

Same Same But Different – Federating Enterprise Modelling for the Digitalized and Data-driven Enterprise

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Abstract: To the extent that digitalization and data-driven innovation change the way how organizations are managed, also enterprise modelling (EM) approaches need to be adapted. We argue that the once dominant process centric approach to EM needs to be increasingly accompanied by EM components which are value centred or decision centred. As EM is challenged by fragmentation and heterogeneous maturity as a consequence of a greater diversity of core concepts, we propose a two-dimensional framework which affords to better reflect EM coverage of multi-modal organizations, understand relations and dependencies between EM components, and guide IS evolution.

Keywords: Enterprise modelling, digitalization, data-driven innovation, multi-modal management, federated enterprise modelling, process modelling, value modelling, decision modelling.

1 Management Becomes Increasingly Multi-modal

In the early 1990s, organizational design and performance management were fundamentally re-shaped by shifting the focus from *functional specialization* (e.g., inventory vs. production vs. accounting vs. sales) to systematic control of *output flow* (e.g., order-to-cash). Process models and process-focused management since then allow to “manage the white space on the organization chart” [RB95]. This shift puts the **process concept** to the forefront which integrates secondary concepts like function, output, resource, organizational unit, and performance indicator.

Pervasive digitalization of organizational life, commonly referred to as digital convergence, has become the “new” reality in information systems (IS) [TLS10]. Digitalization applies “digitizing techniques to broader social and institutional contexts that render digital technologies infrastructural” [TLS10:749]. Consequently, organizational design and performance management have been challenged again by having to accommodate fast-changing, increasingly individualized, context-dependent *digital interactions*. Managing this so-called *front-stage* [GT09] fundamentally differs from managing harmonized support processes (designated as *back-stage* [GT09]) [LP15]. This calls for a bi-modal management approach. Models for managing the increasingly important front stage usually put the **value concept** to the forefront (value proposition and appropriation) which integrates secondary concepts like customer journey, context, channel, and delivery process [B118].

For organizational design and performance management of both the organization’s back

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and front stages, the exploitation perspective [BT03] is dominant. Conversely, the exploration perspective is dominant for innovation. Since the increasingly important **data-centred exploration** portion of the digitalized enterprise has both exploration and exploitation characteristics [Ha15], this calls for a third management mode. It would be too simplistic – and too implementation-oriented – to associate this management mode with data only. From a business perspective, managing data exploration does neither focus on output flows nor digital interactions, but on informed business decisions (or *insights*), going far beyond what is traditionally understood as “data management”. From a management perspective, it is organizational decision-making which needs to be designed, justified and steered. As an extension of early approaches to centre management tasks around decisions informed by multi-dimensional data (“business questions”, cf. [Co98]), the **informed decision concept** integrates secondary concepts like data lineage and data quality [DD17], business purpose [FHS17], and context.

In summary, digitalization and data exploration increasingly call for a multi-modal, tripartite management approach [LP15]. As a consequence, process centricity is additionally accompanied by value centricity and informed decision centricity.

2 Differentiated Design Foci Need Federated Enterprise Modelling

Enterprise modelling (EM) refers to the abstract representation, description, and definition of the structure, processes, information, and resources of an organization. Due to the conceptual differences of the three outlined constituents of tripartite, multi-modal management, EM for the digitalized and data-driven organization needs to be federated:

1. **Back-stage EM:** For modelling the parts of the enterprise that are harmonized for performance (exploitation), **process** is the established core concept of this EM component. Traditionally (e.g., in SADT [RS77]), functions and data were core concepts for EM. With the shift towards a process-orientation, the Architecture for Integrated IS (ARIS) metamodel, for instance, supports **process**-centred performance management. Functions, data, outcomes, performance, and organizational units all become linked by the process concept [Sc87].
2. **Front-stage EM:** For modelling the parts of the enterprise that need to be customized, contextualized, and optimized to support customer journeys and service encounters, **value** increasingly becomes a core concept of this EM component. Early approaches to analysing and designing interactions at digital interfaces and IT-enabled interactions are often still process-oriented. E.g., service blueprinting [Pa11] is still focused on an interaction process. However, service is primarily about value-in-use and value-in-context [VL08] so that process is not the core concept any more [LN15; LVW08; VL04; VL08; VL16]. In service-dominant logic, **service** is the fundamental basis of economic exchange, which refers to “applying specialized competences (knowledge and skills) through deeds, processes, and performances for the benefit of another actor

or the actor itself” [LN15:158]. Consequently, emergent front-stage IS analysis approaches support **value-centred** performance management beyond mere process considerations. In this notion, economic exchange is pervasively linked by value proposition/appropriation [BI18].

3. **Data-centred exploration EM:** For modelling the parts of the enterprise where data exploration is important, we bring forward the **informed decision concept** to denote a powerful candidate for the prevailing core concept of this EM component. Pioneering approaches to modelling data-centred exploration were process oriented. For example, data exploration has been modelled by a supply-chain logic covering extraction, transformation, load, integration, enrichment, provision, and analysis in data warehousing and business intelligence contexts [SRS11]. We believe that, much more than by the data supply-chain process, data-centred exploration is characterized by the purpose-driven, flexible exploration of (re-)combination and reuse potentials of enriched data [Ch12; LP15]. Data is explored for two purposes: decision making and innovation [Ha15]. Consequently, informed decisions are a good candidate for a core concept. A conceptual model of informed decisions needs to link data sources (master, transaction, and derived data), enrichment processes (data lineage), relevant business questions, exploration purpose (including justification of its ethical and legal foundations), and context. A starting point could be a taxonomy of data exploration use case types.

Perspective	Function-centred	Process-centred	Value-centred	Decision-centred
Time	From 1970s	From 1990s	From ca. 2005	From ca. 2015
Managerial Focus	Manage performance of a complex network of functions which are linked by dataflows	Manage output flow per control objectives and quality specifications	Customize, contextualize, and optimize support of customer journeys and service encounters	Manage systematic data-driven decision making and innovation
Business Aspect	Functional organization	Back-stage (mainly exploitation)	Front-stage (mainly exploitation)	Data-centred exploration
Method	Structured Analysis	Business Processes Design / Engineering	Value Modelling / Design	No mainstream yet
Exemplary Techniques	SSD, SADT, SSADM	ARIS-based, BPML, BPMN, UML	Partial support only (e.g., e ³ value, Value Proposition Canvas)	Partial support only (e.g., multi-dimensional modelling, business questions, analytical use case types)
Seminal References	[RS77]	[Sc87]	[VL04]	

Tab. 1: Chronology of complementing perspectives on enterprise modelling

Table 1 illustrates the complementary albeit heterogeneous character of the different EM components. As management approaches become increasingly multi-modal, Business Process Design and Engineering (BPD/E) can be expected to become less and less domi-

nant in EM. For increasingly important front-stage and data exploration parts of enterprises, “local” models/methods/techniques have been proposed or are under development, leading to more **methodological fragmentation** for both management and EM. While BPD/E has become a mature approach over the last 20 years, value modelling/design is nascent (only partial support, inconsistent approaches), and decision-centred modelling is in its infancy. In addition to fragmentation, another challenge for EM is therefore **heterogeneous maturity** of its components. This may however also be a learning potential: Nascent EM components should adapt well-developed models/methods/techniques for their respective domain. It is however widely unclear how the different components can be integrated.

3 An Architectural Vision for Federated Enterprise Modelling

We have outlined fragmentation and different maturity levels as key challenges that accrue from an increasing diversity within EM. To envision an architecture for federated EM, a modelling and a content dimension are differentiated in what follows.

1. The **modelling dimension** refers to federating hierarchically interrelated constituent EM **modelling concepts** on four layers. Iivari et al [IHK01] proposed to differentiate between paradigm, approach, method, and technique. These four layers are hierarchically interrelated. **EM paradigms** are concerned with a set of philosophical (paradigmatic) assumptions and beliefs that guide our interpretation of reality. **EM approaches** embody a set of related features (e.g., goals, guiding principles, and fundamental concepts) that drive interpretations and actions in EM. Therefore, different EM approaches can be distinguished by their distinct fundamental concepts such as processes, value, or decisions. **EM methods** are concerned with a set of activities, which are intended to guide the work and cooperation of various stakeholders involved in EM endeavours. **EM techniques** are concerned with the development of well-defined, reusable procedures to achieve specific types of well-defined outcomes.
2. The **content dimension** refers to federating EM **content integration** on different layers that structure the business-to-IT stack. Many EM approaches (e.g. [Wi11]) propose to differentiate models that **integrate** different aspects, models that **focus** on a specific aspect in more detail, and models that **align** other models.
The main modelling purpose on the **integration layer** is to integrate fragmented aspects from separate, yet related EM components. To integrate heterogeneous aspects, modelling needs to be high-level to keep models comprehensible and manageable. For business-related concepts, the business model concept holds the power to integrate heterogeneous aspects on such a high-level [LP15; MTA17; Wi16]. An ontology- and taxonomy-based development (or integration) of a suitable meta-model serves as conceptual foundation interfacing between aspect models [FM07; Ve15].

The very successful Business Model Canvas [OPT05], for example, already integrates certain back-stage and front-stage aspects. Based on emerging principles for designing modelling concepts for collaborative design [Av18], also high-level aspects of data-centred exploration should be integrated.

For business-related concepts, the main modelling purpose of the **focus layer** is to represent one of the three EM components (process-centred, value-centred, and data exploration-centred), either holistically or partially, for ‘local’ analysis/documentation needs. As a consequence of the focused content, modelling on this layer can be more in-depth. While modelling concepts focusing on process-centred enterprise components have reached a high level of maturity, proposals focusing on value-centred enterprise components (e.g. [B118]) not only lack a serious proof of concept, but also mechanisms for cross-focus references. Modelling concepts focussing on data exploration are usually centred on data – which is an implementation rather than a business concept. Informed decisions have not been analysed from an ontological perspective sufficiently yet to serve as a sufficient conceptual base for appropriate modelling concepts. It is not even clear whether decision purpose, decision justification or decision context should be the leading concept for respective modelling concepts. As new conceptualizations will emerge, also mechanisms for cross-referencing front-stage and back-stage models need to be developed.

For implementation-related concepts, existing focus layer models for software, data and IT infrastructure are not directly impacted by increasingly multi-modal management.

The main purpose of the **alignment layer** is to provide of a basis for associating business-related and implementation-related models. Examples for association concepts modelled on this layer are capabilities, applications or domains [AW09]. As models on the alignment layer need to be more aggregate than the models they align (e.g. application landscape vs. process models and software platform models), additional EM components on the focus layer create no specific challenge here.

Finally, on the implementation layer the relevant IS design concepts (e.g., software services) are represented. Multi-model management

4 Implications

As EM is intended to support the “translation” of organizational design into the design of appropriate IS, recent trends in enterprise management serve as a starting point for this short paper. As enterprise management becomes increasingly multi-modal, the coverage of EM approaches needs to be extended to cover the specific concepts that are central to front-stage business and data-centred exploration. To avoid fragmentation and heterogeneous maturity of EM components, analysis and design principles of mature components

(back-stage EM and IT/business alignment models) should be used as blueprints to establish new (truly business oriented conceptualization of data-centred exploration) or to enhance existing (business modelling, front-stage business) EM components. Special emphasis should be put on the relationships between existing and new EM components because processes, value and informed decisions, while being subject to different management modes, still are closely related core concepts of any enterprise.

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