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MONITORING A PROPERTY BASED PRODUCT DEVELOPMENT – FROM REQUIREMENTS TO A MATURE PRODUCT

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ABSTRACT
Increasing customers` requirements as well as changing market demands are just two examples for influences that result in an increasing complexity of technical products. To assure the fulfilment of all requirements an effective monitoring of product development is essential. Monitoring is often done by observance of required time and caused costs, and does not take into account product’s functionality or properties or behaviour. This contribution introduces a framework which allows combining different approaches for efficient monitoring of product development by focusing the products’ properties from requirements to a mature product. Therefore, at first a short introduction in property based product development is given and a model for property based development is introduced, before existing methods for evaluating and monitoring product development are depicted. After that an introduction in monitoring product development is given and approaches are integrated into the model of property based product development with regard to their capabilities and focuses. Finally, this results in an approach for monitoring property based product development from requirements to a mature product.

Keywords: monitoring, product’s degree of maturity, property based product development

1 INTRODUCTION
Different markets as well as increasing requirements on the part of customers cause a rising individualisation and diversification in today’s product development. Developers have to provide a multitude of variants, which is responsible for more and more complex products. This increase of complexity and with that a development that takes places splitted up among specialized workgroups is responsible for increased complexity of entire development processes. This hinders initial planning as well as traceability of iterative development processes which necessitates an efficient monitoring of product development. Such a monitoring often takes place in late development phases in which designing is rather finished and just slightly optimizations are possible. Additionally a monitoring of product development is often done by observance of indicators just regarding development time and costs.
But for an effective monitoring of product development two key factors are of essential interest: (1) A monitoring has to cover the whole development process, which means it has to include planning and clarification of requirements as well as the product’s release and start of production. (2) Monitoring of factors just as development time and costs does not include an evaluation of product’s functionalities or fulfilment of customers’ requirements and thus completely neglects all aspects regarding the product. Because customers will pay for a product only if the product’s overall-behaviour will meet their requirements, the product’s behaviour caused by the product’s properties is a relevant measurement for fulfilment of customers’ requirements. This means, developers have to create a product that offers an adequate profile of properties, which is expressed by the term *property based product development*.
Hence, aim of this contribution is to introduce an approach for an efficient monitoring of a property based product development that is able to include the whole product development process. Additionally this approach has to take into account that an evaluation of the development process does not state any conclusion on the product itself. Therefore, this contribution dwells on property based product development and introduces the model for property based development. After that the terms “progress of the development process” and “product’s degree of maturity” are defined and some existing methods for evaluating and monitoring product development are depicted. After that, these approaches are integrated into the model of property based product development with regard to their capabilities and their respective focus. This results in an approach for monitoring the complete property based product development form definition of the requirements to the mature product.

2 PROPERTY BASED PRODUCT DEVELOPMENT

In the beginning there is to establish a common understanding for some aspects that are relevant for the monitoring of property based product development. To be able to address the product as well as the process, in essence there are two important aspects: On the one hand there is a need for an appropriate description of the product's behaviour based on the product's properties, and on the other hand there is to develop a process model that is able to support and to lead developers through the product development process. Hence the next two subsections introduce a property based definition of the product's behaviour, before the model for the property based product development is depicted in the next subsection.

2.1 Property based definition of the product's behaviour

To be able to understand the following definition of the product's behaviour and to avoid confusion, an initial introduction, disambiguation and distinction of some terms is necessary. Thus the following section explains the consideration of the terms "characteristics", "properties", "function" and "behaviour" as they are understood in this contribution.

Characteristics

In analogy to the CPM/PDD-framework by Weber [1], in this contribution "characteristics" are used to describe and to configure as well as to influence the product. Thus the product's characteristics are specifications regarding geometry, structure or material. Characteristics can be classified in three classes: The first class is the "physio-chemical form" that is used to describe the material. The second class is the "geometrical form" that defines geometry and design, and the third class is the "structural form" that is used to describe the product's structure as well as connections and interactions between assemblies and parts. Hence characteristics can be seen as information regarding the product's structure, design and material.

Properties

Due to the fact that according to the CPM/PDD-framework [1] the product's "properties" result from the definition of the characteristics: Developers cannot define the product's properties directly. As explained in [2] properties can be measurable and quantifiable properties like weight, stiffness, or cost as well as merely qualitative assessable like security, environmental friendliness and aspects regarding aesthetics. According to [3], properties are divided in "intensive properties" and "extensive properties": "Intensive properties" are specific properties like density, specific weight or specific stiffness and result from the choice of physio-chemical form (material) [2]. "Extensive properties" on part level are a result from the combination of "geometrical form" and the "intensive properties" [2]. In conjunction with the structural form it gets possible to assess the assemblies' properties. Based on these assemblies' properties and in conjunction with the definition of the structural form of the product it gets possible to determine the profile of product's properties.

Function

The "function" of a technical system is comprehended as the system's sense, its task or aim. Thus the function is the cause for the creation of the product. If the system does not fulfil its function, it is more or less useless to the operator. The function explains the system's effect and establishes a relationship between input (mode of conditions and mode of use) and output (behaviour) of a technical system. With this understanding defining the function of a technical system means a description which is neutral to any possible solution [4], [5], [6], and [2].

Behaviour

The product's "behaviour" specifies its interaction with the environment and how it fulfils its function. Thus, the behaviour answers the question for the modality, in which the technical system fulfils its required function. Hence, the product's behaviour is finally a specification of the function: The system's behaviour implies not only its function, but even the way this function has to be fulfilled. Hence, contrary to the description of the function, the behaviour of a technical system is not neutral to the technical solution. When focusing the behaviour, neither the way of realisation, nor single components are relevant, but the system is seen holistic and its interaction with the environment is depicted [2]. Existing boundary conditions of later product utilisation influence the product and thus will affect its resulting behaviour. Thus the behaviour can be described as a result of the product's properties under influence of the mode of conditions and the mode of use. Thus to achieve a desired product's behaviour, developers have to define the characteristics in a way that the result is a profile of product's properties that is adequate to fulfil the function required by customers on examination of the given mode of condition and use.

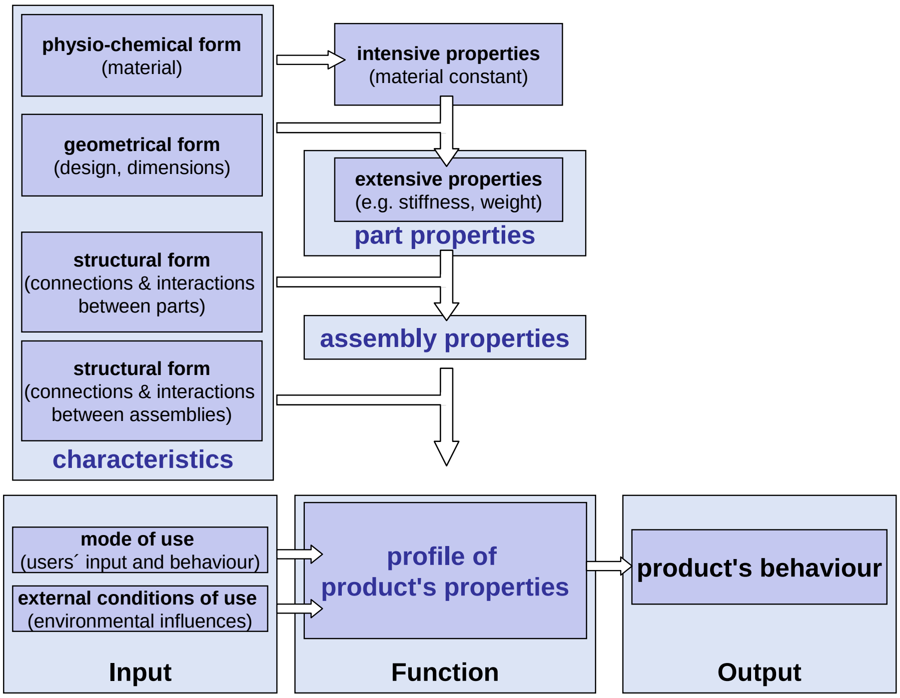

Figure 1: Definition of the product's behaviour based on characteristics and properties

This description of the product's behaviour based on characteristics ("physio-chemical", "geometrical" and "structural" form) and the resulting properties (intensive and extensive) as well as the relations between properties on different levels of the product structure is shown in figure 1.

2.2 Process Model for Property Based Product Development

Aim of this section is to introduce the process model for property based product development. At first glance, this framework has a similar structure as it is known from the VDI-Guideline 2206 "Design methodology of mechatronic systems" [7]. In the style of this VDI-Guideline also the process model for the property based product development provides an approach in form of a V-Model, which consists of several fundamental process steps. The structure of this V-Model is adopted due to the fact that it is widely spread and accepted. Starting from the requirements, this process model leads the developer through "system design", "domain-specific design" and "system integration" until the product development is finished. The process model's step "system design" helps to clarify the task and to deduce requirements. These requirements ate to be formulated in measurable and quantifiably properties that can be proved by conducting analyses. Aim of the steps of synthesis and analysis during "domain-specific design" is to fulfil these required properties by purposeful definition of appropriate characteristics within several loops of synthesis and analysis. By connecting the assemblies to the overall product during "system integration" these properties of the product's constituents are combined to the overall-product's properties. As the VDI 2206 proposes, these steps are accompanied by a continuous modelling and model analysis as well as continuous monitoring of the product's properties. The idea to lead the developer stepwise in a methodical procedure through the product's concretion from general to detail by conduction of several iterations loops is a fundamental component of the framework for property based development. The process model for property based product development that is depicted in figure 2 describes the development process as a procedure of twenty individual process steps. Due to the fact, that the VDI-Guideline 2221 [8] provides a popular and widely accepted procedure in product development, the steps 1-5 are similar to some steps as they are known from this guideline. The procedure as it is recommended by the process model for property based product development is described in the following section.

- Step 1: The property based product development starts with the functional requirements on part of the customers or market research, which are formulated in a solution-neutral way. In the first step developers have to deduce the desired overall-product’s behaviour, which is deemed to be appropriate to fulfil the functional requirements. These functional requirements can be considered similar to the requirements-model (“Anforderungsmodell”) as it is introduced in the product-concretisation-model (“Produktkonkretisierungsmodell”) according to Lindemann [9]. The result of this step is central in the property based product development because it has strong influence on the following process steps.

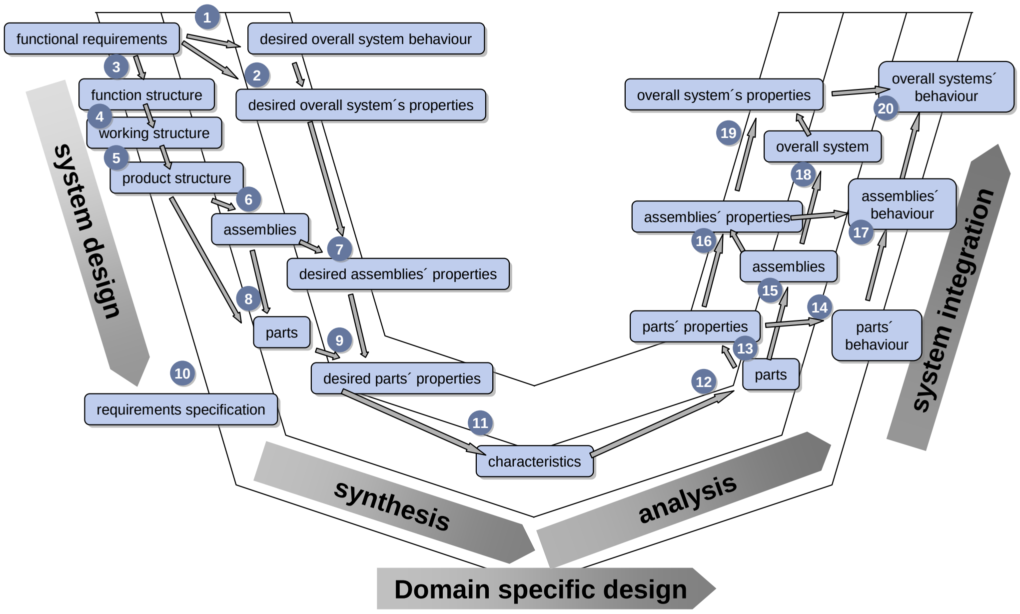

Figure 2: Model for the property based product development

- Step 2: Based on the functional requirements and in consideration of the desired overall behaviour that was deduced in the first step, developers now have to define the required overall-product’s properties. These desired overall-product’s properties are to be regarded as target properties and have to be chosen in a way that under consideration of the mode of use and external conditions the result is a behaviour that is acceptably congruent with the desired one.
- Step 3: Aim of this step is to identify the product’s functions and based on this to determine the corresponding function structure (“Funktionsstruktur”) as it is introduced in [8] or similar as function-model (“Funktionsmodell”) in [9]. This function structure is generated to describe the main functional aspects of the product and to be able to organize and to structure the product that has to be developed.
- Step 4: In the fourth step appropriate working principles have to be chosen with respect to the required product’s functions. These working principles can be combined to the working structure (“Wirkstruktur”) according to [8]. This working structure can be seen similar to the working-model (“Wirkmodell”) as it is described in the product-concretisation-model according to Lindemann [9]. The working structure describes the function structure’s realization by means of physical effects and thus constitutes a specific solution for the functional requirements. Different considered physical effects can be now compared, evaluated and combined to one or more main structures or main concepts.
- Step 5: Starting with the chosen working principles and their structure this step aims at creation of a part structure (“Produktstruktur” [8]) that is similar to the product-concretisation-model’s building model (“Baumodell”) [9]. This part structure is the realization of the chosen working structure and describes the parts of the product as well as their structure.
- Steps 6 &7: In this step the assemblies of the product are defined under consideration of the product structure. Additionally, for each assembly the desired (target) assembly’s properties are to be deduced form the required overall-product’s properties.
- Step 8 & 9: Following the steps 6 and 7 now the parts and their required properties (desired parts` properties) have to be deduced in consideration of the results from steps 2, 5, 6 and 7.

- Step 10: To finish “system design” developers have to define the requirement specification, in which all parts and components are described and their target part properties are defined. This specification has to conform to steps 1-9 and has to integrate all previous results. In contrast to the functional requirements this requirement specification is not solution neutral but is a specific solution that is deemed to be able to fulfil customers´ wishes as well as market demands.
- Step 11: Within this step based on the desired (target) part’s properties the domain specific development can start and the parts can be configured by a purposeful definition of the characteristics. Thus, step 11 represents the step of synthesis.
- Steps 12 & 13: In these steps the actual parts’ properties that result from the definition of characteristics are to be evaluated. Hence these steps represent the analysis. The combination of the steps 11-13 together constitutes the “domain specific design” as it is shown in [7].
- Step 14: Based on the actual parts’ properties the “system integration” is started in this step. Under consideration of later product use as well as the expected external conditions the parts’ behaviour has to be evaluated by domain specific testing and simulation based on the evaluation of the parts’ properties. To assure the fulfilment of customers’ wishes and market demands in this step the parts’ properties as well as the parts’ behaviour has to be compared to the requirements as well as the to required/desired parts’ properties.
- Step 15 & 16: In these steps the parts are combined to assemblies. Additionally the assemblies’ properties are evaluated as it was done in step 12 & 13.
- Step 17: Following step 14, in this step the assemblies’ behaviour has to be evaluated by domain specific testing and simulation based on their properties and under consideration of expected mode of conditions and later product use. Again, this behaviour has to be compared the desired assemblies’ properties to assure a purposeful product development.
- Step 18 & 19: In these steps the assemblies have to be combined to the overall-product and the resulting overall-product’s properties are to be evaluated.
- Step 20: In this step the overall product’s behaviour has to be evaluated based on the actual assemblies’ properties. This has to be done by using domain specific testing and simulation as it is known from step 14 and 17. Finally, to assure a fulfilment of customers’ wishes, this resulting behaviour has to be compared to the desired product’s behaviour as it was formulated in step 1.

To conclude, the process model for the property based product development starts with the definition of the requirements specification which defines the product’s assemblies and the product’s parts as well as the respective properties on both levels. After appropriate definition of characteristics for realization of required part properties, the properties as well as the resulting behaviour are tested on part level, assembly level and overall-product level within the step “system integration”. Several tests and simulations are done to investigate the parts’, assemblies’ and product’s behaviour under certain circumstances and in certain situations. These results have to be summarized and test or simulation results have to be compared to the required product’s behaviour.

3 APPROACHES FOR CAPTURING, MONITORING AND EVALUATING THE PRODUCT DEVELOPMENT

In modern product development there are a lot of contributors engaged in many sub-processes. Those contributors are often merely able to estimate the degree of maturity of their own amount of development work. This hinders a global statement about the progress of the development process and makes reliable statements almost impossible. But the accurate knowledge about the up-to-date progress of product development and about actual achievement of target objectives is essential [10]: By monitoring product development it gets possible to achieve objective statements regarding the progress of the development process and thus to interfere and to stop negative trends as early as possible in case an unsatisfying or insufficient results. There is a diversity of approaches that try to provide a possibility to monitor product development by different procedures. The next subsection dwells on some approaches that were developed to monitor and to supervise product development projects, to track the progress of development processes or to asses the product’s degree of maturity. It is important to mention that this overview can only give a short outline of this field of research and cannot provide a complete review of existent approaches.

[11] introduces an approach for evaluation of product development that consists of fourteen stages, in which the first seven aim at preparation of the assessment and focus on activities as training, selection

of critical components, choice of main indicators, planning dates for evaluation as well as implementation of the data system and preparation of required data bases. The next seven steps (phases 7-14) aim at implementation, followed by an evaluation of current indicators to assess the actual product maturity as well as to predict future target achievement in order to derive trends.

[12] describes an approach to assess the development status based both on an acquisition of product's maturity and on monitoring the development process' progress. By tracking ten different indicators and by comparing their target and their actual state a variable is defined that helps to evaluate product development. To be able to provide a broad approach, three different types of indicators are used: (1) Indicators regarding the "process status" (milestones, accomplished work packages), (2) indicators regarding "documents and workflow" (approved documents and workflow) and (3) indicators regarding the "product maturity" (fulfilled requirements). These three classes of indicators are combined by specific weighting to provide a broad evaluation of the current progress of product development.

[13] introduces a concept of "Product Readiness Level" that is based on the idea of the nine steps of Technology Readiness Level (TRL) that was developed by NASA to assess "flight readiness". Due to the fact that aircrafts often use innovative solutions, the TRL levels 1-5 only assess the technology that is used, while stages 6 to 9 allow evaluating the product. With introduction of steps 10 and 11, Hicks develops an expansion of technology readiness levels to be able to include revision, development of variants and even new operating conditions for the product. [13] also includes aspects of criticality as they are discussed in [14]. Criticality allows classifying the importance of certain technologies for a success of product development and divides this importance in three classes. This criticality is used as a factor for specific weighting when evaluating the technology readiness level of an overall product. Thus, a higher criticality leads to a lower TRL level. By the introduction of the Product Readiness Level based on this idea the statuses of processes in product development are coupled to certain phases of the development process and thus this approach enables a combined evaluation of progress as well as of the product.

[15] develops an approach to monitor development in the automotive sector that wants to cover the whole development process and tries to include the structure of the vehicle. Additionally the dimensions oft the business domain and the supply chain are integrated in the evaluation. In order to address the complexity and variety of relevant aspects of all involved stakeholders, [15] proposes to define part families ("clusters"). Each cluster contains parts that can be evaluated by their stakes using a predefined set of indicators. Due to the fact that each part is connected to exactly one certain cluster, each part is connected with a certain set of five to ten indicators that enables to assess its maturity. Under consideration of influences of joining techniques, based on part maturities and specific weighting the assemblies' and the overall-part's maturity is deduced. Thus, this approach aims mainly at aggregation and presentation of the product's maturity and its dependencies to various stakeholders involved in the process. This procedure assures a transparency in development processes, which is seen as a key factor for successful cross-company project work.

[16] provides recommendations for a monitoring of development projects in context of quality management in the automotive industry. Aim is coordination and standardization of supply chain processes in order to achieve a higher product quality. This approach consists of three phases: (1) initialization, (2) start and (3) control phase, which is a loop of preparation, assessment and implementation. Aim of the initialization phase is to prepare and to create appropriate conditions for implementation of this method and to assess possible risks. This classification of risks allows to classify A-, B- and C-parts and thus to focus on critical aspects and to minimize required resources. [16] recommends monitoring only parts that were classified as A-parts. The approach deals with seven levels of maturity that cover the process from conceptualising (RG0) to start of production (RG7), which can be seen as gates and which indicate a certain progress of the development process. In the beginning the dates are to be defined at that a certain level has to be reached. For each of the seven levels of maturity a detailed list of indicators and corresponding measurement criteria are recommended that have to be answered with "yes" or "no". Based on these statements the corresponding maturity indicator can be coloured green, yellow or red. Even if these checklists allow to asses the status of ongoing development, it has to be noted that these maturity levels rather indicate a certain process status or fulfilment of certain project objectives, than they allow a statement on the actual reached product's degree of maturity.

Another approach that is often mentioned in connection with monitoring is the so-called Capability Maturity Model Integration (CMMI) as it is shown in [17]. CMMI is a collection of reference models to evaluate and to improve process capability levels. One of these reference models addresses product development and aims at improving and structuring product development processes. Since the CMMI aims at a design of product development processes that result in mature product, this approach is often seen as a model to evaluate the product's maturity.

4 THE PRODUCT'S DEGREE OF MATURITY AND THE PROGRESS OF THE DEVELOPMENT PROCESS

In practice and in literature, a certain progress of the development process is often seen as equivalent to a certain degree of maturity of the product being developed. But in fact, the product's degree of maturity that is achieved at a certain progress of the development process has to be evaluated using different sets of indicators than the sets that are used to measure the progress of development processes. This means to be able to monitor the progress of development projects, the development process as well as the product's functionalities has to be kept under surveillance. Both the estimation of the product's degree of maturity and the capture of the progress of development processes is conducted by the use of indicators, which have to provide the possibility of forecasting progressions and trends. Due to the fact that these two terms are often used synonymic, there has to be established a distinction between the terms "progress of the development process" and "product's degree of maturity". In the following section, a short overview and definition of these two terms to be distinguished is given.

Progress of the product development process

As mentioned before a monitoring of product development processes aims mainly at tracing economical parameters just as required time and caused costs. As shown in [5], according to [12] the progress of a development process can be monitored by capturing the amount of accomplished release procedures. Hereby the progress of the process is quantified by comparison of the amount of accomplished released procedures to the number of the release procedures scheduled at that time. Indicators can be released work packages, released documents or for example released CAD-models of parts or assemblies. Another possibility is a monitoring of the number of solved problems in comparison to the number of recognized problems: All appearing problems are captured and their solution is scheduled for a certain date [12], [2].This allows to deduce a statement about the progress of the development process and monitors not only the state of problem solving, but also allows a forecast: By means of the appointed dates for each problem to be solved, it is possible to forecast the amount of solved problems within a certain time in the future. Empirically, a problem is that due to the fact that the amount of problems is increasing also the final value of solved problems is increasing and hence the final target can not be quantified.

The product's degree of maturity

As mentioned before, monitoring the progress of the product development process by means of capturing consumed time and caused costs does not allow any assured statement about the product itself. To assure the quality of the product already during development period, it is essential to supervise and to safeguard the product's degree of maturity separately. As shown and discussed in earlier work the product's degree of maturity can be evaluated by a comparison of the actual profile of properties to the required properties of the product being developed [2], [18]. From this point of view, the product's degree of maturity can be seen as the state of the product that is captured at an arbitrary moment concerning defined indicators [12].

5 APPROACH FOR A MONITORING OF THE PROPERTY BASED PRODUCT DEVELOPMENT

As seen before, the approaches shown before focus on different aspects of monitoring product development: While some approaches focus on monitoring the product's overall criticality, other approaches try to reduce risks by evaluation of critical parts, and some approaches aim at tracing development processes by monitoring development time and caused costs. The proceedings that are proposed by different approaches are as manifold as their objectives. Hence, existing approaches have significant drawbacks in certain aspects: Either they do not cover the whole process from clarification of requirements to the completion of a mature product, or they are not able to track the properties of the product, or they are not able to monitor the overall product as well as its assemblies and parts. Another drawback of some approaches is that they focus only on aspects of the process (cost & time) or only on the product- Additionally they neglect the early phases as well as an integrated monitoring of the development process. Many indicators that are used by different approaches capture data just in terms of controlling time and cost, while really important values that estimate the actual degree of product's maturity are not tracked. But only by monitoring the product's degree of maturity and by comparing it with the progress of the development process an early recognition of aberrations can be obtained. Thus, when safeguarding the product's degree of maturity the progress of the development processes have to be considered additionally. By including the progress of development, not only misjudgements can be avoided, but also an unfortunately established practice can be prevented: Often, near completion of milestones the effort to achieve goals is amplified while quality shortfalls are accepted. In the further progress of the process these arrangements and decisions are detected as not being helpful and are called off, what is equivalent with dropping off of the product's degree of maturity.

Thus there is a considerably need for an approach that manages to monitor product development from the phase of clarification of requirements until a mature product is accomplished. As shown in section 2, focusing on the fulfilment of the required product's properties is recommended in monitoring the product development.

Due to the fact, that each of the twenty steps of the model for property based product development requires different measurement criteria to be evaluated and in consideration that each approach has individual advantages and scopes of application, an approach for the monitoring of the property based product development can be obtained by a purposeful combination of advantageous aspects of different approaches that were shown in section 3.

This section outlines an approach for a broad monitoring of the development process as well as the product's degree of maturity to provide a monitoring of the whole development period. When looking at the process model for property based product development it can be noticed that a monitoring of the product's degree of maturity by comparison of actual and required state of properties according to [12] is limited to late phases of development, thus in phases where the product's properties can be analyzed by testing and simulating. Hence, as depicted in figure 3, the approach to compare required and actual product's properties to monitor the product's degree of maturity can be integrated into the model for property based product development within the steps 13-20. In steps 13, 16 and 19 the actual properties that result from the definition of characteristic can be compared to the required ones on part level, assembly level and overall-product level. In steps 14, 17 and 20 the resulting behaviour of the parts, assemblies and of the overall-product has to be evaluated and to be compared to the required overall systems behaviour that was defined in step 2.

In early phases there is no possibility to evaluate development by comparing required and realized states of properties: Monitoring in early phases requires an approach that proves the quality of each step's target fulfilment. This can be done by checklists that have to be run through in each process step to assure correct execution of each step. By checking each single aspect that has to be considered in execution of these steps, checklists are a purposeful approach for monitoring the fulfilment of the steps 1-11 in the model for property based product development. Additionally, in early steps, for example when creating the functional, the working or the part structure it is purposeful to identify risky functions or working principles as well as critical parts as early as possible and – once they are identified – to track these risks. This can be done by the approach as it is shown in [14] and [13]: By including an assessment of criticality into the checklists for the related steps 3-5 it gets possible to monitor and to track risks and uncertainties in early development stages. Additionally, by identifying critical aspects in development it gets possible to develop and to apply strategies to handle consequences. In step 11 a check is proposed to assure that each functional requirement is realized by an appropriate definition of related characteristics. To identify uncertainties, a classification of criticality for each characteristic allows evaluating the degree of fulfilment of desired and required properties. To be able to evaluate parts and assemblies during ongoing development, a possible approach is to define clusters or part/assembly families and to attach certain pre-defined sets of traceable indicators to each family/cluster. These pre-defined sets of indicators can facilitate the completion of the checklist as well as they can help to chose those properties that are used as indicators for comparison of actual and required properties in later process steps (steps 13, 14, 16, 17, 19, 20). To be able to organize the whole product development process, an integration of milestones at certain process seems to be purposeful. For this purpose, the approach shown in [11] can be used to structure and to prepare the monitoring of the product development. Additionally, in the style of the maturity levels in [16] twelve milestones are integrated in the model for the property based product development (MS1-MS12 in figure 3). Each milestone indicates the fulfilment of an essential step and thus is a condition precedent to proceeding to further development steps. By comparing the current milestone with the milestone that should have been passed at a certain date, it gets possible to identify and to quantify possible delays. The integration of the approaches and ideas into the model for property based product development as it was explained in this section is depicted in figure 3.

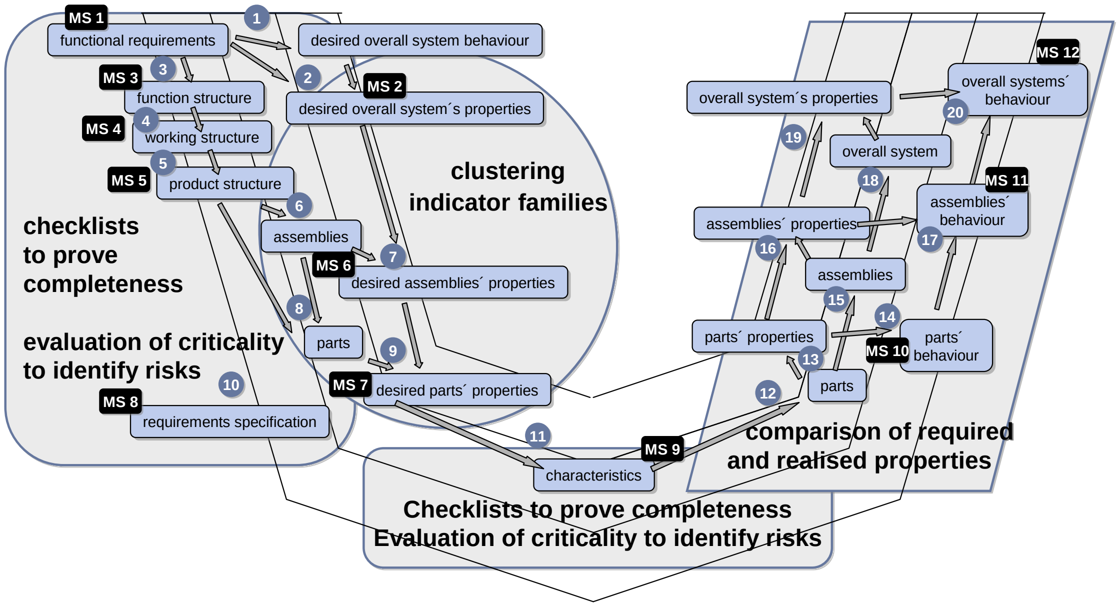

Figure 3: Integration of different approaches to provide a monitoring for the property based product development

Under consideration of their respective advantages and their fields of application, by an purposeful integration of different existing approaches for monitoring, assessing and supervising product development projects, for tracking the progress of development processes or for assessing the product's degree of maturity it gets possible to develop an approach for monitoring property based product development. This approach is able to include the progress of the development process as well as the products` degree of maturity in terms of functionalities, properties and behaviour. In opposition to both complexity and necessary effort, as benefits of this approach can be named the resulting transparency and thus the early recognition of risks, the opportunity to compensate possible aberrations as early as possible and the ability to determine the real state of product development.

6 CONCLUSION AND OUTLOOK

This contribution outlined an approach for a monitoring of the property based product development. After an introduction that dwelled on the motivation for a property based product development as well as on the need of a related monitoring, in section 2 some important terms were de defined. After that a definition of the product's behaviour based on its properties was introduced in section 2.1. With this definition section 2.2 introduced the model for property based product development. Additionally, for each of its steps an explanation was given. In section 3 a short overview on a few existing approaches for monitoring different aspects of product development was given, before section 4 dwelled on the differentiation of the progress of the development process and the product's degree of maturity. Section 5 integrated some different approaches into the process model for property based product development under consideration of their respective fields of applications and advantages. After this, the contribution ends with a short discussion of advantages that are provided by the outlined approach. Objective of further work will be the adaption of the different approaches that are introduced to enable their appropriate use in the context of property based product development. Additionally, their complete integration to provide one single approach that manages to monitor the whole product development period will be the next challenge.

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