Measurement of the quality and maturity of the innovation process: methodology and case of a medium sized Finnish company

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Abstract: Continuous improvement of the effectiveness of R&D requires an adequate and comprehensive assessment and measurement system. The present method, quality and maturity method (QMM), for assessing the quality and maturity of R&D, examines R&D from six viewpoints: R&D as part of business strategy, R&D as part of product and technology strategy, strategic implementation of R&D, R&D as a business section, R&D outputs, and implementation of R&D projects. Procedures for each of the six viewpoints are assessed and scored by five maturity levels. The verifying of the preliminary QMM method in four pilot companies has shown that the viewpoints used in the assessment describe factors pertaining to the quality and maturity of R&D quite well, and indicate central development needs.

Keywords: strategy; innovation; maturity; assessment; research and development R&D; quality maturity method (QMM).

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1 Introduction

Continuously improving overall effectiveness of R&D requires adequate practice, in other words, maturity throughout the innovation chain. The first requirement is that the company have well-defined strategies that take R&D into account and provide information that serves as a basis for R&D decisions. Furthermore, the information has to be utilised and the R&D process itself has to be carried out so that the outcomes are in line with strategic objectives. In addition, there has to be a way of managing these practices as a whole and at every individual stage to optimise the input-outcome ratio and maximise the contribution to business. Such a comprehensive measurement system makes it possible for the R&D manager to get a picture of the R&D effectiveness.

This paper briefly describes a method we have developed for assessing the maturity level of R&D.

- the theoretical background of the method and the present state of assessment of quality and maturity level of R&D in companies are presented
- the structure of the method is described and some experiences from the application of the model are then discussed
- the verifying of the method is described.

This is followed by a discussion of the main conclusions and a scheme of the future research and piloting of the method.

2 Theoretical background of the method

R&D is a hidden component in quality procedures (e.g. quality standards, quality awards). The quality procedures usually contain a requirement to document R&D practices (process), but they fail to give any substantial guidance or methods for doing so. They discuss operational level activities without giving much consideration to the strategic questions of the company.

Maturity models are commonly used in the assessment of effectiveness of software engineering processes. Maturity models (e.g. CMM (Capability Maturity Model)), such as that of Paulk et al. [1], describe processes or activities. They contain no observation of resources, definition of new products or questions related to strategic issues of the organisation. The maturity models classify performance into different maturity levels from ad hoc to world class. By 'climbing' these steps, the actions become more systematic and mature. An analogous maturity level model is also used in the new model for the assessment of quality and maturity level of R&D.

3 Method description

The method for assessing the quality and maturity of R&D (QMM), defining maturity level, contains three parts:

- the assessment model (framework, maturity level definitions)
- the assessment process
- the assessment tools (questionnaire, 'quick assessment' form, scoring guide).

The assessment model will be described next. However, the assessment process and assessment tools will not be described in this paper.

The framework of the model for assessing the quality and maturity level of R&D is presented in Figure 1.

Figure 1 Principle of the new model for assessing the quality and maturity level of R&D

		A BUSINESS VIEWPOINT Why ?	B TECHNOLOGICAL VIEWPOINT What ?	C IMPLEMENTATION VIEWPOINT How ?
1	COMPANY LEVEL	Mission/ business strategy	Vision/ product and technology strategy	R&D-strategy/ Activities of the management
2	PROJECT LEVEL	External and internal impacts	Knowledge, skills and products	Tasks of project personals

Descriptions of the six assessment viewpoints and assessment focuses are as follow:

A1. R&D as a part of business strategy. The key question is: How do the mission, vision and business objectives (business strategy) support R&D, how effectively have objectives for R&D been defined in business strategy?

B1. R&D as a part of product and technology strategy. The key question is: How do competition, marketing, *product*, production and *technology* strategies support R&D, how effectively have objectives for R&D been defined in the product and technology strategy?

C1. Strategic implementation of R&D. The key question is: How effectively does the senior management implement strategies, manages key resources and strategic implementation?

A2. R&D as a part of business. The key question is: How have the internal impacts (for instance turnover) and external impacts (for instance customer satisfaction) been assessed, and how effectively has this feedback information been utilised in setting the objectives for R&D-projects and business objectives?

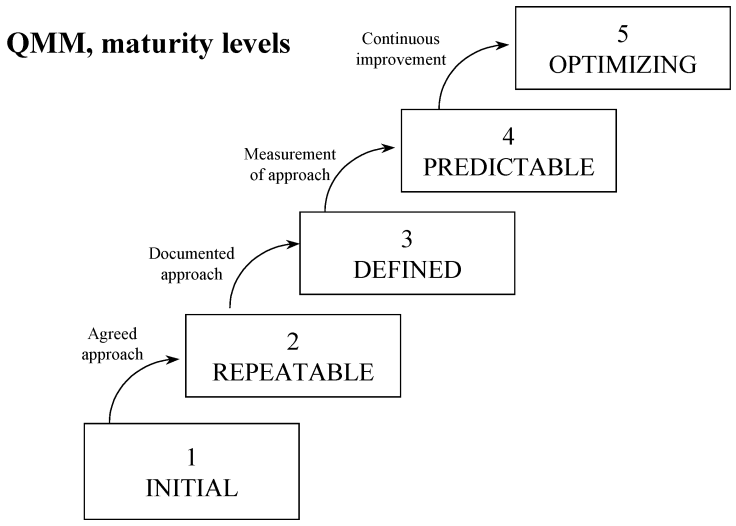
B2. R&D outputs. The key question is: How have the objectives for R&D-project been defined, how effectively have the desired outputs (results) of R&D-projects been defined based on strategies?

C2. Implementation of R&D-projects. The key question is: How has the R&D-project plan been made, how effectively has the R&D-project been implemented?

Each of the six boxes contains some activities (items) to be assessed. The total number of items to be assessed is 41 [2].

The activities in each of the six boxes of the model will be assessed and scored by a maturity level (Figure 2). The maturity levels are based on CMM Paulk et al. [1]. The model makes it possible to determine the maturity level of the whole R&D as well as that of different sectors of the R&D, such as R&D management, R&D-projects, business operations, technology, R&D activities. The assessment also produces an R&D profile (in six sectors of R&D) and the state of R&D practices. The model can be flexibly linked to any quality procedure and other R&D tools.

Figure 2 Maturity levels of R&D



4 Case from the application of the model in a medium sized Finnish company

A systematic collection of metrics related to product development in companies at the Innovation Management Institute of Tampere University of Technology has been an ongoing process since 1993. The QMM method has been an in-depth case-study tested in seven Finnish companies.

The following is a case presentation of a maturity level assessment carried out within a medium sized Finnish industrial enterprise.

4.1 Initial situation

As a starting point and a motive for assessment, there was a need to revise the current state of product development activities in order to enable the firm to meet new challenges by the corporate executives. At the same time, there was a need to achieve a quality of documentation which would better satisfy the demands of the quality audits. The scope of the assessment was limited the first time to the corporate level because there had been changes in the enterprise's external environment, creating new challenges to and thus influencing the strategic goals.

The firm had implemented the process management model a few years ago. The operations in the firm are based on using teams and the interaction between the different processes within the firm is extremely active. The marketing function guides product development, and bases its actions on knowledge of the customer needs. The focus of the operation, the customers, the core technologies, and the products are clearly defined and provide reliable guidance for selection of product development projects and decision making in general.

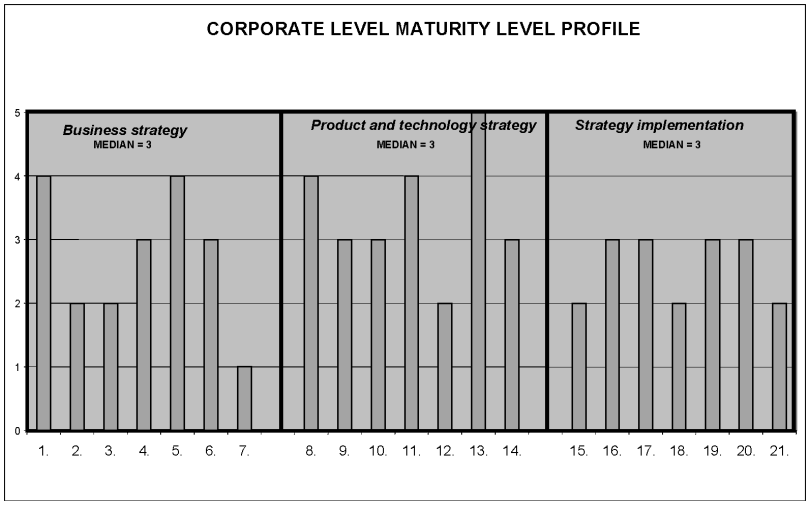
4.2 Assessment

The assessment was conducted in workshops. The participants were those responsible for product management and product development processes within the firm. An external auditor, who had an assistant whose role was to observe and document, led the workshops. The participants had previously made themselves familiar with the assessed matters, and the auditor had analysed the firm's quality and other process descriptions.

4.3 Analysis of the current state

The operation has been well documented and organised, as can be seen from the results of the three assessment areas (Figure 3).

Figure 3 Corporate level maturity profile in case company



Scale: 1 = ad hoc level; 5 = world class level.

Corporate level matters (Figure 3) are examined in 21 questions which are as follows:

1 What is the definition and characterisation of the targeted customers and customer groups of the firm?

2 What is the definition of the geographic areas of the firm's operation, the size of the markets, and the growth of the business areas?

3 What is the definition of the required competence (= core competence) in the defined business area (current, needed and competitor's competence)?

4 How are the key success factors of the industry defined?

5 How are the trends of change described?

6 How is the development of the technology described?

7 What is the definition of the competitors; who are the competitors?

8 How is the competitive profile of the firm's products (= competitive idea) defined?

9 How is the marketing strategy of the firm defined?

10 How is the product strategy (products, programme for products) defined for the firm?

11 How is the production strategy of the firm defined?

12 How are the needs for technology defined?

13 How are the core technologies defined?

14 How are available technologies and sources of technologies defined; what are the sources of new technology?

15 How does management help the personnel in understanding how the firm's business goals, product strategies, and technology strategies influence the operation of individuals? What kind of limitations and conditions does the strategies impose on the operation? How can personnel give their effort and support in reaching the business goals?

16 How are strategic goals taken into account when structuring the organisation of the firm?

17 How does one assign and secure the quality and amount of resources needed to reach strategic goals?

18 How does one take into account and improve the welfare and motivation of personnel in strategy implementation?

19 How has the product development strategy (product development project portfolio) been defined?

20 How can product development use the resources of other functions in the firm for realising its own product development strategies?

21 How is the need to increase the level of knowledge and skills taken into account in the strategy implementation?

The maturity level of all assessed areas was found to be three out of five, which means:

> "The operation is stable and well documented (method descriptions have been documented and the processes have been modelled). The methods are being practiced in all parts of the organisation. It is conventional to define clear targets and action plans."

Regarding the business strategy area in the assessment, two primary areas for improvement arose. There was a need to systematise the way competence required within the firm's business area (Question 3) was monitored and in particular there was a need to conduct a competitor analysis (Question 7).

As regards the assessment area of product and technology strategy, the operation of the firm is well organised. A simulation model of production that has been implemented creates possibilities for quantitative measurement and optimisation of the operation, particularly with regard to assessment of the core, supportive, and totally outsourced technologies in Question 13.

The strategies and the specified goals had been effectively put into practice, which was noted within the assessment area of strategy implementation. The effectiveness had been due to the active interaction between processes and the operation of the teams. As a potential improvement area, the firm needs to take into account the motivation and well being of the personnel affected by the current changes within the firm (Question 18).

4.4 Further actions

The firm will incorporate these results in the next quality audit and in defining the strategic goals. It was further agreed that the assessment would be widened to the project level and that the results of the assessments would be updated periodically. If the assessments were conducted regularly, the impact of changes to product development could be tracked more effectively.

5 Tentative verifying of the QMM method

The verifying of the QMM was also done in four companies [3]. Company 1 had three persons participating in the verification, companies two and three had two persons, and company four had one person for participation. Verification was carried out in the form of individual interviews, which prevented the respondents of the same company affecting each other's opinion.

The objective of the verification was to analyse the validity and relevance of the questions to be assessed in the chosen companies, find out about different ideas inside the same company and establish the suitability of the model to the assessment of the operation of organisations representing manufacturing industry and services. The verification results were intended for defining the points to be assessed in more detail to provide a basis for a more extensive testing.

The most central results of the verification of the points to be assessed in chosen companies were the following:

The structure and contents of the points to be assessed were generally regarded as reasonable and the respondents believed that the assessment results would give an idea of the present state of the innovation activity and improvement needs in the companies.

However, the contents of individual questions need to be revised to be as unambiguously as possible. Overlapping between questions has to be removed and the key questions have to be prioritised in each assessment area in order to reduce the total number of questions.

The developed assessment model as such is not very well suited to the assessment of customer-oriented innovation activity of consultant or service type companies.

Further research should have a particular focus on factors that can be used to classify companies according to the nature of their operation. This allows obtaining comparable information of R&D between companies.

6 Conclusions and future research

The starting point and the need for the assessments vary considerably. The assessment method for product development can provide solutions in various situations. Typical situations include rationalisation of the operation, documentation of the operation in change, improvement of the quality system, and improvement of the processes.

The scope of the assessments varies considerably. Depending on the situation, the status of product development activities can be assessed by starting from an individual's opinion, or the so-called quick test, and ending at the other head of the scale in a perennial development process, in which the assessment is repeated periodically, involving several persons within the organisation.

Strong strategic capabilities benefit product development in a firm. Product development is becoming a more significant competitive factor for firms. Consequently, the descriptions of strategic goals must serve the possible target setting as well as decision-making related to product development.

The new method for assessing the quality and maturity level of R&D has been tested on a minor scale in some companies. Full-scale testing of the applicability of the method to different kinds of companies will be done in future research. One of the central

premises for further development of the method is the analysis of the background variables, especially that of the nature of the R&D in the organisation. The nature of the R&D includes issues such as what is the strategic role of the R&D and how the R&D has been linked to other activities of the organisation. The definition of the background variables should be done very carefully, especially if the assessment data will be used as a benchmarking data.

The assessment method is meant to be developed further and be customised for the needs of a particular firm. In an environment characterised by personal and business networking, the areas of knowledge management and learning are essential for further development.

In addition, in the future, the significance of information and communication technologies will increase for product development functions, as it will in the assessment of those functions.

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