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The Idea Maturity Model — A Dynamic Approach to Evaluate Idea Maturity

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In idea creation and assessment processes, the accruement and the description of an idea are mostly allocated to a fixed point in time, defined as the end of the generating process and the start of the idea assessment. This static approach does not fit the reality in industrial idea processes. A dynamic approach for idea assessment is therefore introduced. An idea is not seen as a static but as a dynamic state, characterized by different degrees of maturity. Maturity is understood as a measure of the assessability of the individual evaluation characteristics.

Based on Crosby's maturity model and classical capability maturity models, a new idea maturity model (IMM) has been developed and is introduced for the first time. The five idea maturity levels (IML) are named Initial, Awareness, Appraisability, Valuation and Realizability and harmonize well with other maturity models. The levels are described by general characteristics, although the development of the maturity model focussed on new product or service development. The compatibility of the IMM with idea assessment processes and conditions in organizations and companies has been checked.

Keywords: Idea definition; idea assessment; idea management; maturity model; maturity level; new product development.

1. Introduction

Innovations are generated through ideas. Ideas are needed to find problem solutions for both innovations based on market pull or technology push. Ideas are often described as incident, thoughts and imagination of human beings entering a new realm of thought while approaching a problem solution [Heyde *et al.*, (1991, p. 167)].

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The success probability of an innovation process increases with the number of new product ideas. Numerous tools and methods have been developed to generate new ideas both from existing sources and from creativity. The decision to pursue an idea or not is mostly made on the basis of an idea assessment. Several characteristics are evaluated, such as economic potential, technology and product features, sales and market characteristics and others [Vahs and Brem (2015, p. 323)]. These characteristics are mostly evaluated separately in well-defined processes, both qualitatively and quantitatively.

The accruement and the description of an idea are mostly allocated to a fixed point in time, defined as the end of the generating process and the start of the idea assessment. Usually, the idea has to be described in detail at this point considering all characteristics of the idea assessment process. Most companies employ idea management systems based on this, organizing idea submission processes with various format templates and idea evaluation sheets. The approach is always that the idea is already appraisable at that moment. This approach is wrong. In reality, these ideas are often vague; they are only suggestions [Gerlach and Brem (2017, p. 145)]. The information basis required for a suitable idea evaluation is not complete. The maturity of the idea is too low to evaluate. Decision on an immature idea with regard to pursuing the idea or not may lead to a very inefficient process. On the one hand, realization of an immature idea may lead to a waste of resources since the important information bases are not available; on the other hand, an unknown and invaluable innovation potential might be lost if the immature idea is rejected in an early stage.

This blurring complicated the assessment of ideas; a rating is often not possible as recognizable in the daily work of organizations and companies. A distinct and explicable decision to follow this idea or not requires a specified idea maturity. In this paper, we present an idea maturity model based on basic maturity models from the literature and fed back to the practical experiences from industrial idea assessment processes. Processes and tools for increasing the idea maturity in the idea generation and assessment process of organizations and companies have to be developed separately.

2. From Static Maturity Description to a Dynamical Approach

A new approach is to break this static understanding of the idea maturity in favor of a dynamic description. An idea is not seen as a static state, but as a dynamic state, characterized by different degrees of maturity. Maturity is understood as a measure of the assessability of the individual evaluation characteristics.

This approach harmonizes generally with Eversheim [2009, p. 66]. He differentiates two orders of ideas. The aim of the idea generation process is to find product ideas of the first order which are very general. First order product ideas are seen as either market-related problems or technological solution ideas. Eversheim assumes identified problems are idea sources; therefore, problem ideas might be product-, material-, or production technology-related. If a problem idea can be coupled with at least one possible solution idea, this is then regarded as an idea of the second order,

which might be described systematically and consistently in relation to the information required for the further planning and rating of the ideas [Eversheim (2009, p. 66)].

Nevertheless, Eversheim's second order idea also focusses on a fixed point in time from which on the idea should be mature enough to be assessable. The experience from industrial innovation processes leads to an understanding that more than two statuses exist, maybe even a continuum.

Eversheim's distinguished the ideas into first and second order ideas. Hence he describes the idea status. From a comprehensive literature review of Gerlach and Brem [2017], we learned that idea management can be segmented into six main phases including preparation, idea generation, improvement, evaluation, implementation and deployment. This idea management approach is characterized by various processes. For each phase, numerous tools and methods can be found in the literature [Gerlach and Brem (2017); Brem and Voigt (2009)] describing how to reach a desired state at the end of the phase.

It is necessary to distinguish between the *status* of an idea, which is given by the characteristics of the idea at a defined level, and the *process*, which describes how to reach a defined status. This paper focuses on the characterization of different idea statuses in a dynamical idea approach and how to characterize them. The questions are whether the status of an idea can be characterized by a measurable maturity level and how these levels are structured.

The question is mooted whether maturity models that are used in software developing and quality management processes are applicable for describing and structuring the maturity process of ideas.

3. Characteristics of Maturity Models

3.1. *Competence and maturity models*

Crosby [1979] introduced a maturity grid to measure the stage of quality management processes by assessing the maturity of six measurement categories. He defined five stages of maturity:

(I) Uncertainty
(II) Awakening
(III) Enlightenment
(IV) Wisdom
(V) Certainty

A few years later, the capability maturity model (CMM) laid the foundation for most modern maturity models. The CMM has been developed to assist software companies in the selection of process improvement strategies. It determines the current process maturity and assigns it to one of five different maturity levels. It also identifies the most critical factors affecting the software quality and process improvements [Ahlemann *et al.* (2005)].

Kerzner [2001] describes his maturity model as a five-level analysis instrument, which is used to measure the degree of maturity of an organization. However, it is not limited to optimizing the development and maintenance processes of software products, but generally refers to project management activities or processes.

As a synonym for the concept of a maturity model, the notion "competence model" is often used. Motzel [2004] generally describes them as "models and procedures for the assessment of individual, organizational and social competence".

While a number of maturity models exist in project management and software development, only a few are used to assess the innovation process. These few models are usually focused only on a part of the innovation management [Wendler (2012)]. An overview of actual scientific maturity models in innovation management is given by Kahn [2016, p. 26].

Müller-Prothmann and Stein [2011] introduced a maturity model for Integrated Innovation Processes based on the requirements engineering integrated innovation process (REI^{2}P). Nevertheless, the early phase of the innovation process is only described as one phase, the idea generation phase. The maturity refers the whole innovation process from ideation to product launch.

Maturity models have also been defined in the social media world. Boughzala *et al.* [2014] introduced a maturity model for the assessment of ideation in crowdsourcing projects (CIMAM). The CIMAM explores the maturity of a given crowdsourcing project from various different perspectives.

Although a lot of research has been carried out on the ideation process, no idea maturity model (IMM) has been introduced describing the maturity on a defined scale from a vague assumption to a realizable suggestion.

3.2. *The characteristics of maturity levels*

The basic idea behind a maturity model is the description of key processes or key skills based by means of maturity stages. The ranking is determined by quantitative maturity levels, which are usually based on three to six levels [Fraser *et al.* (2002)]. Based on the originally defined five stages of Crosby's maturity grid, the (CMM)

Table 1. Basic structure of CMM based maturity models and characteristics of the maturity levels [Ahlemann *et al.* (2005, p. 29); CMMI Product Team (2002, p. 11)].

Maturity level		Process characteristics
1	Initial	Processes are usually *ad hoc* and chaotic. Success depends on the competence and heroics of the people in the organization; they frequently exceed the budget and schedule of their projects.
2	Managed	Processes are planned, executed, checked and controlled.
3	Defined	Processes are well characterized, are understood and described in standards, tools and methods; processes are planned and implemented more proactively and in more detail than at the 2nd level.
4	Quantitatively managed	Quantitative targets for quality control and process execution are established, process execution is predictable.
5	Optimizing	Continuous process improvement is achieved due to technological innovations and the identification and elimination of general process disturbances.

introduced five process maturity levels, designated by Nos. 1–5 [CMMI Product Team (2002)].

These maturity levels consist of a predefined set of process areas (see Table 1). They are measured by the achievement of the specific and generic goals that apply to each predefined set of process areas [CMMI Product Team (2002, p. 11)].

The maturity range is therefore spanned by a minimum status in which the process is running crudely and an almost perfect maximum status where nearly no improvement is possible. The levels in between are characterized by the number and the quality of elements which are steering and controlling the process.

The dynamic approach concludes that the quality of idea descriptions also have different states, therefore they must have a minimum and a maximum status. They spread from a blurred suggestion to a fact-based solution suggestion. To adapt the maturity models to idea assessment and development, one has to define the minimum and maximum status and the measures for the different maturity levels.

4. Maturity Model for the Idea Process

4.1. *Development of maturity models*

While maturity models are high in number and broad in application, there is limited literature on how to develop a maturity model. de Bruin *et al.* [2005] worked out a model development framework containing six phases:

Scope — Design — Populate — Test — Deploy — Maintain

Other development approaches are described by Becker *et al.* [2009] and Kahn [2016], but they are similar due to the fact most of the maturity models are based on the two basic models of Crosby's maturity grid and the CMM.

For developing the IMM we followed the approach of de Bruin in general and compared the requirements and the maturity levels with the original maturity grid and the CMM.

4.2. *Method of developing the IMM*

The scope of the model includes the focus of the model and the addressed stakeholders. Focus refers to which domain the maturity model would be targeted for and applied to [de Bruin *et al.* (2005)]. Most of the general maturity models focus on software development, total quality management or innovation management, as referred to before. The approach of the IMM is to understand an idea as a process from very low maturity to a sufficient decision status while the maturity model is to measure the levels of maturity. In organizations, like industrial companies, the stakeholders are people responsible for the innovation process, the innovation management and the product development and implementation.

The second phase of the proposed framework is to determine a design or architecture for the model. de Bruin *et al.* [2005] focus strongly on maturity stages of business process management (BPM) and knowledge management capability assessment (KMCA) models. Because no dedicated IMM has been developed yet,

we started based on the original maturity grid and the CMM. We analyzed their description of the state of the process at a specific maturity level by identifying the core meaning and transferred it to a possible idea status. In the third step, the populate phase of de Bruin *et al.*, we will define the measure by identifying the main fields of information required to make an idea appraisable and by presenting a method to assess the market potential and the technological feasibility. This phase is followed by a practical test of the model in an international technology company.

4.3. *Minimum and maximum maturity status*

To compare the maturity levels with those of the maturity grid and the CMM, a five segment scale is chosen. The minimum and maximum is defined as follows.

From Ahlemann *et al.* [2005] and CMMI Product Team [2002] (see also Table 1) we learned that in the minimum status (Level 1), processes are running crudely. So a minimum amount of input must exist to start running the process. If it does not start, the level is Zero. In CMM this level is called "Initial" where nothing is really organized (see Table 1). Crosby [1979] characterized the first level by "Uncertainty". No comprehension of quality as a management tool exists, the definitions are inadequate, and unsolved problems are all around. But in both models the process runs regardless of these problems. Transferring to a description of the minimum status in the IMM we find:

Minimum level: Vague assumption about the idea and about possible application or technical solution exists. The information basis is really poor and no clear development path is recognizable.

Anyhow, some rough information of at least one idea characterizing field must be available to start developing the idea.

The maximum level is defined as an almost perfect maximum status where nearly no improvement is possible. Processes are running immaculately and everyone involved knows why and how [Crosby (1979)]. Transferred to the maturity of an idea, the maximum status is when one is able to make a distinct and repeatable decision about whether a realization project could be launched or not. All necessary information for a comprehensive evaluation is available and the management can make a distinct and explicable decision to follow this idea or not.

Maximum level: All information needed for the implementation of the idea is available, including business-related values like market potential, technology attractiveness, expected benefits, strategy compatibility, resource availability, financial affordability; the management can make a distinct and repeatable realization decision; the decision is also comprehensible for other stakeholders

5. The Idea Maturity Scale

5.1. *Appraisable idea*

Thus the extremities of the maturity scale are identified. The scale definition is based on two conditions. First, the maturity scale should consist of five different levels to

be comparable to the original maturity model systems. Therefore, the minimum status represents Level 1, the maximum Level 5, thus three intermediate levels exist.

The second condition refers to the two different methods on how to assess whether an idea is practical. Starting with a rough description of the idea, you first need to qualify the idea by filling up missing information to get an "appraisable idea".

But when is a product or a service idea appraisable from a commercial view? At the end of the idea assessment process one has to make a product development decision, or at least an implementation decision, which means to invest money. This decision is normally derived from an expectation of the market potential and the expenditure of the technical realization of the product. To decide in an earlier phase of the idea assessment process, whether to follow an idea or not, one must know something about the *possible application*(*s*) and the *technical solution approach* (Fig. 1). To derive the market potential, concrete applications are the decisive indication. A potential applicant in the market will only take a decision to buy the product or service if it generates a benefit. To make a market implementation decision, it is not sufficient to name only a performance field.

An *appraisable idea* regarding an economic implementation is therefore given by at least one concrete application and a technological-functional solution approach. A technical invention without a concrete application cannot be valuated due to missing commercial potential, neither a proposal for a new application nor a new market segment due to missing performance.

5.2. *The five idea maturity levels (IML)*

The general course of the maturity curve is already defined by the starting point (= IML 1), the appraisable idea (= IML 3) and the realization maturity (= IML 5). The intermediate Levels 2 and 4 can be defined by both, the original characteristics given by Crosby [1979] and the CMM [Ahlemann *et al.* (2005)], and the requirements to increase the maturity to the next level.

Both Crosby and Ahlemann *et al.* characterized the second maturity level by structuring the vague approach by measurable and projectable criteria and by identifying the missing information. For technically based product ideas we

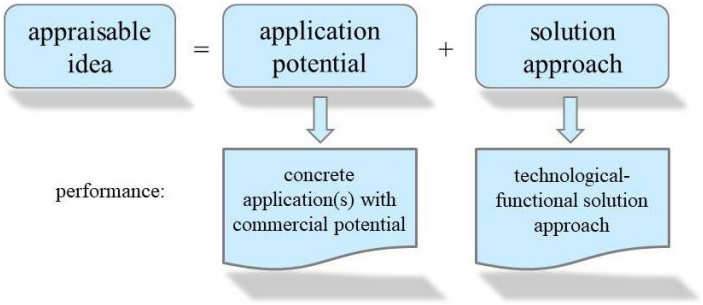

Fig. 1. Definition of an appraisable idea from a commercial view [own representation].

identified technical functionality, performance or application field, possible user, realizing effort and expected benefits as minimum criteria. From a general perspective the minimum criteria are as follows:

- Functionality or impact
- Performance field
- User or affected persons
- Implementation effort
- Expected benefits

According to Crosby and Ahlemann *et al.* it is not necessary to already have detailed information on each criterion at IML 2, but to recognize the respective information gap.

Filling these information gaps is done in the "improvement phase" of most idea management processes [Gerlach and Brem (2017, p. 147)]. This makes the idea appraisable (IML 3), but the assessment has not yet been made. Related to the above definition of an idea, the minimum criteria can be subsumed under the terms "application potential" and "solution approach". For industrial products, they correlate with "market potential" and "technology attractiveness". Evaluating these two variables is not enough to make a final decision on the implementation. One also needs information about e.g. expected benefits, strategy compatibility, competitive advantage, resource availability and financial affordability to bring the idea to IML 5. This confirms the existence of an intermediate level IML 4. On this level, the feasibility has been determined, but a final implementation decision is not yet possible. Crosby [1979, p. 30] characterized the "wisdom" level as the most critical of all stages. The company has the chance to make the necessary changes.

Combining all these approaches, five IML suggestions are shown in Fig. 2. The characteristics are determined for technical product or service ideas in Table 2; for other developments, they must be adapted.

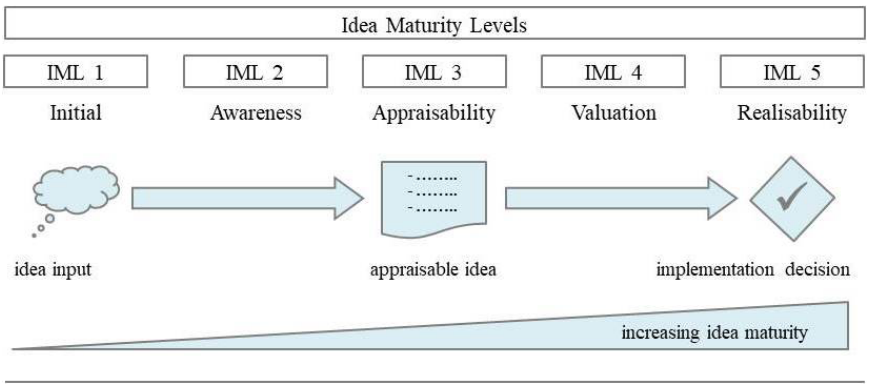

Fig. 2. Five IMLs from a rough idea to the implementation decision [own representation].

Table 2. Characterization of IMLs.

IML [Crosby's stage] [CMM level]	Characteristics
1 Initial [Uncertainty] [Initial]	• Basic assumption for an idea is available; still no clearly described idea. • At least one application or a technical solution is already suspected. • At least one minimum criterion of the idea characterization field is named and roughly characterized. • Information on at least one additional criterion outside the minimum criteria may be available.
2 Awareness [Awakening] [Managed]	• The minimum number of criteria to assess the idea is known. • The information deficits of these minimum criteria are fulfilled by internal research and implicit knowledge of the creator(s). • Plausible relations between the minimum criteria exist and are known. • The idea is qualifiable.
3 Appraisability [Enlightenment] [Defined]	• Information on the minimum criteria is sufficient. • One or more application–solution combinations are clearly visible. • Concrete users in the individual application fields are identifiable. • The analysis of the (market) potential and the realizability are feasible. • The idea is appraisable.
4 Valuation [Wisdom] [Quantitatively managed]	• Market potential and technology attractiveness has been estimated through appropriate assessment procedures. • Technical feasibility is known. • Applications and users are identified and evaluated. • Technical and economic success probabilities can be assessed. • Competition criteria are measurable. • The value of the idea can be determined.
5 Realizability [Certainty] [Optimizing]	• Strategy compatibility is proved. • Benefits are predictable. • Resources are available or procurable. • Implementation costs and potential economic returns are estimated. • Basis for development and implementation decision is given.

6. Compatibility of IMM with Idea Assessment Processes

Both Crosby's maturity grid and the CMM have been derived from real industry processes. Crosby considers the maturity stages of quality management; the CMM focuses on process improvement strategies in the software branch. Our dynamical approach for evaluating a new product or service idea, which yields to the IMM, was developed by combining their models with the experiences from industrial idea assessment processes.

To verify and validate the IMM, its basic compatibility is checked with idea assessment processes and conditions in some organizations and companies. One of these comparisons was done with the ROSEN Group, which is a globally leading provider of innovative solutions for the integrity management of industrial assets,

primarily for the oil and gas industry. In addition we compared the model with idea management processes in medium-sized enterprises in the machinery branch and in the automation branch. In all cases, the five IML could be identified:

- ***IML* 1 — *Initial***

Ideas are generated by one or more persons (creator). Assuming that the creator is a member of the organization, the creator will not realize the idea completely by themselves. The reasons for this deficiency are manifold. Lacking methodological competencies, time and resources, motivation, as well as structural barriers are examples of why creators often do not realize their own ideas. In these cases, additional knowledge sources are required to develop and to realize the idea.

In the beginning, the idea is generated by the creator. Its first status is INITIAL. The idea is known only by the creator. The creator develops the idea further until a certain level. This level depends mainly on his/her expertize, methodological competencies and his/her endeavour to realize the idea. Afterwards, the idea is transferred to the organization to gain support for realization or for further processing.

- ***IML* 2 — *Awareness***

When the organization receives the idea, it is now aware of the idea and can decide how to deal with it. The status of the idea is changed to AWARENESS. The organization first checks the quality of the idea. Very often, the idea is too vague and not appraisable for decision makers due to its missing key information needed for a proper idea evaluation. The reasons for the incompleteness can be that there is limited background information about the corresponding topic, lack of methodical competencies or deficient motivation to explore the idea. The organization determines the gap between the required information for idea evaluation and the received information from the idea creator. The goal is to fill in the missing information to produce an appraisable idea.

- ***IML* 3 — *Appraisability***

The organization identifies which information is needed to produce an appraisable idea. The organization may interact with the creator to get additional background information that was not provided in the idea message. In exchange with the creator, the organization clarifies the available information content of all relevant criteria (see Sec. 5.2). In addition to that the organization may perform research or it may question other knowledge sources, internally or externally, to get the required information.

As soon as the required information is available, the idea is appraisable. Its status is changed to APPRAISABILITY. The idea contains all relevant information that is required to evaluate the idea.

- ***IML* 4 — *Valuation***

In the next step, the idea will be evaluated. The evaluation is done by market research, feasibility studies, technical pre-tests or other internal and external studies

based on criteria defined by the organization. After these examinations, the idea has the status of VALUATION. In the case of new product or service ideas, one is able to assess the market potential and the development effort and is therefore able to estimate the value of the idea.

- ***IML 5 — Realizability***

Even when the monetary market value of an idea is known, the final decision as to whether the idea is implemented or not needs additional checks, e.g. expected benefits, strategy compatibility, competitive advantage, resource availability or financial affordability. Only when all these decision fields have been evaluated is the idea elevated to the level of REALIZABILITY. The management is now able to make a distinct and repeatable realization decision which is comprehensible for all stakeholders.

7. Conclusions

The developed IMM harmonizes with the classical maturity model of Crosby [1979] and the CMM [Ahlemann *et al.* (2005)] as well with the real idea assessment processes in industry. Its five IMLs are comparable to the classical models and allow description of the actual maturity of an idea even in practice. The IMM also harmonizes with most idea management processes [Gerlach and Brem (2017)] and the IML describes the idea status at the end of a specific phase.

First, comparisons with existing idea management processes in industry were made to test the validity of the five IML in practice, but further investigations must be carried out. Nevertheless, the IML fits with basic idea management processes in companies.

Although the five IMLs have not been introduced before, a number of tools, methods and processes exist to improve the quality of ideas. The IMM processes have yet to define how to increase the maturity from one IML to the next. Such processes will be published in a separate paper.

This IMM has been developed on the basis on industrial processes, mainly on idea assessment and product or service developing processes. The compatibility with other maturity models suggests a more general applicability, which indeed must be verified in other application fields.

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Biography

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Ingo Nee is responsible for Global Technology Strategy at the ROSEN Group, a company that offers innovative products and services for the integrity of a wide range of industrial assets. Ingo Nee has more than 15 years' practical experience

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