

# A Decision Support System for Evaluation of Investments in a Computer–Integrated Production System

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## INTRODUCTION

Investments in new manufacturing systems are vital for the well-being of the company as they are means of achieving the objectives and goals the company is aiming at. Both long-term corporate success and short-term profitability are based on the company's investments. Managerial decision making is, however, becoming more difficult due to worldwide competition and the rapidly changing and increasingly complex environment.

A growing concern is that the selection of investment alternatives (manufacturing systems) that in the long run enhance the company's competitive position or other strategic goals cannot any longer be based on conventional financial analysis only. These financial analysis techniques do not provide the decision maker with sufficient support because they do not integrate the investments into the company's strategy sufficiently. Furthermore, the conventional investment planning based on these techniques does not fully respond to the way the investment decisions are actually made. The shortages of the conventional justification techniques include insufficient benefit analysis, a short-term focus, and misassessment of the appropriate discount rate. Therefore, conventional financial analysis techniques alone are not appropriate to justify more strategic investments, but a strategy-oriented investment justification is needed as well.

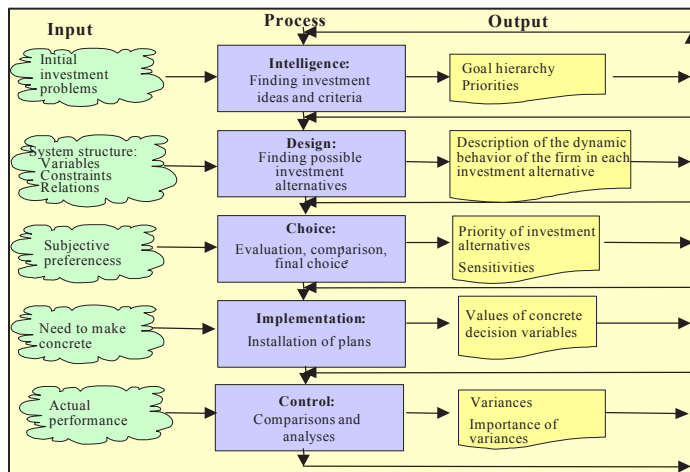
By an investment decision it is meant an irreversible commitment of resources in order to achieve uncertain future gains. The benefits of investments are not wholly exhausted in the short term and the investment decisions always, even if to a varying extent, involve a risk. Generally, investments can be classified to the following three groups:

- **Necessity investments:** These investments are different by nature. However, it is typical that negligence concerning the investments will cause considerable damage.
- **Investments for productivity improvement:** Investments belonging to this class include minor process improvements that are made in order to achieve cost savings or improve productivity.
- **Strategic investments:** These investments have a significant impact on the company as a whole, as well as on its long-term performance. They may be undesirable in the short term and difficult to justify economically. However, in the long run, the investments are necessary in order to maintain and enhance the company's position in the marketplace. Strategic investments are the special concern of this study.

In order to be successfully implemented and to enhance the company's strategic position, the investments ought to be evaluated consistently with the applied strategy and every phase of the investment process should be supported. The phases of the investment process we use here are based on Simon's (1976) general decision-making phases: intelligence, design, choice, implementation, and control. The investment process with its main inputs and outputs is described in Figure 1.

The organizational context cannot be ignored, and the information transmission and delegation of decision rights within the organization should be considered in the investment management process. A critical element in the investment management process is the decision support that transforms strategic plans into concrete investment decisions. Consistent and systematic decision support ensures that those investment alternatives that satisfy the strategic goals of the company best are

Figure 1. Investment process with its main inputs and outputs



identified, selected, and successfully implemented. This study presents how to support each phase of the investment process and provides appropriate techniques and tools for strategy-oriented investment justification and evaluation. According to the methodology, the emphasis is moved from technological aspects closer to substantive, managerial aspects. We believe that all phases of the development process can be supported by appropriate managerial decision models (Kivijärvi, 1997). The developed framework is versatile and can be applied to all strategic investments.

## CONCEPTUAL BACKGROUND

### Problem Structure and Intangible Investments

An essential characteristic of strategic decision making is its lack of structure, which might be due to a shortage of relevant information, high risk and uncertainty, novelty, and deficiencies in the decision-making process (Taylor, 1988). The degree of structure may vary situationally depending on the focus of the decision making, the personal capabilities of the decision makers, or on the strategy adopted. Porter (1980), for example, suggests three classes of competitive strategies—overall cost leadership, differentiation, and focusing—which may impose different kinds of information requirements, uncertainty, and so forth. Thus, it seems that the concept of problem structure is a key to the essence of strategic decision making and problem solving, and

hence to the structure of a support system (Kivijärvi & Tuominen, 1993).

Smith (1988) classifies the existing conceptualizations of problem structure by four notions: goal state, problem space, knowledge, and process. The first conceptualization relates the degree of the problem structure to the clarity of the goal state of the problem. If the goal is adequately specified, the problem is structured. In the other extreme, if there are multiple goals or they are indefinite, then also, as a consequence, multiple solutions exist and justification and validation procedures are missing or they become more equivocal and demanding.

The second conceptualization relates the degree of the problem structure to its representability. If the characteristics of the problem can be easily measured, and the relationships between them can be formulated explicitly and quantitatively, then the problem is structured.

According to the third conceptualization, the problem structure is related to the solver's knowledge. How much is known of the relevant facts? How certain are they? Are they based on subjective evaluations or objective data? By this notion, the degree of the problem structure is regarded as person dependent rather than of a natural kind.

Finally, the degree of the problem structure can be seen in light of the solution process. If an effective solution procedure, no matter how complicated, is known and regularly used, then the problem is structured. On the other hand, if no solution strategy can be found, the problem is unstructured. Problems may also not be structured or unstructured in their entirety but only in terms of some stages in the solution procedure. Problems that are totally

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