

# Organisational design and engineering: proposal of a conceptual framework and comparison of business engineering with other approaches

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**Abstract:** Organisational design and engineering (ODE) is an emerging discipline that aims at replacing intuitive 'handcrafting' of enterprises by a systematic, model and method driven approach. In line with this goal various approaches have been proposed. Due to a missing framework, these approaches are hard to compare due to different terminology, focus, construction direction, genericity, and other aspects. In order to better compare and integrate approaches for ODE, a set of characteristics is proposed. As a hierarchical, iterative approach for the situational design of 'business-to-IT' solutions, the business engineering approach is described using the proposed characteristics. In order to validate the characteristics' utility to frame ODE approaches, we also describe enterprise engineering, the work system approach and business process reengineering on that foundation. The paper closes with implications arising from this comparison.

**Keywords:** organisational design; organisational engineering; design research; design science; situational design; hierarchical problem solving.

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## 1 A framework for organisational design and engineering

As they mature, problem solving disciplines move

from an initially intuitive, 'craftsman' approach towards systematic design and engineering. Disciplines mature however at different speeds: while intuitively handcrafted buildings, airplanes or software systems are not acceptable for most, many of us work in handcrafted enterprises. We use the term 'enterprise' as an overall term to identify a purposefully created (designed) social system that delivers products and/or services to the environment.

Organisational design and engineering (ODE) aims at creating professionally-crafted enterprises – and thereby to contribute to organisational sciences in a similar way as civil engineering contributed to technical sciences or software engineering contributed to computer science. A central assumption to ODE is of course that enterprises can (and should) be designed and engineered, i.e., that they do not primarily 'emerge' as a result of social learning and evolution processes.

The 'design' and 'engineering' sub-processes in ODE are not always differentiated consistently. While some use these designations to differentiate functional from constructional specification of an enterprise, others use them for different levels of creativity, different degrees of freedom, etc., in the ODE process.

In this first section, ODE is positioned as a research discipline, and characteristics for describing ODE approaches are proposed.

### 1.1 Positioning of organisational design and engineering

ODE is aimed at creating useful, generic solutions to certain classes of design problems in organisations. The ODE process bridges the gap between the theory knowledge base of organisational sciences (and applicable portions of technical sciences and computer sciences) on the one side and actual design problems in organisations on the other. This gap exists because theories are well capable of explaining existing phenomena in organisations, but not directly capable of solving design problems, i.e., to support innovation and/or evolution. For that purpose, generic ODE solutions need to be created that refer to the theory knowledge base.

Chmielewicz (1994) describes the difference between theories and generic solutions in the social sciences as one between cause-effect relations and

means-end relations. While he designates cause-effect relations as theories, he designates means-end relations as 'technologies'. By relating specific means to specific ends, generic ODE solutions constitute 'technology' artefacts as means for solving certain classes of design problems (ends). Chmielewicz positions theories as second and technologies as third layer in a four layer pyramid that is based on constructs ('terminology') and whose top are normative statements ('philosophy').

While the theory building process is driven by the quest to better explain or understand an interesting phenomenon, the ODE process aims at creating innovative artefacts. Theory building and ODE pursue fundamentally different goals: While cause-effect relations must be true, means-end relations must be useful instead. Obviously, there should fundamentally different research (including evaluation) methodologies be applied for theory building and ODE.

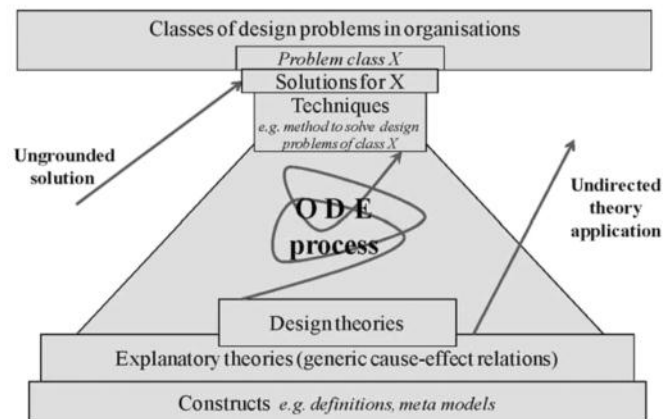
In addition to the problem-driven search elements of

the ODE process that close the gap in a problem-driven, 'top-down' approach, other ODE process elements may extend and adapt theoretical foundations in order to close the gap in a theory-driven, 'bottom-up'

approach. In the bottom-up ODE sub-process, so-called 'design theories' (Gregor and Jones, 2007) play an important role. In contrast to the theory knowledge base of the social sciences which is explanatory in nature, design theories provide a problem-independent foundation for the construction of problem solution artefacts. Examples for such design theories can be found, e.g., in enterprise ontology (Dietz, 2006).

Problem-driven as well as theory-driven ODE sub-processes need to be coordinated by an iterative search process in order to avoid un-grounded solutions or useless theory instantiations. The overall ODE process can therefore be understood as a controlled, iterative search for a grounded problem solution path. Figure 1 illustrates this understanding.

Figure 1. Organisational design and engineering as an iterative search

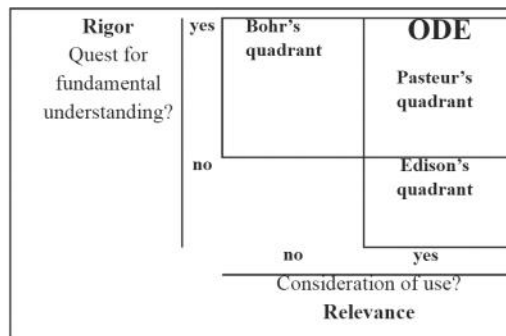


The ODE process has many similarities with other complex problem solution processes like, e.g., in medicine. Medicine also needs to build on a theory knowledge base to construct specific treatments (= generic problem solutions) for specific medical conditions (= problem classes). For that purpose, 'top-down' and 'bottom-up' components need also to be coordinated by an iterative search process. Such process control aims assures that problem-driven solutions (e.g., 'evidence based medicine', Elstein, 2004) are finally grounded on sound clinical trials, and that (design) theory extensions (e.g., exploratory experiments) are finally linked to clinical evidence. Un-grounded

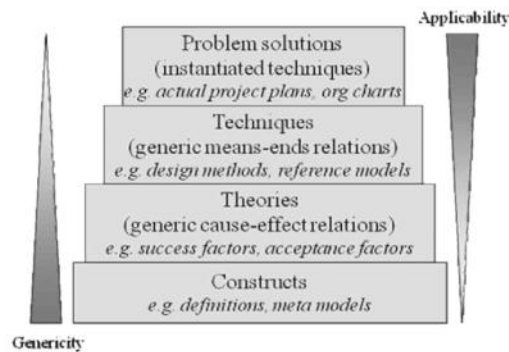
yet effective solutions as well as inapplicable theory applications may nevertheless contribute valuable insights for the overall evolution of the specific search process or its generic understanding.

The iterative search of the ODE process for useful yet grounded solutions allows placing ODE in the 'Pasteur's quadrant' of Stokes' model (Stokes, 1997) which combines rigour with relevance. Ungrounded design can be assigned to the 'Edison's quadrant' (relevance without rigour) and *l'art pour l'art* theory extension/application can be assigned to the 'Bohr's quadrant' (rigour without relevance) of this model. Figure 2 illustrates Stokes' quadrant model and the intended positioning of ODE.

**Figure 2. Organisational design and engineering must be both rigorous and relevant**



**Figure 3. Typology of ODE artefacts**



While ODE makes no assumptions which portions of tasks can be automated by software systems, it can be

assumed that organisational solutions in general include some automated portions, i.e., comprise human as well as machine actors and can be therefore understood as socio-technical systems. As a consequence, contributions of different communities are relevant for ODE:

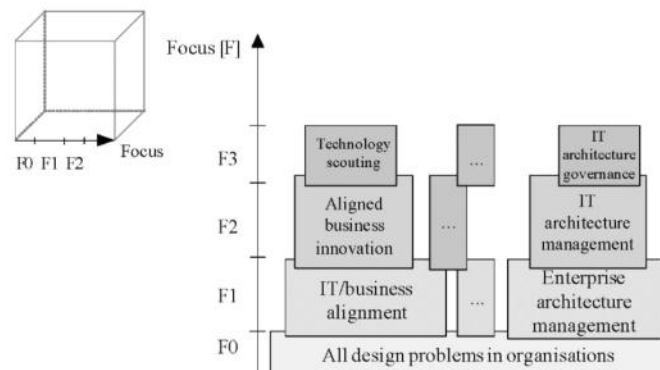
1. ODE can be understood as an extension of design science research in information systems that puts more emphasis on the design and engineering of non-IT artefacts.
2. ODE can be understood as an extension of organisational science which has made many contributions to the design of organisations (e.g., regarding motivational or behavioural aspects), but is less formally methodologically oriented.

Based on the typology of design research in information systems artefacts (March and Smith; 1995, Hevner et al., 2004) as well the above mentioned system of social science approaches (and results) by Chmielewicz (1994) which are conceptually consistent (Winter, 2008b), a typology of ODE artefacts and their dependencies results. This typology is illustrated by Figure 3.

### 1.2 Characteristics of organisational design and engineering

In order to determine general properties of ODE approaches, certain characteristics of design problems in organisations and respective solutions are discussed in the following.

**Figure 4. Focus dimension of ODE meta model**



Since most modern companies heavily deploy IT, design problems are mostly related to both organisational and IT support issues. ODE solutions need therefore to address the entire business-to-IT stack, i.e., represent a consistent state of business-related

and IT-related artefacts. A wide range of concepts is necessary to represent ODE solutions spanning the entire business-to-IT stack. ODE meta research needs to propose suitable meta models including a wide range of consistency constraints, decoupling mechanisms,

derivation rules and other dependencies. In order to enable ODE to deal with such *focus* issues, ODE meta research applies results from computer science (like meta modelling, ontology design, formal languages) as well as from systems theory (e.g., systems decoupling, hierarchical problem-solving). Within the business-to-IT stack, specific problem domains (e.g., IT/business alignment, standard software integration, business process redesign) may be defined on a meta model subset. Other problem domains (e.g., strategy design, business networking, enterprise-wide IT architecture management) may require meta model extensions. The focus of ODE can therefore be interpreted as a concept multi-hierarchy by which the 'standard' business-to-IT stack, narrower ODE domains as well as wider domains (e.g., financial engineering, skill/competence management) can be represented. Figure 4 illustrates the focus dimension of possible ODE meta models.

ODE problem classes are usually subject to many class-specific as well as generic contingency factors. If the problem-specific configuration of contingency factors is used to 'customise' generic ODE solutions, problem classes can be addressed in ODE instead of singular problems. ODE therefore needs:

1. to identify contingency factors for a problem domain and classify organisational design problems according to these factors
2. construct solutions at a useful level of genericity

within a problem domain

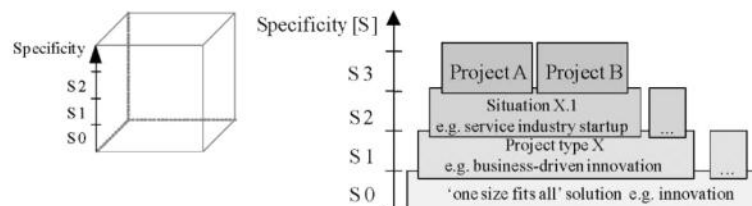
3. construct adaptation mechanisms that use the actual configuration of contingency factors to derive a problem-specific solution from a generic one.

Problem solution then comprises:

- a the identification of the problem class the problem at hand can be assigned to
- b the determination of the actual contingency factor configuration for the problem at hand
- c the adaptation of the generic ODE solution according to the respective contingency factor configuration.

This process is similar to the customisation process of standardised software solutions for a specific organisational setting. In order to enable ODE to deal with *specificity* issues, ODE meta research applies various theories and techniques from social sciences (e.g., contingency theory, diversity theory, factor and cluster analysis) as well as from computer science (situational method engineering). The specificity of ODE/ODE solutions can be interpreted as a concept hierarchy with 'one size fits all' approaches on bottom and more specific generic problem/solution subsets on upper levels. Singular design problems and respective singular ODE solutions are found on the top of the specificity concept hierarchy. Figure 5 illustrates the specificity dimension of ODE solutions

Figure 5. Specificity dimension of ODE meta model



ODE problem classes as well as corresponding ODE solutions cannot only have different focus and different specificity, but also can be regarded/specified on a higher or lower level of granularity. While 'architecture' models represent only fundamental concept types (IEEE, 2000; The Open Group, 2007), other models may represent a broader range of concept types or even individual concepts – e.g., concept models instead of type models. The organisational design problem class at hand determines whether ODE/ODE solutions:

- should be highly aggregated (e.g., enterprise architecture analysis aimed at discovering certain IT/business misalignment problems)
- should address a specific set of concept types (e.g.,

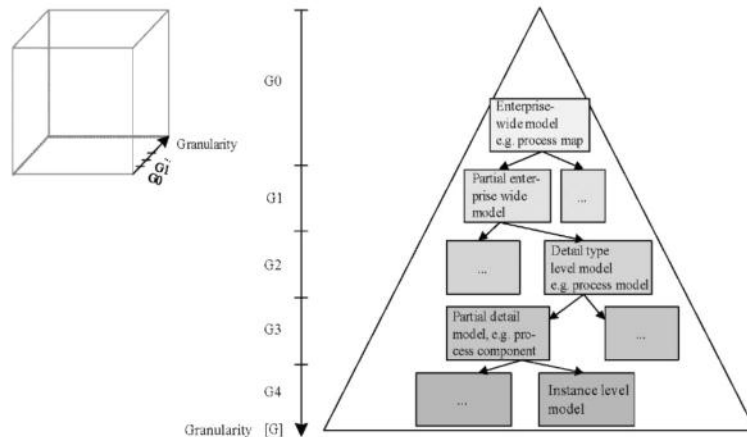
business process redesign aimed at improving certain performance indicators)

- should address a specific set of concepts (e.g., business rule (re-)design aimed at avoiding certain organisational dysfunctions).

In order to enable ODE to deal with *granularity* issues, ODE meta research applies various theories and techniques from engineering (e.g., using system vs. constructional system) and from computer sciences (e.g., conceptual modelling on type level). The granularity of ODE models can be interpreted as a concept hierarchy with 'enterprise-wide architecture' models on top and detailed problem/solution models on lower levels. Concepts and concept-related models represent the

bottom of the granularity hierarchy. Figure 6 illustrates the granularity dimension of possible ODE models.

**Figure 6. Granularity dimension of ODE meta model**



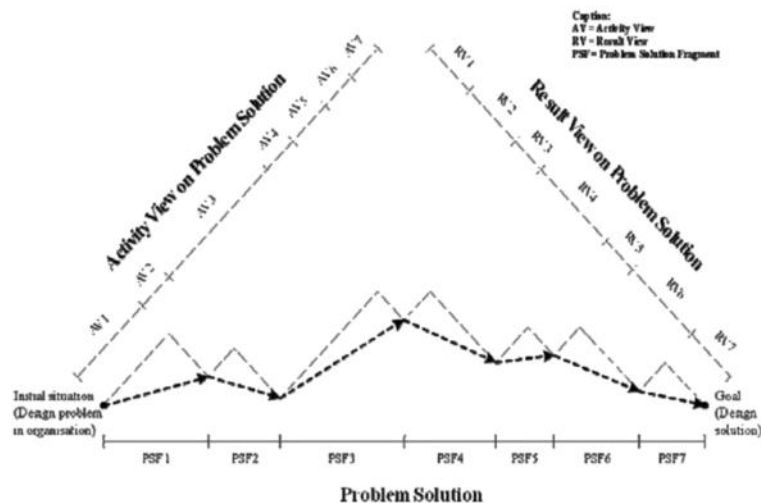
ODE solution steps can be assigned to two classes:

- Activity-focused problem solution steps: while the activities are widely determined, the result is implied but widely open (e.g., business process reengineering methods)
- Result-focused problem solution steps: while the results are widely determined, activities are implied but widely open (e.g., reference model-based solution engineering).

The IEEE (2000) definition of 'architecture' (for software intensive systems) is a good example of the

dual character of artefact oriented problem solutions: Architecture is defined on the one hand as the fundamental structure of a system (result focus), but on the other hand as the principles that guide its design and evolution (activity focus). Winter et al. (2009) discuss the dual character (activity guidance vs. result guidance) of complex ODE problem-solving processes and state the hypothesis that in general a mix of prescribed activities and recommended results will be most adequate for most complex ODE problem classes. Figure 7 illustrates the dual character of ODE problem-solving processes.

**Figure 7. Activity vs. result perspectives of ODE problem solutions**



Source: Winter et al. (2009)

As a consequence, ODE approaches should aim at amalgamating activity focused as well as result focused related work. Two approaches seem to be in particular well suited for that purpose:

- A clear activity focus (as well as a situational approach and fragment composition) characterises method engineering in information systems development (e.g., cf. Ralytė et al., 2007).
- A clear result focus (as well as a variety of well-understood artefact adaptation mechanisms) characterises reference modelling for information systems (e.g., cf. Fettke and Loos, 2007).

While first proposals aim at combining adaptation mechanisms from method engineering and reference modelling (Becker et al., 2007; Schelp and Winter, 2006), much more conceptual integration is necessary.

Summarising this section, ODE should be understood as a goal-directed, iterative search process that combines ‘bottom-up’ (i.e., theory instantiation and application) and ‘top-down’ (i.e., problem analysis and solution evaluation) components to bridge the gap between the body of explanatory theory and actual organisational design problems in a systematic, model and method based way. The search space can be better understood by differentiating a focus dimension, a specificity dimension and a granularity dimension as well as by differentiating between activity-oriented and result-oriented solution steps. Using the resulting multi-dimensional ODE framework, existing approaches can be described, compared and (hopefully) amalgamated in a structured way. More concrete, the framework helps to position:

- foundational explanatory theories (such as, e.g., contingency theory, theory of hierarchical multilevel systems)
- foundational design theories (such as, e.g., enterprise ontology)
- foundational practices (such as, e.g., meta modelling, specification and usage of formal languages, conceptual modelling, factor and cluster analysis, hierarchical planning)
- actual approach characteristics (such as, e.g., dominant search direction, focus range, granularity range, specificity range, activity vs. result orientation).

## 2. Business engineering – an approach to organisational design and engineering

This section describes the business engineering (BE) approach (Usterle and Winter, 2003) as a hierarchical, iterative approach to develop situational ‘business-to-

IT’ solutions. In the following, BE is characterised as an ODE approach using the various aspects discussed in Section 1.

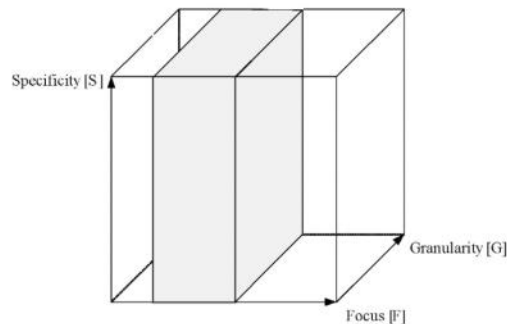
The overall aims and principles of the approach are described first. Then the main artefacts are presented so that the approach can be classified as activity or result oriented. The artefact range is characterised regarding its focus, specificity and granularity. After summarising the most important theoretical foundations, design theories and dominant practices associated with the approach, it can be classified regarding its dominant search direction (problem-driven or theory-driven). Since organisational aspects are important for ODE, we then present addressed stakeholder concerns, proposed actor types and/or roles. Finally, the capability of the approach to adapt ODE solutions to specific contexts and design goals is assessed.

The term ‘business’ in BE is synonymous to our understanding of ‘enterprise’ (see Section 1). ‘Engineering’ is used to denote model and method based ODE. Since ODE is usually associated with organisational change, BE states its *overall aim* to support transformation (‘change the business’) projects in a systematic and holistic manner. In order to conduct organisational change, concerns of different stakeholders such as employees, customers, government, etc., should be taken into consideration.

Important *principles* of BE are, e.g., hierarchical design and engineering of ODE solutions (‘IT follows business’, detailed solutions follow certain architectural principles) or consistency of solutions within and across architectural layers.

Regarding *focus*, BE addresses representation, analysis, design and implementation aspects of conceptual strategy, organisation and IT models throughout the entire ‘business-to-IT’ stack, while financial aspects as well as skill/competency aspects are neglected. Since not all potential focus aspects are covered, the focus range in Figure 8 starts at F1 (not F0). The focus range ends at F3/F4 because BE only covers certain (and not all) project types. Regarding *specificity*, BE increasingly adds situational, customisable ODE artefacts (S2/S3) to the already existing wide body of results that mostly consists of ‘one-size-fits-all’ (S0) solutions and project type specific artefacts (S1). In Figure 8 the S-axis is therefore completely covered. Regarding granularity, BE is traditionally focused on enterprise-wide models (G0) with detailed type level models (G1ff) being provided for specific design situations only (like, e.g., business process reengineering), leading to a completely covered G-axis in Figure 8.

**Figure 8 . Business engineering characterisation in the (focus X specificity X granularity) space**



BE solutions are usually *activity-oriented* (methods), but reference model aspects are increasingly incorporated. A standardised core meta model with defined extension/adaptation mechanisms is provided (Isterle et al., 2007).

As *explanatory theory foundations*, the theory of hierarchical systems (e.g., cf. Mesarovic et al., 1970) and contingency theory (e.g., cf. Fiedler, 1964; Simon, 1997) are often referenced. Instead of explicit *design theories*, informal engineering guidelines are in use: e.g., the transformation of an organisation can only be realised successfully if strategic, organisational and IT support aspects are considered in an integral way (Isterle and Winter, 2003). Hence, a holistic approach is regarded as being essential. Furthermore, IT is not only an enabler for business change, but does also restrict the range of business solutions that can be successfully implemented. The dominant *practices* in BE artefact design are metamodelling, conceptual modelling, a broad range of semiformal languages, factor and cluster analysis, hierarchical planning, requirements engineering, prototyping (= iterative design) and inductive activity consolidation (Winter and Fischer, 2009). In actual transformation projects, generic BE artefacts in form of situational methods and reference models (e.g., cf. Gericke et al., 2009; Baumul, 2005; Bucher and Winter, 2009; Klesse and Winter, 2007; Mettler and Rohner, 2009) are adapted and instantiated partly using the provided mechanisms and partly in an informal way. Although being based on a common, cross-layer meta model (Isterle et al., 2007), BE artefacts are constructed subject to explicit layer, stratum and echelon considerations, i.e., according to the theory of hierarchical systems (Mesarovic et al., 1970). The most important foundation to construct layers and echelons is the analysis of stakeholder concerns and respective goal hierarchies.

garding the *dominant search direction*, ‘top-down’ components dominate: BE project types and BE methods have many elements that are inductively derived from successful problem solution practices.

Different *actors* are involved in the execution of transformation/change projects. The BE approach distinguishes six different roles (Baumul and Winter, 2003):

- Enabler and supporter: this role initialises the change project. Mostly this role is assigned to top management.
- Change architect: the change architect is responsible for the holistic design of the change process. His/her role is characterised by further roles that are integrated as well, such as the role of a manager, a controller or a marketing expert.
- Change implementer: employees who are responsible for the implementation of the change project should possess expert knowledge. They have to fulfil the change tasks assigned by the change architect.
- Maintainer and developer: after successfully completing the change project, newly developed structures and changed cultures have to be maintained and further developed.
- Networker and coach: change projects are often subject to resistance. It is the task of networkers and coaches to resolve them and implement adequate communication strategies.
- Innovation scout: innovation scouts are responsible for the identification of enablers for change projects. Using their results as a basis, enabler and supporter can push certain change projects.

Sine all these roles are project related, project independent roles like *business (unit) strategy owner*, *enterprise architect*, *project portfolio manager* etc are also specified.

While the BE framework is static, the so-called BE map (Isterle and Winter, 2003) provides a very coarse procedural suggestion. In a recent addition, four generic *project types* are differentiated for which procedure models are suggested (Winter, 2008a):

- Business-driven change: changes in the business strategy form the basis for the redesign of the organisation which results in changes of its IT support.

IT-driven change: certain IT innovations enable new/amended business solutions and/or strategic repositioning. For the realisation of IT-driven changes, the layers of the BE framework have to be worked through in reverse direction. The same dependencies between artefact types that are used to guarantee consistent, holistic business-driven change, are utilised

now to guarantee consistent, holistic IT-driven change.

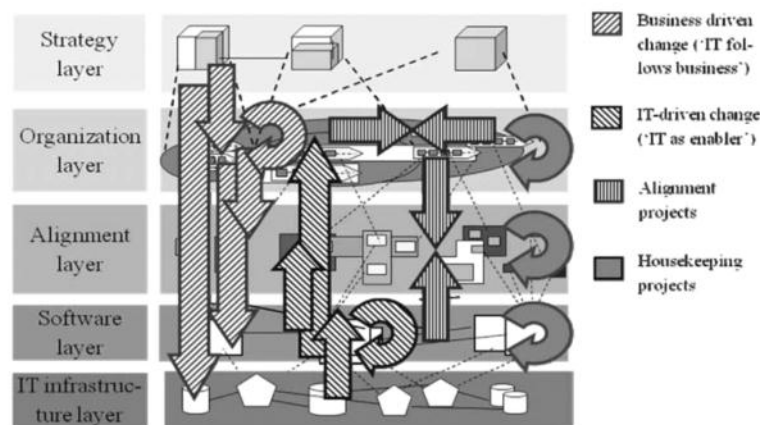
Alignment: due to different life cycles of business solutions and IT solutions, realised business and IT structures become inconsistent over time. The BE framework's IT/business alignment layer is intended to 'buffer' as many changes as possible in order to reduce project size and complexity (Aier and Winter, 2009). Not all changes can however be 'buffered' by alignment artefacts like capabilities, applications and functional domains. If necessary changes could or should not be propagated

through all affected framework layers, alignment projects are necessary to re-create consistency.

- Housekeeping: while business-driven and IT-driven change is intended to create business value, 'housekeeping' projects are intended to simplify structures, reduce inconsistencies, or enhance flexibility. For such projects, the creation of indirect future value potentials is dominant.

Figure 9 illustrates the different character of these four BE project types.

Figure 9. Business engineering project types



Using the BE framework and the proposed project types as a basis, various transformation methods for different design problem classes (and classes of different genericity) are provided. The adaptation and instantiation of these methods in organisations results in concrete project plans, implementation models, and communication means. BE therefore not only addresses the design and engineering, but also the implementation of transformations.

Future evolution will focus on better supporting the systematic 'navigation' in the (focus X specificity X granularity) artefact space for developers, better integration of activity and result aspects in problem solving, explicit grounding of BE artefacts on suitable design theories, and the integration of economic considerations in artefact design/engineering.

### 3 Related approaches

In this section, we compare BE with other ODE approaches. Since it is incorporating design theories as an integral part of ODE, we first compare Dietz' *enterprise engineering* (Dietz, 2006; Dietz, 2007). Alter's *work system approach* (Alter, 2006; Alter, 2009)

is compared for its foundation on systems theory and its explicit focus on organisational aspects. Lastly, we compare business process (re)engineering (Hammer and Champy, 1993; Davenport, 1993) because this approach can be regarded as an ancestor of many ODE approaches. The descriptions are oriented along the aspects which have already been used to characterise the BE approach.

#### 3.1 The enterprise engineering approach

##### 3.1.1 Overall aim

Enterprise engineering (EE) uses a sound design theory foundation to create a conceptual model of an enterprise. Such a model – which is also denoted as ontological model – should be coherent, comprehensive, consistent, and concise and only represent the 'essence' of the enterprise operations. Thus, EE focuses on the documentation, development, implementation and operational use of enterprises on a conceptual/ontological level that aims at abstracting completely from all realisation and implementation issues.

As a complement to enterprise ontology, enterprise architecture (EA) defines a consistent and coherent set of *principles* and standards that guide enterprise design. Within EA there are various aspect architectures, like IT architecture. A differentiation between ‘running the business’ and ‘changing the business’ does not become evident.

### 3.1.2 Focus, specificity and granularity range of artefacts

The focus of EE is on business transactions – which are interpreted in a very fundamental sense so that management activities and information provision can also be seen as transactions. Although being defined on the concept level, ontological enterprise models are somewhat generic since they abstract from realisation and implementation. Transactions are however not specified generically, but very concretely.

#### 3.1.3 Activity or result orientation

In particular the explicit definition of architecture as “normative restriction of design freedom” (Dietz, 2007) and the provision of many ODE principles and standards in EA allow to state that EE is primary activity-oriented.

#### 3.1.4 Explanatory theory foundations, design theories and dominant practices

EE is based on a design theory comprising different axioms and a theorem: at first, the operation axiom (what?), the transaction axiom (how?) and the composition axiom (with what?) can be differentiated. Second, further theoretical concepts, e.g., the distinction axiom or the organisation theorem are proposed. The proposition of these axioms and theorems is based on the so called language-action perspective which allows for the derivation of terms such as facts, system, model, ontology, etc. Using this design theory as a basis, EE aims at the separation of ontological components of an enterprise (i.e., organisational structures or processes/activities) from the realisation (how?) and implementation (with what?). Thus, the detailed specification of organisational structures and processes/activities (what?) is in focus.

In order to create ontological models of an enterprise, Dietz (2006) suggests a generic elicitation method that consists of the following three analysis and three synthesis steps/activities:

- Performa-informa-forma analysis: this activity deals with the division of all available knowledge according to the distinction axiom into data logical transformations (forma), infological transformations (informa) and ontological transformations (performa).
- Coordination-actors-production analysis: the performa items, i.e., the abilities “of human beings to produce original new things, i.e., facts that cannot be derived from existing facts” (Dietz, 2006) such as decisions or judgments, are divided into coordination acts/results, production acts/results, and actor roles. This division follows the operation axiom.
- Transaction pattern synthesis: the production and coordination acts are clustered into transaction types according to transaction patterns of the transaction axiom. In a second step, the result type is correctly and precisely formulated for every transaction type.
- Result structure analysis: according to the composition axiom, transactions are often cascaded. In this analysis step, the results of these cascaded transactions are explicated which can be interpreted as components of the end result.
- Construction synthesis: based on the transaction axiom, the initiating actor role(s) and the executing actor role are identified for every transaction type in this step.
- Organisation synthesis: so far no distinction relating to the extent to which the ontological model refers to the studied enterprise and to its surrounding environment has been made. In this step, the ontological model is ‘transformed’ into an appropriate organisational model.

Ontological models are implicitly (design) theory applications. They are however not derived, but individually created as solutions for actual design problems. Since no explicit linkage between design theories and actual problem solutions can be observed, EE has neither a ‘top-down’ nor a ‘bottom-up’ *search direction*.

#### 3.1.5 Stakeholder concerns, actor types/roles (if available)

Although EE allows the modelling of different actors within the analysed enterprise, the approach does not distinguish between different roles that deal with ODE and/or work with the ontological model of the enterprise.

### 3.1.6 ODE problem classes addressed and adaptation mechanisms

Following Dietz (2006), organisational engineers are free to iterate through the proposed analysis and synthesis steps or to even skip steps. The specified activities have a rather method fragment character. However, neither are situations specified in EE, nor are any adaptation mechanisms proposed.

### 3.2 The work system approach

#### 3.2.1 Overall aim

Alter (2006) defines a work system as “a system in which human participants and/or machines perform work using information, technology, and other resources to produce products and/or services for internal or external customers”. The work system framework supports the description of the work system being studied by outlining those “elements that are included in even a basic understanding of a work system’s scope and operation” (Alter, 2006). It is composed of nine component types (Alter, 2006): *work practices*, *participants*, *information* and *technologies* are the basic components of the work system that perform the ‘work’. Work practices include all activities that are conducted within the work system, such as information processing, communication, decision making or physical actions (Alter, 2006). These activities are performed by the participants of the work system who might use IT or not to do so (Alter, 2006). During their work, participants create and use information that is codified or non-codified, and they use technologies that help them to work more efficiently (Alter, 2006). These four component types are complemented by *products and services* that the work system produces, by *customers* who consume these products and services, the *environment* that surrounds the work system, and finally by the *infrastructure* which is shared with other work systems and the *strategies* which have been defined for the work system (Alter, 2006). The work system framework aims at identifying problems and opportunities, describing possible changes and tracing of how such changes might affect other parts of the work system under consideration (Alter, 2006). As indicated by the different component types of the work system, this ODE approach focuses on the system as a whole.

Several *principles* are proposed for designing work systems which follow a holistic approach as well: Among other principles, Alter (2009) proposes that a work system that is to be designed should include

codified and non-codified information as well as IT and non-IT technologies. Furthermore, instead of software users, work system participants as part of the system should be included (Alter, 2009). Next to these principles, others – which we denote as meta principles – do not refer to the design of a work system, but instead to the use of the work system method. Two examples for metaprinciples are that the work system framework and that the work system principles should be explicitly applied (Alter, 2009).

#### 3.2.2 Focus, specificity and granularity range of artefacts

The work system method is not focused on specific sub-classes of work systems. Regarding specificity, very generic as well as very specific work systems may be designed using this method. Exemplars in (Alter, 2006; Alter, 2009) are mostly quite detailed; It seems however possible to create more aggregate work system models.

#### 3.2.3 Activity or result orientation

The work system approach can be interpreted as a (very generic) method. As results are not specified, the approach can be attributed as activity-oriented.

#### 3.2.4 Explanatory theory foundations, design theories and dominant practices

The work systems approach is referring to general systems theory. In order to analyse and design work systems, the work system method suggests the following activities without prescribing a certain order (Alter, 2009):

- identify the problem or opportunity
- identify the work system that has that problem or opportunity. Constraints or other considerations should be included as well
- summarise the work system with the help of the work system framework
- gather relevant data
- analyse the work system using design characteristics, measures of performance, and work system principles
- identify possibilities for the improvement of the work system
- decide what to recommend
- justify the recommendation using relevant metrics and work system principles.

### 3.2.5 Dominant search direction

No explicit statement is made whether problem solutions should be primarily constructed by theory extension/application or by problem abstraction.

### 3.2.6 Stakeholder concerns, actor types/roles

The work system method is a semi-formal systems analysis and design method that can be used by different roles, i.e., by business professionals and/or IT professionals (Alter, 2006). These roles can use the method at every level of depth that is appropriate for their particular concerns.

### 3.2.7 ODE problem classes addressed and adaptation mechanisms

Due to the underlying work system framework, the work system approach follows a holistic design approach. However, neither are situations specified, nor are adaptation mechanisms proposed.

## 3.3 The business process (re)engineering approach

### 3.3.1 Overall aim

The business process re(engineering) (BPR) approach has been proposed in the early 1990ies. In contrast to BE, BPR focuses on business process innovation ('change the business') and not on holistic business-to-IT solutions. Cultural and communications aspects are not incorporated. Since actual innovations are addressed, BPR in contrast to EE combines conceptual and implementation issues. The BPR approaches of Hammer (1990) and Hammer and Champy (1993) as well as the approach of Davenport and Short (1990) have been widely applied. Due to space limitations we will concentrate on the latter approach in the following.

Although not explicitly expressed, the work of Davenport (1993) implicitly proposes, among others, the following *principles*: before proceeding with the innovation of processes, existing processes must have been documented. For the definition of new processes it is advisable to follow an iterative procedure, starting from the process level to the sub-process level and finally to the activity level. As a third principle the constitution of project teams in respect of team members that can provide creative and innovative process solutions as well as team members that can help to ensure the implementation of these solutions can be derived. Finally, Davenport (1993) advises not to stop after the first process redesign initiative, but

instead to continuously repeat the procedure model presented above.

Business process (re)engineering aims at process redesign in order to accomplish cost reductions, time reductions, improved output quality and improved quality of work life, learning, and empowerment (Davenport and Short, 1990). Process redesign is interpreted as a transformation of the enterprise which demands for the consideration of different stakeholders in the organisation, e.g., the head of key functions affected by the process, key general managers with operational responsibility for the process, suppliers of important change resources as well as process customers and suppliers, both internal and external (Davenport, 1993).

### 3.3.2 Focus, specificity and granularity range of artefacts

Depending on the level of analysis and design, BPR can be performed on all levels of aggregation. Malone et al. (1999) have shown that BPR artefacts can also be specified on most levels of genericity. Regarding focus, however, BPR addresses only the dynamic aspects of managed output creation in an enterprise, while aspects like organisational structure and governance, information flows, and many other are not regarded.

Its core object and its core method make clear that BPR has to be classified as *activity oriented approach*. Reference process models or process repositories could serve as result-oriented extensions.

### 3.3.3 Explanatory theory foundations, design theories and dominant practices

Without sufficiently explicit references to explanatory or design theories, Davenport (1993) suggests a procedure model/method in order to conduct process redesign projects systematically. He proposes the following five phases, each containing four to six activities:

- Identifying processes for innovation: enumerate major processes, determine process boundaries, assess strategic relevance of each process, render high-level judgments of the 'health' of each process, and qualify the culture and politics of each process.
- Identifying change levers: identify potential technological and human opportunities for process change, identify potentially constraining technological and human factors, research opportunities in terms of application to specific

processes, and determine which constraints will be accepted.

- Developing a process vision: assess existing business strategy for process directions, consult with process customers for performance objectives, benchmark for process performance targets and examples of innovation, formulate process performance objectives, and develop specific process attributes.
- Understanding and improving existing processes: describe the current process flow, measure the process in terms of the new process objectives, assess the process in terms of the new process attributes, identify problems with or shortcomings of the process, identify short-term improvements in the process, and assess current information technology and organisation.
- Designing and prototyping the new process: brainstorm design alternatives, assess feasibility, risk and benefit of design alternatives and select the preferred process design, prototype the new process design, develop a migration strategy, and implement new organisational structures and systems.

Regarding the *dominant search direction*, BPR is clearly problem-oriented ('top-down'). Based on an analysis of existing business processes (Davenport and Short, 1990) or based on a process vision (Hammer and Champy, 1993), incremental (Davenport and Short, 1990) or fundamental (Hammer and Champy, 1993) innovation is designed and implemented. A BPR 'theory' which could serve as a foundation for extension or application is not specified.

### 3.3.4 Stakeholder concerns, actor types/roles

In order to successfully conduct a transformation project to redesign processes, different actor roles should be assigned. Davenport (1993) distinguishes between the following four roles:

- Change advocate: he/she proposes change but lacks sponsorship.
- Change sponsor: he/she legitimises the change.
- Change target: those are the (groups of) individuals that must undergo the change.
- Change agent: those are the (groups of) individuals that must implement the change.

Following Davenport (1993), process redesign projects should be realised with the help of two different project teams: an executive team and a process innovation team. In both teams the aforementioned actor roles should be represented, although for the executive team at a senior-most level (Davenport, 1993).

### 3.3.5 ODE problem classes addressed and adaptation mechanisms

The application of the presented procedure model results in the redesign of enterprise processes. Despite providing a procedure model, Davenport and Short (1990) state at the same time that each redesign project varies considerably and thus requires different levels of management attention and ownership and different forms of IT support. Each redesign project also might have different business consequences. However, the authors do not go into detail and fail to specify situational procedure models that address the specifics of different process redesign projects.

## 4 Conclusions

The proposition of differentiating characteristics for ODE approaches is explorative. Although the review of BE, EE, work system approach and BPR indicates some utility of the proposed set of characteristics, additional conceptual work is needed to validate that the proposed aspects are sufficiently important and discriminating to characterise and integrate ODE approaches.

Although the basis is somewhat weak, the structured comparison of BE, EE, work system approach and BPR yields some interesting preliminary insights:

- ODE approaches do not sufficiently support the iterative solution search process. Although certain techniques for problem analysis/abstraction and/or theory extension/application are provided in many approaches, the fundamental search process for grounded solutions is widely left to the designer/engineer. Since software engineering, artificial intelligence and management science have created numerous guidance approaches to multi-stage problem solution (or planning), there is a clear necessity – and chance – for an enhancement of ODE in this regard.

- ODE approaches are very different regarding artefact focus, artefact specificity and artefact granularity. While BE and BPR cover a certain focus range (BE wider than BPR) and a wide granularity and genericity range, EE's ontological models as well as work system models are (at least in the case of EE intentionally) covering only a narrow specificity and granularity range.

- ODE approaches are either activity or result oriented. Taking into consideration that activities as well as results are only 'two sides of the same coin', the question arises why ODE does not try to integrate these views into a concept that combines activity-

oriented solution steps (e.g., method identification and adaptation) with result-oriented solution steps (e.g., reference model identification and adaptation).

- ODE approaches often come with their own design theory that justifies the construction of ‘their’ artefacts. General systems theory, the theory of multi-level, hierarchical systems or the axioms on which EE is founded, however, should not be applicable within only one ODE flavour. Research in ODE should aim at integrating design theories into a ‘design theory body of knowledge’ for the systematic construction of ODE artefacts.

- With the exception of BE, ODE artefacts are not systematically adaptable to context factors and project goals. Examples like a situational BE method for the design of process-oriented business intelligence solutions (Bucher, 2009), a situational BE method for the design of transformation projects (Baumul, 2005) or a situational construction process for the development of BE methods that support change management in the health care sector (Gericke and Winter, 2006) show that situational techniques can be consistently incorporated into ODE artefacts. As an important precondition, however, deep knowledge about the context factors and goals must exist that influence a class of design problems in organisations. The BE project types are a first step to differentiate design problem classes ‘top-down’. Much more problem analysis is needed to expand the BE project type classification into an ODE typology, and to understand single ODE problem classes sufficiently to enable situation.

- It seems straightforward to propose a ‘dominant practice’ or even full-fledged method for each ODE approach. Looking at the different proposed methods, however, a more flexible, generic design and engineering guidance seems to be necessary to support a variety of ODE problems which is not limited to the respective problem scope. The problem of modularisation and reuse arises immediately. Instead of proposing monolithic methods or collections of analysis/design components, ODE research should identify foundational fragments and provide mechanisms to configure such fragments according to the characteristics of the design problem (or problem class) at hand.

ODE is an emerging discipline that aims at replacing intuitive ‘handcrafting’ of organisations by a systematic, model and method driven approach. Like in other design disciplines, integration and openness are growing with maturity.

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