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WHAT MAKES ENGINEERING DESIGN SCIENCE "APPLIED"?

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1 Introduction

Engineering Design Science has evolved over the last 40-50 years. The first mention of the term (in German: *Konstruktionswissenschaft*) goes back to [Hansen 1974], but it is today mainly connected with the names of Hubka and Eder [Hubka and Eder 1992, 1996] whose concepts are based on much earlier studies on the theory of artefacts [Hubka 1973, 1984] as well as the theory of creating them [Hubka 1976].

Besides "Engineering Design Science", the term "Design Theory and Methodology" has been used – with the relation between the two sometimes being not very clear. In this paper they are considered synonymous, with the term "Design Theory and Methodology" differentiating between the descriptive and the prescriptive aspects while "Design Science" focuses on their integration.

With first dedicated activities during the late 1950s and the 1960s mainly in Europe (Czechia, Germany, Great Britain, Russia, Scandinavia, Switzerland), Design Science or Design Theory and Methodology, respectively, became an important and interesting research and teaching issue also in Australia, Canada, Japan, and the United States of America. Particularly well known approaches are:

- The "European school(s)" on one hand (represented, besides Hubka and Eder, e.g. by Pahl and Beitz [Pahl and Beitz 1983, 1996] and the 222x series of VDI-guidelines such as [VDI 2221/87] which were all translated into the English language)
- The Theory of Axiomatic Design by Suh on the other hand [Suh 1990, 2001]

Until today, both approaches and models of designs and designing are considered incompatible and rival for supremacy in academia as well as industrial practice.

After all these years, there still is a quite frequent discussion about applying (or rather: the ***lack*** of applying) the findings and recommendations of Design Science or Design Theory and Methodology, respectively, in engineering design practice (e.g. [Birkhofer 1991, Franke 1999, Birkhofer 2005, Marek 2006]). Usually the diagnosis is: Design Theory and Methodology – and here the "European school(s)" in particular – is "too general", "too broad", "too rigid/inflexible", therefore "too time-consuming" for industrial practice. Not all of the criticism is justified, but the basic message must be taken serious.

In principle, only [Hubka and Eder 1992, 1996] dedicate substantial parts of their book to the difference between "General Design Science (GDS)" and "Specialised Design Sciences (SDS)"; as

the focus of the book is different (how to *arrange knowledge* within particular application fields and for particular recipients) only few instructions on the transition between the two are given, however. Some very general considerations and hints can also be found in [VDI 2221/87].
The task of developing and propagating “Specialised” or “Applied” Engineering Design Sciences was the main driver for the formation of the AEDS group in Pilsen, Czech Republic, in 1992 which today is a Special Interest Group (SIG) of the Design Society.
This contribution is based on a still relatively new approach to modelling products and product development processes – called “Characteristics-Properties Modelling” (CPM) and “Property-Driven Development” (PDD), respectively. In the last couple of years the CPM/ PDD approach has been confronted with a variety of questions in order to check, improve, maybe altogether falsify it:

- CAx architectures (including PDM/PLM) [Weber and Werner 2000, Weber and Deubel 2003, Weber et al 2003, Weber 2005]
- Control of product development processes (including evaluation) [Weber 2005, Deubel et al 2005, Deubel 2007]
- Development of Product-Service Systems (PSS) [Weber et al 2004a, 2004b]
- Design for X (DFX) [Weber and Werner 2001, Weber 2007]
- Measuring the (degree of) product maturity during product development [Weber 2007]

In this contribution the CPM/PDD approach is used to present new answers to the question “What makes Engineering Design Science ‘applied’?”.
CPM/PDD was explained in a couple of earlier publications (most recently in [Weber 2005, Weber 2007]), a book is in preparation. In order enable reasoning about application aspects of Engineering Design Science on that base it is, however, necessary to give a brief recapitulation of the fundamentals of the CPM/PDD approach first.

2 Basic approach to product and process modelling: Characteristics-Properties Modelling (CPM) and Property-Driven Development (PDD)

2.1 Fundamentals

The CPM/PDD approach stands in the tradition of “Design Theory and Methodology” (DTM). It has the following goals:

- To build upon and consolidate the results and the knowledge created in design theory and methodology so far. This includes concepts originating in Europe (e.g. [2-5]) and in the USA (e.g. Axiomatic Design [6, 7]).
- To integrate many existing models and strategies into a common framework (e.g. DfX, as will be discussed).
- To explain some still open theoretical and practical questions.
- To re-define the role of computer (but also other) methods and tools in product development based on a more solid scientific foundation, thus giving concrete hints for the further development of methods and tools.
- To bring design theory and methodology closer to the way practitioners think and proceed in product development.

Characteristics-Properties Modelling (CPM) is the ***product*** modelling side of the new approach. Based on this, Property-Driven Development (PDD) explains the ***process*** of developing and designing products.
Both are mainly based on the distinction between characteristics (in German: “*Merkmale*”) and properties (“*Eigenschaften*”) of a product:

- The ***characteristics*** (formally denoted $\mathbf{C_i}$ later on) describe the structure, shape, dimensions, materials and surfaces of a product ("*Struktur und Gestalt*", "*Beschaffenheit*"). They can be directly influenced or determined by the development engineer/designer.
- The ***properties*** ($\mathbf{P_j}$) describe the product's behaviour (e.g. function, weight, safety and reliability, aesthetic properties, but also things like "manufacturability", "assemblability", "testability", "environmental friendliness", cost). They can ***not*** be directly influenced by the developer/designer.

The characteristics are very similar to what is called "internal properties" in [Hubka and Eder 1996] and what in [Suh 1990, 2001] is called "design parameters". The properties as introduced here are related to the "external properties" as defined by [Hubka and Eder 1996] and to "functional requirements" according to [Suh 1990, 2001].

For reasons not to be discussed here the author of this paper still sticks to the nomenclature "characteristics" and "properties" (or *"Merkmale"* and *"Eigenschaften"* in German) which originally goes back to M.M. Andreasen of the Technical University of Denmark.

To be able to handle characteristics and properties – literally thousands of them in complex products – and to keep track of them in the development process they have to be structured. **Fig. 1** shows the basic concept as it is discussed in CPM/PDD:

- On the left of fig. 1 a fairly obvious proposition for the (hierarchical) structuring of characteristics is given following the parts' tree of a product. It complies with usual practice, but also links our considerations to data structures of CAX-systems. Different criteria of structuring characteristics are theoretically possible, but not discussed here.
- On the right of fig. 1 a proposition for the top-level "headlines" of structuring properties is presented which is based on criteria determined by the typical product life phases but at the same time reflects frequently discussed issues in product development/engineering design. Again, different methods of structuring properties (different "headlines") could be theoretically imagined, but are not discussed here.

  Of course, also the properties should be structured more deeply by further decomposition. The author is, however, convinced that the further structuring of properties as well as their importance are always specific to individual industries (product classes), often even specific to individual companies and are even time-dependent.

  The question of which properties are relevant and how they are structured will be the first issue when answering the question of this article "What makes Engineeering Design Science 'applied'?".

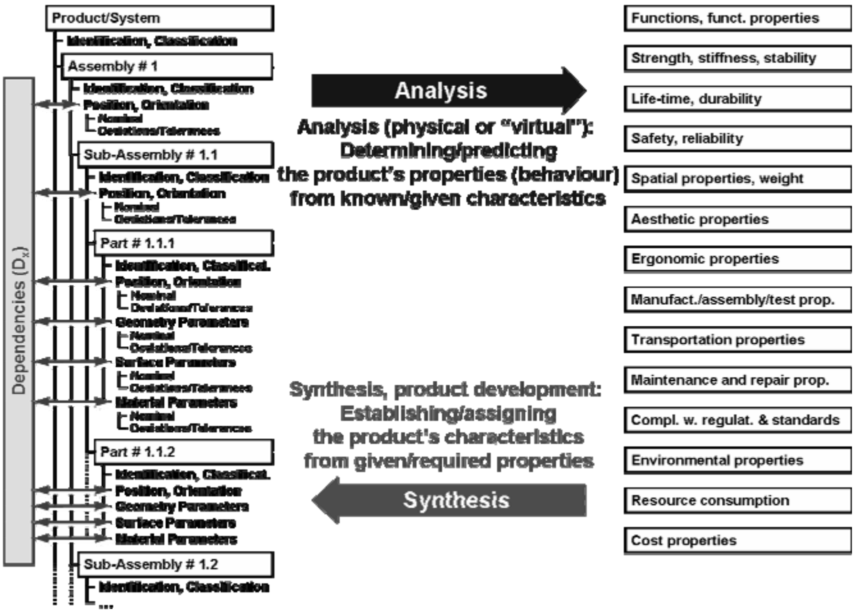


Fig. 1. Characteristics (left) and properties (right) with analysis and synthesis as the two main relations between the two

On the characteristics (left) side of fig. 1 an additional block is drawn which represents dependencies (formally called $\mathbf{D_x}$) between characteristics. Any development engineer/designer is very familiar with these dependencies, e.g. geometric or spatial dependencies (which today can be captured and administered by parametric CAD-systems), but also concerning fits, surface and material pairings, even conditions of existence.
Finally, fig. 1 introduces the two main relations between characteristics and properties:

- ***Analysis:*** Based on known/given characteristics (structural parameters) of a product its properties are determined (its behaviour is determined), or – if the product does not yet exist in reality – predicted. Analyses can, in principle, be performed by experiments (using a physical model/ mock-up or a prototype) or "virtually" (by calculation and/or using digital simulation tools).
  Sometimes – in particular industries and/or in particular companies – there are specific procedures to analyse certain properties (e.g. assessing passenger and pedestrian protection of motor cars by applying the Euro-NCAP [European New Car Assessment Program] or analysing the durability of components by company-defined test procedures).
  The question of applying pre-defined analysis procedures will be the second issue when answering the question of this article.
- ***Synthesis:*** Based on given, i.e. required, properties the product's characteristics are established and appropriate values are assigned. Synthesis is the main activity in product development: The requirements list is in principle a list of required properties and the task of the development engineer/designer is to find appropriate solutions, i.e. an appropriate set of characteristics to meet the requirements to the customer's satisfaction. Of course, the requirements list may already contain characteristics, but then it predefines certain solution patterns, i.e. specific partial sets of characteristics, right from the beginning (at least implicitly).

In the CPM approach (as well as in PDD based upon it) analysis and synthesis as the two main relations between characteristics and properties are now modelled in more detail, in principle following a network-like structure. **Fig. 2 and fig. 3** show the two basic models for analysis and synthesis, respectively. In order to keep considerations simple, both on the side of the characteristics (**C_i**) and on the side of the properties (**P_j** or **PR_j**, respectively) a simple list (or vector) structure is displayed.

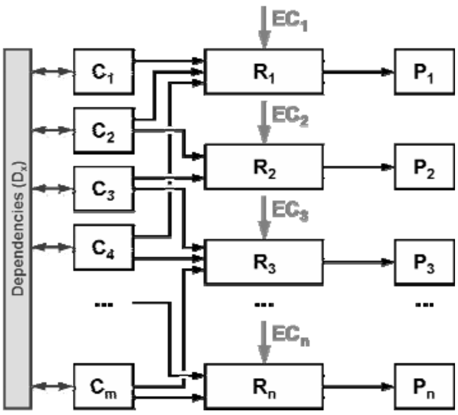


Fig. 2. Basic model of analysis

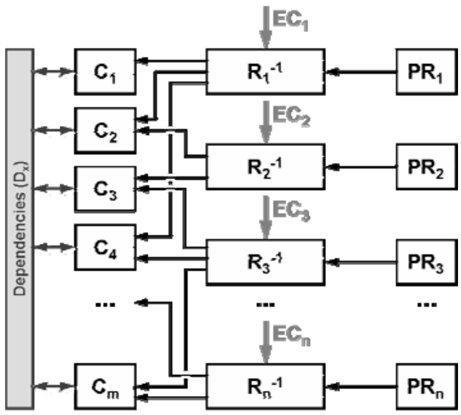


Fig. 3. Basic model of synthesis

The expressions used in figs. 2, 3 and in all subsequent figures have the following meaning:

C_i:	Characteristics ("*Merkmale*")
P_j:	Properties ("*Eigenschaften*")
PR_j:	Required Properties
EC_j:	External conditions
R_j, R_j^{-1}:	Relations between characteristics and properties
D_x:	Dependencies ("constraints") between characteristics

2.2 Analysis

Models, methods and tools to realise the relation-boxes (**R_j**) shown in fig. 2 can be based on physical objects (phys. models, phys. mock-ups, prototypes of components or the whole product, components or product in finalised state) or non-physical models (mental models, mathematical or graphical models, computer models). Roughly sorted from "soft" to "hard":

- Guesswork, estimation
- Experience
- Interrogation (e.g. customers)
- Physical tests/experiments
- Tables, diagrams (= formalised experience & experimental knowledge)
- Conventional/simplified calculations
- Computer tools

Note that computer tools can be based on many different concepts: physical models turned into mathematical models and numerically solved (the most common case), but also rule-based strategies, "fuzzy logics", semantic or neural networks, case-based reasoning, etc.

Once the product exists (i.e. when the product's characteristics **C_i** are physically realised) and operates, the analysis of its properties/behaviour (**P_j**) according to fig. 2 can be performed by testing and measuring. In this case the product itself is the representation of the relations (**R_j**).

During product development, however, when there is not yet a finished product, its properties can only be analysed by means of appropriate methods and tools which are based on (physical or non-physical) models. They are exactly what the relation-boxes (**R_j**) in fig. 2 stand for; their purpose is to tell about the influences of relevant characteristics (**C_i**) on the respective properties (**P_j**), thus ***predicting*** the properties given at that moment.

Using computer models and tools to model a product and analyse its properties is today called "virtual product (modelling)", see [Spur and Krause 1997]. Against the background of the CPM approach, the ***completely virtual product (model)*** can now be defined as an approach where computer tools are used to ***determine/predict all relevant properties*** of a product which, consequently, does not have to exist (yet) in the physical world.

The basic product model according to fig. 2 (and also fig. 3) displays one more element: The determination/prediction of every product property via an appropriate model, method and tool must be performed with respect to certain external conditions (**EC_j**). They define the framework in which the statement about the respective property is valid (e.g. load conditions when assessing mech. strength, manufacturing conditions for analysing manufacturability, etc.).

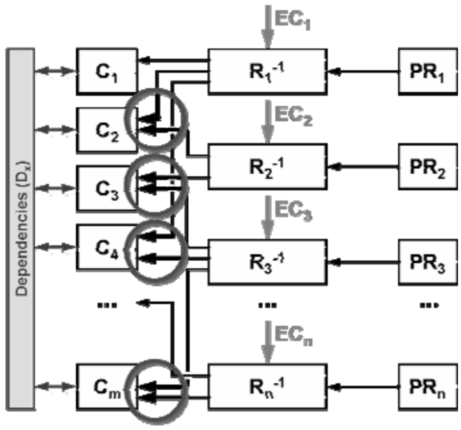
2.3 Synthesis

Looked upon from a formal point of view, synthesis is "just" the inversion of analysis (figure 3): Based on given properties – which are now ***required properties*** **PR_j** – the product's characteristics (**C_i**) are to be established and/or assigned.
In engineering, the only way to do synthesis is to use appropriate methods and tools which the "inverted relation-boxes" (**R_j^{-1}**) in fig. 3 stand for. Again sorted from "soft" to "hard":

- Human genius (= quick association?)
- Association – technical or biological patterns ("bionics")
- "Experience" (= association based on past cases?)
- Catalogues, standard solutions
- Collection of rules
- Methodical/systematic approaches (combining several of the above)
- Inverted conventional/simplified calculations
- Computer tools

Even the most simple synthesis model shown in fig. 3 displays the nature of conflicts, **fig. 4**: Different required properties demand the same characteristics to be determined differently.

Fig. 4.
Conflicts in synthesis: Different properties try to establish/assign the same characteristics differently



2.4 Solution patterns, solution elements

The definition and utilisation of solution patterns, solution elements, etc. is extremely important in practical product development/design. The (re-) use) of solution elements/patterns can serve different purposes:

- Limiting risk (by using proven and tested elements)
- Easing and speeding up development/design
- Re-using knowledge, standardisation
- Enabling product modularisation

Seen from the perspective of the CPM approach introduced here, a solution pattern is nothing else than an aggregation of characteristics (**C_i**) ***and*** properties (**P_j**) with known relations (**R_j**) between the two, **fig. 5**. In this context, the use of solution pattern/elements is also attractive for another reason: If characteristics (**C_i**), properties (**P_j**) and relations between them (**R_j**) are all known, then this "knowledge" can be used in ***both*** directions, i.e. for analysis as well as for synthesis (e.g. searching for solution elements/patterns with required properties as an entry point).

Solution patterns can also be stored in computers: Variant programmes, pre-defined features and feature libraries and – as a quite recent extension of CAD making even a bigger step from the characteristics to the properties side – "Knowledge-Based Engineering" (KBE) are nothing else than digital representations of solution elements/patterns as introduced here.
The use of certain proven and tested solution patterns is the third issue to be addressed when answering the initial question of this article.

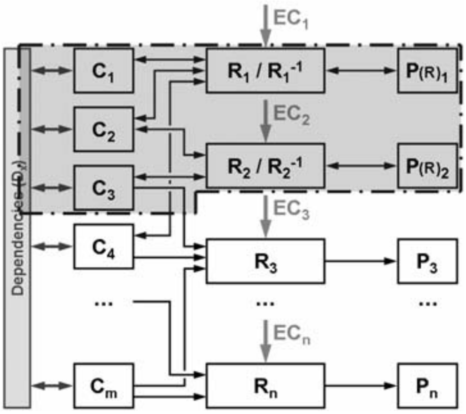


Fig. 5.
Schematic representation
of a solution element/pattern

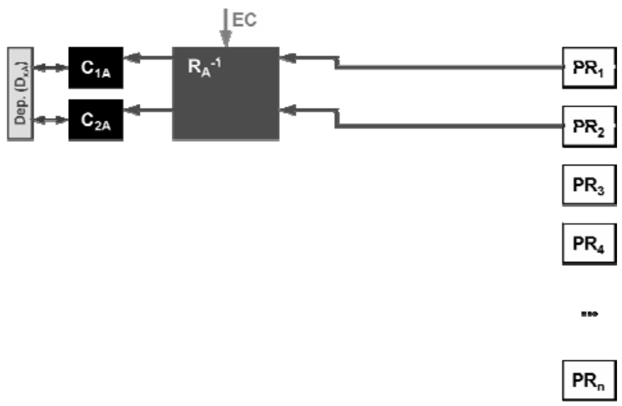
2.5 Property-Driven Development (PDD)

Based on the considerations on the new approach to modelling products (CPM, sections 2.1 to 2.4), now the consequences for the modelling of product development processes are presented. The product development process can be seen as an activity which, in principle ("strategically"), follows the synthesis model according to fig. 3 but has in between ("tactically") many analysis steps according to fig. 2. During the process – in every synthesis step – ever more characteristics of the product are established and their values assigned, in parallel – by means of the analysis steps – ever more and ever more precise information of the product's properties/behaviour is generated.

Fig. 6 gives a schematic overview; for reasons of space, only the first synthesis-analysis-evaluation cycle ("cycle A") is shown. It runs as follows:

- The product development process starts with a list of requirements. This list is in PDD represented by the required properties (**PR_j**, *Soll*-properties). In step 1 (synthesis step) the development engineer/designer starts from some of the properties and establishes the first set of characteristics (**C_i**) of the future solution. This is often done by adopting partial solutions known from previous designs (= solution elements/patterns, see fig. 5).

1 Synthesis



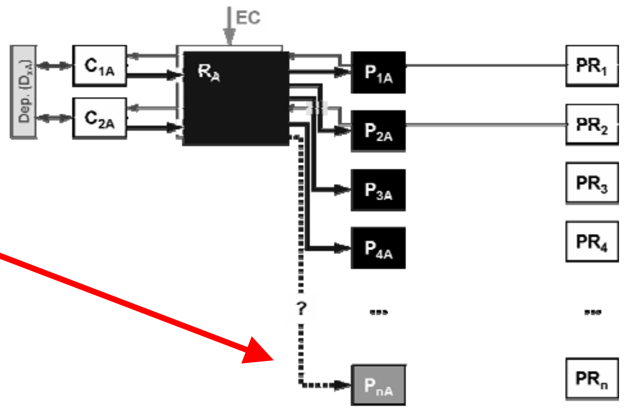
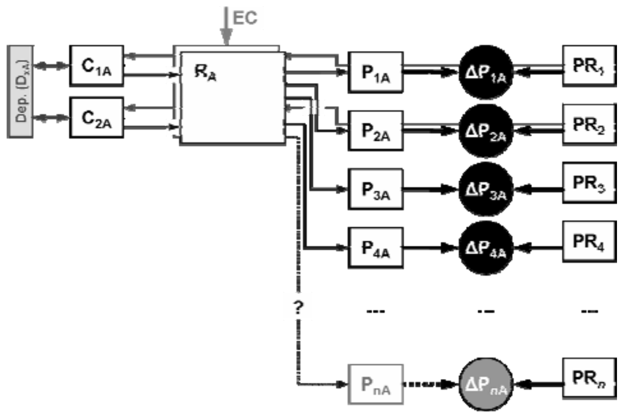
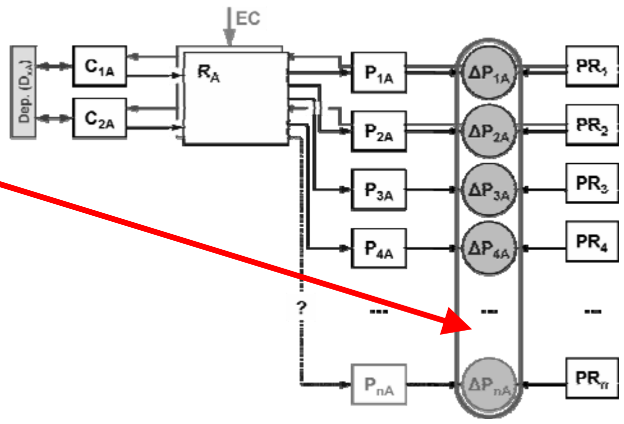
2 Analysis Notes: – Always all properties are analysed, including those that did not stimulate the initial synthesis step(s) – In early stages, however, it may not yet be possible to determine all properties	
3 Individual deviations Note: During the process it may be necessary to modify the requirement (**RP**$_j$), e.g. in order to consider additional properties that only come up later	
4 Overall evaluation Note: Results of overall evaluation are actual driver of the process	

Fig. 6. PDD-scheme of steps in the first cycle ("cycle A") of product development

- In step 2 the current properties (**P**$_j$, *Ist*-properties) of the present solution state are analysed, based on the characteristics currently established. In this analysis step not only those few properties, which went into the first synthesis step, are considered, but all of the relevant properties (if possible – if there are too few characteristics defined yet, then it may be difficult to reason on some of the more complex properties).
- Next (step 3), the results of this analysis are used to determine the deviations of the individual *Ist*-properties against the required (*Soll*-) properties, the result of the comparison (Δ**P**$_j$) representing the shortcomings of the current design.

- The development engineer/designer now has to run an overall evaluation (step 4): Extract the main problems and decide how to proceed, i.e. pick out the property or properties to attack next and select appropriate methods and tools for the subsequent synthesis-analysis-evaluation cycle.

All subsequent cycles of product development/design (B, C, …) are analogous, but not explicitly shown in fig. 6 anymore. From one cycle to the next as a result of each synthesis step ever more characteristics are established and their values assigned (= “detailing” the structural description of the solution). The analysis steps of all cycles basically all deal with the same properties over and over again – but with a modified and/or extended set of characteristics.

In consequence, the analysis methods and tools have to switch from rough to ever more exact ones enabling an ever more precise determination/prediction of properties along the process (or, in the terminology of the C-K theory presented by [Hatchuel and Weil 2003]: generating increased “knowledge” about [the behaviour of] the solution).

The product development process itself is controlled (driven) by the overall evaluation of the current “gap” between *Soll*- and *Ist*-properties at the end of each cycle.

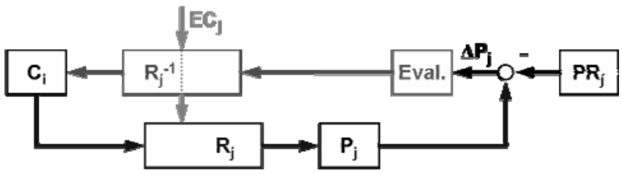
In a strongly abstracted representation, the product development process can be seen as a control circuit, **fig. 7**, where

- the required properties ($\mathbf{PR_j}$) are equivalent to the reference value,
- the actual/current properties ($\mathbf{P_j}$) are both output and feedback value,
- current deviations between required and as-is properties ($\mathbf{\Delta P_j}$) correspond to the current “error”,
- the characteristics ($\mathbf{C_i}$) are analogous to the input value and where
- the external conditions ($\mathbf{EC_j}$) play the role of disturbances (which is a quite “interesting” analogy!).

In terms of the structure of the control circuit

- the synthesis methods and tools ($\mathbf{R_j^{-1}}$) act as the “actuator”,
- analysis methods and tools ($\mathbf{R_j}$) are the “sensors” and
- the overall evaluation of current deviations between required and as-is properties (called “Eval.” in fig. 7) plays the role of the control unit.

Fig. 7.
Abstract representation of product development as a control circuit



The sequence of cycles of the product development process is the fourth issue to be addressed when answering the question of this article as in a particular application area (e.g. a particular branch of industry and/or a particular company) there may be certain proven and tested – maybe even “certified” - process patterns.

2.6 Termination of the product development process

The product development/design process terminates if and when

- all characteristics needed for manufacturing and assembly of the product are established and assigned ($\mathbf{C_i}$),
- all (relevant) properties can be determined/predicted ($\mathbf{P_j}$),
- with sufficient certainty and accuracy, and
- all determined/predicted properties are close enough to the required properties ($\mathbf{\Delta P_j} \rightarrow \mathbf{0}$).

3 What makes Engineering Design Science "applied"?

Based on the approach of Characteristics-Properties Modelling (CPM) and of Property-Driven Development (PDD) describing and prescribing product modelling and product development processes, respectively, we can now come back to the initial question of this contribution. As indicated by the bold paragraphs in the previous sections, four main issues can be named to transfer the "general theory" of CPM/PDD into an "applied science". These will be explained in more detail in the following sub-sections.

3.1 Relevant properties

In the general description of the CPM/PDD approach only the "top headlines" for typically relevant product properties ($\mathbf{P}_j$) can be stated (e.g. function, safety, manufacturability, cost, etc.). The author is convinced that it is impossible to decompose these further in general terms as sub-functions, sub-aspects of safety, etc. strongly depend on the type of product (the branch of industry) involved. Additionally, the weighting of properties and sub-properties is not only dependent on the branch of industry, but also varies from one company to the next.

Therefore, the first step towards an applied Engineering Design Science is to define, structure and weigh the properties relevant in the particular area of application.

Additional remarks in this field (which can also give hints for innovation) are:

- Compared with the state-of-the-art new properties may be introduced – either for reasons of external pressure (e.g. legislation, competitors, market changes) or in order to go for enhanced products (e.g. new functional, safety or technological features).
- Also new concepts of weighting the defined properties and sub-properties can be introduced in order to open new market segments (e.g. "high precision", "high reliability" opposed to "low price").

3.2 Analysis procedures

As was already mentioned in section 2.1, in a particular application area there are often dedicated procedures, methods and tools to analyse certain properties of the product ($\mathbf{R}_j$). In order to proceed from a "general" to an "applied" Engineering Design Science they have to be defined and structured. When doing so, the following aspects play a role:

[1] Analysis is usually done with regard to one or more properties. Therefore, the analysis methods and tools must correspond with the properties regarded relevant in the previous step. In practice, this argumentation sometimes is reversed as software vendors try to sell tools they have which may not exactly address the set of properties relevant in the particular application area.

[2] In all cases, the term "analysis methods and tools" ($\mathbf{R}_j$) – explicitly or implicitly – includes certain external conditions ($\mathbf{EC}_j$). It must be checked whether the external conditions behind all analysis methods and tools correspond with the actual external conditions relevant in the application area. Again, this might be a problem with off-the-shelf tools.

[3] As was outlined before, in a particular application area all analysis methods and tools basically all deal with the same (set of) properties over and over again. But for early stages we need methods/tools which deliver results from a small number of characteristics for the price of limited accuracy, while for later stages different methods/tools are needed which can deal with all the details (= big number of characteristics) and from which we expect highly dependable results.

Therefore, besides structuring analysis methods/tools according to the property/properties they address and the external conditions they imply, they should be structured according to number of characteristics they need as inputs, i.e. according to the stage of product development they are applicable in.

Some additional remarks, this time addressing the development of methods and tools (in academia and in software development):

- An important field of innovation is finding analysis methods and tools for (“old” or “new”) properties or sub-properties which before were impossible or difficult to assess. This approach probably offers large opportunities because – as indicated above – the set of relevant properties and sub-properties is industry-, even company-specific; it must be seen, however, that this situation also makes the numbers of possible applications of a specific method or tool very small and economically un-attractive for commercial developers.
- Another innovation trend is to find analysis methods and tools which can predict certain important properties earlier in the process (i.e. based on a smaller number of characteristics) than existing methods/tools; a nice (however difficult) example is early cost-prediction.
- A development running already for a long time, but still not finished is establishing “cheaper” and/or “quicker” analysis methods and tools – which today usually means substituting experimental methods by computer tools.
- Finally, changing to computer-based analysis methods and tools very often also means to offer enhanced precision (for early as well as later stages of the product development process).

3.3 Solution patterns/elements

In a particular application area (i.e. in a particular branch of industry and/or in a specific company) usually certain proven and tested solution patterns/elements are implied for several purposes (limiting risk, ease and speed-up of the development/design process, re-use of knowledge and standardisation, product modularisation). In order to come from a “general” to an “applied” Engineering Design Science it is, therefore, necessary to collect and structure relevant solutions patterns for systematic re-use.

As was explained in section 2.4, in the view of the CPM/PDD approach solution patterns/elements are aggregations of characteristics (**C_i**) ***and*** properties (**P_j**) with known relations (**R_j**) between the two; they can be used in ***both*** directions, i.e. for analysis as well as for synthesis.

In general terms, solution patters/elements can be certain solution principles or organs [Hubka 1973, 1984, Hubka and Eder 1992, 1996] (not necessarily all related to functional properties: there are also principles/organs which serve safety, manufacturing, assembly and other purposes), but can also be detailed partial solutions. Collections of relevant solution patterns/elements could be catalogues, but today are increasingly “realised” in form of digital libraries (in terms of CAx called “parts libraries”, “feature libraries”, or “templates”).

The problem with these digital libraries has been that only the characteristics side of the respective solution patterns is explicitly represented (e.g. geometry, parts structure) and that the properties side (as well as the relations between characteristics and properties) is missing. Therefore, neither the synthesis-oriented search for suitable solution patterns (from required properties to characteristics) is supported, nor can the reasoning behind a specific selection be documented in the CAx model.

Only recent CAx developments, under the term “knowledge-based engineering” (KBE), display extended approaches which can represent and even control the characteristics side of “knowledge” about solution patterns by externally represented relations to certain required properties.

3.4 Process patterns

Finally, in a particular application area (i.e. again: in a particular branch of industry and/or in a specific company) a certain sequence of cycles (= process patterns) of the product development process can be defined in order to come from a “general” to an “applied” development

procedure. Such a result is, in fact, often the main outcome of so-called (business) process re-engineering activities.
Seen from the perspective of CPM/PDD, however, it is very doubtful whether the definition of an application-specific product development process ***alone*** is of any significance because the sequence of cycles

- is dependent on the (sequence of) properties considered and
- is – at the end of each cycle – controlled by the overall evaluation of the current deviations between *Ist*-properties and required (*Soll*-) properties.

Moreover:

- The analysis of *Ist*-properties is dependent on the methods and tools and applied, and
- the number of cycles necessary to come to the final solution is dependent on the structure and use of solution patterns/elements.

Therefore, seen from the perspective of the CPM/PDD approach, process patterns as defined here can only be considered based on the results of, i.e. ***after*** running through the three aspects explained in the previous sub-sections 3.1 to 3.3.

4 Conclusions

Based on the approach of "Characteristics-Properties Modelling" (CPM) and "Property-Driven Development" (PDD) which was developed by the author and his team and which gives a new perspective on modelling products and product development processes, this contribution tries to give answers to the question "What makes Engineering Design Science 'applied'?".
The proposals are meant to spark off discussions among experts from academia and industrial practice (hopefully primarily ***between*** representatives of the two fields) – especially within the framework of the Applied Engineering Design Science (AEDS) Special Interest Group located in Pilsen, Czech Republic.

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