# Change Management Maturity Model

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***Abstract*— Since computer systems exist, a lot of implementation projects fails. The Implementation of computer systems causes changes in processes of work and behavior of people. Change Management is one of the most important success factors, when implementing software systems in organizations. Because it is the key to successfully transform business processes. The ability to change varies between the different organizations. This ability depends on different critical success factors. To evaluate the ability to change of an organization, a maturity model is introduced. Therefore, the critical success factors of change are presented. With this critical success factors as key process areas, the development of the change management maturity model starts. In a five stage maturity model, the shape of each key process area is defined. The model is evaluated by experts for maturity models and experts for change management. The result is a maturity model to assess the ability to change of an organization.**

***Keywords*— change management, computer systems, critical success factors, design science, maturity model.**

## I. Introduction

In 1968 the first software engineering conference was held in Garmisch-Partenkirchen. The "software crises" was discussed, because large number of software projects fail [32]. From this starting Point "the trend in successful project delivery seems to be slowly improving from a historical low point of 29% in 2004 to a more recent figure of 39% [37], well over half of IS projects are not delivered successfully" [17]. Today, the Standish Group [37] assumes that 66 % of software projects fail [37]. Why is that so? To answer this question, numerous papers describes success factors for implementing software systems. One of the factors is Change Management. In his paper, Kotter [23] describes, that change management is the key to successfully transform business processes.

The introduction of a new software system is nothing else than a transformation of a business process. The transformation is sometimes successful, sometimes not. Therefore, the success factors of change management were investigated. The results of this investigation are recorded in [28]. To evaluate the ability to transform of an organization, a maturity model was developed. In the next section, a method to develop a maturity model is presented. Afterwards, the critical success factors of change management are introduced. In the main the section the model development process is described, and the model is described.

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## II. Change Management

The goal of change management in IT-projects is to document, plan, and implement all changes [22]. The holistic and systematic planning, initiating, realizing, reflecting and stabilizing of change processes is the purpose of change management. There are two types of change: transitional and transformational. Transitional change is the crossover from an unsatisfying initial state into a jointly supported final state. Supporting individuals in their own learning process is called transformational change. Both kinds of change are addressed by change management because the implementation of IT-systems needs usually the change of business processes and a change in employee behavior. With change management a better culture and an appreciatively together should be reached [22]. Change management is a continuous improvement process leading to an agile and learning organization [22]. The most popular model of change management is the action research 3-phase-model from Kurt Lewin [10, 22, 23, 24, 20, 39]. Lewis Model defines a process with three phases. First the organization must be "unfreeze". That means established hierarchies and processes are questioned. The next phase is "moving". This phase is the real transformation. Last phase is "freezing". In this phase new processes and a new organization structure is settled. In his bestseller "Leading Change" Kotter [23] transforms Lewis Model in an abstract universal plan for change management [22]. Kotter's Plan consists of eight steps. First step is establishing a sense of urgency. Therefor the market and the existing competitive is examined. Crisis, potential crises, and major opportunities be considered. The next step is the forming of a powerful coalition by assembling a group with enough power to lead the change and encourage is team. Third step is the creation of a vision and strategies to implement this vision. Afterwards the communication of the vision is the next step. The following step is to empower others to act on the vision. Planning and creating short-term wins follows. The seventh step is consolidation improvements and producing more change. The last step is institutionalizing the new approach.

## III. Maturity Models

Maturity models are stage models which describes an evolution path. They can be used for comparing and/or for continuous development. They arise from quality management and offer benchmarking and performance improvement [14]. The most prominent maturity model is the CMM or rather CMMI from Software Engineering Institute (SEI) of the Carnegie Mellon University. With this model maturity models getting popular and variety of models for a lot of issues are developed.

Becker et al. [8] developed a method to develop maturity models. They use a design science approach to develop this method. First, they derive eight requirements from Hefner's Guidelines for Design Science for the development of maturity models:

1. Comparing with other maturity models to justify the development of a new maturity model,
2. Iterative approach,
3. Evaluation of usefulness, quality and effectivity of the new maturity model,
4. Multimethod approach,
5. Relevance of the problem,
6. Definition of the issue,
7. Presentation of the results appropriate to the addressee,
8. Scientific documentation.

Becker et al. [8] start with the definition and relevance of the issue (requirements 5 and 6). This can be done with a literature review. With this literature review also the comparison with other maturity models can be done. Is there no such model, that solves the issue, the need to develop a model exists. Otherwise, the existing model is to be checked whether it solves the issue or should be modified. Is there no model or is it necessary to modify an existing model, then developing of the development strategy starts. The development process of the maturity model or model modification is a Demming-Circle which is to be run through

Iteratively. The steps in the circle are: choice of the design level, choice of the approach, model design, and test. This circle is being run from the architecture of the model over a variety of (part-)model on different levels of abstraction until the model is created. With the documentation of the different approaches and on the different design levels and with the test the requirements 2, 3 and 4 are fulfilled. After the iterative development of the model, the transfer and evaluation of the model follow to accomplish the requirements 3 and 7. Becker et al. [8] envisage the continuous development of the model until its retiring.

## IV. Development of the Change Management Maturity Model

According to the method of Becker et al. [8] a literature review was done. The literature reviews follows the method of Kitchenham and Charters [21]. Two literature reviews were done. One literature review on the success factors of change management. This literature review is documented in [28). This review shows the relevance of the problem. The second literature review asks about change management maturity models. With this two literature reviews, the requirement 1 (comparing with other models) is fulfilled.

### *A. Problem definition and relevance*

The Standish Group [37] assumes that 66 % of software projects fail [37]. One of the main critical success factors for the success or flop of a software implementation is change management [22]. Thus the ability of an organization to change is relevant and to estimate the prospect of success of a project. The change management maturity of the organization is therefore important. With this the requirements 5 and 6 are done.

### *B. Literature review on critical success factors of change management in software projects*

Lübbecke [28] found with a literature review 22 critical success factors for change management in software projects. These factors are: stakeholder involvement, culture, communication, training, top management support, team work, leadership, vision, testing, technical infrastructure, champions, resource availability, audit, incentive system, team efficiency, feedback, cross-departmental cooperation, project management, partnership, knowledge management, process reengineering, and the organization structure. The literature review is documented in [28].

### *C. Literature review on change management maturity models*

The systematical literature review starts with identification of reasons and goals. In this case, it is to find a maturity model for change management. After this, protocol and evaluation of the literature review are designed. According to Kitchenham and Charters [21] the databases IEEExplore, IET Digital Library, Google Scholar, Citeseer library, Inspec, and ScienceDirect were searched. Search String was „change management maturity model". The result was: 849,000 hits at Google Scholar, 153 hits at IEEExplore, 1.477.998 hits at Citeseer Library, 238 hits at ScienceDirect, 48,152 hits in Inspec, and 1695 hits in IET Digital Library.

The hits were sorted by relevance, and the first 100 hits per database were analyzed by headlines and abstracts. 105 papers describes a maturity model.

No paper describes a maturity model for change management. Next Step is the development of the model in a iterative, multimethod approach.

### *D. Iterative, multimethod approach*

Because there is no model, the development strategy is designed. The development is a Demming-Circle with the steps choice of the design level, choice of the approach, model design, and test. From model architecture over a variety of (part-) models on different abstraction layers, the circle is run through until the model is ready. It is an iterative process, the documentation of the diverse abstraction layer, approaches and tests to fulfil requirements 2, 3, and 4.

After the model development, it is necessary to design concepts for transfer and the evaluation of the model. These concepts include a description of how to realize requirements

7 and 8. Afterwards, implementation of the model transfer and the evaluation of the model takes place.

*1) First iteration*

Lübbecke [28] found with a literature review 22 critical success factors for change management in software projects. These factors are: stakeholder involvement, culture, communication, training, top management support, team work, leadership, vision, testing, technical infrastructure, champions, resource availability, audit, incentive system, team efficiency, feedback, cross-departmental cooperation, project management, partnership, knowledge management, process re-engineering, and the organization structure. The literature review is documented in [28].

The success factor were defined as key process areas of the maturity model. With this the first layer is modelled.

*2) Second iteration*

For each key process area, a definition was given in the form of a description. Therefore, a literature search for each success factor was done. On the result of this search, a descriptive definition for each key process area was created. So the second layer of the model is created.

*3) Third iteration*

With literature reviews, maturity models for each key process area were searched. The different models for each key process area were compared and combined. The third layer is ready.

*4) Forth iteration*

The different maturity models were integrated and consolidated into one maturity model with five stages. This is the first version of the complete model.

## V. Evaluation of the Model

To classify the different evaluation possibilities, Helgesson et al. [16] introduced the following framework. It consists of three evaluation types. First, evaluation by the author on basis of his expertise. Second, evaluation by practitioners with surveys, interviews or assessments. Third, evaluation by practice. The three types of evaluation suggest a chronically order of evaluations. Beginning with the evaluation of the model by model experts, normally the author, then by domain experts, usually practitioners, and at least by use in practice.

Regard to the here presented model, the first step of the evaluation was done by the author in form of proofreading.

For the second evaluation step, Salah and Cairns [34] developed a questionnaire. This questionnaire was translated into German and send to experts for change management. 7 experts responded. The answers and remarks were analyzed and in the model integrated respectively the model was changed.

When reworking the model the criterion champion is integrated in leadership, team work and team efficiency are conflated just as stakeholder involvement and partnership. So there was a reduction from 22 success factors to 19 key process areas.

## VI. The Model

The model is a five stage model with 19 key process areas. The stages are:

1. initial, no requirements,
2. managed, projects are planned and documented,
3. defined, there is a standard process,
4. quantitatively managed, there is a controlled standard process, and
5. optimized, there is a continuous improvement process.

The key process areas are stakeholder involvement, culture, communication, training, top management support, team, leadership, vision, test, technical infrastructure, resource availability, audit, incentive system, feedback, cross-departmental cooperation, project management, knowledge management, process reengineering, and the organization structure.

Stakeholder of a project are shareholder, owner, management, clients, customer, supplier, and employees. Management of expectations, understanding of stakeholder requirements, fostering the system understanding of the stakeholder, increasing system acceptance, overcoming resistances, and preparation of change are the topics of stakeholder involvement [6, 29].

Culture is a set of ideas, assumptions, beliefs, standards, principles, behaviours, and values like responsibility, customer orientation, willingness to change, teamwork and nature of decision-making [2, 3, 7, 9, 11, 12, Müller et. al., 2009, Urban, 2015).

Generation, dissemination, configuration, transfer of information and the interaction in a social environment are the topics of communication [13, 24].

Training is precondition to adopt new modes of work and behaviour.

Top management support is an important factor for changes, it helps to overcome resistance, provides technical, financial and human resources, takes leadership, has strategies, serves as role model, makes decisions and has the responsibility, represents the changes, is member of the steering board, gives incentives and rewards, is part of assessments and workshops [6, 36, 38, 41, 42, 44, 45].

The team needs the right skills and qualifications in sufficient extent qualitative and quantitative. The team members must be able to work together.

To reach new behaviour and business processes leadership is necessary.

A goals defining vision is the starting point for every change project [7, 26, 41, 42].

The development process, testing and troubleshooting are the way to successful information system implementation [6, 42].

A sufficient technical infrastructure is the key basic for the operation of an information system.

For the success of every project sufficient resources are necessary [5].

To control the project progress and the quality of created artefacts, audits takes place [18, 30, 40, 43].

Behaviour changes and the collaboration in and with change projects can by motivated by incentives [13, 19].

Self-efficacy and self-control will be increased by feedback, also system and/or process design can be improved by feedback [1, 43].

To implement new behaviour and processes cross-departmental cooperation is inevitable [42].

Project Management is the application of knowledge, skills, tools, and techniques to project activities to meet the project requirements [27].

Every organization has internal and external partners who are involved or affected by the change project.

Knowledge management is the set of all activities to collect, organize, manage, distil, present, share, use, and store knowledge [15].

Process improvement is the issue of business process re-engineering [31].

The organisation structure is described by its hierarchy and procedures [33].

### *A. Maturity level 1*

On this level there is no stakeholder involvement in change projects. Partnerships are fix, there is no cooperation with regard to the intended change.

A welcoming culture did not exist in the organization. There is no induction concept for new employees.

Employees are not encouraged to produce innovations and ideas, therefore they did not communicate their ideas. There is only poor communication between Employees and between departments. A communication culture did not exist. Communication is informal, there is no formal reporting or status meetings. The content of change projects is not communicated.

The knowledge in the organization about change is not sufficient to design an appropriate training plan. The top management support is missing. Team work did not happen. The success depends on individuals. Work is function oriented. Work in teams is not supported by the management. There is command but no leadership. The link between management vision and intended change is not discernible.

Test is chaotic and takes place with debugging. Test cases design is ad hoc. The result is software without big bugs. The organization has no effective control on its infrastructure. The processes are not managed. Standards, guidelines and procedures are missing. Resources are not planned, a systematic overview on the availability of resources is missing. Audits are unknown. There is no incentive system.

Decision-making in the organization is informal, individual and weak defined. It is based on personal, tacit experiences and individual appraisal. Decisions are not documented. There is no feedback on the efficiency of a decision.

Cooperation ends at the frontier of the own department.

There is no defined project management process. Project processes are not documented. Documentation standards did not exist.

Knowledge management practical did not exist. It is not defined. A concept is not available in the organization. Processes of knowledge management are operated unconscious, unsystematic, and aimless.

Processes are not structured and bad defined. Process measurement did not exist and workplace and organization structure are based on traditional functions, and not on horizontal processes.

Local and functional layers are autonomous. There are no organization wide standards, governance, and formal ratings.

Goals are not named. Therefore, the goal achievement is not rated. There is no governance. Processes are unknown, not documented, not measured and not controlled. A conscious examination with the organization structure and the used technology did not happen.

### *B. Maturity level 2*

At maturity level 2 activities are planned, controlled, and documented. To enhance the involvement of the employees, information about changes and the progress of the project is given to them. Only internal Partnerships are on the focus, there is still no involvement of external partners. The organization encourages ideas and innovation and takes initiative to experiment with new concepts. Employees feel involved in decision processes. The organization recognize employees as valuable resources and their doing as important for successes. There is a communication protocol. Employees are informed about changes and the progress of the change project. Informal reports exist and reviews are implemented. Information systems occur. Training is offered. Employees are able to discuss knowledge and experiences with each other. The top management take notice of the change and received reports on the project.

Teamwork is focused, it takes place occasionally, and it is atypical. Each team has its own, individual management and controlling approach.

The top management knows the necessity of a performance improvement. One member of the top management supports the operational changes and provides resources. The implementation is done by the middle management. The change is part of the vision of the top management. The organization has an IT strategy that implement the operational requirements of the organization.

Test is an independent process that takes place after implementation. Introduction of test plans and test strategies starts. Stakeholders take part. Risk management techniques are used to identify product risks. The organization controlled their key infrastructure. For fundamentals, guidelines exist. There are enough resources available. A poor audit trace exists and can by noticed.

An incentive system is defined. Decision-making is informal. Experiences and opinions that lead to the decision are documented. There is no feedback on the efficiency of decisions.

Cooperation between departments is like „corresponding silos“. It happens in a clearly-outlined on few organizational interfaces.

Project management is weakly used, the process and the documentation are informal. Positive decisions on projects to implement knowledge management exist. Knowledge artifacts are identified. First structures are implemented. The essential

processes are identified and documented. Work places and organization structures include process elements. Representatives of functions meet regularly for coordination. First organization wide standards or governance exist, but no formal measurement system. Goals are defined, but not measured. The necessity of governance is known. Processes are named and assessments run. There is an open discussion on. The implementation of change management and leadership runs. The used technology is identified.

### C. *Maturity level 3*

This maturity level is the level where processes starts. At maturity level 2 the activities are planned, controlled, and documented, now the activities are defined and standardized. Though processes oriented change management starts.

The staff is involved in change projects. Internal partnership are established, customer and/or supplier are involved if necessary. The staff understand the vision, goals and values, and agree to them. Employees decide how to do tasks. Information about change, its strategical alignment, and the plans about implementation are known beyond department boundaries. All involved and affected people know the scope of the change. For documentation, structured data formats are used. Analyses, reviews and assessments occur regular. Necessary trainings are offered. Employees are able to participate by problem-solving and idea generation activities. Information from external resources are available for all. Formal and informal, internal and external discussion forums are open to all. Employees are encouraged to experiment with their knowledge.

The top management is present in the project. Interdisciplinary teams work on change projects. Norms and standards, expert knowledge and tools are used. There are informal project management trainings. Customer and suppliers are involved. A member of the top management took over the role of the leader, declares goals and took responsibility for the program. The change strategy is aligned with die business and IT strategy and documented.

Test is integrated in the development process. Test planning takes place in early phases. There is a standard test process, a test organization unit, trainings on tests are provided, and a formal review program exists. There is a standard infrastructure with SLA's and a proactive problem management. Human and financial resources are available. Audits are documented. An incentive system is established. Decision-making is formalized and accepted in the organization. Basics and results are transparent. There is no feedback on the efficiency of the decision. In phases, cross-departmental cooperation respectively assistance takes place.

The project management process with controlling, formal planning, and data collection is performed consistently. Knowledge and experiences are identified. The organization structure with roles and responsibilities for knowledge management are defined. Standards, policies, tools and methods are documented. A training program is provided. The business process is the basic of the organization. Work places are aligned to processes. Process metrics measure the performance. Process management is used to reach strategy goals. Goals are defined, communicated and measured. Work flows are designed. Risk management is established. Change management and leadership is practiced. The used technology is designed.

### D. *Maturity level 4*

When at maturity level 3 processes where implemented, the measurement of this processes is the main topic at level 4. The goal of this maturity level is to manage the change process quantitatively.

Forums and teams for exchange are established. Long-time partnerships with customer and suppliers are arranged. The management promote changes. The staff understands changes, wage it positive, and supports it. Interdisciplinary teams pass, share, and keeps knowledge. Open, cross-departmental communications takes place. The whole staff has all necessary information. Communication protocols for communication with external partners exist. Communication technique and communication process are implemented. Formal and informal mechanism of learning and knowledge transfer are used. The organization learns from its experiences and prevent the repetition of failures. Innovation is aligned to the goals of the organization. The top management is active, engaged in changes. Teamwork is mandatory. The top management works as a team, it controls the organization by processes, has a vision and delegates the controlling to the process owners. More and more others in the organization take over the role of leaders. The realization of the vision is measured by processes.

There is a technical and personnel infrastructure. The test process include inspections in the development process. The test is continuously evaluated by a measurement program. Infrastructure and their processes are optimized. Continuous service advancement take place, SLAs are flexible. Technical, human and financial resources are provided. The audit process is controlled and on improvement analyzed.

The incentive system is operated. Decision-making is formalized and accepted in the organization. Basics, process and results are transparent. There is no feedback on the efficiency of decisions. There is cross-departmental cooperation in projects. The project management process is mature. The project management process is measured and quantitative analyzed. The results of measurement and analyses are the basis for process improvement. Build, share, and use of knowledge is organizational integrated and quantitative evaluated. Employees expect to be successful when searching for knowledge artifacts. Documentation of knowledge management tools is available. Organization, customer, and supplier cooperate on basic of processes. Processes are the basic of organization structure and work places. Process measurement and management systems are implemented in the organization. The measurement of goal attainment ensued continuously by metrics. Work flows are implemented and accepted. Change management is used strategically

### E. *Maturity level 5*

Now the change process is defined and measured. The results of the enduring measurement are basic for continuously improvement of the change process.

There is a complete, and optimized supply-chain. A conflict resolution plan is established. All members of the organization value quality, service and reliability. Innovation are supported. Communication is in free flow and accurate recognized. There is a system to optimize communication. Research and development are continuous processes in the organization. The organization learns. The Top Management is active engaged in and for the project. Teamwork with customers and suppliers is mandatory. People out of the whole organization took over leadership and get qualification therefore. Strategical planning and policies are regularly updated and consider information to performance, customer, supplier, and other facilities that interrelate with the organization. Benchmarks are operated.

The test process is optimized. It is quantitative measured and is continuously improved. The infrastructure is robust and agile. It is a catalyst for innovation. The resource provision is demand-driven. The audit process is optimized.

The incentive system is optimized. Decision-making is formalized and accepted in the organization. Basics, processes and results are transparent. Feedback on the efficiency of decisions exists and is documented. It is the basis for future decisions. Cross-departmental cooperation is mandatory. The project management organization is mature, complete understood, and continuously optimized. Project management is integrated into the management. The organization uses its extensive knowledge to optimize continuously processes. The process integration inclusive partners is completed. Continuous adaptation to market requirements takes place. Goals are continuously evolved, the vision is constantly aligned. Results are evaluated and processes evolved.

## VII. Conclusion

With a design science approach, a maturity model was designed and evaluated. The evaluation was carried out by change management experts. This model consists of 22 key process areas. The model measured the maturity of organizations to change, when implementing software system. With the results the organization have the possibilities to change in factors relevant for changes to have a greater likelihood to be successful in information system implementation.

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