MEASURING SOFT FACTS
IN SOFTWARE DEVELOPMENT

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Introducing cooperative working environments in software development makes it necessary to consider soft facts in a measurement program. The European Foundation Quality Model (EFQM) is a framework for solving this problem because it takes into account products, processes and people in an adequate manner. This paper describes how the EFQM Excellence Model may be fitted to serve as a holistic framework for a measurement program of a software development process. After a short explanation of the EFQM basic model three model adaptations of increasing complexity are lined out. The most complex and thus the most interesting model adaptation is shown in detail.

1   Introduction

Software Development is a rather complex business process. Three different interest groups (orderer, user, project team) should influence the results of the development process. 19 different roles (see [6], p. 17) may be distinguished within a software development team. This is one main reason why the software development process is difficult to manage. In the past managers just considered the people within the development process itself. This led to software products which did not meet the needs of the users, and had to be revised over and over again. Overwhelming costs and unsatisfied orderers as well as users were the results well-known as the software crisis.

In order to overcome this problem, cooperative, participative and learning-orientated working techniques (see [3], [4], [6], [7]) were introduced. Consequently measurement programs have to evalu-

ate not only the products but the whole process including all interest groups. Assessment and evaluation models like ami (application of metrics in industry, [10]) or CMM (Capability Maturity Model, [9]) take into account the quality and improvement of the software development process but not soft facts like *leadership* or *people satisfaction* which are critical success factors for solving such complex tasks like software development.

Additionally organizations are more often forced to certify their business processes in order to meet market demands. This expenditure is only worth while if the organization can reach business advantages continuously by introducing an appropriate quality management system. This can only be reached if a holistic approach is used where processes, products and people are taken into account accordingly. The task to be solved is to find or invent an appropriate procedure for this purpose.

2   Short Description of the EFQM Excellence Model

The EFQM (**E**uropean **F**oundation for **Q**uality **M**anagement) Excellence Model [2] is a non-prescriptive framework to help organizations on their path to business excellence. It is a practical tool for measuring through self-assessment where they are and helping them to understand the gaps as well as stimulating solutions. Strengths and weaknesses are identified and may be put into action plans. The model consists of two parts, the enablers and the results (see Figure 1).
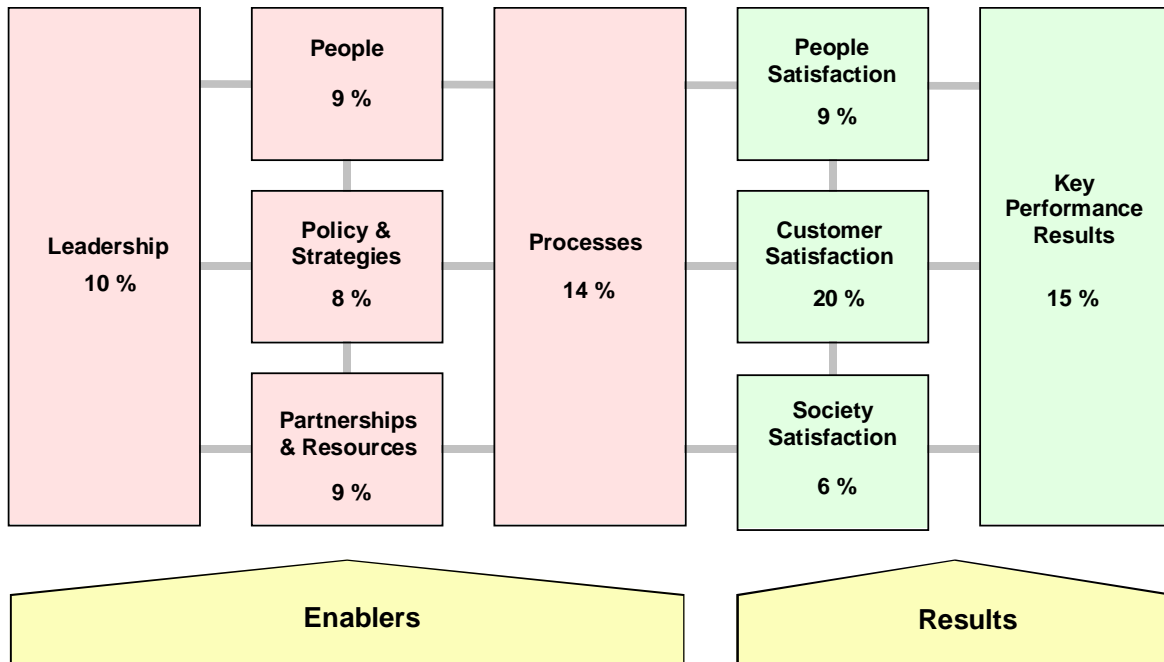
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Figure 1: EFQM-Model

The five **enabler** criterions *Leadership*, *People*, *Policy & Strategy*, *Partnerships & Resources*, *Processes* allow to analyze the activities and business processes of an organization and to evaluate their maturity of usage. The four **result** criterions *People results*, *Customer results*, *Society results*, *Key Performance results* allow the systematical measurement of business results, benchmarking with other organizations, to poll the opinion of customers as well as employees about the organization and to link these results to enabler criterions to identify improvement necessities.

For the purpose of a self-assessment a Corporate Description Handbook has to be worked out first. It is structured by the EFQM Model criterions and describes the actual situation of the organization as complete as possible. In the following this description is the base for the assessment teams for their evaluation. The EFQM Model also includes the assessment procedure for evaluating the criterions. The evaluation investigates to what degree the Corporate Descriptions cover the criterion descriptions in the model. Every assessment team member rates every criterion of the enablers part according to the scheme shown in Figure 2 by combining two factors. The first factor describes how good the **procedure** is and the second how efficiently the **realization** of the procedure is.

PROCEDURE	*VALUE*	*REALIZATION*
Anecdotal or without improvement.	**0%**	Low effective use.
Some proofs of well-grounded approaches and systems based on prevention. Occasional audits. Partial integration into normal business activities.	**25%**	Procedures applied to a quarter of all relevant business fields and activities.
Proof of well-grounded, systematical procedures and systems based on prevention. Audits regularly. Good integration into normal business activities and planning.	**50%**	Procedures applied to half of all relevant business fields and activities.
Obvious proof of well-grounded, systematical procedures and systems based on prevention. Clear proof of refinement and of improved business efficiency through regular audits. Good integration into normal business activities and planning.	**75%**	Procedures applied to three quarters of all relevant business fields and activities.
Obvious proof of well-grounded, systematical procedures and systems based on prevention. Clear proof of refinement and of improved business efficiency through regular audits. Good integration into normal business activities and planning. Procedure is totally integrated into everyday work. May be used as a best practice model for other organizations.	**100%**	Procedures applied to the whole organization.

Figure 2: Evaluation Scheme - enablers

Again every assessment team member rates every criterion of the results part according to the scheme shown in Figure 3 by considering two factors. The first describes the quality of the results, the second to what extend the results were met.

RESULTS	*VALUE*	*EXTENT*
Anecdotal.	**0%**	results concern few relevant business fields and activities.
The trends of some results are positiv and/or show satisfying performance. In some cases promising comparisons with own goals.	**25%**	results concern some relevant business fields and activities.
The trends of many results are positiv and/or show constant satisfying performance over 3 years at least. In many business fields promising comparisons with own goals. Some comparisons with external organizations. Some results can be linked to the implemented procedures.	**50%**	results concern many relevant business fields and activities.
The trends of most results are obviously positiv and/or show constant satisfying performance over 3 years at least. In many business fields encouraging comparisons with own goals. Promising comparisons with external organizations in many business fields. Many results can be linked to the implemented procedures.	**75%**	results concern most of the relevant business fields and activities.
Clear positiv trends and/or constant satisfying performance since 5 years at least. Excellent comparisons with own goals. and with external organizations in most business fields. "Best in class" in many fields of activity. results can be definitely linked to the implemented procedures. Positive indication that the position of business excellence can be kept up.	**100%**	results concern all of the relevant business fields and activities.

Figure 3: Evaluation Scheme - results

The covering of a criterion is expressed with help of a percentage value according to the evaluation schemes described above. Afterwards the percentage values are weighted as shown in the EFQM Model and summed up. The strengths and improvement possibilities are documented. Based on

these results the action plan is worked out. Through repetition of this evaluation procedure it can easily be shown in which fields improvements were realized and how. Best practices in the organization become obvious and thus easier to achieve.

3 Model Adaptations for the Software Development Process

If the key business process of an organization is software development the EFQM Excellence Model might be used unmodified more or less. In case of software development being a support business process for the organization (that means software is developed for internal use only) it is necessary to adapt the model accordingly. Following variations of model adaptations [8] seem to be useful:

- *Variation 1 – limited adaptation*
  The software development process is the key business process of the organization. All EFQM model criterions are taken over, only the descriptions of the criterions are adapted accordingly.

- *Variation 2 – adaptation of criterions*
  Software development is **not** the key business process of the organization, the software products are only used internally. In this case some criterions like *Policy & Strategies* and *Society results* may be dropped, the descriptions of the left criterions and the weight values have to be adapted accordingly.

- *Variation 3 – model adaptation*
  In this variation only the base schemes (link between enablers and results, evaluation procedures) of the EFQM Excellence Model are left, all criterions are redefined and weighted. This variation is extremely useful, if a very complex software development project shall be controlled and assessed.

For variation 1 and 2 only simple adaptations of the EFQM base model are necessary. Variation 3 is the most challenging and thus interesting one which cannot be achieved through plain adaptations. This is the reason why the third variation will be shown in detail in the following.

3.1 Description of the Adaptation Procedure

First of all the whole software development team (P-Team in Figure 4) has to be acquainted to the EFQM Excellence Model. All team members should understand the criterions and be able to use the evaluation procedure accordingly. Afterwards the P-Team develops suitable criterions for their needs in the project. Based on these criterions a whole new model is built. The P-Team elects some of them to be a member of the Quality Team (Q-Team in Figure 4). The Q-Team works out the Evaluation Handbook and Project Description as a base for the Evaluation Procedure, which is undertaken by the speaker of the user group (User in Figure 4), the orderer of the software product and the Q-Team itself. As a result of the evaluation process overall points, strengths and improvement possibilities are documented.
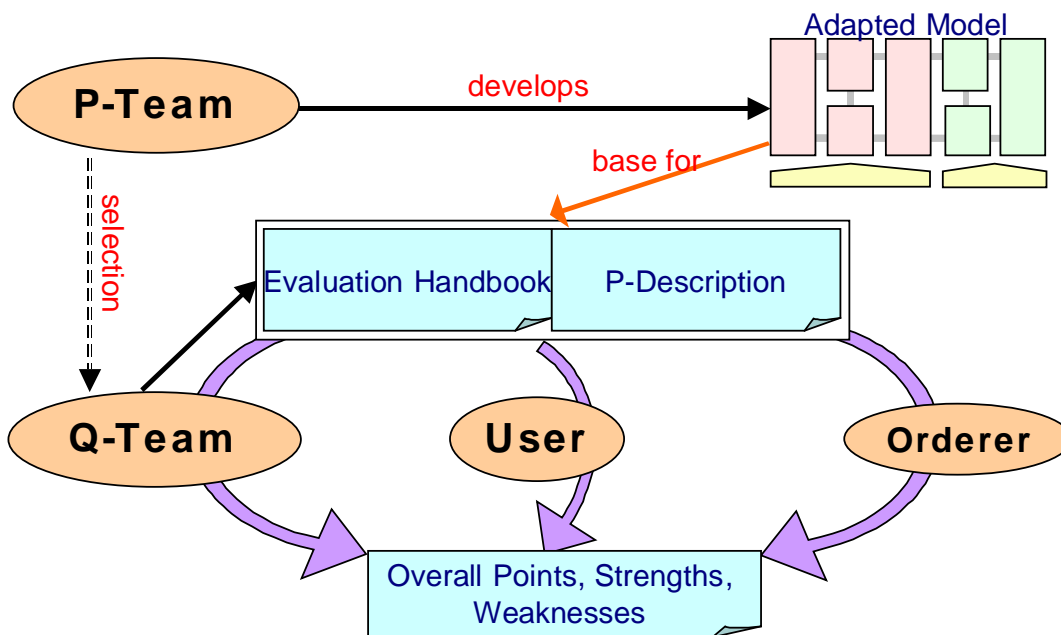

Figure 4: Adaptation Procedure

In the following the most important steps of the adaptation procedure will be described in detail.

3.2 Development of Model Criterions

After the training of the P-Team in the basics of the EFQM Excellence Model the members of the P-Team come together in a half-day workshop with the goal to develop a suitable new Quality

Model according to the goals of the project. With aid of brainstorming and meta-plan technique (see [6], p. 99 – 101) the team members search for suitable (sub)criterions for their needs in the project. The P-Team decides which (sub)criterions to use. Afterwards the chosen (sub)criterions are clustered to useful groups. This groups complemented with suitable weights form the new Quality Model which can be used for project supervision. An example is outlined in Figure 5. The guidance of the EFQM Excellence Model leads to a holistic model which includes soft facts as well.
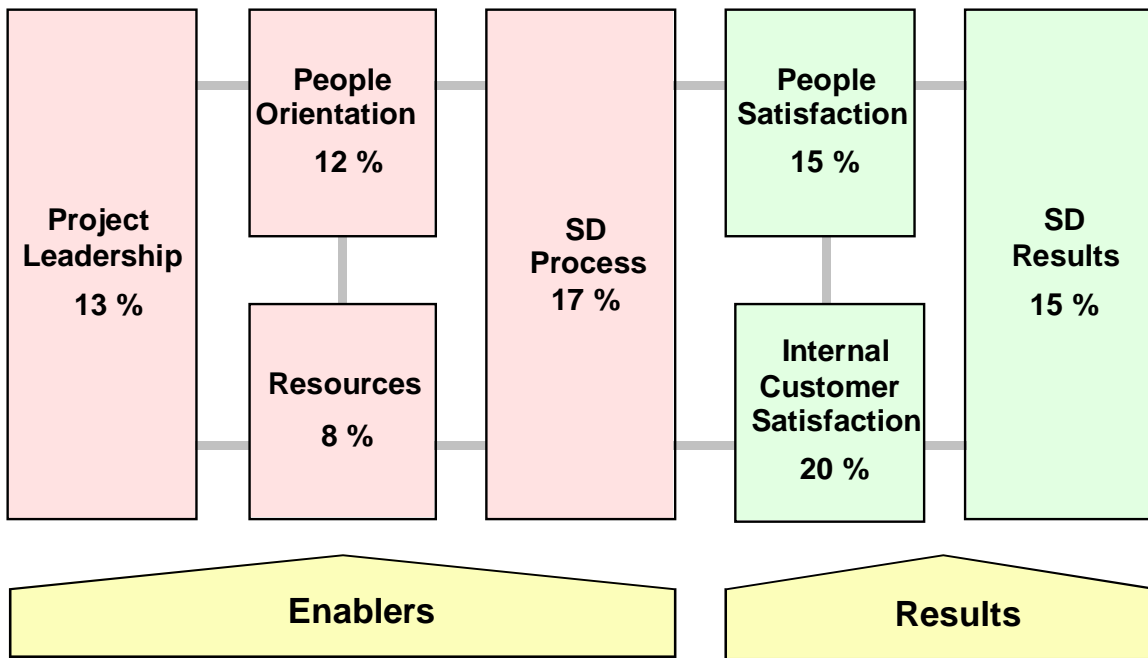

Figure 5: Example of an Adapted Model

Now the P-Team is ready for the next step of the adaptation procedure, the development of the Evaluation Handbook.

3.3   Evaluation Handbook

Now a detailed description of every criterion has to be worked. For this purpose the team members elect some of them to be a member of the Q-Team which will be responsible for the whole evaluation process for now on till the end of the project. The members of the Q-Team are wisely the most experienced with the EFQM Excellence Model. The Q-Team works out the meaning of every criterion and how the quality is measured. It adds the computing method to evaluation procedures which also includes the weights for every criterion.

The following description of the criterion *Project Leadership* (see Figure 6) may serve as an example of an enabler criterion.

1	**Project Leadership**	**How** project leaders develop values required for long term success and implement these via appropriate actions and behaviors, and are personally involved in ensuring that the total quality management system is developed and implemented.
		It has to be proved, **how** the project leader encourages personally process improvement activities, and commits internal as well as external customers and suppliers. Starting points may be, how the project leader • is involved in the establishment of priorities, the supply of resources, the organization and support of process improvement activities within the project, • appreciates the performance of single team members and teams, of customers and suppliers, • organizes partnerships to customers, suppliers and other external organizations, and undertakes positive steps towards involving them into the improvement process, • propagates total quality within and outside of the project.

Figure 6: Example Description for *Project Leadership*

The following description of the criterion *People Satisfaction* is shown (see Figure 7) as an example for a result criterion.

7	**People Satisfaction**	**What** the organization does for people satisfaction.
		results have to be shown in terms of judgement of the project organization by the project team members. As starting points may serve the feedback of the project team members which helps the organization to assess, evaluate and understand how well the wishes and expectations fit to the people's needs. This includes e.g.: • the working environment • communication • career possibilities • management • assessment • appreciation of performance • training.

Figure 7: Example Description for *People Satisfaction*

The enabler and result criterions are linked together in the sense of a feedback loop. That means if the project leader acts in the sense of *People Orientation* suitable for the distinctive organization, the criterion *People Satisfaction* will reach an accordingly high value. The other way round a low value for People Satisfaction points to deficiencies in *Project Leadership* and *People Orientation*.

3.4   Project Description

The Evaluation Handbook is the base for the Project Description which has to be written by the Q-Team as part of the next step. The structure of the Project Description follows the model construction. That means for every criterion in the Evaluation Handbook there will be a section in Project Description containing how the criterion is met in the project. If the project is at an early stage the results may be described in terms of what documents will be/were created and how their quality will be/was checked. The Project Description is revised at the end of each project phase. Therefore it becomes a valuable source during the ongoing project. After the completion of the project it serves as a useful resource for newly formed project teams in the sense of the continuous improvement process.

4   Evaluation Process

In order to execute an appropriate Evaluation Process two additional groups of people have to be recruited. Beside the Q-Team members it is essential to encourage prospective key users of the software under construction and the group formed by the oderer himself to support the evaluation process in order to draw a holistic picture of the situation. The orderer's group should also include people of the IT management in order to prove that the project supports the strategies and goals of the IT department.

All groups get base information on the quality model and the evaluation procedure. Afterwards the groups work out their results in separated conferences and document them in the Evaluation Hand-book. During the following consensus meeting the Q-Team, the speaker of the user's group and the orderer as the speaker of his group bring together the results (see Figure 4) and create the action plan for the realization of the identified improvements.

5   Experiences

Two important application areas can be distinguished for the described procedure. The first is its implementation in a larger complex software development project, the second is to evaluate and improve the software development process of a larger corporation.

The disadvantage is the procedure being very resource intensive, especially if there are no people experienced in EFQM self-assessment. In this case the members of the project team have to be educated first, a time consuming task where they are not available for software development activities. The used resources cannot be accounted for the project.

Beside these disadvantages the following important improvements may be achieved in the whole organization:

- All interest groups (orderer, users, IT management, project team) of a larger software development project are involved in the ongoing project by means of regularly performed evaluation meetings and therefore can influence directly improvement actions.

- Soft facts like customer or people satisfaction become integrative part of the quality management system which leads to better software products in the long run.

- The software development process is continuously improved which helps to develop further the whole IT organization.

- The execution of the evaluation process leads to a better understanding between the developers and the users of the software product under construction. This makes it more likely that the users get what they wanted.

- The execution of the procedure might be seen as a team building activity which leads to better communication and cooperation within the project team because they know and share the

quality rules by heart. Growing together with the tasks to solve becomes an integral part of the project culture.

- Last but not least the team members know the strengths and weaknesses of their working environment and are able to actively influence its improvement which leads to higher satisfaction and motivation.

6   Conclusion

Experiences in an industrial environment (see [5], [8]) encourage the development of holistic measurement programs. Further investigations of this problem area should include the development of appropriate computer-based tools based on the definition of a standardized software development process (for details in this area see [1]).

References

[1]   Chroust, G.: Software Process Standardization in IS/IT. In: Hofer, S.; Beneder, M. (eds.): IDIMT'99 7th Interdisciplinary Management Talks, Universitätsverlag Rudolf Trauner, Linz 1999, p. 76 – 77.

[2]   The EFQM Excellence Model. http://www.efqm.org/imodel/, Status: 05/06/00.

[3]   Floyd, C. et al.: STEPS to software development with users. In: Ghezzi, C.; McDermid, J. A. (Hrsg.): ESEC'89. Lecture Notes in Computer Science Nr. 387, Springer, Berlin 1989.

[4]   Heinrich, L. J.: Informationsmanagement. 5. Auflage, Oldenbourg, München/Wien 1996.

[5]   Mittelmann, A.: Implementation of a Measurement Plan in an Industrial Environment. In: Lehner, F.; Dumke, R.; Abran, A. (Eds.): Software Metrics. Gabler Edition Wissenschaft, Wiesbaden 1997, p. 211 - 228.

[6]   Mittelmann, A.: Der Einsatz von Methoden des Organisationalen Lernens in den Software-Lebenszyklus-Prozessen. Dissertation, Universität Linz, Linz 1998.

[7]   Mittelmann, A.: Quality Improvement through Human-Centered Management of the Software Development Process. In: Proceedings of 6 th European Software Quality Conference, Vienna 1999.

[8]   Mittelmann, A.: Messen von weichen Faktoren – Ein Erfahrungsbericht. In: Lehner, F. et al.(Eds.): Software-Metriken. Gabler Edition Wissenschaft, Wiesbaden 2000, p. 221 - 229.

[9]   Paulk, M. C.; et al.: Capability Maturity Model for Software (Version 1.1). Technical Report, CMU/SEI-93-TR-24. Software Engineering Institute Carnegie Mellon University, Pittsburgh 1993.

[10] Pulford, K.; Kuntzmann-Combelles, A.; Shirlaw, St.: A quantitative approach to Software Management, Addison-Wesley 1996.