Choosing an adequate level of detail in business process modelling

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Abstract: It is a basic matter of business process modelling to determine an adequate level of model detail, a problem which also can be derived from the guidelines of modelling by Becker et al. [BRU00]. In literature, only few recommendations how to solve this problem can be found. In addition they are quite unspecific and have gaps. In this paper, we investigate which measurable factors influence the adequate detail level, and on this basis make proposals for guidelines how it can be determined in a specific application situation.

1 Motivation

According to Becker et al. [BKR03, 4] a process is „a completely closed, timely and logical sequence of activities which are required to work on a process-oriented business object. (…) A business process is a special process that is directed by the business objectives of a company and by the business environment.“ A process model helps in abstracting the real business matter for certain modelling purposes [Ro96, 17]. To model processes, a number of graphic modelling techniques are available, having a fixed defined set of rules and regulations concerning the design of the models each. The most important are the event-driven process chain (EPC), the extended event-driven process chain (eEPC), the Business Process Modelling Notation (BPMN), the activity diagrams of the Unified Modelling Language (UML), Petri nets and the PICTURE method [Ga10, 71]. By using these methods a modelling can be carried out at different levels of detail (LOD). As a conclusion, there is the question how detailed a process should be modelled. This question also results from the guidelines of business process modelling as defined by Becker et al. [BRU00]. The principle of relevance leads to the question, to which extent the modelling in relation to the modelling purpose in mind is to be carried out. Here, the principle of efficiency stands in the way as a limiting factor, which says that the necessary efforts to create a model have to be in an appropriate relation to the benefits of the model. Becker et al. [BRU00] clearly state that their modelling guidelines are rather general and require further refinement.

In the literature concerning process modelling an adequate LOD is often demanded without giving a concrete recommendation how this LOD should be determined [TNW12, 54]. In most of the cases only information about the hierarchical subdivision of processes into refined sub-processes can be found. The terms ‘detail level’ and ‘hierarchy of process models’ are often used synonymously. Other possible aspects of detailing, such as additional information objects or the enrichment of process elements with attribute information are rarely subject of discussion. To the best of our knowledge, a comprehensive work dealing with the detailing problem is not available. Today it is one of the central problems of process modelling to choose the adequate level of model detail, a fact that is also confirmed by a study investigating current problems and future challenges in business process management [IRR09, 9]. Therefore, this contribution deals with the following two research questions: 1. Which factors may influence the adequate LOD of business process models (BPMod)? 2. How can the adequate LOD of BPMod be determined?

2 Data and methodology

A model is an artefact in the sense of Hevner [Hev04]. In our research process we refer to the Design Science Research (DSR) Methodology Process Model (Fig. 1) of Peffers et al. [PTR07, 54], which is widely accepted. By means of the artefact created it shall be possible to choose the correct detail level of the process modelling in an application situation. We demonstrate the applicability and the usability of the artefact by using it in an exemplary scenario. The broader evaluation of our proposal will have to be left to future work. This article is our intention to communicate the so far results to the scientific community.

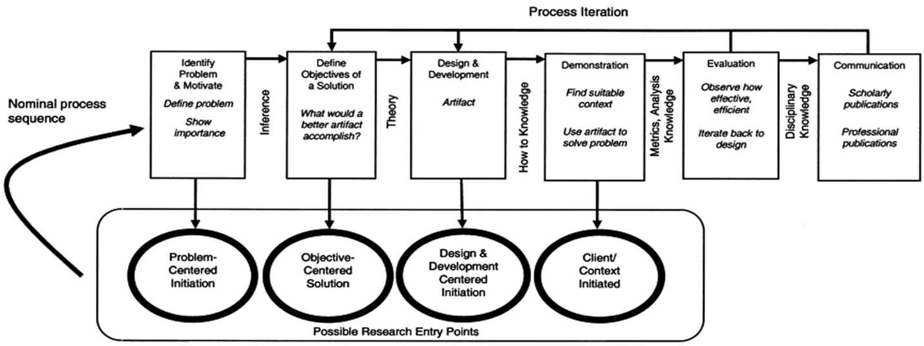

Fig. 1: DSR Methodology Process Model after Peffers et al. [2007, 54].

A literature analysis according to the procedure proposed by Fettke [Fe06] was carried out as a basis for our design plan. For this, books, journal and conference articles with a focus on process modelling, respectively process management, were analyzed. As a starting literature, relevant textbooks for process management such as Allweyer [Al09], Becker et al. [BMW09] and Gadatsch [Ga10] and for business information technology such as Ferstl and Sinz [FS13] and Heinrich et al. [HHR11] were chosen. Furthermore, the keywords „detail level“, „abstraction level“, „granularity“, „detailing“ and „abstraction“ as well as „business process“, „business process modelling“, „process“ and „process modelling“ where taken for a detailed search in data bases and scientific search engines. The German equivalents were used as well. Next to journals and proceedings being A-classified in the business information systems rankings of VHB and WKWI, the following databases and search engines were consulted as well: ACM Digital Library, AISeL, Bielefeld Academic Search Engine, EBSCO, Gemeinsamer Verbundkatalog (GVB), Google-Scholar, IEEE Xplore, Ilmenauer Discovery Tool, catalogue of the library of the University of Ilmenau, Scirus, Springer Link, Web of Knowledge. In this phase, at first only the headlines and, if necessary, the abstracts were used in order to limit the result to relevant hits only. The then following reading of the table of contents, abstracts, summaries or even complete texts further narrowed down the results. In addition, a forward and backward search according to Webster & Watson [WW08] was carried out with the aim to find further sources by using the literature already identified. Then the relevant sources found were analysed and interpreted.

3 Preliminary considerations concerning the level of model detail

A generally accepted definition of the term LOD cannot be found in literature [BT96, 5]. None of the currently existing definitions of the LOD covers it completely. Here, the detail level is to be understood as a characteristic of BPMod, which shows the extent, respectively the granularity of the modelling. A practical visualisation of different LODs is the process hierarchy, which however should have a vertical content-related consistency. Characteristics of the LOD are the process depth, the process width, the process length, the content of information and the attribution [Ro96, 71-84, 132-133].

The process depth describes to how many levels a process model was disaggregated and specified until the desired detailing is reached. The process width describes which states of the system are covered by the model. If the number of modelled special cases increases, the process width rises. The process length is the size of a process model under the condition that process width and process length remain constant. If the process length is too big, it may happen that the process model shows too many details and therefore becomes confusing. But if the process length is too small, important information may not be included. Furthermore, the information content in process models can be further specified. Herewith process models can be further refined with information objects such as organisational units. By means of attributes, process models as well as the information objects can be further specified.

Not all aspects of this definition are equally relevant for the development of a model to determine the adequate LOD. Only the process depth and the process width are completely relevant. A statement about the information content, the process length and the attributes of a model cannot be given precisely. Information objects for example can contain organisational units and by means of attributes these may be enriched. Attributes can be attached to information objects as well as complete BPMod [Ro96, 133]. The investigated objects are not build on one another and therefore a gradation of them is not recommended [TNW12, 63]. For these reasons it is only possible to give hints to the potential information objects and attributes.

Furthermore, the LOD has to be limited adequately, for example dependent on the purpose of modelling [TNW12] [SS08] [BRU00]. An adequate LOD is the solution of a certain process modelling task with the help of a suitable refinement level. To determine the adequate LOD, a top-down approach is useful. This means that models have to be further specified until the LOD needed is reached. The reason why a bottom-up approach is not taken, is that in this case all existing BP of a company have to be modelled on a high LOD first [SS13, 140-142], which could already exceed the LOD needed. Furthermore, the vertical content-related consistency can better be ensured by a top-down approach, as the detailing of the BP is raised gradually. In addition, the relevance and the relation of the respective BPMod to the company are easier to comprehend by means of a gradual refinement.

In literature there are already approaches that intend to identify the correct LOD [Ga83, 65-75] [BR98, 212-219]. The 'problem-oriented approach' concentrates on those areas where problems arise and tries to solve them with the help of BP modelling. The existing problems are initially too complex for a solution approach. Therefore they have to be detailed into sub-problems and to be narrowed down. The detailing has to be continued until concrete measures to solve the problem are possible to take. This approach has the disadvantage that the measures developed to solve the problem may perhaps not cover some parts of the BP and therefore a complete examination and modelling of the BP is not performed. The 'goal- oriented approach' focussed on business goals. Such goals can for example be a reduction of lead time, an optimization of capacities or a reduction of the productions costs. These goals are further specified until concrete measures how to achieve them can be developed with the help of BPMod. In case of the goal-oriented approach only those parts of BP are covered that contribute to the achievement of the goals. As a conclusion, this approach as well as the problem oriented approach involves the risk that BP are modelled incompletely.

4 Factors influencing the adequate level of detail

4.1 Professional criteria

The following professional, respectively content-related criteria were identified to have an impact on the adequate LOD of BPMod:

Structuring: Processes are foreseeable at different degrees, and the resulting models vary in size. Highly structurable BP make it possible to outline the sequence with a high LOD. Weakly structurable BP make it necessary to model the BPMod with a rather lower LOD, as deviations and uncertainties exist [Al09, 65-66].

Repetitiveness: For processes that are carried out often, a rather higher LOD can be strived for than for processes that are carried out rarely. It is easier to find for example improvement potentials when using a high LOD in case of a high repetitiveness [FL97, 29-30] [Al09, 67-68].

Automation: It is necessary to have a high LOD of the modelling, when an automated running of a BP is intended [TNW12, 61]. The more human interventions are necessary, the more this professional criterion tends to be manual and as a conclusion the adequate LOD connected to it decreases.

Modification frequency: Models may have to be changed, for example due to new technologies, changing customer demands or new laws. A BPMod with a high modification frequency should be modelled on a rather low LOD [TNW12, 61].

Flexibility: The necessity for flexibility arises, when uncertainty factors are there or certain liberties for the process handling are necessary. An uncertainty factor can for example arise, when the input of a BP can be diverse and the objects to handle therefore may vary. If the necessary flexibility for a BP is high, it should be rather modelled on a lower LOD. The detailing of the process width may be an exemption, as it shows the different states of the system [Ro96, 133]. In this case a high flexibility can make a high detailing rather necessary [GS05, 137-141] [FL97, 29-30].

Knowledge intensity: According to Schmelzer and Sesselmann [SS13, 70-72] the LOD of BPMod is also dependent on knowledge intensity of the process. Knowledge may be available implicitly as well as explicitly and contains the totality of know how and abilities being necessary to solve a problem [HS11, 286]. Especially the implicit knowledge is relevant here, which is bound to the knowledge carriers. The explicit knowledge contributes to the criterion of data and information intensity. If a BP is dependent on implicit knowledge and therefore has a high knowledge intensity, a low LOD is recommended as often only abstract processing specifications can be made.

Data and information intensity: This criterion is connected to knowledge intensity, with explicit information and data being in the centre of attention here, which can be modelled easily. In case of a high data and information intensity, a high LOD is therefore recommended. As a result, the information and data needed can be set for the processes [Al09, 66-72].

Security aspects: Security aspects may, for instance, concern the protection of internal company data against unauthorised access or the reduction of the accident risk during production processes. For the case that relevant security aspects exist, the LOD should be rather high to show these completely and comprehensible. However, if there are no relevant security aspects, a low LOD can be adequate [LWS08, 287].

Process KPIs: If data for calculating key performance indicators (KPI) has to be collected in a BP, the LOD has to be chosen in such a way that it is possible to determine the KPIs. Thus, usually a rather high LOD is necessary, as to later automatically collect the data through information and communication systems. Furthermore, in case of a high detailing the reasons for possible deviations from the predicted, respectively expected KPI values can be found faster. As a conclusion, the necessary improvements of the BPMod, respectively the BP can be carried out target-oriented and promptly [GSV94,64-66] [HS98, 168-169].

Number of triggering and provisioning events: Triggering events can be seen as an input that starts the BP. Provisioning events are an output of an BP and are able to trigger other BP. If the number of triggering and provisioning events is too big, a detailing should be carried out, otherwise for example uncertainties in handling the BP may arise or the search for the causes of errors is complicated. Therefore the LOD should be rather high, when a BP contains many triggering and provisioning events [SS08, 206].

Resources in the process: Conflicts may arise, when for example a machine is needed for a BP, but the occupancy and release events were modelled in one function only. In this case, the modelling should be more detailed to show the exact use of the resource. A BPMod with an unclear use of resources suggests a higher LOD [Ga83, 81].

Process length: It contains the size of a BPMod on an elected detail level. If the process length is too big, the BPMod may be too complex and loose its clarity [Ro96, 133]. To provide clarity in this case, for example parts of the BP can be summarized to explain them in the next detailing step. Or the BPMod can be divided to raise the clarity. If the process length is too small, there is the risk that not all relevant contents are included. But the process length can only be seen after modelling and the correct process length has to be determined for each model individually. As a conclusion, as general recommendations concerning the process length with reference to the correct LOD are not possible, this criterion is not included into our model. The adequate process length has to be determined after modelling and to be adapted if necessary.

4.2 Model purpose

This article bases on the classification of the process modelling purposes into the categories organisation design and application system design of [RSD08, 50-58]. For the organisation design illustrative BPMod are needed, especially to show the processes in the organisation. In application system design rather formal models are used, as the objectives here have a relation to the application systems [Ro96, 45-46]. The LOD of BPMod for the purpose of organisation design is usually rather smaller than for the purpose of application system design [SS08, 206]. The two purposes mentioned above can be further subdivided on a second level. So on one hand BPMod can be taken as the fulfilment of the purpose and on the other hand as a means to an end. As a result for the modelling purpose we have a matrix consisting of 2x2 arrays. When a BPMod is already the result of a purpose, for example of an organisation design, it may have been created e.g. with the objective of an organisation documentation or of a certification project. When a BPMod serves as a means to an end, the result of the modelling is not simultaneously the fulfilment of the purpose. Herewith the BPMod are used to contribute to the result. To choose a standard software with the help of BPMod, the existing reference models of the software are compared to the company-specific BPMod [RSD08, 54-55]. In this case the BPMod are only needed to support the choice of standard software.

4.3 Basic conditions of process modelling

Basic conditions include factors that may influence the BPMod from the outside. Herewith the external conditions of the BPMod are considered to determine the adequate level of detail.

If the employees taking part in the BP have a sufficient qualification, the LOD should be rather lower than with employees having a low level of qualification. If the LOD is too high in case of a sufficient qualification, this may lead to a limitation of liberties and also to a reduction of motivation. Then, improvement potentials or innovations may not be uncovered or individual creativeness is curbed. But if the qualification of the employees is low, the LOD should be high, as by means of detailed instructions the possibility of processing errors can be reduced [SS08, 206] [Ro96, 139].

BP are influenced by regulations, laws and rules that must be followed by the company and the employees (Compliance). As a conclusion they have an influence on the LOD during BP modelling. It is not possible to give the probable LOD for this criterion, as it has to be chosen depending on the compliance requirements in question.

A further basic condition for the determination of the adequate LOD is the relevance that BP, respectively parts of BP, have on the achievement of the objectives of the company or of a higher-order BP. It makes sense to model a BP in detail, if it is able to contribute a considerable share to the achievement of the objectives. Herewith the handling of this BP becomes easier and improvement potentials can be discovered.

Furthermore, the urgency of a BPMod to be made can have an influence on the LOD. Urgency here means the time horizon, until which a BP is to be modelled [Hä00, 61]. If a BPMod has to be created contemporarily, the LOD should be rather low. But it has to be stated that it may be a preliminary model, which should be revised, specified and improved later. In case of high urgency, the actual LOD necessary can also be attained by increasing the number of employees being involved in modelling.

„Best practices“ is the course of action which seems to be the best to solve certain problems [HHR04, 116]. An existing „best practice“, consisting of already existing models or parts of models which may be used for BP modelling, can be taken as an orientation aid for choosing the adequate LOD.

5 Determination of the adequate detail level

In the following, a methodology to determine the adequate LOD for BPMod is outlined that uses the relevant factors identified above. Then, in section 6, this methodology is applied in order to illustrate its practical use.

5.1 Differentiation according to process depth and process width

The question how detailed a process should be modelled can be answered with view to the process depth and to the process width. Therefore it is at first necessary to describe in greater detail the classification of the adequate detail level along these two dimensions.

In this work a division of the process depth into five levels is taken, which follows [Hü03, 88-93], who differentiates between main (end-to-end) process, process, process step, operation and elementary activity, with the process depth and therefore also the detailing of the BPMod rising in this order starting at main process and going to elementary activity. Main processes as the first hierarchy level of process depth are the value creating primary processes, which may reach across the whole company. The levels below specify only excerpts of the respective higher level of the process depth down to those elementary operations that cannot be further divided in a practical way. Fig. 2 illustrates the different levels of process depth using the example of customer order processing.

The process width shows the states of the system, which are covered by the BPMod and rises with the number of modelled states of the system [Ro96, 133]. In literature only one approach [TNW12, 63] dealing with the grading of the process width could be found. Here the process width is dependent on the execution frequencies of the individual process alternatives as well as on the totality of the possible process variations. Our model refers to this logic, but carries out a five steps differentiation of the process width.

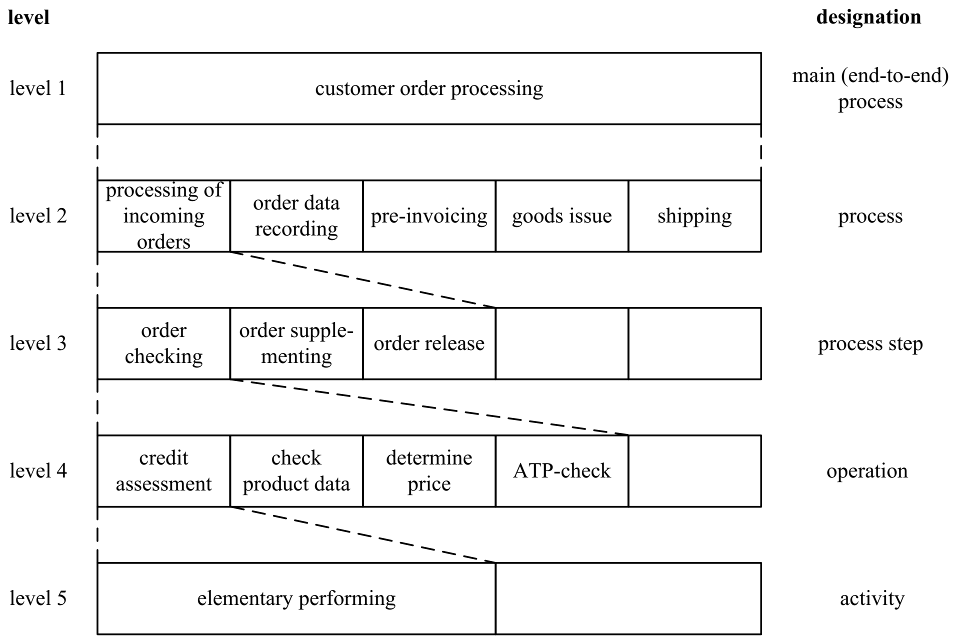

Fig. 2: The different levels of process depth illustrated for main process 'customer order processing'

The process width and therefore the detailing of the BPMod rises from step one to five. The first step is called „Happy Path" [FRH10, 131] and shows the best case of the process, with only those variations recorded, that are necessary to carry out the best case. Generally the execution frequency of this best case should be higher than that of the other variations. On the second step further variations of the BP come on board, which is called „Standard Case" and should cover approx. 65 % of the cases carried out in the system. The third step in the process width is called „Special Case" and contains more variations than the previous steps. It covers approx. 80 % of the cases carried out in the system. The fourth step is called „Extensive" and covers approx. 95 % of the cases. The fifth and highest specified step of the process width covers up to 100 % of the possible alternatives and is called „Complete".

On the basis of these two aspects the adequate LOD of a BPMod can be shown clearly in short form like in the example in Fig. 3. A name field can be used to identify the BPMod as well as a further field for the purpose of the model. The LOD determined is to be entered in the fields process depth and process width. For this, the scale from one to five is to be used and has to be marked until the determined practical LOD. The minimum LOD values recommended are marked darker in the scale. Contrary to that, the lighter colourings are a marking for the recommended maximum detailing. The annotation field can be used for remarks like relevant information objects or attributes.

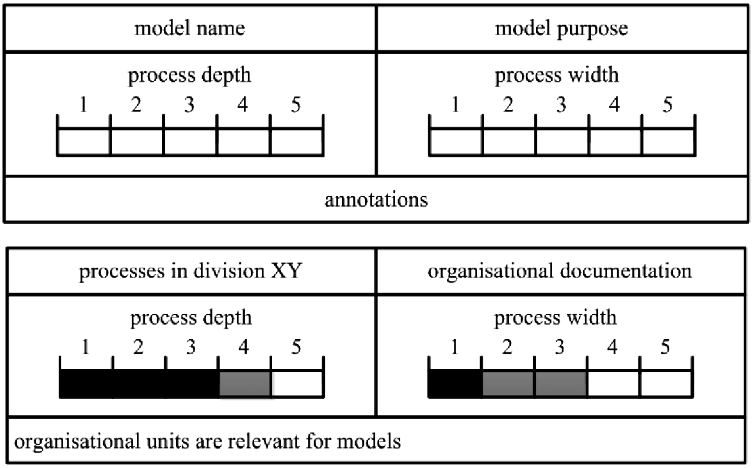

Fig. 3: Template and example for a brief description of the adequate detail level

5.2 Determination of the adequate detail level

To design the model for the determination of the adequate LOD it is necessary to seize on the factors involved shown before and to further structure them. Incompatible combinations of the individual factors are excluded by rules. The individual factors should be weighed out, so that their differing relevance for the LOD can be included.

Rules show probable relations between variations of different professional criteria (Tab. 1) and help to efficiently and consistently determine the variations, if no other information are given. Each line in Tab. 1 represents a rule. The rules put two professional criteria into an „if-then-relation“ and are set according to the following scheme: If criterion one is there in its respective variation, then criterion two tends to have the variation cited. In rule one for example a rather weak structuring is given and therefore the automation criterion should tend to manual. For reasons of space we go without a more precise presentation of the interrelations of the rules.

Tab. 1: Rules concerning the variations of the professional criteria

Rule	If	Then
1	Structuring (weak)	Automation (manual)
2	Structuring (strong)	Knowledge intensity (low)
3	Structuring (weak)	Knowledge intensity (high)
4	Structuring (strong)	Data / Information intensity (high)
5	Structuring (weak)	Data / Information intensity (low)
6	Knowledge intensity (high)	Automation (manual)
7	Automation (automated)	Data / Information intensity (high)
8	Automation (automated)	Modification frequency (rare)
9	Automation (automated)	Flexibility (low)
10	Automation (automated)	Use of resources (unambiguous)

Our suggestion for weighting of the professional criteria can be seen in Fig. 4. This suggestion is open to discussion. We are currently conducting a Delphi study to identify the best weightings. Here it also has to be taken into account that the criterion of flexibility has a deviating weighting concerning process depth and process width, which is made clear by the naming in brackets (W, D).

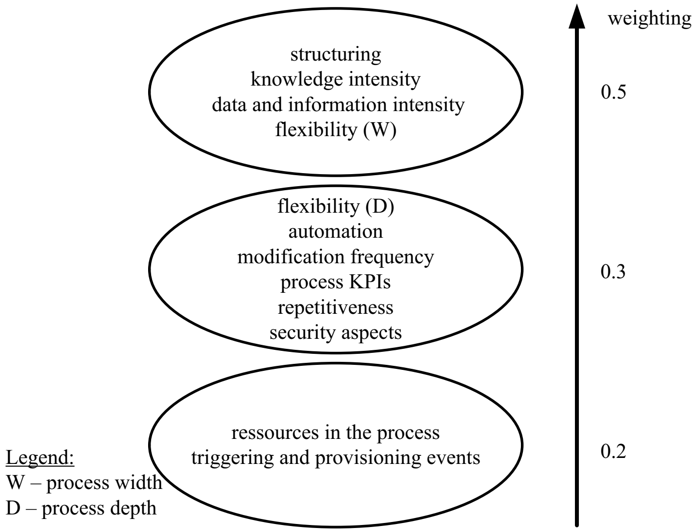

Fig. 4: Weighting of the professional criteria

The highest weighting have the professional criteria structuring, knowledge intensity as well as information and data intensity. As the criteria influence each other, the importance of these criteria can be derived by means of the rules set above. In addition, they are very important for the adequate LOD. Contrary to that, the use of the resources as well as the triggering and provisioning events have to be put into the lowest weighting category, as they only have small influence on the LOD and should only show a tendency for the finding of the adequate LOD.

For the basic conditions of modelling, no weighting or interrelations of rules among each other are assumed. But it is supposed that compliance always has to be fulfilled. Models need to contain all details that are required for meeting the defined compliance requirements. As a conclusion, the subsumed aspects indicate a minimum LOD for the entire BPMod. A second assumption deals with the handling of best practices, which should only serve as a clue for the LOD and not as a fixed default. An adaption of the LOD has to be carried out for example to adapt the best practices to the qualification of the existing employees or to the urgency of completion.

Concerning the relation between modelling purpose and LOD the assumption, taken from literature, is made that BPMod for the purpose of organisation design have to be rather less detailed than the BPMod for application system design [SS08, 193]. It is assumed that BPMod for the purpose of application system design should have a minimum LOD of 3. This detailing refers to the process depth as well as process width.

In Fig. 5 the meanwhile derived model how to determine the adequate LOD is shown. This model consists of the three groups of factors involved: professional criteria, basic conditions and model purpose deliver a LOD. The recommended LOD for the respective BPMod can be derived from them. Furthermore, this model has to be completed two times, to be able to determine the appropriate process depth and process width for a BPMod. In the following demonstration example (referring to [KR12, 535-539]) the application of the model is explained.

6 Application example

For a mail-order company the adequate LOD for the modelling of the BP order processing is to be determined. In addition, this BP is to be supported by a workflow management system in the future with the BPMod being automatically transferred into workflows then. As a conclusion, the purpose of this BPModng can be assigned to application system design, which already says that we have a minimum LOD of three for the process depth and the process width.

In case of the order processing in a mail-order company mostly all steps can be fixed before the processing starts and the arising uncertainty is rather low. For these reasons it can be assumed that the value of the professional criterion structuring is 'high'. Furthermore it can be assumed that for this BP only few knowledge is needed and that employees after a short introduction are able to carry out this BP as all relevant information for the processing of the BP are available.

As a conclusion it can be said that this BP has a low knowledge intensity and a high data and information intensity. As the support by a workflow management system should be possible, the value of the automation may be considered as high, but not fully automated. Due to the rather few uncertainties it may be deduced that there do not exist many triggering and provisioning events for this BP. Furthermore, due to the tenth rule of the professional criteria, the use of the resources tends to be unambiguous. Concerning the professional criterion flexibility, a value differentiation between process width and depth has to be set. In Tab. 2 the values of the professional criteria for this example are given in an overview, in Tab. 3 the basic conditions for the modelling.

In Fig. 6 the model for the determination of the adequate LOD for the process depth is filled with these exemplary data of the BP. The same table should be made for the process width as well, but differences concern only the criterion of flexibility and the overall condition of best practices, so this table is left out here for reasons of space.

professional criteria	lowest value	LOD 1 ¦ 2 ¦ 3 ¦ 4 ¦ 5	highest value	weighting	calculation	weighted LOD	LOD	highest value	LOD 5 ¦ 4 ¦ 3 ¦ 2 ¦ 1	lowest value	basic conditions
structuring	weak		strong	0.5	0.5 * LOD			low		high	employee qualification (I)
repetitiveness	low		high	0.3	0.3 * LOD			high		low	compliance
automation	manual		automated	0.3	0.3 * LOD			important		unimportant	relevance
modification frequency (I)	frequent		rare	0.3	0.3 * DetLev			low		high	urgency (I)
flexibility (I for D)	high (D) low (W)		low (D) high (W)	0.3 (D) 0.5 (W)	0.3 or 0.5 * LOD			high		low	LOD of best practice
knowledge intensity (I)	high		low	0.5	0.5 * LOD						
information and data intensity	low		high	0.5	0.5 * LOD						
security aspects	low		high	0.3	0.3 * LOD						
process KPIs	few		many	0.3	0.3 * LOD						
triggering and provisioning events	few		many	0.2	0.2 * LOD						
ressources in process (I)	non-ambiguous		ambiguous	0.2	0.2 * LOD						
			sum	3.7 (D) 3.9 (W)	sum			sum			
			sum weighted LOD / sum weighting					sum LOD / 5			
					model purpose:						
					required level of detail:						

Legend:
W - process width
D - process depth
I - inverse scale to standardize calculation

Fig. 5: Scheme for the determination of the adequate detail level

professional criteria	lowest value	LOD 1 2 3 4 5	highest value	weighting	calculation	weighted LOD	LOD	highest value	LOD 5 4 3 2 1	lowest value	basic conditions
structuring	weak		strong	0.5	0.5 * LOD	2.5	4	low		high	employee qualification (I)
repetitiveness	low		high	0.3	0.3 * LOD	1.5	3	high		low	compliance
automation	manual		automated	0.3	0.3 * LOD	1.2	5	important		unimportant	relevance
modification frequency (I)	frequent		rare	0.3	0.3 * LOD	1.2	4	low		high	urgency (I)
flexibility (I for D)	high (D) low (W)		low (D) high (W)	0.3 (D) 0.5 (W)	0.3 or 0.5 * LOD	1.2	4	high		low	LOD of best practice
knowledge intensity (I)	high		low	0.5	0.5 * LOD	2.0					
information and data intensity	low		high	0.5	0.5 * LOD	2.0					
security aspects	low		high	0.3	0.3 * LOD	0.9					
process KPIs	few		many	0.3	0.3 * LOD	1.2					
triggering and provisioning events	few		many	0.2	0.2 * LOD	0.4					
ressources in process (I)	non-ambiguous		ambiguous	0.2	0.2 * LOD	0.2					
			sum	3.7 (D) 3.9 (W)	sum	14.3	20	sum			
			sum weighted LOD / sum weighting			3.9	4	sum LOD / 5			
					model purpose:		order processing (application system design)				
					required level of detail:		minimal LOD of **3** required				

Legend:
W - process width
D - process depth
I - inverse scale to standardize calculation

Fig. 6: Recommended detailing of the process depth for the application example (to be made analogous for the process width, left out for reasons of space)

Tab. 2: Content-related criteria in the demonstration example

Professional criterion	Value	Process depth	Process width
Structuring	High	5 of 5	5 of 5
Repetitiveness	Often	5 of 5	5 of 5
Automation	Automated	4 of 5	4 of 5
Modification frequency	Rare	4 of 5	4 of 5
Flexibility	Low	4 of 5	2 of 5
Knowledge intensity	Low	4 of 5	4 of 5
Information intensity and data intensity	High	4 of 5	4 of 5
Security aspects	Medium	3 of 5	3 of 5
Indexes	High	4 of 5	4 of 5
Provisional and triggering events	Few	2 of 5	2 of 5
Use of resources	Clear	1 of 5	1 of 5

Tab. 3: Basic modelling conditions in the demonstration example

Condition	Value	Process depth	Process width
Employee qualification	Low	4 of 5	4 of 5
Compliance	Medium	3 of 5	3 of 5
Relevance	Important	5 of 5	5 of 5
Urgency	Low	4 of 5	4 of 5
LOD of Best Practices	High	4 of 5	3 of 5

As can be seen in Fig. 6, the LOD should be taken rather high. According to the modelling conditions and the professional criteria, the LOD in the process depth (and process width) should be four (the values determined of the professional criteria are 3.9 (respectively 3.6) and those of the conditions 4.0 (respectively 3.8), they were rounded up to four. Concerning the process depth, this BP should be modelled until the hierarchy level of the operations. And the process width should be modelled until the step „Extensive“, which means that up to 95 % of the possible system cases are covered. Due to the rules and assumptions defined, the minimum LOD for the process depth and the process width is three. This is mainly caused by the main purpose of the application system design and also by the compliance requirements given. In this example, the upper limit of the LOD is defined by the professional criteria and modelling conditions and the lower limit by the model purpose.

In Fig. 7 the relevant LOD can be found as a summary. The minimum LOD recommended has a dark marking, the maximum LOD recommended a lighter marking. Furthermore, the annotation field suggests some information objects for the model. Organisational units may for example show, who is responsible for which step in the BP. Attributes for example can support the automated recording and derivation of KPI data and the introduction of a workflow management system.

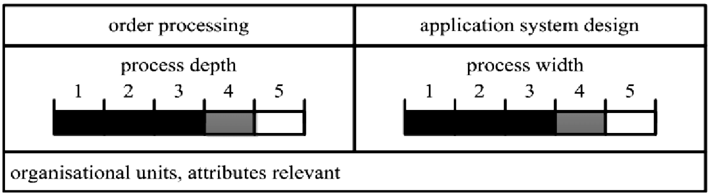

Fig. 7: Recommended LOD for the demonstration example (overview)

7 Limitations and future work

In this work we suggested a model for the determination of the adequate LOD in process modelling and with the help of a demonstration example its practical applicability was shown. A detailed evaluation, for example by means of a case study or by expert interviews, is left to future research. In addition, rules and weightings concerning the relevant factors involved were drawn up, which may be incomplete and would have to be verified in the future as well. A weighting of the model purposes and the basic modelling conditions was left out, a procedure that seems to be justified here, but which also needs further verification. And, the model purpose currently is considered only in a very rough differentiation, which should be refined in the future, too.

Another interesting avenue of research in our context would be the LOD analysis of existing process models in the light of the individual model purpose. This inductive approach would complement our own considerations and might be helpful in the evaluation.

At the moment the efforts necessary to model a BP are not considered. It can be assumed that a rising LOD leads to a rising modelling effort. As a conclusion it is currently not clear, at which LOD of the BPMod the relation between the efforts arising and the benefit is optimal. Finally, it might make sense to implement the proposed model to carry out the assumptions and rules in an automated way and to herewith facilitate the determination of the adequate LOD.

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