticated methods for assessment. Only rough, experience-based data is meaningful in the earliest phase, for instance like "a road tunnel with a width and length like this in this type of rock typically costs in the range of $ to $$ per meter".

From figure 2 we can see that front-end decisions to make a choice between concepts may be more challenging than subsequent decisions regarding the size of investment with respect to value estimates. One of the reasons is *time* in addition to *scant information,* but also in addition to *imprecise description* of the project alternatives *per se*. The fact that each of the alternative concepts only are more or less vaguely defined, clearly adds to this problem.

In the total assessment, time will have the effect of increasing the span of possible outcomes, where these outcomes evolve more or less *stochastically*. This will in particular apply to input factors whose value is determined by market forces. An important distinction is the circumstances under which new information becomes available, i.e. uncertainty is revealed. We can distinguish between uncertainty external to the project and uncertainty internal to the project. With *external* uncertainty, new information will become available in time independent of whether the investment is carried through or delayed. Price uncertainty is a good example. With *internal* uncertainty new information is only revealed *if* certain actions are carried out. In e.g. an oil field development context, exploration drilling, drilling of appraisal wells and production testing are examples of actions that can reveal information and create option value, given operating flexibility to make use of the information. So, while external uncertainty will strengthen the economic requirements to the project, internal uncertainty will work in the opposite direction.

Very often there is also some leeway about the timing of the front-end decision point and the timing of the final investment decision. The decision can be postponed to get more information about conditions important for the success or failure of the project. Full certainty, however, can never be achieved. However, at one point in time the decision maker has to decide whether information is sufficient to make a choice between concept alternatives. Irreversibility, uncertainty and the possibility to delay to get more information are three characteristics working together, influencing the optimal decision by creating opportunity costs. The extra value created through decision flexibility or operational flexibility is rarely quantified through traditional DCF-approaches. It is by now well known, however, that optimal investment rules can be obtained from methods that have been developed for pricing options in financial markets.

In making this decision at the front-end decision point, one has to ask if there is a possibility that more information will be revealed with time, and in that case, will this information also have an impact on the ranking of alternatives.

The corresponding question at the investment decision point is whether information will be revealed that have an impact on the decisions to invest or not. Thus, *waiting* can have a value in both cases, and the framework for assessing this value is presented in i.a. Dixit and Pindyck (1994). In both cases, one has to make sure that the proper methodological framework is applied in order to *assess project flexibility*, i.a. to correctly reflect ability to adjust to changing circumstances in project values.

If we return to our tunnel example, as the project planning proceeds, the geology of the different project alternatives, e.g. different trajectories, will be revealed through geologic examinations, and the requirements to the tunnel itself will be more precise, for instance with respect to outfitting and safety requirements. However, until uncertainty is completely revealed, there will always be some room for surprises. How big the surprise become, is obviously determined by the quality of existing and new qualitative and quantitative information sources, in addition, but not less important, how this information is used, i.e. the methodological issue.

In this context, the significance of updated and accurate quantitative and qualitative information cannot be stressed too much. Thus, an important part of the (ideal) estimation system will be a *database* with information based on previous projects with technical as well as market data, price estimates from different suppliers, continuously updated information from other projects under way in addition to assessments with respect to different factors affecting uncertainty, technical, market development as well as important and relevant premises to the project(s) in question. The *quality* of this database is obviously important to precision in estimates, and quality is assured i.a. through continuous updating.

In the above mentioned report, NOU 1999: 11, the importance of *further development of estimation techniques* is underlined, in addition to the importance of information quality as such. We will not linger much with traditional methods for estimation and uncertainty assessment, nor with methods like scenario techniques etc, but will concentrate on more recent methodological developments, and discuss their potential application in practical estimation work in the early phase.

We will here distinguish between existing information and new information. With respect to existing information we will focus on techniques used in order to improve the quality of existing qualitative information and methods used to exploit the information content in existing (quality assured) information in a more efficient way to assure more robust decisions. Basically, this is the work we do in order to establish the *a priori distribution* of outcomes.

With respect to new information we will give some attention to Bayesian techniques, and how this can be used to establish a more robust *a posteriori* distribution.

ASSURING QUALITY AND USING EXISTING INFORMATION

What is information quality? Too often, important investment decisions are based solely on data that just happened to be available or readily obtainable, but which yield measurements that others would not accept as meaningful in the actual decision context.

The most basic aspect of information quality is the extent to which it corresponds to what we want to measure. This involves two important concepts, i.e. *validity* and *reliability*. Validity is usually defined as closeness or fit between an intellectual construct and the things we measure empirically as indicators or proxies for that abstraction. Validity cannot be verified or tested directly, but will have to be based on the judgement of the analyst. However, validity can often be improved by using several different measures for the same phenomenon, such as several different measures of income in the example above. *Methodological triangulation* is a keyword in this context. This implies using different methodological approaches, or that different estimators applies the same methodological approach. If this leads to the same result, we would expect higher validity.

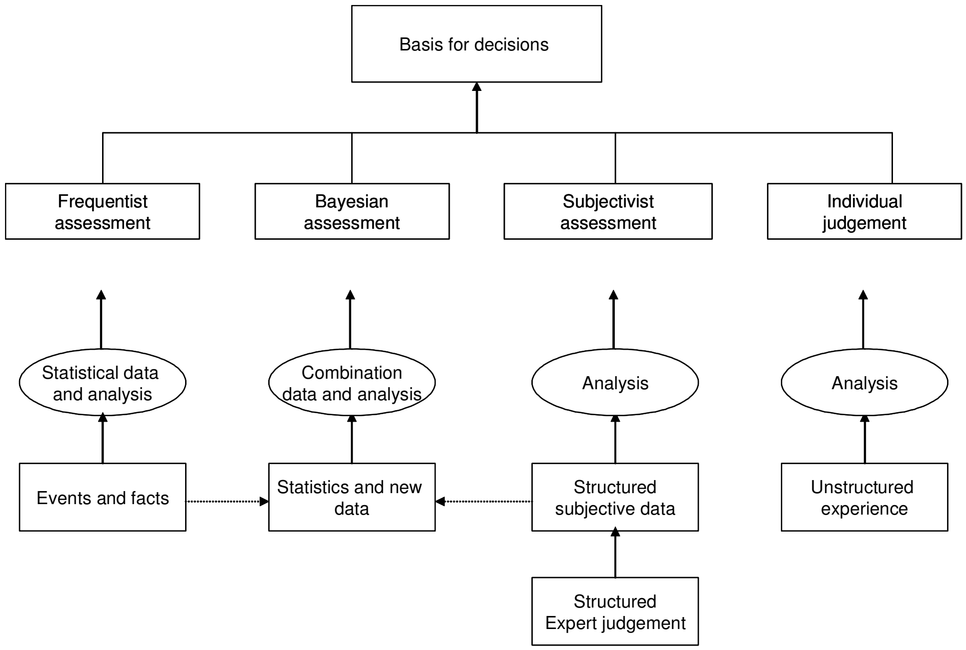

Figure 4. Four classes of information that are used as basis for decisions, ranging from quantitative statistics to qualitative subjective judgement

Information is *reliable* if the measurement procedure yields the same results if applied repeatedly; in other words, that the analytic instrument with a certain degree of confidence can ensure that the measurement results correctly represent empirical relationships. For instance, a seismic survey conducted to examine the potential for petroleum resources in an area would be unreliable if it was administered to the same area twice and produced different data.

If we try to put these crucial concepts in the context of an up front evaluation and subsequent decision between alternatives, the first requirement is that evaluation instruments are checked as to whether they measure what they intend to measure. Secondly, we need to assert that evaluation questions correspond to the evaluation criterion being focused. Thirdly, questionable validity should be compensated using several information sources or methods. Finally, we need to assess to what extent the evaluation questions in combination are sufficient to provide a valid overall conclusion.

Thus, when a decision maker is interested in the outcome of some chance event, he may solicit information from one or more sources. The importance of seeking information from more sources become even more important if the outcome of this chance event potentially can affect *the ranking* between project alternatives.

These sources of information may be human experts, mathematical models or computer simulations, based on different sources of qualitative and quantitative data. A practical example of combining quantitative and qualitative information sources in a macroeconomic perspective is presented in Jefferson (1998). However, the decision task of combining the information to form beliefs about the outcome is complicated, in particular so if the information is statistically dependent. Clemen (1985) and Clemen (1989) provide references to the literature on appropriate Bayesian procedures for combining information. In addition, in the former reference, Clemen also points out that when an information source will have no effect on the decision maker's posterior beliefs, no matter what that source says, the information source is *extraneous*. Clemens furthermore discusses Bayesian conditions for extraneous information sources.

In the process of knowledge acquisition, the decision maker sometimes has access to the judgment of multiple experts. Correcting for biases in probability assessment is exemplified in e.g. Goodwin and Wright (2004), based on knowledge further detailed in i.a. Gilowitch et al. (2002). This is important issues also in a front-end context. Here, however, we will in particular pay attention to the issue of multiple expert information sources. In those cases it is likely that the developer may have to aggregate across the experts to develop a single estimate. One approach is to average expertise. A survey of the literature, in addition to discussing a general Bayesian model for linear combination of forecast, is presented in Anandalingam and Chen (1989).

The task of aggregating the judgments of multiple experts into a single system is discussed in principle in O'Leary (1993), and studied empirically in O'Leary (1998). O'Leary's point is that in such circumstances it is desirable to determine if the experts have different views of the world *before* their individual judgments are aggregated. If the experts do not have similar views, their evaluations or assessment may differ, resulting in a meaningless average assessment. With different views O'Leary means e.g. experts from different firms or experts with distinctly different views of the world. For instance, who would be interested in averaging the assessment of election outcome between a representative from a conservative party and a representative from a socialist party. Alternatively, if all the validating experts do have similar views of the world then the validation process may result in paradigm myopia. This corresponds to asking only representatives from the socialist party as to what their estimate of the election outcome will be. In this context it is tempting to refer to Surowiecki (2004), which explores the idea that large groups of people are smarter than an elite few, no matter how brilliant; "better at solving problems, fostering innovation, coming to wise decisions, even predicting the future." Even though his ideas have resulted in commercial undertakings using these principles in order to predict the outcome of elections etc., we will not stretch the normative implication of this section longer than underlining that great care should be taken when selecting experts, adjusting their assessments and combining their forecasts.

USING NEW INFORMATION

In Bayes' theorem an initial probability estimate is known as a prior probability. When Bayes' theorem is used to modify a prior probability in the light of *new information* the result is known as a posterior probability. The process of revising initial probability estimates in the light of new information using Bayesian techniques is illustrated with practical examples in e.g. Goodwin and Wright (2004).

However, new information, be it from geological surveys, market research, scientific or consultants, can be expensive to obtain. The same Bayesian methodological framework can be used to assess whether acquiring new information is worthwhile. Two crucial requirements can be put forward in this respect. The first is that new information actually will have a potential impact on decisions. New information *per se*, is worthless unless decisions will potentially be effected. Secondly, the expected value of new (imperfect) information must exceed the costs acquiring it.

As pointed out in Goodwin and Wright (2004), assessing the expected value of imperfect information requires the decision maker to judge how reliable the information will be in order to obtain the conditional probabilities for the Bayes' theorem calculations. In some circumstances this assessment can be made on the basis of statistical theory. In most cases, however, the assessment of the reliability of the information will ultimately be based on the decision maker's subjective judgment.

However, Rommelfanger (2003) points out that empirical opinion polls indicate that posterior probabilities are not applied in case of solving real decision problems. Several explanations for this can put forward. One is that in real-world applications the decision maker is often not able to specify objective prior probability distributions. For improving the situation the decision maker could look for additional information. Another is that the Bayesian framework requires rather advanced theoretical skills.

Knowing the conditional probabilities, the a priori probability distribution can be substituted by the posteriori probability distribution. However the calculation of posterior probabilities is a complicated procedure which needs a lot of information and implies intensive calculations. In practice the decision maker has to devote money and time to these activities, before it is actually possible to calculate the value of additional information. In particular, it seems absolutely improbable that a decision maker is able to assess all likelihoods.

Thus, Rommelfanger (2003) suggest the use of *fuzzy decision theory* to improve upon the situation. Fuzzy decision theory seems particularly interesting as a decision support tool in the front-end phase. The reason why is that fuzzy decision theory involves making decisions with *imprecise information* and measures. It deals with situations that might happen, as opposed to assuming situations will happen. Uncertainty about probability is taken to be a form of (fuzzy) vagueness rather than a form of probability. Fuzzy decision theory is based on of fuzzy logic and fuzzy set theory. Fuzzy logic allows intermediate values to be defined between conventional evaluations like true/false, yes/no, high/low, etc. One of the most useful aspects of fuzzy set theory is its ability to represent mathematically a class of decision problems called multiple objective decisions (MODs). This class of problems often involves many vague and ambiguous (and thus fuzzy) goals and constraints. The vagueness of expert judgment can be represented by possibility in this sense. The object of the fuzzy decision methodology is to obtain a decision based on attaining a set of goals while observing (i.e. not violating) a simultaneous set of constraints (O'Hagan (1993)).

CONCLUSION

In this paper, we have identified some issues and challenges that need to be explored further. There are no answers at this point. However, finding ways to improve front-end decisions about funding, and particularly the more fundamental problem of selecting the most appropriate concept for an investment project is no doubt worth vile and will be pursued further.

REFERENCES

Goodwin, P., og G. Wright (2004): *Decision analysis for management judgment*. Chishester: John Wiley & Sons.

Rommelfanger, H. (2003): "Fuzzy decision theory. Intelligent ways for sollving real-world decision problems and for solving information costs," i *Planning based on decision theory*, red. G. D. Riccia, D. Dubois, R. Kruse, og H.-J. Lenz. Wien: Springer.

Anandalingam, G., & Chen, L. (1989). Linear Combination of Forecasts: A General Bayesian Model. *Journal of Forecasting*, 8, 199-214.

Clemen, R. (1985). Extraneous Expert Information. *Journal of Forecasting*, 4, 329-348.

— (1989). Combining Forecasts: A Review and Annotated Bibliography. *International Journal of Forecasting*, 5, 559-583.

Dixit, A. K., & Pindyck, R. S. (1994). *Investment under Uncertainty*: Princeton University Press.

Faniran, O. O., Love, P. E. D., & Smith, J. (2000). Effective Front-End Project Management - a Key Element in Achieving Project Success in Developing Countries, *Proceedings of the 2nd International Conference of the CIB Task Group 29 (TG29) on Construction in Developing Countries, pp. 451-456, Printing and Publishing Company, Botswana*.

Gilowitch, T., Griffin, D., & Kahneman, D. (2002). *Heuristics and Biases - the Psychology of Intuitive Judgment*. Cambridge: Cambridge University Press.

Goodwin, P., & Wright, G. (2004). *Decision Analysis for Management Judgment*. Chishester: John Wiley & Sons.

Jefferson, J. P. N. (1998). Inference Using Qualitative and Quantitative Information with an Application to Monetary Policy. *Economic Inquiry*, 36, 108-119.

Miller, Roger and Lessard, Donald R. 2000. *The strategic Management of Large Engineering Projects: Shaping institutions, Risk and Governance.* Cambridge Mass.: MIT Press.

O'Hagan, M. (1993). A Fuzzy Decsion Maker.

O'Leary, D. (1993). Determining Ditterences in Expert Judgment: Implications for Knowledge Acquisition and Validation. *Decicion Sciences*, 24, 395-407.

— (1998). Knowledge Acquisition from Multiple Expert: An Empirical Study. *Management Sciences*, 44, 1049-1058.

Rommelfanger, H. (2003). Fuzzy Decision Theory. Intelligent Ways for Solving Real-World Decision Problems and for Solving Information Costs. In G. D. Riccia, D. Dubois, R. Kruse & H.-J. Lenz (Eds.), *Planning Based on Decision Theory*. Wien: Springer.

Samset, Knut 1998, *Project management in a high-uncertainty situation. Uncertainty, risk and project management in international development projects*, Ph.D dissertation, Norwegian University of Science and Technology, Trondheim, Norway, May 1998

Surowiecki, J. (2004). *The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies and Nations*: Little, Brown

World Bank. 1996. *Evaluation results 1994*. The International Bank of Reconstruction and Development. Washington DC.

.