ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume X (XX), 2011, NR1

THE FIELDS OF SOFTWARE ENGINEERING AND MEASUREMENT PROCESS

Radoje Cvejić, Sanja Nikolić, Miloš Stević
MEGATREND University, Belgrade, Serbia, drradojecvejic@gmail.com

Abstract: Management of software engineering can be defined as the application of management activities of planning, coordination, measurement, monitoring, control and reporting for the sake of ensuring that the development and maintenance of software is done in a systematic, disciplined and quantifiable way. The field of software engineering management deals with management and evaluation of software engineering.

Key words: management, software engineering, measurement

1. INTRODUCTION

The word management is an English word whose roots come from French-English word *ménage,* which in its original meaning implies being capable (able) to do something, manage something, so it is synonymous with the words administration and leadership [9].

Management – special scientific discipline, of multi-disciplinary character, which deals with examining the problems of managing the tasks, undertakings and social systems. This discipline studies management as a complex process with a series of sub-processes, and as a group of people that manages processes and systems, and also it studies all the individual management problems and phenomena related to the efficient performance of particular tasks and jobs. At this point, many questions can be asked, and those are whether management in general can be seen as scientific discipline, it can also be concluded that such, wrong approach that people in our country have brings management to a direct conflict with affirmed sciences and their disciplines because manager in the world is the position within a company, and not the official title which is the case in our country [9].

Activities oriented on efficient provision, distribution and use of human and material resources in order to achieve the goal set is management's function. The carriers of these activities are the people who are specially trained for performing the functions of management – manager. The term of *management* in Anglo-Saxon terminology implies *managing* the organizational systems in various fields of social activity. In such a form, with specific transcription and pronunciation, this term entered many world languages, including Serbian. The term *management,* in a broader sense, implies *decision-making about the goals* of organizational system, than about the way and means by which such goals can be achieved, as well as about the use of that system's business results. At first, owners of the capital invested into enterprise were carriers of the functions of management and leadership. They have even participated in executive jobs. That was possible in smaller enterprises and in conditions of simple activities. However, with the development of economy and social life in general, it has come to delegation of management and leadership competencies and responsibilities to the professional managers. Management is observed, on one hand, as the skill of managing and leading organizational systems as well as the carriers of that function, and on the other hand, as a theory that studies this phenomenon and contributes to its enhancement. In that sense, management as phenomenon can be observed from three aspects [9]:

- Management skill,
- Management theory and
- Management structure.

Although the function of management is as old as human society, management as a scientific discipline is of recent date. The first author that systematically studied the management field and that has given significant contribution to its development is Frederic Taylor. Taylor used scientific methods and performed specific experiments in managing production facilities. Significant contribution to development of scientific management was given by the following authors: Gant, Emerson, Ford, Gilbret, Berner. We can especially mention the Frenchman Henri Fayol, who studied the problems of managing the enterprise as a whole, and formulated 14 principles of efficient management of the enterprise [9].

Management of software engineering can be defined as the application of management activities of planning, coordination, measurement, monitoring, control and reporting in order to ensure that development and maintenance of software is done in a systemic, disciplined and quantifiable way. The field of software engineering management deals with management and evaluation of software engineering [2, 4, 5, 6, 8, 12].

2. SOFTWARE PRODUCTION MANAGEMENT

Software engineering management can be done in the same way as for any other complex field. There are specificities characteristic for software production management unlike the other disciplines [2, 4, 5, 6, 8, 12].

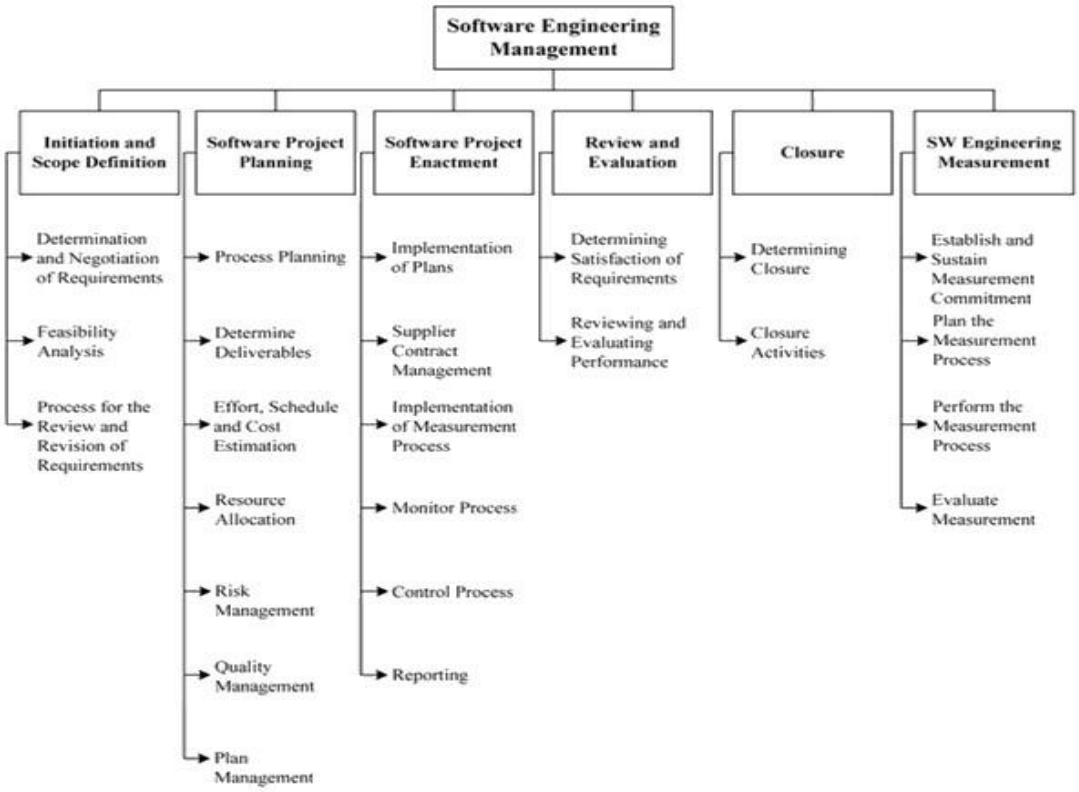

Figure 1. Scheme of software engineering management [2, 4, 5, 6, 8]

Client's perception is such that there is often a lack of understanding for the complexity contained in the process of software engineering, especially in the relation of of the impact of requirements' change. It is inevitable that the very process of software engineering will generate the need for new requirements or the change of existing ones. As a result, software is often not developed iteratively, but as a sequence of closed tasks.

Software engineering incorporates aspects of creativity and discipline, the combination of these activities is rather difficult, especially difficult is to keep the

appropriate balance between these two opposites. The degree of novelty and complexity of software is often extremely high. There is a high degree of changes in development technology as well.

When it comes to software engineering, activities of management occur at three levels: organizational and infrastructural management, project management, planning and control of measurement programmes.

In Figure 1, the scheme of software engineering management according to SWEBOK is presented (The Software Engineering Body of Knowledge) [IEEE 2004] [2, 4, 5, 6, 8, 12].

3. FIELDS OF SOFTWARE ENGINEERING MANAGEMENT

As it can be seen from the Figure, there are six sub-fields that deal with software engineering management [2, 4, 5, 6, 8, 12].

Initiation and scope definition deals with decision on initiating the project of software engineering.

Software project planning deals with the activities taken in order to prepare for successful software engineering from the perspective of management.

Software project enactment deals with generally accepted activities of software engineering management that occur during the process of software engineering.

Review and Evaluation deals with ensuring that the software is satisfactory.

Closure involves the activities of completing the projects of software engineering.

Software engineering measurement deals with effective development and implementation of programmes of measurement and evaluation in the organization of software engineering.

The field of software engineering management involves the process of software project management in the first five sub-fields and measurements of software engineering in the last sub-field. Although these two fields are often observed separately, there are mutual relations that lead them into the sphere of common treatment. Conventional opinion is that software industry delivers products with delay, with breaking the budget, with poor quality... management based on measurements can change these prejudices.

Management process represents the activities that are implemented in order to provide for the process of software engineering to be conducted in such a way that is in compliance with objectives and standards of organization. Measurement and evaluation represents the attribution of values and meaning to the aspects of software engineering (products, processes, resources etc.) and models derived from them.

Focus of this set of activities is in efficient determination of software requirements through various methods of drawing and determining the feasibility of project from various standpoints. Once when the feasibility is determined, a part that remains within this process is specification of the validation of requirements and procedures of change.

Techniques from drawing software requirements (e.g. observation), their analysis, specifications and validity tests (e.g. prototypes) need to be selected and applied, taking into account various perspectives of interested parties. That process further leads up to the determination of the range of project, goals and constraints. That has always been an important activity because it sets visible limits for the set of tasks that are undertaken, and especially where the novelties in undertaking are big. Additional information about this subject are available in the course „Software requirements“ [2, 4, 5, 6, 8, 12].

Software engineers need to be sure that adequate capacities and resources are available in the aspect of experts, objects, infrastructure and support (both internal and external) in order to ensure for the project to be successfully done, in time and within

budget costs. This often requires the assessment of work and costs based on appropriate methods.

Having in mind the inevitability of changes, it is important that the agreement between interested parties is achieved in early phase, which implies the definition of method and range. Thus, the requirements will be reviewed and revised (e.g. through the agreed procedures of change management). That clearly implies that the range and requirements will not be „set in stone“, i.e. that they can and that they should be revised in predefined points of the process that is developing. If the changes are accepted, then we take a form of the analysis of traceability and risk analysis that should be used to determine the impact of changes. The approach to change management should also be useful when it comes to the time for re-examination of project's outcome, just as the scope and requirements should make a basis for the assessment of success. Additional information about this subject are available in the course „Software configuration management“ [2, 4, 5, 6, 8, 12].

4. MEASUREMENT PROCESS

Characterization of organizational units – Organizational units provide a context for measurements, so that it is important for that context to provide explicit and clear assumptions that are based within the context and constraints that are imposed. Characterization can be in the aspect of organizational processes, domains of application, technology and organizational interface [1, 3, 7, 8, 10, 11, 12].

Identification of necessary information – Needs for the information are based on goals, constraints, risks and problems. They can be derived from business, organizational, regulatory and production goals. Information need to be identified as priorities. Then, the selected subset is processed, results are documented and necessary communication and review from the part of interested parties is performed [3].

Selection of measurements – Necessary measurements must be selected, with clear connections towards the information necessary. Measurements further need to be selected based on priorities of necessary information and other criteria, such as costs of collection, degree of disturbance during the collection, simplicity of the analysis, easiness of obtaining accurate results etc. [ISO15939-02: 5.2.3].

Defining the way of collecting the data, analysis and procedures of reporting – It involves a set of procedures and schedules, warehousing, verification, analysis, reports and data for configuration management [ISO15939-02: 5.2.4].

Review, approval and provision of resources for measurement tasks – Measurement plan needs to be reviewed and approved by representatives of interested parties. That includes all the procedures of data collecting, warehousing, analysis and procedures of reporting, criteria of evaluation, schedules and responsibilities. The criteria for review of these artefacts should be established at the level of organizational unit or at the higher level, and they should be used as basis for those reviews. Such criteria should take into account the following experiences, availability of resources, as well as potential problems on the project when it comes to the changes in suggested procedures. [ISO15939-02: 5.2.6.1]. Resources should be available for the implementation of planned and approved measurement tasks. Special attention needs to be paid when attributing the resources for successful implementation of the new procedures or measurements [ISO15939-02: 5.2.6.2].

Obtaining and implementing the accompanying technology – Includes the assessment of availability of the accompanying technology, selection of the most

appropriate technologies, procurement of those technologies and its implementation [ISO 15939-02: 5.2.7].

Integration of measurement procedures with relevant processes – Measurement procedures, such as data collection, need to be integrated into the processes that are measured and assessed. This can also include the change of the current process in order to adapt to these activities. Moral issues and other issues of human resources also need to be considered for the successful implementation of measurement procedures. The support and training also need to be provided. Data analysis and reporting procedures need to be integrated into organizational processes.

Data collection – All data need to be collected, verified and properly stored [3].

Data analysis – The data need to be consolidated or rearranged as a result of the process of analysis, using a particular degree of rigidity that corresponds to the character of the processed data and necessary information. Results of the analysis are presented to all interested participants, usually through graph, numbers or in some other way that is selected for presenting the data that are the subject of processing. Results and conclusions need to be reviewed, using the processes established in organization. Participants in measurement process need to take part in review and analysis of data in order to ensure their meaning and accuracy. Based on the analysis, logical actions are undertaken. [3]

Evaluation of measurement process – Measurement process should be evaluated and the measurement processes should be measured according to the specific evaluation criteria. In addition, process measurement determines both good and bad sides of the process. This is can be derived by internal processes or external revisions and it should include the feedback from the personnel on measurements. According to the standard ISO/IEC 15939 [3], the recording of experiences in appropriate database is recommended.

Identification of potential improvements – Such improvements can be the changes in form of indicators, changes in measurement units or reclassifications of the categories of measurement. It is necessary to determine the costs and advantages of potential improvements and select the appropriate actions of improvement. It is recommendable to discuss about suggested improvements in measurement process within the circle of all interested parties for the sake of review and acceptance and discuss about the lack of potential improvements, if the analysis fails to identify the improvements [1, 3, 7, 8, 10, 11, 12].

5. CONCLUSION

Software engineers need to be sure that adequate capacities and resources are available in the aspect of experts, objects, infrastructure and support (both internal and external) in order to ensure for the project to be successfully done, in time and within budget costs. This often requires the assessment of work and costs based on appropriate methods.

Having in mind the inevitability of changes, it is important that the agreement between interested parties is achieved in early phase, which implies the definition of method and range. Thus, the requirements will be reviewed and revised (e.g. through the agreed procedures of change management). That clearly implies that the range and requirements will not be „set in stone“, i.e. that they can and that they should be revised in predefined points of the process that is developing. If the changes are accepted, then we take a form of the analysis of traceability and risk analysis that should be used to determine the impact of changes. The approach to change management should also be useful when it comes to the time for re-examination of project's outcome, just as the scope

and requirements should make a basis for the assessment of success. Additional information about this subject are available in the course „Software configuration management“ [2, 4, 5, 6, 8, 12].

References

[1] D.J. Reifer, ed., Software Management, IEEE Computer Society Press, 2002.
[2] IEEE Computer Society, Software Engineering Coordinating Committee, Guide to the Software Engineering Body of Knowledge, 2004.
[3] ISO/IEC 15939:2002, Software Engineering “Software Measurement Process”, ISO and IEC, 2002.
[4] M. Dorfman and R.H. Thayer, Software Engineering, IEEE Computer Society Press, 2002.
[5] M. Dorfman and R.H. Thayer, eds., Software Engineering, IEEE Computer Society Press, 2002.
[6] N.E. Fenton and S.L. Pfleeger, Software Metrics: A Rigorous & Practical Approach, second ed., International Thomson Computer Press, 1998.
[7] S.L. Pfleeger, Software Engineering: Theory and Practice, second ed., Prentice Hall, 2001.
[8] Sommerville, Software Engineering, seventh ed., Addison-Wesley, 2005.
[9] http://sr.wikipedia.org/sr/
[10] R.S. Pressman, Software Engineering: A Practitioner's Approach, sixth ed., McGraw-Hill, 2004.
[11] R.H. Thayer, ed., Software Engineering Project Management, IEEE Computer Society Press, 1997.
[12] Radić G.: Menadžment softverskog inženjerstva.