Designing and Evaluating Prescriptive Maturity Models: A Design Science-Oriented Approach

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***Abstract*— Maturity models are helpful tools to assess and improve the performance of processes, people or objects. While various guidelines supporting the design of these models exist, they mainly remain generic and lack individual guidance. Furthermore, continuous evaluation remains neglected, even though it is the basis for developing rigorous design science artefacts. Based on an existing design-oriented maturity model development procedure and a framework for continuous evaluation, this paper proposes a detailed process model for future maturity model users and developers. Following the eight steps described in this process model aims to help design prescriptive and strongly evaluated maturity models. A case study is used to illustrate the procedure by developing a maturity model for communities using telemedicine following the proposed process model.**

Keywords — Design Research Evaluation, Development Guidelines, Maturity Model, Method

I. Introduction

Maturity models are helpful tools when it comes to the performance evaluation of processes, people or objects [1]. Given their level-based structure, these models offer the opportunity to assess the maturity of the entity under consideration in order to determine a current as-is situation (descriptive), identify potential improvement opportunities (prescriptive) or benchmark the applier's position against other industries or regions (comparative) [2]. Given their promising intentions, these models have become popular in various areas like software development, controlling or information technology management [3]. Despite criticism — i.e. a lack of validation and evaluation as well as missing operationalization of maturity measurement [4] — new models are constantly being developed [5], [6]. Frameworks guiding the design of these tools exist in different granularities, e.g. providing procedure models [7], [8], collecting applicable development methods [9] or presenting design decisions [10]. However, these approaches remain largely generic, and individual guidance for the design of especially prescriptive maturity models is lacking thus far [11]. Users are left alone with generic steps that describe maturity model development on a relatively high level, e.g. [7], or collections of possible methods [9]. A combination of both, providing specific guidance, is missing so far. Regarding maturity models as design artefacts [10] and their development as design research, additional aspects should be considered. In addition to a rigorous development process, the aspect of evaluation "with respect to the utility provided for the class of problems addressed" [12, p. 77] should be continuously considered throughout the whole development process [13]. However, in the area of maturity model development, these evaluation activities often remain neglected.

The aim of this research is, therefore, to propose a process model based on the design steps inherent in existing design-oriented maturity model development procedures [10]. The proposed process model will help guiding the user through each design step by explicitly providing applicable methods and incorporating continuous evaluation [13]. Future maturity model users and developers should be able to design prescriptive and strongly evaluated maturity models by using our proposed process model. The focus is on prescriptive maturity models as they explicitly guide the improvement process after the as-is situation is defined, instead of solely assessing the status quo [2]. To illustrate the procedure, a case study will be used.

The remainder of this paper is structured as follows. After theoretical perspectives on maturity models and evaluation approaches are described, the eight-step process model is proposed in section III. Afterwards, the eight steps are applied in a case study in section IV to exemplarily demonstrate the process model's applicability. Finally, the results are discussed, before the paper is concluded in section V.

II. Theoretical Perspectives on Maturity Models

A. *Anatomy, Development and Criticism of Maturity Models*

Although the overall structure of maturity models may vary, it typically consists of a number of levels, which are named (e.g. initial, defined, optimizing) and described, and a number of dimensions, each including described elements or activities at each maturity level [14]. Depending on the model's intention, its composition of dimensions and levels, different types of maturity models are distinguished (i.e. grids, staged or continuous). Staged maturity models are currently the most widely developed and accepted types, which is why we focus our research on this form of maturity models. The maturation process is represented in a simplified step-by-step approach, including a combination of key factors that must be present in order to achieve a certain level of maturity [14].

Considering the long history of maturity models, multiple development guidelines evolved over time that focus on these processes and can be regarded as supportive instruments for maturity model development. De Bruin et al. [2] presented a famous and established six-step generic phase model comprising scope, design, populate, test, deploy, and maintain. Solli-Sæther and Gottschalk [15] focused on a procedure model for staged-maturity models, proposing

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theoretical and empirical foundations for the development process. Also new kind of maturity models were proposed. Van Steenbergen et al. [8] suggested a development approach for Focus Area Maturity Models and Lasrado et al. [16] created a development approach for maturity models applying a set theoretical methodology. Also from a design science perspective, the artefact of maturity models became relevant for research and scientists: Becker et al. [7] applied a design science perspective on maturity models. They suggested an eight-phase development approach, focusing on problem definition, comparison of existing maturity models, determination of the development strategy, iterative maturity model development, the conception of transfer and evaluation, implementation of transfer media, evaluation, and rejection of the maturity model. Pöppelbuß and Röglinger [17] as well suggested design science driven principles of form and function for the development of useful maturity models. A different design science-oriented approach was postulated by Mettler [10]. He developed a five-step framework, which is based on 18 decision parameters, providing a guideline for "theoretically sound and practically useful maturity models"[10, p. 85].

However, most of these approaches provide only generic steps to be followed without guiding the realization of these steps explicitly [11], i.e. a description of what methods to follow in which step is often not included. Moreover, maturity model development has received much criticism, especially regarding the lack of an empirical research foundation [2], which results in models simply demonstrating a gap instead of cause-and-effect relationships [18] and a simple copying of existing model structures. Another aspect not often considered in maturity model development is the importance of validation and evaluation when it comes to the selection of factors and requirements during the development of the maturity model's dimensions and levels [4]. Due to the lack of these validation options, the rigorous development, as it is postulated by researchers, is not possible and the scientific relevance, especially with regard to design science research (DSR) is doubtable.

B. A Design Science Perspective on Maturity Model Evaluation and Development

Maturity models can be regarded as artefacts [11] whose relevance depends on their usefulness, which, in turn, depends on the possibility of evaluating the model or measurement method. Given these dependencies, our research focuses on the importance of evaluation and validation of the development steps that are applied. A process model can only represent a helpful tool for future researchers and offer a possibility for evaluation if two aspects are fulfilled. These are the provision of specific propositions and the presentation of methodologies a researcher should apply in the respective development steps to overcome the model's highly theoretical and generalized intention.

Our process model proposed is supposed to strongly focus on continuous evaluation and feedback loops. It considers the well-established framework for continuous evaluation in DSR (FEDS) by Venable et al. [13]. In this framework, four DSR evaluation strategies are presented, depending on the circumstances of the artifact to be developed (in our case a maturity model). The evaluation strategies represent prototypical patterns of how certain aims (but also risks and uncertainties) should be addressed. It can be differentiated according to the functional purpose of evaluation, which can be either formative or summative, as well as according to the paradigm of evaluation, which is either artificial or naturalistic. Depending on the characteristics of the artefact (i.e. if it is technical or social/user oriented), one of the four evaluation strategies proposed by Venable et al. should be selected to assure a rigorous artefact development in DSR. For our maturity model development approach, the strategy of 'Human Risk & Effectiveness' is selected as the described selection criteria are met: 1) users represent the main risk to the artefact if they decide not to use it, 2) evaluation in real-world setting is relatively cheap, and 3) the benefit of maturity models should be ensured in the real-world setting on a long-term basis [13]. By choosing this strategy, Venable et al. suggest to implement artificial formative evaluations at the very beginning of the development process and proceed in changing to more naturalistic formative evaluations and later on to summative evaluations [13].

We combine this well-established evaluation strategy with the design steps for maturity model development by Mettler [10], who strongly relates to the generic DSR process by Peffers et al. [19]. Thus, we respond to major criticism about missing operations in the development process of new maturity models.

III. Proposal of a New Process Model

The process model proposed consists of eight steps. These eight steps and their relation to the ones described by Mettler [10] and the DSR process by Peffers et al. [19] are displayed in Table I.

A. Define Problem and Scope

First of all, the problem, which should be solved with the help of a prescriptive maturity model, and its relevance need to be clearly defined. This step sets the frame for all following ones. Conditions to be considered are necessary preconditions (which need to be fulfilled), possible user groups (i.e. who can assess the status quo, and who will use the results of the assessment) and the scope of the model (only applicable in a certain country, for a certain technology, etc.). This step, as well as the following ones, needs to be conducted by at least two researchers independently to avoid bias.

TABLE I. Relation of Proposed Steps to Mettler's Approach [10] and the DSR Process by Peffers et al. [19]

<table>
<tr><th>Steps of the Proposed Process Model</th><th>Design steps according to Mettler [10]</th><th>DSR Process According to Peffers et al. [19]</th></tr>
<tr><td>A – Define problem and scope</td><td rowspan="3">1 – Identify need or new opportunity
2 – Definition of scope</td><td>1 – Identify problem and motivate</td></tr>
<tr><td>B – Understand the domain</td><td rowspan="2">2 – Define objectives of a solution</td></tr>
<tr><td>C – Identify the need for a new model</td></tr>
<tr><td>D – Define levels and dimensions</td><td rowspan="2">3 – Design model</td><td rowspan="2">3 – Design and development</td></tr>
<tr><td>E – Shift to a prescriptive maturity model</td></tr>
<tr><td>F – Evaluate the final draft</td><td rowspan="2">4 – Evaluate design</td><td>4 – Demonstration</td></tr>
<tr><td>G – Apply the model in real-world setting</td><td>5 – Evaluation</td></tr>
<tr><td>H – Document the final maturity model</td><td>5 – Reflect evolution</td><td>6 – Communication</td></tr>
</table>

When aiming to develop maturity models for a group of stakeholders, they should be part of setting the problem definition. A Delphi panel of experts is suitable to prioritize problem areas and define the scope of the model to be developed [20].

B. Understand the Domain

After the problem is defined, the domain under consideration needs to be known. As De Bruin et al. suggested, barriers and success factors, which arise when implementing innovations within a domain, are helpful [2]. The barriers should be derived by applying a literature review that includes the central terms describing the domain under consideration as well as pretested synonyms for the term "barrier" (e.g. obstacle, gap, challenge or difficulty) as search terms. As we suppose that existing maturity models within a certain domain incorporate a wide range of success factors on the way to higher maturity, we also suggest identifying existing models and extracting the necessary success factors they address. A literature review and a grey literature search are suitable, as such models come from the realms of both research and practice. In case no maturity model already exists, broad factors and theories related to the domain can help to understand it. Afterwards, both the barriers and success factors need to be mapped and categorized to generate definite factors describing the domain considered (by mapping) and to get a deeper understanding of the domain itself (by categorizing). When mapping the categories of barriers on success factors, a conclusive picture of the domain to be studied arises. Categorization can be realized inductively, where no previous theoretical knowledge of the subject exists, or deductively, where existing research already roughly describes the domain [21].

C. Identify the Need for a New Model

Based on the domain understanding achieved, the identified models can be further analyzed to determine a possible need for a new model. This analysis should happen in two parallel ways by assessing characterizing attributes (e.g. availability of the maturity model or support of its application) as well as the content of the models. To classify and describe maturity models, different attributes are described in the literature [22]. Incorporating this approach, we developed an extended classification scheme (see Table II[a]), which helps to assess the applicability of existing models, to compare different models and to identify shortcomings.

TABLE II. EXTENDED CLASSIFICATION SCHEME FOR MATURITY MODELS

Research Information	**General Model Attributes**	**Maturity Model Design**	**Maturity Model Use**
Author	Name of the model	Concept of maturity	Method of application
Year	Acronym	Design strategy	Support of application
Title of publication	Addressed topic	Development method	Practicality of evidence
	Origin	Composition of the mode	Further usage of the model
	Purpose	Dimensions	
	Respondents	Levels	
	Technology	Reliability	
	Perspectives considered	Mutability	
	Country		
	Availability		

[a] A detailed description of each attribute can be found in [23].

TABLE III. BARRIERS (B) AND SUCCESS FACTORS (S) COVERED PER MODEL AND PERSPECTIVE

	Perspective 1	**…**	**Perspective p**
Maturity model 1	B	…	-
…	…	…	…
Maturity model m	S	…	B, S

Afterwards, a further content analysis is needed to assess in how far the maturity models identified consider necessary perspectives (shaping the domain). The success factors and barriers identified and categorized in step B will guide this assessment and define the perspectives relevant for all maturity models dealing with the domain under consideration.

To analyze in how far the models consider important success factors (S) and address barriers (B) in each perspective, a matrix can be helpful (see Table III). For each model and perspective, it needs to be marked in this matrix if barriers to be overcome or success factors, or both, are included in the model. If cells remain empty or cells state that only one of the two aspects (either S or B) have been addressed, this marks a possible shortcoming that needs to be further analyzed.

Once the need for a new maturity model has been identified, the development of the model can follow. As the identified need is based on literature reviews describing domain aspects, this can serve as the first (artificial formative) evaluation step [13]. In case no need could be identified for developing a new model, the analysis of the models can help to choose the best existing one to apply for a given use case.

D. Define Levels and Dimensions

The development of a maturity model requires defined levels and dimensions. Not only the previously analyzed but also generic maturity models can serve as a basis for defining the number of levels, as well as the names and descriptions of each level. However, the levels can also be defined from scratch.

Once the levels are set, the dimensions need to be defined. The core question here is, which characteristics of the domain need to reach higher levels of maturity or change in the maturation process, i.e. are qualified to become dimensions. The problem definition from step A or the domain components (barriers and success factors) identified in step B can serve as a basis. Each characteristic identified as important needs to be combined with each of the levels. Ultimately, a matrix evolves (see the upper part of Table IV) describing the characteristics of each dimension per level. This matrix further forms the frame for the model to be developed and can already support the assessment of the status quo.

TABLE IV. THE FIRST DRAFT – ASSIGNMENT OF IMPROVEMENT ASPECTS TO THE LEVEL-DIMENSION MATRIX

	Level 1	**…**	**Level n**
Dimension 1	Characteristic dimension 1 level 1	…	Characteristic dimension 1 level n
…	…	…	…
Dimension d	Characteristic dimension d level 1	…	Characteristic dimension d level n
Aspects for improvement	Factors needed to be fulfilled at level 1	…	Factors needed to be fulfilled at level n

E. *Shift to a Prescriptive Maturity Model*

To derive a prescriptive maturity model, aspects for improvement need to be added to the currently descriptive model. In addition to the barriers and success factors describing the domain, suitable theoretical underpinnings need to be included here. Theoretical underpinnings can be drawn from existing theories reflecting the entity under consideration, e.g. diffusion, technology acceptance or community readiness theories. This strengthens the model's development and addresses the critique regarding missing theory in maturity model development at the same time [24]. The mapping of barriers and success factors in step B yields several definite factors describing the domain.

Complemented by theoretical insights, these factors form the basis for proposing improvement measures. For each level-dimension combination, all the factors relating to the combination need to be assigned. Each factor assigned needs to be fulfilled on that level before further 'maturing' to the next level (see Table IV). By providing improvement opportunities based on the as-is situation, the model shifts from a descriptive to a prescriptive one [2]. When the first draft is ready, the scope (defined preconditions, user groups or the framing setting) defined in step A can be re-examined.

F. *Evaluate the Final Draft*

The first draft can be evaluated with real (potential) users through naturalistic formative evaluations [13], e.g. a mixed methods approach combining both qualitative and quantitative methods to prove the adaptability of the model [25].

Semi-structured expert interviews are useful to get practical feedback, as they are common in user-centered design processes [26]. The interview guidelines need to contain a clear explanation of the model's aim before asking for the applicability of the assignment of levels and dimensions within the level-dimension matrix. The think aloud technique [27] can be used for this purpose, as the experts can assess the given model without receiving further explanations and tell the interviewer their thoughts while doing so. This makes their decisions more understandable and lowers inter-viewer bias [27]. Afterwards, each expert should get the level-dimension matrix as a printed frame and all relevant improvement aspects on printed cards, separately. Using the matrix and the factors as a jigsaw puzzle, each expert can place the improvement aspects on the level where s/he thinks they need to be fulfilled. Each decision can again be commented on (think aloud) to allow the interviewer to understand the reasons for the decision. After a sufficient number of experts (we suggest interviewing at least five experts per country) have been asked, the median can be calculated for the placement of each improvement aspect to sum up the cumulative assignment of each aspect to a level.

Furthermore, an international survey can also be conducted to further validate the findings with a more diverse group of stakeholders. Quantitative online surveys are especially useful to reach a higher number of diverse experts [28]. Each expert needs to classify his/her (project) site by rating each dimension individually based on his/her expert knowledge. In addition to further administrative information describing the experts (country, position, etc.), each improvement aspect needs to be rated by the experts according to whether these aspects are already in place. Dichotomous scales are preferable as they facilitate the coverage of a large number of improvement factors. A statistical analysis (using cross tabulation) can then identify the relation between improvement aspects and levels in the status quo. Chi^2 should be applied to make sure a relationship exists, while related indicators such as Cramer's V or Fisher's exact test help assess the strength of the relationship. As a precondition, levels need to be disjunctive, i.e. contain improvement aspects that only apply to one level and no other. Treating the aspects as variables and the levels as scales constructed of multiple variables, disjunctive levels become a matter of reliability which can be tested using the Cronbach's Alpha statistics.

Findings from both evaluation methods can then be compared and analyzed. While the survey findings represent the as-is-situation, the maturity model and the interview findings represent the should-be-situation. Furthermore, country-specific differences are possible and need to be studied by differentiating the results per country. To gain the final draft, the assignment of improvement aspects to levels needs to be adapted where necessary. Where both evaluation steps suggest a change in assigning the improvement aspects to levels, the model needs to be adapted accordingly.

G. *Apply the Model in Real-World Setting*

The final draft can be applied with real users to solve real problems within real systems [29], representing naturalistic summative evaluation [13]. Evaluation in the form of additional expert interview sessions is useful. The aim is to prepare the model in a way that its documentation is understandable and usable. Especially practitioners, as a possible user group of maturity models, need to be included to increase the model's impact [30]. Again, the think aloud method [27] is useful to understand the experts' intentions, thoughts and problems. An activity diagram describing all necessary steps in deploying the model (see Fig. 1) can guide the application process (i.e. step G) and ensure the model's applicability after publishing it.

In the activity diagram, five phases are important. First, the model's area of application needs to be clearly defined (a) before all necessary preconditions are checked (b). In case they are not or are only partly fulfilled, the model is not applicable. Afterwards, experts who can assess the current status quo need to be identified (c). They can either use the model themselves or name other people who have more detailed expert knowledge in that area. The fourth phase includes the assessment of the status quo, where each dimension needs to be rated individually and the status quo level can be derived, guided by the activity diagram (d). Finally, based on the status quo assessment, aspects for improvement need to be identified (by checking the current and previous levels) and addressed.

If no improvement aspects could be identified, higher level aspects can be checked for fulfilment (e). However, if no improvement potential is found, the continuous maturity assessment must be terminated. By using this diagram during the evaluation, its usability is checked, and necessary adaptations can be made.

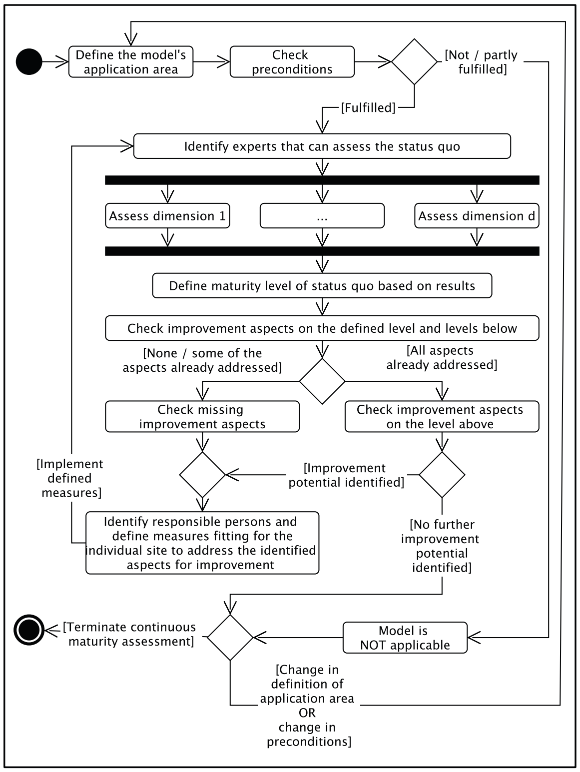

Fig. 1. Activity diagram for applying the maturity model.

H. *Document the Final Maturity Model*

Once the developed maturity model is finalized, it needs to be clearly documented for publishing. To maximize the maturity model's impact and ensure its usability (especially for practitioners), the documentation needs to be stakeholder-oriented (e.g. presented in their native language, illustrated with examples or graphics) [30]. The extended classification scheme (see Table II) can guide this documentation. Each of the attributes described should be addressed and communicated clearly. The mutability of the model in the future and its long-term availability particularly need to be ensured [10]. As an example, documentation on a webpage (to ensure the model is accessible for its intended stakeholders) should be accompanied by a research publication, where the model, its components and application description are clearly documented [24]. This supports its correct interpretation and use.

All eight steps including suggested methods and fulfilled evaluation steps [13], are summarized in Table V.

TABLE V. METHODS SUGGESTED AND EVALUATION STEPS FULFILLED [13] PER STEP

Steps of the Process Model	Methods Suggested and Evaluation Steps Fulfilled
A – Define problem	Delphi panel [20]
B – Understand the domain	Literature review(s), incl. grey literature search; qualitative content analysis [21] for mapping and categorizing the results
C – Identify the need for a new model	Mapping of results within expert panel [fulfils artificial formative evaluation [13]]
D – Define levels and dimensions	Expert panel
E – Shift to a prescriptive maturity model	Mapping of results; mixed-methods (semi-structured expert interviews [26]; think aloud method [27]; jigsaw puzzle; quantitative online survey [28]; statistical analysis)
F – Evaluate the final draft	Adaptation [fulfils naturalistic formative evaluation [13]]
G – Apply the model in real-world setting	Semi-structured expert interviews [26]; think aloud method [27]; activity diagram [fulfils naturalistic summative evaluation [13]]
H – Document the final maturity model	Documentation/ handbook

IV. EXEMPLARY APPLICATION OF THE PROCESS MODEL

The process model described has already been used to develop a maturity model for implementing telemedicine initiatives in communities. This serves as a case example.

A. *Define Problem and Scope*

Scaling up telemedicine initiatives is still hindered worldwide [31]. To address this problem, the aim was to develop a maturity model to guide the scaling up process. Scaling up refers to the progress innovations make from the stage of pilot projects towards increasing the number of people benefitting from them [32]. This progress is also necessary for telemedicine initiatives but needs further support to be successful. The intended maturity model should therefore be applicable to telemedicine as a technology and used by developers and decision makers in that field. Telemedicine, as defined by Sood et al. [33], refers to the provision of care and/or medical education over distance. Information and communication technology is thereby used by a health care professional for providing the service.

Regarding the scope, no country-specific restriction should be applied. Further preconditions could not be identified at this stage.

B. *Understand the Domain*

Two independent literature reviews were conducted to identify barriers and success factors for telemedicine initiatives. Ninety-eight barriers and 91 factors were identified and categorized into ten categories: core, public/community, provider, patient, health sector, legal, financial, strategic, organizational and technological readiness [23], [34].

C. *Identify the Need for a New Model*

Based on the extended classification scheme and the analysis of the identified models' content, different shortcomings could be identified. None of the models analyzed incorporated a theory or applied a structured process model during the development. Furthermore, they solely help to define the status quo without guiding the improvement process. Additionally, different perspectives were not sufficiently considered, especially core readiness as a necessary precondition or the public/community. The consideration of barriers and success factors was also not sufficient in the models analyzed, and aspects like mutability, definition of respondents and evaluation and clear documentation of the models were not adequately addressed [24]. Consequently, a need for a new prescriptive maturity model that should focus on supporting the community around telemedicine users could be identified.

D. Define Levels and Dimensions

Based on the telemedicine maturity model by van Dyk and Schutte [35] and the Community Readiness Model (CRM) [36], [37], six levels were defined and named according to the process and structure at each level (preplanning — chaotic; preparation — coordinated environment; initiation — controlled environment; stabilization — consistent execution; confirmation/expansion — quality and productivity; professionalization — continuous improvement). Furthermore, three dimensions (status of telemedicine initiatives, community involvement, evidence for telemedicine in the community) were identified as relevant to scale up telemedicine initiatives in communities, based again on the CRM [36], [37], the analyzed maturity models and the determinants by Broens et al. [38]. For each level, the dimension characteristics were described.

E. Shift to a Prescriptive Maturity Model

All factors evolved during the mapping of barriers and success factors were checked in an expert panel for relevance within the given model scope. Together with relevant factors from the CRM, the first draft was formed by assigning the factors (i.e. improvement aspects) to the different levels. Additional preconditions arose (the existence of core readiness and no contradiction for the intended disease/condition applied to) and the definition of possible user groups could be sharpened.

F. Evaluate the Final Draft

Semi-structured expert interviews were conducted in Australia (n=5) and Germany (n=7) with experts from health insurance companies, health care professionals, and representatives of network organizations in health care. Both countries were chosen as they are economically comparable (high developed countries) but have different framing conditions regarding the health care system and settings for communities. In both countries, private actors are responsible for providing care services, while regulation and finance is the responsibility of the state in Australia (National Health Insurance System) and the responsibility of societal actors in Germany (Social Health Insurance System) [39]. In Australia the country is strongly separated in rural and urban areas, Germany is densely populated. Therefore, the model could be tested in two similar but still contrasting environments. All experts were selected on two factors, their job title and practical experience with telemedicine initiatives. After the model's intention was explained to each interviewee, the level-dimension-matrix was presented. Each interviewee had the possibility to give feedback on this part while thinking aloud. The feedback was positive, showing that this process is the same in the experts' communities. Afterwards, the assignment of improvement aspects to levels was checked with the jigsaw puzzle and think aloud method. Both methods were well-accepted by all participants. Depending of the assignment of each individual aspect to one of the six levels (1-6), the number between 1 and 6 was noted down. After all interviews, the median could be calculated about all assignments to levels per improvement aspect to reveal necessary adjustments.

Furthermore, eight experts from seven countries participated in a standardized online survey. Statistical analysis of the results showed that most improvement aspects were previously unknown to the participants and thus had not been applied so far. Consequently, most projects remained on a rather low maturity level. Therefore, and due to the small n, an analysis of correlations between each level was not feasible. An analysis of reliability where the levels were treated as multi-item scales, however, revealed a Cronbach's Alpha above the acceptable threshold of 0.6 in all but one case [40]. Such, the levels are disjunctive.

Resulting from the two evaluation steps conducted, some adjustments were made to the model. Some of the changes included adding percentage shares for assessing the community involvement as well as adjusting and renaming of individual improvement aspects; "all technical/infrastructural requirements are clear to those planning telemedicine initiatives" was for example accompanied by "basic technical/infrastructural requirements are clear to those planning telemedicine initiatives", as the experts expressed a high need for knowing technical/infrastructural requirements early in the process without necessarily being comprehensive.

G. Apply the Model in Real-World Setting

After conducting the first evaluation steps in Australia and Germany, the application in the real-world setting was also realized in these two countries. Three Australian and two German experts were asked to rate their communities with the help of the presented activity diagram and give feedback by thinking aloud. The five experts were health care professionals and/or representatives of health networks. Again, they were chosen based on their job title and experience with telemedicine in their community. Each of them could rate his/her community with the model provided and identify at least one improvement aspect that had not already been considered. Four of the five communities were on level 1, one of the Australian communities was on level 4 already. The model was generally seen as helpful to consider all aspects necessary to bring telemedicine in communities forward. Some language issues in the activity diagram had to be adjusted in the non-mother tongue of the authors.

H. Document the Final Maturity Model

The Telemedicine Community Readiness Model is now finalized, and documentation is under preparation. All attributes described in the extended classification scheme will be addressed, and an exact guide on how to use the model will be added in the published version.

V. Discussion and Conclusion

The process model proposed presents a design-oriented approach for developing maturity models, which incorporates continuous evaluation and methods to be followed explicitly. It is in line with the maturity model development steps consolidated by Mettler [10] and Peffers et al.'s DSR process [19], even though it is of higher granularity and provides specific methods to be used in each step. The continuous evaluation incorporated follows the 'Human Risk & Effectiveness' evaluation strategy by Venable et al., i.e. progresses quickly from artificial to naturalistic formative and summative evaluation [13]. Thereby, effectiveness and usability of the resulting maturity model can be increased. The process model contributes to the field by providing a guideline to be followed for future maturity model developers, which includes continuous evaluation and proposes specific methods, not inherent in many of the existing process models. Moving from the build-evaluate pattern (typically inherent in DSR processes) to continuous evaluation is also supported by other authors, e.g. Sonnenberg and vom Brocke [41]. Furthermore, the proposed process model helps fulfil necessary requirements many maturity models do not yet meet [24]. It incorporates existing theories, provides aspects for improvement, covers necessary preconditions, considers mutability and long-term availability and helps document the model and its respondents clearly. The case study illustrates the process model's functionality as a helpful tool.

This work also comes with some limitations. Even though the process model has already been used to develop one maturity model, it needs to be applied to other domains as well, to strengthen its reliability and usability. The case study was a suitable test for the process, even though the interviewees rated the improvement aspects or their communities mainly on the levels 1 to 4. This could be due to the low readiness within the communities they are experienced with. None of the experts was experienced with the levels 5 and 6, but theoretical insights, like Rogers' Diffusion of Innovations theory [42], suggest having six levels. On the higher levels, continuous improvement or a large trained workforce are needed. Each improvement aspect was rated at least by one interviewee on the level intended in the first theory-based draft. This underlines the plausibility of assignments to levels as intended in the first version.

The methods named for all individual steps represent only an extract and can be extended, e.g. by incorporating other methods from the domain of user-centered design [26]. To develop a consistent maturity model, however, the methods named were shown to be sufficient.

The process model provided describes a design-oriented maturity model development procedure, focusing explicitly on applicable methods and continuous evaluation during this development. It should support the development of helpful and strongly evaluated maturity models in the future for researchers and practitioners (e.g., international institutions, policy-makers, national/local governments, firms, etc.) alike. By illustrating the procedure in a case study, its applicability could be demonstrated. By applying the process model for future maturity models, relevance and rigor for these models as well as more intensive usage are goals that may soon be achieved.

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