The Enterprise Engineering Series

Jan L. G. Dietz · Hans B. F. Mulder

Enterprise Ontology

A Human-Centric Approach to Understanding the Essence of Organisation

Second Edition

Springer

The Enterprise Engineering Series

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dag sterke Sanne
bezorger van geluk

goodbye strong Sanne
deliverer of happiness

Preface to the Second Edition

Next to numerous 'typing' errors that readers of the first edition reported to us, it was the writing of the book on Enterprise Design (which we hope to finish mid-2024) that forced us to conceive some things a bit different or to be more precise in writing about them.

A prominent example of the first class of changes is in Chap. 11: splitting the D-organisation into a purely documental D-organisation and a physical M-organisation (M from material) that supports the D-organisation with material services, like storing and retrieving files.

A prominent example of the second class of changes is the reconsideration of the action rules in Chap. 12. The with-clause is moved from the event part to the response part, where it actually belongs. In order to allow people to specify the original data (facts) that are going to be used in the execution of the rule, the event part has got an optional given-clause.

Chapter 19 contains a new practical report in Sect. 19.10. This contribution has convinced us to include the revocations of the decline and reject step in the complete transaction pattern in Chap. 8. In the first edition of the book, we were confident that these revocations were not needed. It is the feedback from the practical application of DEMO (cf. Chap. 12), as reported in Sect. 19.10, that has made us think differently.

In addition to these major changes, we have added a lot of small improvements, which will make reading the book an even more rewarding journey.

Voorburg, The Netherlands — Jan L. G. Dietz
The Hague, The Netherlands — Hans B. F. Mulder
1 January 2024

Preface

Our knowledge can only be finite, while our ignorance must necessarily be infinite
(Karl Popper)

Would it be possible to develop a way of thinking about enterprises that offers substantially more insight into their operation and overview over their composition? And if so, how would such a way of thinking be like? And how could you make it practical? These are the core research questions addressed in this book.

When the first author finished the book *Enterprise Ontology: Theory and Methodology* in 2006, he was quite confident about his understanding of enterprise ontology. However, both by teaching and by practicing the subject, it became clear that he had to keep thinking. Thanks to this continuous process, the book that you are about to read is not just an extended edition of the one in 2006; it is a quite different book.

What we try to emphasise in the current book is the key role of human beings, in enterprises and in society at large. In contrast to our deep conviction that human beings are the pearls of enterprises, we witness the madding crowd drift away in the opposite direction. Unfortunately, this madding crowd does not only include ICT and AI professionals, but it also comprises people who are supposed to lead the world into a safe and steady future: philosophers, directors, corporate and public governors, etc.

Even more firmly than before, leading business schools teach us that employees can best be considered as carbon-based robots, who are intrinsically untrustworthy and lazy, and therefore should be replaced by silicon-based robots the sooner, the better. We think that even Frederic Taylor, who laid the foundation for the currently dominant mechanistic world view, would turn in his grave if he would see the madness. People all over the world get ever more brainwashed by the idea that silicon-based robots will soon be better decision-makers than we, poor carbon-based creatures, are. And that it is about time to recognise robots as equivalent fellow citizens, as the government of Saudi Arabia did in October 2017. How far can one get derailed?

Fortunately, the falseness of the madding preachers can easily be unmasked if one gets a clear sight again on the distinction between computing (or information processing) and decision-making and between our rational and our social existence. Let us exemplify this. In determining the alimony in a divorce case, judges rely heavily on software applications and rightly so, because the applicable legislation is often complicated. But the result of the computations is not automatically the alimony that one party has to pay to the other. It is only after the judge has decided it to be so; decision-making is not a rational but a social act. It is because we have given the judge the authority to do so that we accept her/his judgment, regardless whether we agree or disagree. The basic understanding of this important distinction is the red thread in the theoretical part of this book. Adopting and nourishing this crucial insight is the only way, as we see it, to keep the world human or to make it human again.

Therefore, it is good that public governors and councils require governments to be transparent to the people about whether a decision is made by an authorised officer or by a computer (or algorithm). But they better understand that these artefacts cannot make decisions that they can only compute! Deciding is an exclusive human (social) ability. Making errors is another one, but that is all in the (social) game.

Another distinction between humans and androids is the human ability to feel responsible for ourselves and for others, i.e. to be a social individual. Of course, we can let androids mimic human behaviour. For sure, we can declare androids to be equivalent social players in our society. But this will be an explicit and freely taken human decision, which the decision-maker has to justify towards her/his fellow social individuals. History teaches us that humans can make stupid decisions and succeed in justifying them. There is no reason to assume that they won't in the future. So, indeed, judges and governors make errors, as all decision-maker do. But we, members of the common society, can hold them responsible and accountable for their deeds. That is also a rule of the game.

Enterprise Ontology, as defined and applied in this book, is therefore an ever more important way of understanding human social behaviour, more specifically of human cooperation that is based on trust. Endowed with the authority that is needed to do their work, people will act responsibly, they will excel in their work and they will hardly need being managed.

Next to a substantial extension and improvement of the theoretical foundations of the notion of Enterprise Ontology, this book contains almost as many pages that are devoted to its practical applications. This makes the book perfectly suited for being used as a text book in courses on Enterprise Ontology and Enterprise Engineering or on the principal methodology in Enterprise Engineering: DEMO (Design and Engineering Methodology for Organisation). In addition to six exercises in producing so-called essential models of organisations with DEMO, we have included two chapters containing reports about the practical application of DEMO on various subjects in a wide range of enterprises (companies, institutions, governmental agencies).

Although even after finishing the book, our ignorance regarding Enterprise Ontology is necessarily infinite (thanks to Popper), we hope that our finite

knowledge of it will appear to be sufficient for convincing you and inspiring you to keep on reading and thereby enter into a wonderful world.

Voorburg, The Netherlands — Jan L. G. Dietz
The Hague, The Netherlands — Hans B. F. Mulder
15 October 2019

Acknowledgements

We have got corrections to the first edition of Enterprise Ontology from many people. We feel particularly indebted to Junichi Iijima, who meticulously went through the first edition for the sake of translating it to Japanese, as well as to Marien Krouwel and Martin Op 't Land.

Summary of the Book

The book is divided into three parts: Introduction, Theories and Applications.

The Introduction consists of three chapters. Chapter 1 provides a short history of organisation and ICT,[1] headed by this quote of Peter Drucker: "The test of a healthy business is not the beauty, clarity or perfection of its organisational structure, it is the performance of people". A history of the Organisational Sciences is sketched, along with a history of the ICT Sciences (comprising Computer Science, Software Engineering, Artificial Intelligence, etc.). The first one starts with the famous publication by Frederick Taylor in 1911. The history of the ICT Sciences begins in the late 1950s, with the first use of computers in organisations. The two histories converge at the time that communication is (also) understood as action, around the year 2000. This insight paves the way to the development of the discipline of Enterprise Engineering (EE), of which Enterprise Ontology (EO) is an important pillar. EO is a human-centric approach to understanding the essence of organisation.

Chapter 2 is an introduction to the emerging discipline of EE, headed by this quote of Henry Petroski: "Science is about knowing; engineering is about doing". Because of their increasing complexities, modern societies have an urgent need for the discipline of EE. Despite their age, the ideas of Frederic Taylor still determine the mindset of managers: a machine-like understanding of organisations still dominates managerial practice. EE offers three general goals: intellectual manageability, organisational concinnity and social devotion. They are brought about by the thoughtful application of Enterprise Ontology, Enterprise Design and Enterprise Governance respectively.

Chapter 3 introduces the reader in the main subject of the book, namely, EO. It is headed by this quote of John Maynard Keynes: "The difficulty lies not so much in developing new ideas as in escaping from old ones". EO is the name of a

[1] Information and Communication Technology commonly refers to the digital electronic, optical, etc. means to process, store and transmit data. Regarding the term "technology", we prefer to stick to the original meaning of the word, which stems from its Greek origin: *technè* (meaning making) and *logos* (meaning knowing). So, by technology, we primarily understand knowing how to make and only secondarily the means (devices, etc.) mentioned above.

scientific discipline that offers a sound theoretical foundation to understanding the construction and operation of enterprises. In contrast to the general notion of ontology, which is about the essence of almost everything, EO offers a coherent, comprehensive, consistent and concise understanding of the essence of enterprises, fully abstracted from realisation and implementation. This notion of essence is the right starting point of many kinds of improvement of enterprises.

The Theories part comprises eight chapters and is headed by two quotes, one by Kurt Lewin ("There is nothing as practical as a good theory") and one by Sumantra Goshal ("There is nothing as dangerous as a bad theory"). Chapter 4 provides an overview of all EE theories. It is headed by this quote of Albert Einstein: "Whether you can observe a thing or not depends on the theory that you use. It is the theory that decides what can be observed". The foundations of the discipline of EE, as envisioned by the Ciao Network,[2] consist of the CIAO Paradigm and a number of theories. After the discussion of the paradigm, which has its origins in the communication-centric view on information systems engineering that emerged around 2000, the role of the EE theories and their relationships with the EE methods and the practice of EE is explained. A suitable classification scheme is provided, consisting of four classes: philosophical, ontological, technological and ideological. Each of the theories is briefly discussed: the EE information theory (philosophical), the EE model theory (philosophical), the EE function-construction theory (philosophical), the EE organisational operation theory (ontological), the EE system theory (ontological), the EE organisational construction theory (ontological), the EE organisational essence theory (ontological), the EE design theory (technological), the EE implementation theory (technological), the EE automation theory (technological) and the EE governance and management theory (ideological). Only the three philosophical theories and the four ontological theories are elaborated in this book. The three technological theories are discussed in the book *Enterprise Design*.[3] The ideological theory is extensively discussed in the books *Foundations of Enterprise Governance and Enterprise Engineering* and *Practicing Enterprise Governance and Enterprise Engineering*.[4]

In Chap. 5, the EE information theory or FI theory is presented. It consists of Ogden and Richard's semiotic triangle and Stamper's semiotic triangle. They clarify that information is a dyadic notion: it is the inseparable combination of content (the communicated thought) and form (the sign that serves to signify the thought). The contribution of the semiotic ladder is the distinction between the semantics and the pragmatics of thoughts and the clarification that a thought consists of a fact and an intention. Intentions correspond with commitments in the social world. The core of the FI theory is the semiotic mill, refined into the ontological mill, which is a framework for understanding perception and conception. It explains how factual

[2] For more information, visit www.ciaonetwork.org.

[3] This book is authored by Jan Dietz, Marien Krouwel, Martin Op 't Land and Hans Mulder. It is published by Springer Nature.

[4] The two books are authored by Jan Hoogervorst. They are published by Springer Nature.

knowledge is created from perceptions of concrete things, directed by (fact) types, which operate as conceptual sieves. Three topics are elaborated. The first one is the recognition that most of the types people use are functional types. Functional types are inherently subjective and therefore hard to define precisely. The second topic is the problem of sameness and change, illustrated with the well-known paradox of Theseus. The third topic regards the composition and decomposition of things, based on the part-of relationship between things. Lastly, two issues in current programming and modelling practice are discussed. The first one is the duality of types, as opposed to the synonymy of signs. The second issue is the value types in software.

Chapter 6 provides the EE model theory. It is a theory of models and modelling in general and of conceptual modelling in particular. The foundations part starts with this definition of model by the philosopher Leo Apostel: any subject using a system A to obtain knowledge of a system B is using A as a model of B. It conveys clearly the basic understanding of the notion of model as a role notion. Next, the model triangle is introduced, based on the semiotic triangle from the FI theory. It clarifies how complexes (systems or aggregates) of three major sorts (concrete, conceptual and symbolic) can be used as models of each other. By adding two levels of abstraction, the schema level and the meta schema level, the General Conceptual Modelling Framework (GCMF) emerges. It clarifies the notions of conceptual complex, conceptual schema and meta schema, for any Universe of Discourse or system's world. The elaborations part comprises the presentation and discussion of the General Ontology Specification Language, a universal language for specifying conceptual complexes, conceptual schemas and meta schemas. The syntax of the language consists of graphical as well as textual symbols and constructs. The discussions part starts with a comparison of the GCMF with two other frameworks. Next, the influence of O-O thinking on conceptual modelling is discussed. O-O thinking blurs two crucial notions in conceptual modelling: the type-instance and the subtype-supertype relationship.

Chapter 7 introduces the reader into the important distinction in modelling between function and construction. This EE function-construction theory, or TAO theory, is a theory about the way subjects (people) perceive the things that surround them. TAO stands for Teleology, Affordance and Ontology. The foundations part starts with an excerpt from Gibson's theory of affordances. This theory clarifies the subjectivity of affordances. Next, the intended affordances, commonly called functions, of designed things (artefacts) are discussed. Although people are mostly and primarily interested in the functions (affordances) that things may offer them, engineers are also interested in the construction of things. Contrary to function, construction is an objective notion. Related to function is the notion of experience, defined as the sensation that an affordance evokes in the mind. The notion of value is discussed as the intensity of experience, measurable on an ordinal scale. The elaborations part starts with a discussion of constructional models and functional models, their incommensurability and the fundamental difference between constructional decompositions and functional ones. Next, these findings are illustrated to an example of an enterprise. The discussions part addresses three topics. The first one is the subjective nature of functional models, and the second one is the mapping

from functional to constructional models. It concludes with the importance of ontological modelling and a comparison of TAO theory and TAO philosophy.

The first and crucial ontological theory is presented in Chap. 8, headed by this quote of Henry Mintzberg: "Every organised human activity—from the making of pots to the placing of a man on the moon—gives rise to two fundamental and opposing requirements: the division of labor into various tasks to be performed and the coordination of these tasks to accomplish the activity". The EE Organisational Operation Theory or PSI theory is a theory about the operation of organisations. PSI stands for Performing in Social Interaction. Based on the CIAO Paradigm (Communication, Information, Action and Organisation), a communication-centric view is taken on the cooperation of people in enterprises, as manifested in business processes. The fundamental notion in understanding the operation of organisations is the coordination act. It consists of a performer, an addressee, an intention and a product. The performer and the addressee are actors, i.e. subjects filling an actor role. Actor roles are the units of authority and responsibility. Coordination acts can be performed verbally, non-verbally and tacitly. They are the key elements in (business) conversations, which are the constituting parts of (business) transactions. A transaction is carried out by actors in two roles: the initiator and the executor. The executor brings about the product of the transaction. The process of a transaction is a path, possibly including iterations, through a universal transaction pattern, which consists of one main pattern and four revocation patterns. The latter serve to revert the state in the main pattern to a previous state. Because of the inherent connection between an actor role and the transaction kind of which fillers are the executor, the combination of the two is called transactor role. Transactor roles are the universal building blocks of business processes. Performing a coordination act results in creating the corresponding coordination fact. A fundamental principle in the PSI theory is that actors act autonomously, also if they are guided by business rules. Based on this principle, definitions are developed for the notions of authority, responsibility, accountability and competence.

The EE systems theory, which is discussed in Chap. 9, can best be viewed as a formalisation of the PSI theory. The EE systems theory is about the construction and operation of systems. Systems are divided into three regions: organised simplicity, organised complexity and unorganised complexity. The definition of a (homogeneous) system is presented as a triple (C, E, S), where C is a set of elements of some category, E is a set of elements of the same category as the elements in C and S is a set of interaction bonds among the elements in C and between them and the elements in E. Examples of categories are physical, biological and social. Organisations belong to the category of social systems. Three sorts of conceptual models are distinguished: black-boxes, grey-boxes, and white-boxes. The well-known finite automaton or finite-state machine and the discrete event system are examples of grey-boxes. For a thorough discussion of the grey-box and the white-box, the PRISMA model is introduced. In this meta model, systems are considered to be discrete event automata, operating in a linear time dimension. Its formalised ontological model is particularly suited to study organisations. In the PRISMA grey-box, three ways of mutual influencing between (the elements of) systems are

distinguished, called activating, restricting and impeding. The PRISMA white-box allows one to conceive organisations as prismanets: networks of processors, channels and banks. Prismanets are comprehensive formalised systems, open to formal analysis and to implementation in software. They can conveniently be expressed in prismanet diagrams. To illustrate the PRISMA model, two example prismanets are presented: one regards a traffic control system and the other a car rental organisation. Next, the generic transaction prismanet is discussed. It is the understanding of the complete transaction pattern from the PSI theory in the PRISMA model. Lastly, the quality aspects of PRISMA models are discussed, as well as their importance for software engineering.

Chapter 10 presents a core ontological theory that builds on the PSI theory. The EE Organisational Construction Theory, also called OMEGA theory, is a theory about the modular structures that can be distinguished in organisations. Based on the organisational building block (the transactor role) from the PSI theory, three kinds of coordination structures are identified and discussed: interaction structure, interstriction structure and interimpediment structure. The interaction structure of an organisation consists of tree structures, which are constituted by the initiator links between transactor roles. An interaction tree determines a business process kind. The interstriction structure of an organisation consists of the access links between transactor roles. Through access links, actors have reading access to the facts in transaction banks. The interimpediment structure of an organisation is constituted by the wait links between transactor roles. Three topics are elaborated in-depth. The first one is the notion of responsibility range of a transactor role, as an extension of the responsibility area from the PSI theory. The second subject is a comprehensive way of modelling business processes, which allows for all the details that are needed, but that is still very concise. Next, several general patterns in process structures, called reference models, are discussed. To conclude, the presented structural way of thinking about business processes is compared with the currently dominant flow way of thinking.

In Chap. 11, another theory that builds on the PSI theory is discussed. The EE organisational essence theory, or ALPHA theory, is a theory about the distinction of layers of transactor roles in an organisation, based on the sort of production that transactors bring about: original, informational, documental or material. Original production comprises all production acts that result in original new facts. Examples are devising things, deciding and judging, as well as manufacturing, transporting and observing things. Informational production acts comprise remembering, computing and deriving facts and sharing (remembered or derived) facts. Documental production acts comprise saving, providing and transforming documents or datasets (containing facts). Material production comprises storing, retrieving, copying, transmitting and destroying files. Accordingly, the organisation of an enterprise can be partitioned into four partial organisations: the O-organisation (O from original), the I-organisation (I from informational), the D-organisation (D from documental) and the M-organisation (M from material). The I-organisation supports the O-organisation by means of informational services (remembering and sharing facts), the D-organisation supports the I-organisation by means of documental

services (saving and providing data sets or documents) and the M-organisation supports the D-organisation by means of material service (storing and retrieving files). Because original acts are the only acts that change the state of the 'business' world of an enterprise (i.e. the production world of its O-organisation), they must be performed by human actors. For I-, D- and M-acts, it holds that they can be taken over by artefacts, notably ICT systems, including AI-artefacts (like logistic control systems and robots). However, as pointed out in the PSI theory, human actors are ultimately responsible and accountable for the acts of these artefacts. The ontological model of an enterprise's O-organisation is called its essential model. Like every ontological model, it is abstracted from implementation, but it is also abstracted from realisation, that is, from the supporting I-, D- and M-organisation. Yet it contains everything that is needed to understand the essence of an enterprise's operation. The ALPHA theory contributes to the generic EE goal of intellectual manageability by an unprecedented reduction of complexity. It also clarifies that every enterprise information system is nothing more or less than a part of the I-, the D- and the M-organisation that support the O-organisation, only implemented by using ICT.

The part Applications is headed by a quote of Confucius: "I hear and I forget, I see and I remember, I do and I understand". The aim of this part of the book is to show the reader how the theories can be put into practice.

Chapter 12 presents the DEMO methodology (Design and Engineering Methodology for Organisations). It helps one to produce the essential model of an enterprise or in general of a Scope of Interest (which may cover a part of one enterprise or of a network of enterprises). Like every proper methodology, DEMO comprises a Way of Thinking (WoT), a Way of Modelling (WoM) and a Way of Working (WoW). The WoT consists of the theories in this book. The WoM consists of an integrated whole of four sub-models: the Cooperation model (CM), the Action Model (AM), the Process Model (PM) and the Fact Model (FM). The CM of a Scope of Interest (SoI) is the ontological model of its construction, thus of the identified transactor roles and the coordination structures among them. Three structures are distinguished: the interaction structure, the interimpediment structure and the interstriction structure. The AM of an SoI is the ontological model of its operation. For every internal actor role, it provides the rules that guide the role fillers in doing their work. The guidelines for responding to coordination events are called action rules (similar to business rules), and the ones for performing production acts are called work instructions. The PM of an SoI is the ontological model of the state space and the transition space of its coordination world. The FM of an SoI is the ontological model of the state space and the transition space of its production world. All four sub-models are expressed in the DEMO Specification Language (DEMO-SL),[5] which comprises diagrams, tables and formal textual descriptions. For producing essential models of enterprises, the WoW of DEMO offers the OER method

[5] The latest version of DEMO-SL can be downloaded freely from www.ee-instituite.org.

(Organisational Essence Revealing). It consists of a number of steps in which the four DEMO models are produced.

Chapters 13 through 18 present exercises in applying DEMO to various cases: Fixit, Pizzeria, Rent-A-Car, Library, PoliGyn and GloLog.

The case Fixit is an exercise in understanding and applying the full potential of the complete transaction pattern, including the revocation patterns and the consequent rollbacks of the main business process. The analysis of the case demonstrates that the complete transaction pattern covers all 'exceptional' situations, which, in current practice, are commonly taken care of in separate business processes, thereby blurring the inherent connections with other processes as well as the involved responsibilities. Understanding exceptions within this pattern not only helps actors in all enterprises get a deeper insight into the business processes they are involved in, but it is also an invaluable intellectual asset for the designers of business process management systems, specifically regarding the design of the user-system interaction.

The case Pizzeria is an exercise in understanding and applying the full potential of abstracting from realisation and implementation, thus focusing on the O-organisation of an enterprise. In the course of its existence, the pizzeria passes through three phases. The transition from the first to the second phase means a change in the essential model. The change appears to have interesting consequences for the allocation of authority. Despite the huge differences between the second and the third phase in terms of implementation, their ontological models do not differ.

The case Rent-A-Car is an exercise in producing the essential model of an enterprise that offers the usufruct of tangible things: Rent-A-Car is a company that rents cars to customers. By applying the OER method to the narrative case description, one acquires the knowledge to produce the essential model of the enterprise. All four aspect models (CM, AM, PM and FM) are presented. Together, they constitute a coherent whole that offers full insight into and overview over the essence of car rental companies. The produced action rules can directly be transformed into executable computer code.

The case Library is an exercise in producing the essential model of an enterprise that offers the obtaining of usufruct of tangible things (borrowing books) and the creating of intangible things (starting and ending memberships). By applying the OER method to the narrative case description, the information is achieved on the basis of which the essential model is produced. The essential model is a stable beacon when discussing the impacts of alternative ways of implementing it. Far-reaching changes in the operational activities appear to have no or little impact on the essential model because they mainly regard implementation matters. Special attention is given to showing how revocations can be indicated in the process structure diagram.

The case PoliGyn is an exercise in producing the essential model of an enterprise that offers the creating of (tangible and intangible) things: producing diagnoses and performing clinical and sonographic examinations. The CM, PM and FM are (partially) presented and discussed. Three, basically general, topics are elaborated, because they have a typical role in PoliGyn. One of them is the identification and

formulation of product kinds. The second is the order in which enclosed transactions are carried out, and the third one is the delegation of tasks.

The case GloLog is an exercise in producing the essential model of an enterprise that offers the transporting and storing of tangible things: goods, containers and ships. The CM, PM and FM of the GloLog organisation are presented and discussed. Emphasis is put on four topics. The first is the unavoidable need to conceive notions that are not present in the narrative description but that are nevertheless ontologically crucial: the container content and the ship content. The second is the necessary existence of four distinct, only 'loosely coupled', business processes. The necessity stems from the incompatibility of the case cycles in these processes: sale, purchase, container content and ship content. The third topic is the distribution of responsibilities: the ontologically necessary ones, as represented in particular by the CM, cannot easily be traced back to the narrative description of the case. The fourth topic is the current implementation of the essential model. Without the help of the essential model, it is almost impossible to clarify the role of the many parties involved and the many document kinds used (respectively to point at their redundancy).

The last two chapters contain contributions from practice: nine real-life applications of DEMO in Chap. 19 and five enhancements of DEMO in Chap. 20. The selected applications are (1) The VISI Standard in Civil Engineering, (2) Getting firm grip on software development, (3) Agile Law Making, (4) Enterprise Transformation, (5) Designing Data Warehouses, (6) Enterprise Ontology based Process Simulation, (7) Designing Digital Document Archives, (8) Air France KLM Cargo—post-merger decision-making and (9) DEMO's human dimension in practice.

In Chap. 20, a number of contributions are presented in which DEMO is used in combination with an existing and well-accepted approach or activity in the broad field of enterprise engineering, all resulting in improving the quality of the other approach or activity. The selected contributions are (1) DEMO enhanced Agile Software Development, (2) DEMO enhanced Lean Six Sigma (3) DEMO enhanced BPMN, (4) DEMO enhanced software testing and (5) DEMO enhanced mining.

The book is concluded by a 14-page glossary of terms and a list of abbreviations.

Contents

About the Authors

Jan L. G. Dietz is emeritus professor at Delft University of Technology and visiting professor at the University of Lisbon and the Czech Technical University in Prague. He has always combined academic work with applying research outcomes in practice. He has supervised over 300 MScs and 16 PhDs, and he has published over 250 scientific and professional papers and books. Jan Dietz is the spiritual father of DEMO (Design and Engineering Methodology for Organisations), a founder of the Enterprise Engineering Institute (www.ee-institute.com) and the founder of the Ciao! Enterprise Engineering Network (www.ciaonetwork.org).

Hans B. F. Mulder is an entrepreneur and founder of Viagroep nv, Standish research director, executive professor at the Antwerp Management School and lecturer at the Police Academy of the Netherlands. He is regularly engaged as an IT expert when conflicts between companies need to be resolved in or out of court, such as participating in arbitration, mediation and expert reports. He received his PhD at Delft University of Technology, MSc in Business Administration at Nijenrode Business Universiteit and BSc in Informatics at The Hague University of Professional Education. Furthermore, he has published more than 100 articles in specialist journals and international magazines and is the author of several books such as *Eenvoud in Complexiteit*.

Abbreviations[1]

ADT	Authorisation Delegation Table [representation form of the *Action Model*] (Chap. 12).
AM	Action Model [*aspect model* of the *ontological model* of an *organisational layer*] (Chap. 12).
ARS	Action Rule Specifications [representation form of the *Action Model*] (Chap. 12).
BAT	Bank Access Table [representation form of the *Cooperation Model*] (Chap. 12).
BCT	Bank Contents Table [cross-model representation form of the *Cooperation Model* and the *Fact Model*] (Chap. 12).
CM	Cooperation Model [*aspect model* of the *ontological model* of an *organisational layer*] (Chap. 12).
CSD	Coordination Structure Diagram [representation form of the *Cooperation Model*] (Chap. 12).
ct	creation time (Chaps. 8 and 12).
CUT	Create Use Table [cross-model representation form of the *Process Model* and the *Fact Model*] (Chap. 12).
DFS	Derived Fact Specifications [representation form of *Fact Model*] (Chap. 12).
et	event time (Chaps. 8 and 12).
FM	Fact Model [*aspect model* of the *ontological model* of an *organisational layer*] (Chap. 12).
ICT	Information and Communication Technology. It combines Information Technology (IT) for information processing and storage, and Communication Technology (CT) for transmitting information.
OFD	Object Fact Diagram [representation form of *Fact Model*] (Chap. 12).
ot	operative time (Chaps. 8 and 12).

[1] Hereafter, the most common abbreviations of terms in Enterprise Ontology, as used in this book, are explained, in alphabetical order. The chapter(s) where the term is defined is indicated between "(" and ")".

PM Process Model [*aspect model* of the *ontological model* of an *organisational layer*] (Chap. 12).

PSD Process Structure Diagram [representation form of the *Process Model*] (Chap. 12).

TPD Transaction Process Diagram [representation form of the *Process Model*] (Chap. 12).

TPT Transactor Product Table [cross-model representation form of the *Cooperation Model* and the *Fact Model*] (Chap. 12).

WIS Work Instruction Specifications [representation form of the *Action Model*] (Chap. 12).

Part I
Introduction

Part I contains the three introductory chapters to the main contents in the Parts II (theories) and III (applications). Chapter 1 offers a history of the developments of both the Organisational Sciences and the ICT Sciences (Computer Science, Software Engineering, Artificial Intelligence, etc.) and their current convergence. In Chap. 2, the reader is introduced into the emerging discipline of Enterprise Engineering, in which a design-oriented view is taken toward organisations. One of the conceptual pillars of Enterprise Engineering is Enterprise Ontology, the core subject of the book. Chapter 3 provides an introduction to this key notion.