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## Design of a Methodology to Support Software Release Decisions

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## **PART 3: TESTING PHASE – VALIDATION OF METHODOLOGY**



## 11 VALIDATION OF THE METHODOLOGY

*"There is nothing so practical as a good theory."  
-- Kurt Lewin --*

### 11.1 Introduction

In the previous Chapter, when discussing different aspects of the designed methodology, it is assumed the methodology has two properties, a descriptive character and a judgmental character. These properties are derived from theoretical reasoning, but were not confirmed by evidence from a practical setting. This required a second series of case studies, with the objective of validating the assumed properties of the methodology:

*Descriptive character: Can the methodology be used to describe strategic software release decisions?*

*Judgmental character: Can the methodology identify improvement areas for strategic software release decisions?*

In Section 11.2 some introductory remarks are made on the case study approach. In Section 11.3 the results of case study H, in Section 11.4 the results of case study I, and in Section 11.5 the results of case study J are presented.<sup>95</sup> In Section 11.6 general conclusions from these case studies are drawn. The Chapter ends with a summary and conclusions in Section 11.7.

### 11.2 Case Study Approach

Different case studies are conducted for similar software manufacturer types, namely software manufacturers developing in-house systems, chosen to predict similar results [literal replication]. All case study environments were from the same country. The case study environments were selected so satisfactory implemented practices of the defined process areas would vary, creating a broader basis for analysis. Some variation was obtained by selecting different project types: developing new software [cases H, J] versus the new version of an existing product [case I].

Environments were selected using the following criteria:

- ❖ The selected organization has previously released a significant number of substantial software products. This criterion is used to avoid case studies in learning environments, where it is less likely to find consensus between informants, or supporting documentary evidence.
- ❖ Each selected case [consisting of one project] has recently released a software product. This criterion is used to reveal the initial objectives of the project, how they were addressed during product development, how the software release decision was taken, and how the decision was implemented.
- ❖ Presence of trade-off between time-to-market, budget, functional requirements and non-functional requirements, including reliability and maintainability. This criterion is considered important to ensure a comparison between releasing the software product early and delaying its release.
- ❖ The strategic value of the software release decision is high.

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<sup>95</sup> To prevent possible obscurities, all case studies were given a unique identification.

A case study protocol, as in Appendix A, was written and reviewed prior to conducting the first case study. Further information on the case studies:

- ❖ In Appendix D an example of a case study questionnaire is given. The actual questionnaire used in each case study was adapted to the specific characteristics of each organization.
- ❖ In Appendix E a cross-reference between the practices of the methodology and the questionnaire in Appendix D can be found.

In the next Sections, the results of the case studies are described, answering the questions raised in the previous Chapter. The names of the participating organizations are not revealed, as the selected projects and the organizational processes are in most cases considered to be of strategic importance. For the validity and reliability of the results, these anonymous descriptions are not considered a problem. The findings in each case study originate from the approved case study report. In this thesis the interpretation of the data by the researcher is found in Sections 11.3.2, 11.4.2 and 11.5.2 in discussing the findings of each case study. It therefore remains auditable (Berghout 1997, p.52; based on Boskma and Herweyer 1988).

In each case study, a post-mortem or retrospective analysis [cross sectional time horizon, see Section 2.6] is made to assess the extent to which each practice is met. An ordinal scale is used with scores ranging from: *Low (score 1) - Medium (score 2) - High (score 3)*, with each participating organization assigned scores for the practices. The individual scores for the practices within each process area were summed to determine the overall resultant score for that process area, using the rules presented in Figure 11-1.

Total Score for Process Area	Resulting Score	Abbreviation
4-6	Not Satisfied	NS
7-8	Partially Satisfied	PS
9-10	Largely Satisfied	LS
11-12	Fully Satisfied	FS

**Figure 11-1: Score Table for Process Area**

The scores obtained for the four process areas are used to explain the release decision-making process for each case studied. Explanation-building is used as the strategy for analysis (Section 2.7). The scores obtained are further used to see if the hypotheses defined can be confirmed, or contradicted.

In the next Sections, each case study is discussed separately before drawing general conclusions. For each case study the following summarized data is presented:

- ❖ *Case Description.* A description of the organization, and selected case, mainly derived from the first survey filled in by the organization. Additional documentation, like annual reports, are used, if found necessary. The main findings and scores for each individual practice are given, as is the resultant score for each process area, with detailed information on each case study to be found in the individual case study reports.
- ❖ *Analysis.* Findings on the practices are analysed. Using the findings and scores, at practice and process area level, explanation-building is used to see if the case studied confirms the descriptive and judgemental character of the methodology.

After presenting the individual results of each case study, the overall results are reviewed.

### 11.3 Results ~ Case Study H

#### 11.3.1 Case Description

The participating organization is a leading global financial services company, providing financial services and products to retail and business markets. Services provided are insurance, pensions, occupational health and safety, asset management/investment, leasing, real estate, venture capital and mortgage finance. The case selected was conducted in the IT department of this organization, developing custom systems for internal and external use. The department's process capability is estimated to be CMM level 1 [no institutionalized processes at project level].

The stakeholders, as discussed in Section 5.3.3, could all be identified:

- ❖ Senior Management [strategic level].
- ❖ Project Steering Committee Team [tactical level], consisting of the following constituencies: Marketing, Development and Maintenance & Exploitation.
- ❖ Product Development Team [operational level], consisting of Development, cooperating with Maintenance & Exploitation.

The case presented is the development of a new website. A pre-study was executed, resulting in the definition of the following global requirements:

- ❖ Entirely new platform/infrastructure to realise an increased visitor capacity, involving the introduction of many new technologies.
- ❖ Euro-proof.
- ❖ Transfer of hosting to their own organization and implementing a firewall for security.
- ❖ Improvements regarding style and functionality.

Pre-study results are used for a detailed project plan, dividing the project into four subsequent stages:

- ❖ Stage 1 [scheduled for 1<sup>st</sup> July 2001]: All applications Euro-proof and existing functionality transferred to a more stable environment.
- ❖ Stage 2 [scheduled for September 1<sup>st</sup> 2001]: Integration of existing applications, new look-and-feel style, enhanced functionality, transfer of application to own organization.
- ❖ Stage 3 [scheduled for November 1<sup>st</sup> 2001]: Additional functionality, implemented in own organization.
- ❖ Stage 4 [scheduled for January 1<sup>st</sup> 2002]: Additional functionality.

This project plan also mentions some non-functional requirements: the development of a future-proof, scalable and expandable product.

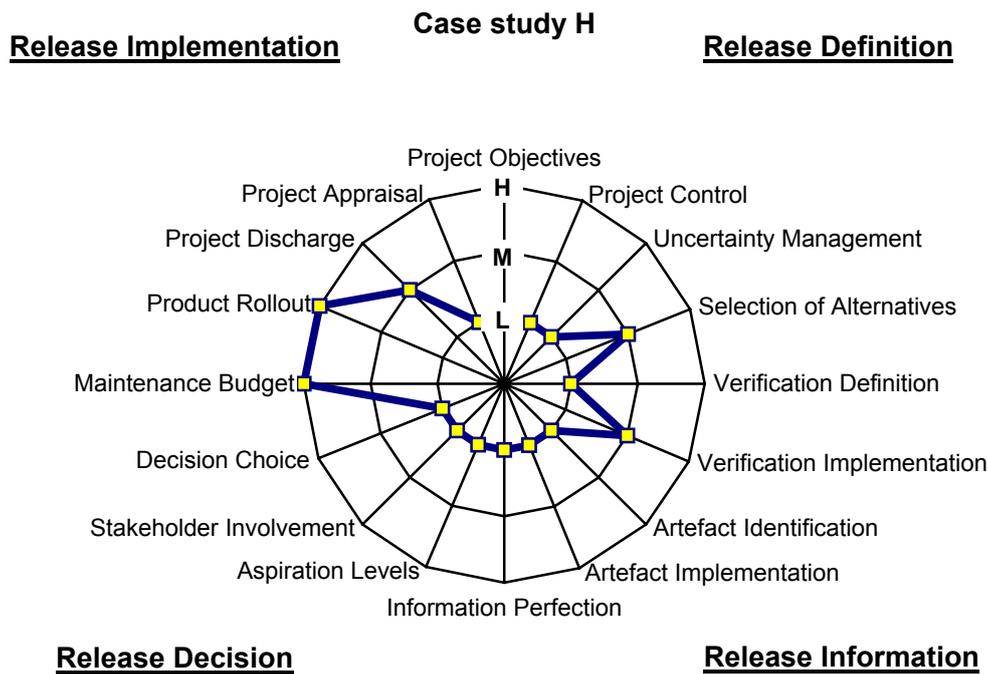
The initial estimate for the schedule was 10 months [pre-study included] and for the pre-release cash outflows Euro 15M. Budgets were reserved for the technical infrastructure and post-release cash outflows for maintenance and exploitation. During the first months, the project encountered several set-backs: technical problems surfaced and the development budget turned out to be too optimistic. Progress control was not in place, mainly through the absence of clearly-defined milestones or quality gates. These problems increased, and in November 2001, the project was re-defined. Major changes were:

- ❖ Internal project management replaced external project management.
- ❖ Priorities were re-arranged [making the product Euro-proof received highest priority].
- ❖ Both schedule and development budgets were adjusted.

In Figure 11-2, the main findings for each practice are listed. In Figure 11-3, the scores obtained for all practices are graphically displayed in radar.

	Finding	Score
<b>1. Release Definition Process Area</b>		<b>NS</b>
Project Objectives	A well-substantiated justification for the project was not found. Informants expressed different possible reasons. The project's budget and schedule were also not substantiated. Expected [additional] cash inflows were not addressed, although informants expressed the opinion that this was possible [increased number of leads, more customers, internal efficiency improvements]. Further, the project plan was not reviewed with all stakeholders involved. Marketing and Development accepted the project, but the opinion of Maintenance & Exploitation, as an important stakeholder, was not included.	L
Project Control	The project's progress was discussed periodically at the level of the Project Steering Committee. The progress was however mainly expressed in terms of problems encountered and the need for additional budget; the true status of the project was unclear. The original milestones for the first stages were not met. This resulted in major changes to the project in November 2001. Internal project management replaced external project management and a new project plan was made with new planning for the final release date (May 2002) and a substantially increased budget. This restart did not result in an increased transparency of the project's objectives and status.	L
Uncertainty Management	Uncertainties are briefly addressed in early documents [expressed as risks and uncertainties]. However, the corrective and preventive measures were of a very global nature. During the course of the project no pro-active management of uncertainties have taken place. Problems were not foreseen, resulting in a reactive attitude with a short-term horizon.	L
Selection of Alternatives	The original project definition did not include an evaluation of different project alternatives. In November 2001, different alternatives were presented and discussed to agree on the best course of action for the remainder of the project. During the test phase, an analysis has taken place comparing different alternatives of how to proceed.	M
<b>2. Release Information Process Area</b>		<b>NS</b>
Verification Definition	Activities are not defined to verify the correct implementation of the product's requirements. The initial statement to realise a 'future-proof, scalable and expandable' application was not addressed in defined tests. Maintainability was not addressed during the entire course of the project.	L
Verification Implementation	Toward the end of the project, the focus was to improve the stability of the product. Testing was frequently extended based on test results obtained.	M
Artefact Identification	No evidence could be found that the required artefacts supporting the product were identified.	L
Artefact Implementation	No activities were undertaken to develop supporting product documentation.	L
<b>3. Release Decision Process Area</b>		<b>NS</b>
Information Perfection	The information available for the release decision was far from optimal [below the zone of cost effectiveness]. Stakeholders involved claimed that increased testing to increase the level of information perfection would have been beneficial. Time pressure prevented them from doing so.	L
Aspiration Levels	During the initial phase of the project, the aspiration levels of Marketing and Development on one hand and Maintenance & Exploitation on the other hand, diverged. This issue has not been addressed and during the course of the project, the situation further worsened.	L
Stakeholder Involvement	Maintenance & Exploitation as an important organizational authority was not involved in the decision-making process. Further, Maintenance & Exploitation was unwilling to accept the product after its release. The consequence was a Task Force brought into being, with the assignment to stabilize the product.	L
Decision Choice	During the last months of the project, Development was put under high pressure by Marketing to release the product as soon as possible. Testing was extended until Development finally agreed to release the product, using a veto. Ultimately, the product was released in September 2002.	L
<b>4. Release Implementation Process Area</b>		<b>LS</b>
Maintenance Budget	In the integral project plan, a budget was assigned for corrective maintenance activities. This budget was updated when the project was restructured.	H
Product Rollout	When the product was released, many problems were known, additional problems were found. The Task Force responsible for corrective actions solved the identified problems.	H
Project Discharge	After the product release, the development responsibility was taken over by the Task Force. Development itself has not been officially discharged from its responsibilities. The Task Force remained active until late 2003.	M
Project Appraisal	No evidence found that a project appraisal was executed.	L

Figure 11-2: Findings ~ Case Study H



**Figure 11-3: Radar Presentation of Case Study H Results**

### 11.3.2 Analysis

In this Section, the results obtained are used to validate the assumed properties of the methodology and its descriptive and judgmental character.

#### 11.3.2.1 Descriptive Character

To assess the descriptive character of the methodology, the information level as input to the decision-making process should be determined. In the case studied, this information level was below the zone of cost effectiveness as can be derived from the 'Release Information' process area [Score: Not Satisfied]. No serious attempt was made to define the verification needs, or to define the supporting artefacts.

1. *Economic Perspective.* Both Senior Management and Marketing exerted pressure on the Product Development Team to release the product as soon as possible. The team was however faced with an unstable product under test and had to use a veto, several times, to postpone a scheduled release date. When the product was released, uncertainty was high as many known problems were not resolved [although not considered critical] and it was felt that continued testing would reveal more defects, potentially critical ones, that could severely hamper the correct functioning and stability of the product. After the product was released, the special Task Force was assigned the responsibility of temporarily performing corrective maintenance activities. This team needed more than a year to resolve the known, and newly-detected, defects. Despite the original requirement to develop a maintainable product, it was decided in 2004 to start a pre-study toward a totally new product to replace this product, as corrective maintenance is expensive and it is difficult to enhance the product with additional functionality. In other words, the early release of the product saved the organization additional testing cost [pre-release cost

savings], but the post-release maintenance cost turned out to be significantly higher than originally expected.

2. *Decision-making Perspective.* The collective decision-making process showed very different positions among the stakeholders. Senior Management and Marketing strived for an early release of the product, whereas Maintenance & Exploitation favoured a high-quality [stable and documented] product. Development was stuck in the middle, as in Figure 11-4. In the decision-making process itself, Maintenance & Exploitation was not involved, although an important stakeholder. The decision-making process revealed a high presence of ‘challenge’ processes/strategies and a low presence of ‘management of meaning’ processes/strategies. Development was continuously challenged to stabilize the product as soon as possible so as to make a release possible.

		Quality		
		Low	Middle	High
Time Pressure	High	Senior Management Marketing		
	Middle		Development	
	Low			Maintenance & Exploitation

**Figure 11-4: Aspiration levels of Stakeholders Involved**

These observations were discussed in a feedback session and corroborated by the people interviewed. This confirms the descriptive character of the methodology as discussed in Section 10.3. Below the zone of cost effectiveness, uncertainty is high and this is likely to have a negative impact on post-release cash outflows. It may lead to differences in aspiration levels, and the decision-making process is likely to reveal a high presence of ‘challenge’ and a low presence of ‘management of meaning’ processes/strategies.

#### 11.3.2.2 Judgmental Character

In this case the quality of the decision-making process is assessed as low [practices were mostly assigned low scores], because of insufficient information at hand, different aspiration levels, not all stakeholders involved in the decision-making, and the absence of a judgmental decision strategy with consensus as a decision rule. The resultant score for the ‘*Release Decision*’ process area is ‘Not Satisfied’. The resultant score for the ‘*Release Implementation*’ process area is ‘Largely Satisfied’; a maintenance budget was reserved and corrective actions were taken. The overall decision success, namely the sum of the quality of the decision-making process and the quality of decision implementation, is assessed as low. This is also true for the congruence between expected and actual outcome. It might seem that there was congruence between the expected and actual outcome, as the released product was relatively stable and end-users did not experience major problems. However, when revisiting the objectives as formulated in the original project plan and in the revised plan, it is concluded that many of the objectives were not met. For example, securing part of the functionality by placing it behind a firewall was a requirement formulated, but never implemented, while maintainability of the product was formulated as an important non-functional requirement, but not addressed during product development [no deployment and evaluation]. The consequence is the start of a pre-study towards a totally new product to replace this product due to the problems experienced with maintainability.

Using the proposed methodology, areas where improvements would lead to increased decision success:

1. *Release Definition.* The lack of an attainable, commonly-accepted, product development strategy has bedevilled the project from its start. A severe lack of project control, and the

absence of pro-active uncertainty management, resulted in reactive behaviour. The result is the absence of clearly-defined, attainable, release criteria steering the project in the right direction. Increasing the quality of the decision-making process would require improvements in all practices in this process area; the definition and control of an attainable, commonly-accepted, product development strategy being the most important.

2. *Release Information.* No serious attempt was made to define the necessary verification needs and to define the supporting artefacts. As a result, information perfection was low, hampering the comparison and evaluation of different alternatives, and leading to high uncertainty in the decision-making process. Increasing the quality of the decision-making process would have required improvement in all practices in this process area, for which the definition and control of an attainable, commonly-accepted product development strategy is an important pre-requisite.

These observations were discussed in a feedback session and corroborated by the people interviewed. This confirms the judgmental character of the methodology, as discussed in Section 10.3. The methodology can be used to identify strengths and weaknesses of the decision-making process and its implementation, and can thus be used as the basis for identifying areas of improvement.

This case study is of interest in the sense that the project studied failed to implement nearly all proposed practices. Low scores were assigned to almost all practices, except the availability of a maintenance budget (P-D1) and the implementation of corrective actions (P-D2). The informants described the project as ‘disastrous’, and confirmed the complexity of the project was underestimated from the beginning although its strategic value, and that project control had not been in place.

## 11.4 Results ~ Case Study I

### 11.4.1 Case Description

Case I was conducted in the IT department of a government ministry. The IT department develops information systems by order of this authority for internal and external use. The department’s process capability was estimated at CMM level 1-2 [limited institutionalized processes at project level].

The IT department is organized in a matrix (Figure 11-5). The sectors Development, Continuity, Exploitation and Service focus on the operational side of product development and reflect the production cycle of an IT-service. The sectors Account Management, Architecture, Purchasing, Planning/Finance & Control, and Resource Management support the operational sectors.

	Development	Continuity	Exploitation	Service
Account Management				
Architecture				
Purchasing				
Planning/Finance & Control				
Resource Management				

Figure 11-5: Matrix Organization

The stakeholders, as discussed in Section 5.3.3, could all be identified:

- ❖ Strategic level: Senior Management [Management Team].

- ❖ Tactical level: Project Steering Committee Team, consisting of the following stakeholders: Marketing [Account Management], Development, and Maintenance & Exploitation [Continuity, Exploitation, and Service].
- ❖ Operational level: Product Development Team, consisting of Development, closely cooperating with Maintenance & Exploitation [Continuity].

The case selected was the introduction of a new application for tracking imported goods within the European Union, required as a temporary solution for an existing application used to register imported goods. In 2001 an assignment was given to the software manufacturer to realise this temporary solution of an interface between the new and existing applications, and additional functionality to enable automatic verifications and updates. It took until April 2002 before the assignment was analysed, resulting in an approved study in June 2002. Initially, the proposal was to implement a ‘quick and dirty’ solution, however the stakeholder Maintenance & Exploitation refused to accept this because it was expected to hamper post-release maintenance activities. It was finally decided to follow the standard development process. Establishing the development budget was another issue between the two stakeholders. Initially, Maintenance & Exploitation would develop the interfaces of the new application to the existing applications. However, Development claimed that the estimated budget was too high. The decision made was that Development would have the responsibility of developing the entire application. Development started the project in August 2002, although the final offer was only accepted in October 2002. The development budget was low and the scheduled release dates were late November [internal release to Maintenance & Exploitation] and late December [external release at customer’s site].

In Figure 11-6, the main findings for each practice are listed. In Figure 11-7, the scores obtained for all practices are graphically displayed in radar.

	Finding	Score
<b>1. Release Definition Process Area</b>		<b>LS</b>
Project Objectives	<p>Although the project objectives were established in October 2001 with common acceptance by all stakeholders involved, the process followed revealed some serious deficiencies:</p> <ul style="list-style-type: none"> <li>▪ The assignment was worked out relatively late.</li> <li>▪ The initial requirements described were vague and had omissions.</li> <li>▪ The negotiations between the stakeholders were laborious.</li> </ul> <p>From its start the project was faced with major time pressures to meet the delivery dates. Although the project cannot be characterized as a strategic project in terms of its budget and/or product requirements, it came onto the agenda of Senior Management due to its delayed start.</p>	L
Project Control	The initial project objectives were not adjusted, other than a one-week delay of one internal release date. Progress was monitored.	H
Uncertainty Management	Uncertainties were documented as risks in several documents [requirements, project plan, offer]. In the offer, measures were defined to reduce or eliminate the risks identified. However, during the course of the project the uncertainties were not pro-actively managed, with the project’s focus being to meet its delivery dates.	M
Selection of Alternatives	Prior to the start of the project, the global architecture was already available. The description of the system concept, application architecture and important development issues was complemented with a description of the alternatives considered and the rationale for selecting the best alternative.	H
<b>2. Release Information Process Area</b>		<b>LS</b>
Verification Definition	There was no clear traceability between the functional and non-functional requirements on one hand and the defined tests on the other hand. How the correct implementation of the stated requirements could be verified was not clearly analysed.	M
Verification Implementation	Not all defined tests were executed due to lack of time.	M
Artefact Identification	The standard development process used prescribes the artefacts supporting the software to be delivered.	H
Artefact Implementation	Following the defined standard development process, all identified artefacts were implemented/accepted by Marketing & Exploitation.	H

3. Release Decision Process Area		LS
Information Perfection	The information available to the release decision was not considered optimal, although close to the zone of cost effectiveness. Certain tests were left out under time pressure and the application had not been tested in a real environment, i.e. the infrastructure of the end-user. Stakeholders involved claimed that increased testing to increase the level of information perfection would have been beneficial. Time pressure prevented the Product Development Team from doing so.	M
Aspiration Levels	Despite the problems encountered prior to the project start, differences in aspiration levels were largely eliminated at that time. During the course of the project, the co-operation between Development and Maintenance & Exploitation went reasonably well and smaller issues during the course of the project [like the internal release date] were addressed and resolved [the internal release date was postponed one week]. Prior to the decision to release the product externally, no severe differences in aspiration levels were present.	M
Stakeholder Involvement	All relevant stakeholders were involved in the release decision. A proposal to release the application was signed by all stakeholders involved and presented to the customer.	H
Decision Choice	Characteristics of decision-making were: a negotiated decision-making strategy, an interacting group type, and consensus as the decision rule.	H
4. Release Implementation Process Area		LS
Maintenance Budget	Implicitly, a budget for maintenance was reserved under the umbrella of an existing service level agreement for the existing application. However, the estimated maintenance effort was left open in the prescribed project plan template. Further, it was unclear which organizational authority was responsible for corrective maintenance directly after the product release.	M
Product Rollout	Several failures and faults were found in the first weeks/months after product release. They've all been solved, but the long average time between reporting and implementing was considered unsatisfactory.	M
Project Discharge	Development stayed involved after the product release, and was discharged from its responsibilities, following a standard procedure.	H
Project Appraisal	The project has been appraised. However, this appraisal took place within the first month after the release date, when corrective actions still took place. Further, the appraisal showed an <i>ad hoc</i> character and it is unclear how the appraisal results have been further used.	M

Figure 11-6: Findings ~ Case Study I

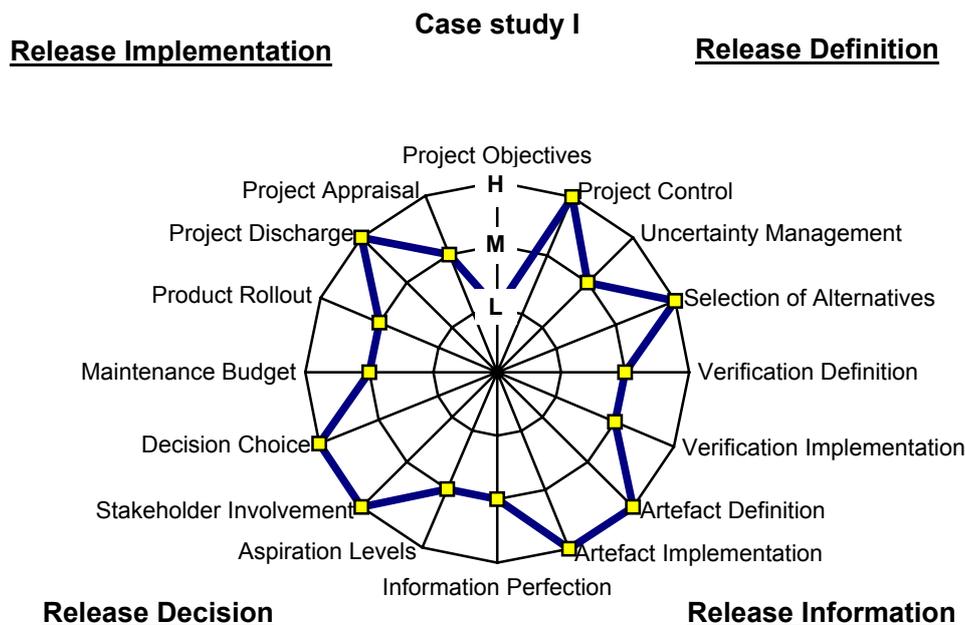


Figure 11-7: Radar Presentation of Case Study I Results

## 11.4.2 Analysis

In this Section, the results obtained are used to validate the assumed properties of the methodology and its descriptive and judgmental character.

### 11.4.2.1 Descriptive Character

To assess the descriptive character of the methodology the information level, as input to the decision-making process, should be determined. In the case studied, this information level was near the zone of cost effectiveness as can be derived from the 'Release Information' process area [Score: Largely Satisfied]. Because of time pressure, some tests were left out, but all identified artefacts were implemented.

1. *Economic Perspective.* When the product was released, uncertainty was still high, as not all tests planned had been executed. It was felt that continued testing would have been preferable. After the product was released, several failures and faults were found. The early release of the product saved the organization additional testing cost [pre-release cost savings], but a consequence was that post-release corrective actions were needed to resolve failures.
2. *Decision-making Perspective.* The collective decision-making process showed identical positions among stakeholders. It further reveals a negotiated decision-making strategy, an interacting group type, and consensus as the decision rule. All stakeholders supported meeting the scheduled release date, thus compromising on quality, as in Figure 11-8. In the decision-making process itself, all stakeholders were involved. The decision-making process reveals a low presence of 'challenge' processes/strategies and a high presence of 'management of meaning' processes/strategies.

These observations were discussed in a feedback session and corroborated by the persons interviewed. It confirms the descriptive character of the methodology, as discussed in Section 10.3. Near the zone of cost effectiveness, uncertainty is reduced and is likely to have a positive impact on post-release cash outflows: a product released with high reliability reduces corrective maintenance costs. Differences in aspiration levels are reduced, or even eliminated, and the decision-making process is likely to reveal a lower presence of 'challenge' and higher presence of 'management of meaning' processes/strategies.

		Quality		
		Low	Middle	High
Time Pressure	High		Senior Management Marketing Development Maintenance & Exploitation	
	Middle			
	Low			

Figure 11-8: Aspiration Levels of Stakeholders Involved

### 11.4.2.2 Judgmental Character

In this case the quality of the decision-making process was assessed as medium-to-high [practices concerned were assigned medium and high scores]; the availability of information, although below the zone of cost effectiveness, equal aspiration levels for the decision outcome,

all stakeholders involved in decision-making, and applying a judgmental decision strategy with consensus as the decision rule. The resulting score for the '*Release Decision*' process area is 'Largely Satisfied'. The resulting score for the '*Release Implementation*' process area is also 'Largely Satisfied'; a maintenance budget was reserved, corrective actions were taken, Development was officially discharged from its responsibilities, and the project was appraised. The overall decision success, being the sum of the quality of the decision-making process and the quality of decision implementation, is assessed to be medium-to-high for this case [practices concerned were assigned medium and high scores]. This is also true for the congruence between the expected and actual outcome. Although some failures were reported after product release, the product was afterwards relatively stable and offered the intended functionality.

The methodology can indicate the areas where improvements could be made to increase decision success:

1. *Release Definition*. Despite a delayed start and a high time pressure, Development was able to get a good grip on the project, working closely together with Maintenance & Exploitation, and supported by Marketing. The Project Steering Committee, once established, worked well. The release criteria were clear to all stakeholders involved, and attainable. Time pressure could however have been avoided by working out the assignment earlier. In this case more time would have been available to define the tests needed [including traceability] and perform all tests [*Release Information*' process area], thereby increasing the information level within the zone of cost effectiveness [*Release Decision*' process area].
2. *Release Implementation*. More attention should have been given to the expected maintenance budget, and identifying the responsibility for corrective actions, when rolling out the product. This would have led to improvements on decision implementation.

These observations were discussed in a feedback session and corroborated by the interviewed persons. This confirms the judgmental character of the methodology, as discussed in Section 10.3. The methodology can be used to identify strengths and weaknesses of the decision-making process and its implementation and can thus be used as the basis for identifying areas for improvement.

## **11.5 Results ~ Case Study J**

### **11.5.1 Case Description**

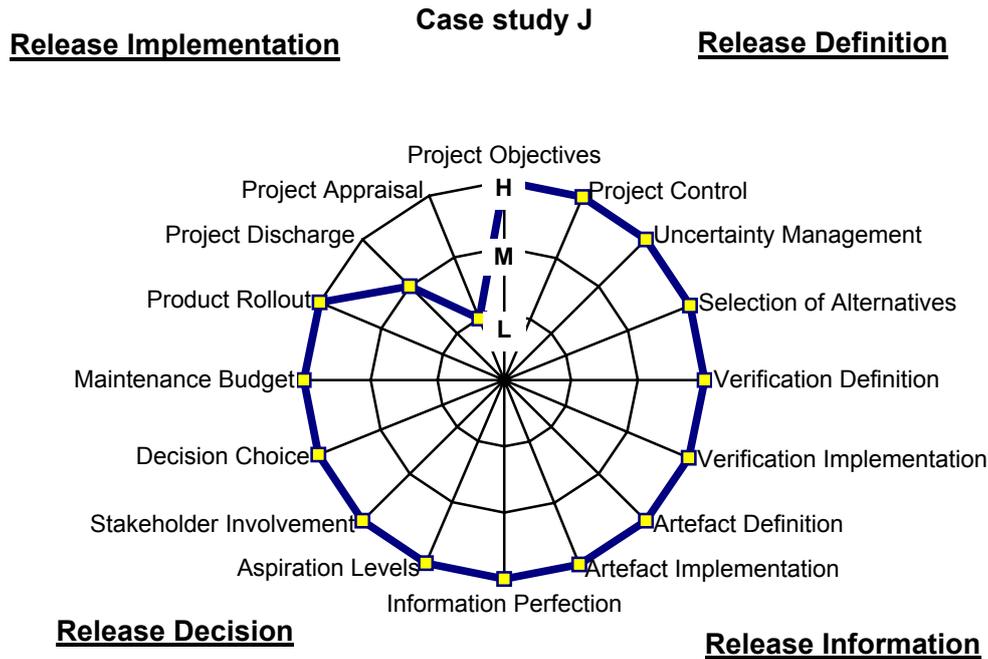
Case J was conducted in a department of the same organization as in case I, but in another unit with a different application domain, another technology infrastructure and other customers. The case selected was the development of a new information system for salaries. An external party had developed the existing information system. However, the maintenance of this system was becoming increasingly labour intensive. The assignment given to the organization was different in that it did not fit in any of the organization's programs. Prior to bringing out the offer, a study was conducted, resulting in a global architecture description, a blueprint and an integral project plan, in early 2002. These activities were carried out on an hourly basis. The offer, based on the blueprint, estimated the development cost to be at a medium level and scheduled release dates were October 1<sup>st</sup> 2003 for the internal release, January 1<sup>st</sup> 2004 for the official release to the customer, and May 1<sup>st</sup> 2004 end of direct support [transition to service level agreement]. The release date to the customer was important in the sense that, for practical reasons replacing the existing system with the new system could only take place at the turn of the year.

The stakeholders as discussed in Section 5.3.3 could all be identified (Section 11.4.1).

	Finding	Score
<b>1. Release Definition Process Area</b>		<b>FS</b>
Project Objectives	The project started with clear, commonly accepted objectives: <ul style="list-style-type: none"> <li>The estimated budget and schedule were based on expert estimations.</li> <li>The integral project plan represented the positions of all stakeholders</li> </ul> The project was assessed as strategic and received much attention from Senior Management. If the project was not successful, this would severely undermine the reputation of both the customer and the organization.	H
Project Control	The project's progress was continuously monitored and reported to the Project Steering Committee. The project was faced with change requests [33 in total]. These have all been managed according to a documented procedure. Each change request underwent an impact analysis and if the change request did not fit within the existing project scope, a separate offer was made. Although under pressure, the project did not deviate from procedure. In total, twenty-five change requests were accepted; two of them leading to an increased budget.	H
Uncertainty Management	Both in the integral project plan and in the offer starting points, assumptions and risks were documented. During the course of the project, uncertainties [addressed as risks, but probabilities could not be assigned] were managed in a pro-active way. A good example is the identification of possible uncertainties and definition of preventive measures in June 2003 for the period November-December 2003, between the internal and external release.	H
Selection of Alternatives	An initial choice was to implement the information system using 'Standard SAP', with limited room for different alternatives available. As the project followed initial planning closely, no different courses of action were evaluated.	H
<b>2. Release Information Process Area</b>		<b>FS</b>
Verification Definition	Verification activities were defined in the early phases of the project. In the offer, audits and tests were foreseen to verify the correct implementation of functional and non-functional requirements. Reliability could be verified by comparing results of the new system with the results of the existing system, whereas maintainability was implicitly reached by using 'Standard SAP'.	H
Verification Implementation	Defined audits and tests were further detailed and executed without exception.	H
Artefact Identification	The standard development process used prescribes the artefacts supporting the software to be delivered. By reason of the peculiar character of the information system, a detailed list with all artefacts was created and maintained throughout the project.	H
Artefact Implementation	By following the defined standard development process and using the list as a reference, all identified artefacts were implemented and accepted by Marketing & Exploitation.	H
<b>3. Release Decision Process Area</b>		<b>FS</b>
Information Perfection	The new information system was intensively tested. An advantage was the availability of the existing system, enabling the Development team to compare results. The information level was well within the cost effectiveness zone. Certain tests were re-executed to eliminate any uncertainties left.	H
Aspiration Levels	Differences in aspiration levels were identified and resolved prior to the start of the project. During the project expectations were monitored but did not give rise to different positions of stakeholders involved. At October 1 <sup>st</sup> 2003 it was decided to cancel the contract with the external party. Enough confidence was gained that the new information system would meet its requirements.	H
Stakeholder Involvement	All relevant stakeholders were involved in the release decision. A proposal to release the application was signed by all stakeholders involved.	H
Decision Choice	Characteristics of decision-making were: a negotiated decision-making strategy, an interacting group type, and consensus as the decision rule.	H
<b>4. Release Implementation Process Area</b>		<b>PS</b>
Maintenance Budget	In the integral project plan, a budget was assigned for corrective maintenance activities, periodically updated during the project to reflect the newest insights.	H
Product Rollout	Only minor problems were found after the information system was put in use. They were readily identified and solved.	H
Project Discharge	Development has been involved in the project after the product release. No evidence has been found however, that Development has been officially discharged from its responsibilities. Development activities have continued to take place after May 1 <sup>st</sup> 2004 [enhancing functionality].	M
Project Appraisal	No evidence has been found that a project appraisal was executed.	L

**Figure 11-9: Findings ~ Case Study J**

In Figure 11-9, the main findings with respect to each practice are listed. In Figure 11-10, the scores obtained for all practices are graphically displayed in radar.



**Figure 11-10: Radar Presentation of Case Study J Results**

11.5.2 Analysis

In this Section, the results obtained are used to validate the assumed properties of the methodology and its descriptive and judgmental character.

**11.5.2.1 Descriptive Character**

To assess the descriptive character of the methodology, the information level as input to the decision-making process should be determined. In the case studied, this information level was within the zone of cost effectiveness as can be derived from the *'Release Information'* process area [Score: 'Fully Satisfied'].

1. *Economic Perspective.* When the product was released, uncertainty was low, as all planned tests had been executed. Everybody agreed that continued testing would not be beneficial, and some informants claimed that certain re-tests were redundant: the re-tests did not increase the information level regarding the implemented functionality and the stability of the product. After the product was released, only minor failures were found. The post-release corrective actions were minimal and could all be resolved without inconvenience for the end-users.
2. *Decision-making Perspective.* The collective decision-making process showed no differences in positions for the decision outcome among stakeholders. It further revealed a negotiated decision-making strategy, an interacting group type, and consensus as the decision rule. The scheduled release date had to be met, but no compromises were allowed on the functionality and quality of the product [stability and documentation], as shown in Figure 11-11. All stakeholders were involved in the decision-making process. The decision-making process revealed a low presence of 'challenge' and a high presence of 'management of meaning' processes/strategies.

These observations were discussed in a feedback session and corroborated by the persons interviewed. This confirms the descriptive character of the methodology, as discussed in

Section 10.3. Within or above the zone of cost effectiveness, uncertainty is reduced and this is likely to have a positive impact on post-release cash outflows, as the product is released with sufficiently high reliability, reducing corrective maintenance costs. Differences in aspiration levels are reduced or even eliminated and are likely to reveal a low presence of ‘challenge’ and a high presence of ‘management of meaning’ processes/strategies.

		Quality		
		Low	Middle	High
Time Pressure	High			Senior Management Marketing Development Maintenance & Exploitation
	Middle			
	Low			

**Figure 11-11: Aspiration Levels of Stakeholders Involved**

#### 11.5.2.2 Judgmental Character

In this case the quality of the decision-making process was high: availability of information was good, although below the zone of cost effectiveness, equal aspiration levels with respect to the decision outcome, all stakeholders involved in the decision-making, and applying a judgmental decision strategy with consensus as the decision rule. The resulting score for the ‘*Release Decision*’ process area is ‘Fully Satisfied’. The quality of the decision implementation was also medium-to-high: a maintenance budget was reserved and corrective actions were taken, however Development was not officially discharged from its responsibilities and the project was not appraised. The resultant score for the ‘*Release Implementation*’ process area is ‘Partially Satisfied’. The overall decision success - the sum of the quality of the decision-making process and the quality of decision implementation - is also high in this case. This is also true for the congruence between the expected and actual outcome. A few minor failures were reported after product release: the product was stable and gave the intended functionality and quality.

The methodology revealed the following:

1. *Release Definition* [score: FS]. The Project Steering Committee was established prior to the official launch of the project. The integral project plan, reviewed thoroughly by all stakeholders involved, eliminated possible differences in aspiration levels. The project plan stated clear and attainable project objectives, and provided a solid basis for the release criteria.
2. *Release Information* [score: FS]. The available standard development process and the close co-operation between Development and Maintenance & Exploitation led to a sound level of information perfection within the zone of cost effectiveness.
3. *Release Decision* [score: FS]. The availability of clear, attainable commonly-accepted objectives and information within the zone of effectiveness enabled the Project Steering Committee to make the release decision far ahead of the release date.
4. *Release Implementation* [score: PS]. The release implementation itself was without any major problem. The only essential shortcoming found was the absence of a project appraisal, identifying strengths and weaknesses and possible areas for improvement.

These observations were discussed in a feedback session and corroborated by the interviewed persons. This confirms the judgmental character of the methodology as discussed in Section 10.3.

This case study offers an excellent example for validating the methodology, as the project studied successfully implemented most practices. The following questions arise:

1. How can the success of the project be explained? High scores were assigned to all practices but the formal discharge of the project (P-D3) and an appraisal of the project (P-D4). The absence of a formal appraisal of the project does not directly concern the quality of the release implementation itself, but for the success of the project it provides a good internal example for deriving best practices. It might be argued that the success of the project is remarkable, because the process capability of the department's process capability was estimated to be CMM level 1-2 [limited institutionalized processes at project level] and the project was faced with the implementation of a new product. The success is however explained by reviewing the eight common failure factors for unsuccessful software projects as discussed in Section 4.4.1 (Figure 4-9). In the first place, an advantage to the project has been the availability of explicitly-stated and stable product requirements [eliminating failure factors 1 and 6]. Secondly, both senior management and users were involved from the beginning until the project end [eliminating failure factors 2 and 5]. In the third place, enough time was spent to derive a realistic and complete plan with the allocation of sufficient resources [eliminating failure factors 3, 4, and 7]. Fourthly, the need for the application remained present throughout the project [eliminating failure factor 8]. Finally, the project had another major advantage. The availability of an existing and operational product, allowed the comparison of test results with the results from the existing product. This enabled the project to make strong statements about the reliability of the product. Summarized, the project experienced some favourable conditions to make it successful, not hereby implying that it was an easy project.
2. Does a relationship exist between project success and release decision success? The project's conditions were favourable and it could be argued that, if this is true, the practices as defined in the methodology will automatically receive high scores [cause-effect relationship]. So, a software manufacturer should not concentrate on the practices of the methodology but on a project's conditions. This is an invalid argument. Excellent project conditions are not a guarantee for release decision success. If a project omits, for example, to deploy and evaluate non-function requirements sufficiently, the available information as input to the decision-making process might be below the zone of cost effectiveness. This increases uncertainty and might reveal a higher presence of 'challenge' processes/strategies. There will be circumstances in which the conditions of a project cannot, or can only partially, be influenced. In these cases, it is still possible to increase release decision success by implementing the practices of the methodology. If a project is faced, for example, with incomplete and unstable requirements, it is still possible to aim for release decision success. Important practices are in this case P-A1 [defining the project objectives], P-A2 [controlling the project], and P-A3 [managing uncertainties].
3. Is the methodology complete? In this case study the important practices for the release decision were all satisfactorily implemented. This was discussed during the feedback session, but this did not reveal new insights. Project members involved recognized the elements contributing to release decision success. A review of the description of the methodology, using the data-flow diagram as presented in Figure 9-3 (Section 9.4), did also not identify additional elements. To increase release decision success, decision-makers should agree on the release criteria and ensure that information perfection is within the zone of cost effectiveness and that the decision is successfully implemented once made. Additional research is needed in similar and other software manufacturer environments to further explore this question.

## 11.6 Review of Results

### 11.6.1 Overall Conclusions

The process areas of the methodology cover the important aspects of strategic software release decisions: defining and controlling the product development strategy [*release definition*], defining and acquiring the information needed as input for the release decision [*release information*], establishing a broad basis for the release decision outcome [*release decision*], and establishing congruence between the expected and actual release decision outcomes and determining lessons learned [*release implementation*]. Both the descriptive and judgmental character of the methodology are validated in the cases studied.

- ❖ On the descriptive character of the methodology, the following conclusions are drawn: Below the zone of cost effectiveness, uncertainty is high and this is likely to have a negative impact on post-release cash outflows. This may lead to differences in aspiration levels and is likely to reveal a high presence of ‘challenge’ and a low presence of ‘management of meaning’ processes/strategies. This situation is confirmed in case study H. When information increases, uncertainty is reduced and this is likely to have a positive impact on post-release cash outflows. Differences in aspiration levels are reduced or even eliminated and the decision-making process is likely to reveal a low presence of ‘challenge’ and a high presence of ‘management of meaning’ processes/strategies. This is confirmed in case studies I and J.
- ❖ On the judgmental character of the methodology, the following conclusions are drawn: Decision success requires a high quality for the decision-making process and for decision implementation. In this way, it is likely there will be congruence between the expected and actual outcome, in meeting the objectives that gave rise to the decision. This was confirmed in all cases. Case H reveals a low quality for the decision-making process, and a relatively high quality for release implementation, however the original objectives are not met. Cases I and J reveal a high quality for the decision-making process and release implementation, both meeting the original project objectives. It is concluded that the judgmental character as an assumed property of the methodology is validated in a practical context. Using the proposed methodology, the quality of the decision-making process and quality of decision implementation can be determined, offering the possibility of assessing the strengths and weaknesses of strategic software release decisions. This judgmental character of the methodology offers the possibility of identifying areas of improvement, and meets the primary research objective of this study.

Finally, the following reflections on the methodology are made:

1. Limitations of the methodology. The methodology focuses on the decision-making process of software products with strategic value. The practices identified describe the important aspects, which need to be addressed to increase decision success [what], but gives limited guidance on the way these practices can be successfully implemented [how]. A short list of examples of supporting methods is given. The methodology does not pay attention to requirement engineering. Issues like how the requirements are elicited, how they are specified and how they are validated are not addressed. Implementation of the methodology does not guarantee the right product is being built. No explicit attention is paid to choosing the most appropriate project management or development methodology. Implementation of the methodology does not guarantee the product is being built in the right way. Focus is limited to increasing release decision success.
2. Added value of the methodology. When comparing the methodology with project management methodologies, development methodologies, standards and models, some overlap can be observed. The identified practices for the ‘*Release Definition*’ process area are [partially] addressed in, for example, PRINCE2 and CMMI: defining the project

objectives and controlling the project's progress during its execution. However, the methodology offers added value by explicitly recognizing that a) there needs to be a clear rationale for a project throughout its existence, b) information has its price in time and money, c) there is a need to reduce the aspiration levels of all stakeholders involved early during product development, and find consensus amongst all stakeholders when making the release decision, and d) product development only ends when the product has been successfully rolled out and lessons learned have been collected. Combining the economics, software management and decision-making disciplines has led to this multi-perspective view on the study phenomenon.

### 11.6.2 External Validity

For external validity of the obtained results in the environments studied, the following considerations are stated. For the validation of a methodology using multiple case studies, cases have to be carefully selected. The objective can be to either predict similar results [literal replication] or to predict contradictory results under explicit conditions [theoretical replication] (Yin 1994, p.46). The cases selected are similar software manufacturers; selected so that the extent to which the practices of the defined process areas are satisfactorily implemented is expected to vary. The course of literal replication is followed as similar results for the methodology properties were expected; confirmation of the property assumptions. For the external validity of the results to a wider context beyond the cases studied, the following conclusions are drawn:

1. *Generalization of results to similar and other software manufacturer types.* The first question to be answered is the extent to which the descriptive and judgmental character of the methodology can be generalized, to similar and other software manufacturer types. The case studies selected are software manufacturer types developing software products for internal use. As argued in Section 10.2.3, a review of the methodology indicated no practices specific to a software manufacturer type. The cases studied revealed environments with high pressure on both time and quality, in relatively turbulent environments [especially in case H], similar to environments in which, for example, customer software or mass-market software is developed. It is therefore considered that no major obstacles exist in successfully applying the methodology to other similar or different software manufacturer environments.
2. *Generalization of results to more routine software release decisions.* The second question that arises is whether the conclusions are restricted to strategic software release decisions [non-routine decisions]. The methodology has been designed for strategic software release decisions, a requirement stated in Section 1.6. As discussed in Section 4.4.3, routine decisions should not be the concern of higher-level management, and can probably be made at operational level. As such, the need for the establishment of a Project Steering Committee at tactical level to control the project, with involvement of Senior Management at strategic level, is limited for more routine release decisions, as controversial issues between different stakeholders, requiring a negotiated decision-making strategy addressing the perspective of satisficing behaviour, is less likely. This methodology can be considered for more routine software release decisions, however for each practice it must be carefully considered if its implementation gives sufficient added value and whether the involvement of higher management levels is required.
3. *Generalization of results to other product development decisions.* A third question that arises is whether the conclusions are restricted to [strategic] software release decisions. Could, for example, the methodology also be used for investment decisions or product design decisions; important milestones during product development? Although the methodology has been designed for strategic software release decisions, its general nature makes this worth considering. The methodology focuses on the decision-making process [*Release Decision* process area], extending it with defining and controlling the

decision objectives [*'Release Definition'* process area], the definition and collection process of information as input to the decision-making process [*'Release Information'* process area], and the implementation and evaluation of the release decision [*'Release Implementation'* process area]. These are common aspects of decision-making and usage for other product development decisions can, therefore, be considered. The underlying practices should, for such cases be revised to focus more specifically on the decision type considered.

4. *Generalization of results beyond the scope of software product development.* A fourth question that may arise is whether the application of the methodology is limited to strategic release decisions for software products only. Could the methodology be useful in other engineering disciplines like mechanical engineering and hardware engineering [and their combinations with software: systems engineering] or even product development in general? A review of the methodology indicates no practices, which are specific to software [apart from the supporting methods]. However, software has certain specific properties. In the first place, as discussed in Section 3.2.1, software is an experience good: its lack of transparency introduces uncertainty to potential customers and end-users of the software on purpose and quality. Secondly, as discussed in Section 3.3.2, software differs in the manner in which it fails and thus influences the verification and validation process, as complete testing is not realistic. These two sources of uncertainty are strong arguments for adopting a methodology especially in cases where the release decision is of strategic value. In other engineering disciplines and product development both uncertainty and strategic decision value can also be present, especially where new products are developed and introduced into the market. This indicates the methodology could be of interest beyond the scope of software product development.

### **11.7 Summary and Conclusions**

In this Chapter, the results of the three validation case studies are presented and discussed. The case studies cover three different findings on the fulfilment of the practices of the process areas in the designed methodology. In case H, all process areas, but one, were not satisfied. In case I, all process areas were largely satisfied. In case J, all process areas, but one, were fully satisfied. The case studies confirmed both the descriptive and judgmental character of the methodology, hereby meeting the primary research objective of this study.

Some limitations of the methodology are discussed. The methodology focuses on describing practices, which are considered important, but does not prescribe how they should be satisfactorily implemented. There is little attention to ensuring the right product is being built [requirements engineering], or whether the product is being built in the right way. Focus is limited to improving release decision success. For the added value of the methodology it is concluded that combining the economic, software management and decision-making disciplines has led to a multi-perspective view on the study phenomenon. As such, the methodology goes beyond the scope of existing methodologies, standards and models.

The external validity of the results of the case studies is discussed, resulting in four main conclusions on the generalization of the results obtained. No reasons were found to limit the conclusions to the particular software manufacturer type found in the cases, developing products for internal use. The properties of the methodology are assumed to be valid beyond the cases studied; to either similar or other software manufacturer types. The validity of the methodology is not necessarily restricted to strategic software release decisions, although stakeholders at tactical and strategic level will play a far less important role, as routine decisions should be more the concern of operating management.

In the next Chapter, the research results are summarized and general conclusions are drawn.