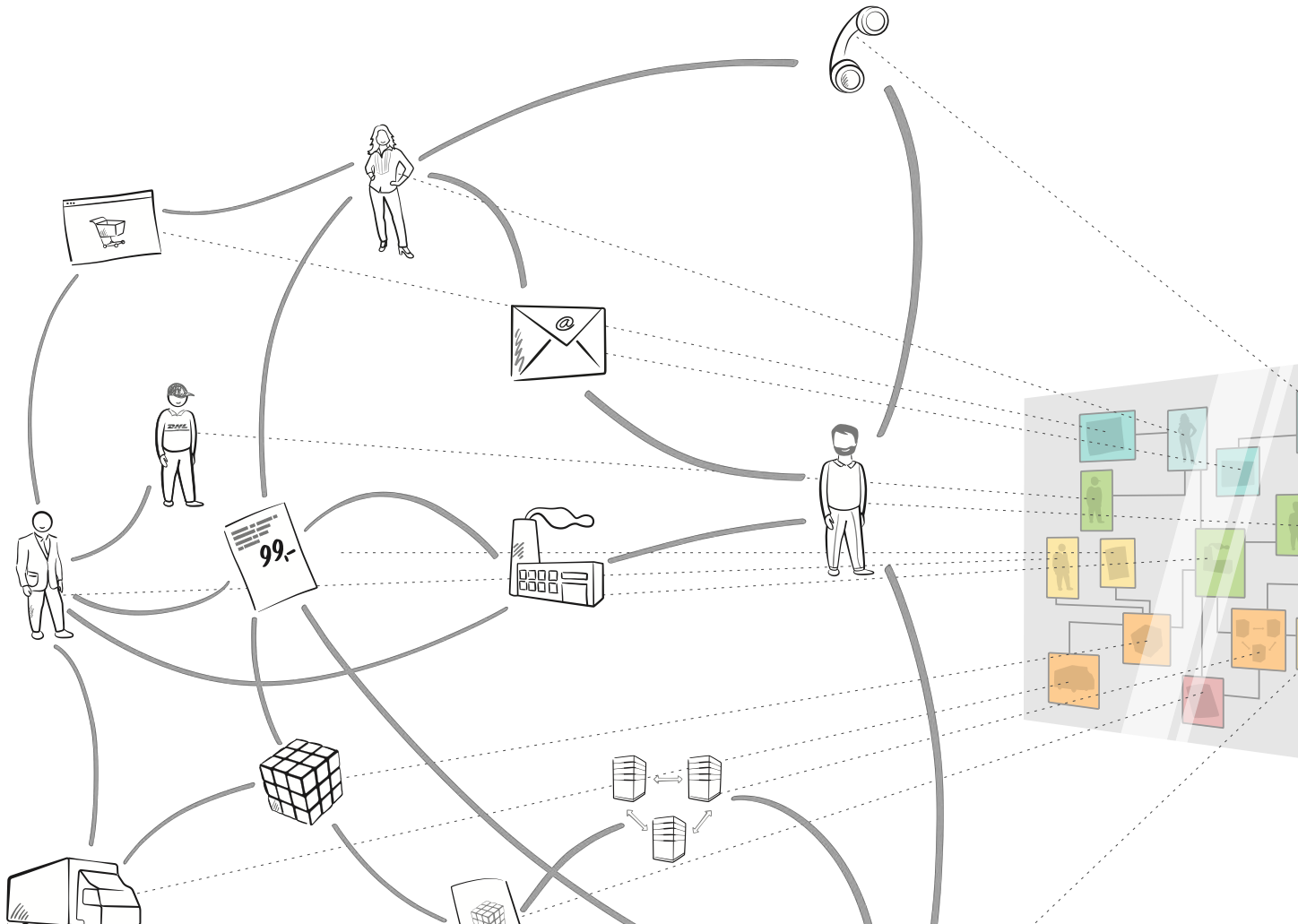
With this white-paper, foryou andyourcustomers introduces ‘information modelling’: the se mantic mirror for your business and its digital challenges.



Information modelling by
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20.April 2019

Introduction

The premise for this white-paper is that the digitisation of companies and their business units represents one of the biggest challenges for organisations today. The challenges posed by digitisation and the ways of approaching these challenges have already been described in 'The "Exploded View", for a better overview of digitalisation' by Jonathan Möller et al. [möller].

Are you aware of and in control of the information units required for the successful digitisation of your company?

Digitisation is generally understood to mean the management and use of information in the form of electronically managed data. Therefore, the successful digitisation of your business processes directly depends on the quality and availability of your information. Digital products, digital twins, big data, and a 360° view of products and customers – are based on information and data. Quotes such as 'Data is the oil of the 21st century' or 'Data is the new oil, information the new gold' are mantras used in management training and consulting today.

In this white-paper, we show that proficient handling of information which is used in, or provided by, a company is a necessary competence for remaining competitive in a digitised world in the future. We will explain the difference between data and information and why efficient data management, whilst necessary, is not enough.

Information modelling is not software architecture; it is company architecture.

The information model is designed to help provide a company-wide context for standardised understanding and better communication. It offers companies and the individuals acting within them standard terms and structures, encourages mutual understanding across departments and leads to unique interfaces between internal and external systems.

The model forms the basis for many aspects of successful digitisation and enables a target-oriented, measurable approach en route to becoming an efficiently digitised company. In spite of its pivotal importance for business success, the information model is surprisingly simple and can be learnt and applied in a short space of time.

To which questions does this white-paper provide answers?

Do you already have answers to these questions in your company?

- How can a company develop a common language which clarifies and documents terms, contexts and understanding and makes these available to all the employees in the company?
- How can misunderstandings and, thereby, avoidable costs be prevented or at least reduced? How do you achieve a *single source of truth* in your company, not only in terms of technical solutions but primarily on a semantic level?
- What influence does a clean information basis have on all areas of your company (processes, organisation, IT, communication, management and sales approach)?
- How does data become information? And why can this transition be decisive in the success or failure of digitisation within an organisation?
- How does the information model fit with the Exploded View?

Which questions would you like answered?

Imagine this:

- You could present the multidimensional nature of your company and your tasks clearly and communicate these to all employees within a short space of time.
- Consolidated business data is collected and calculated across countries and areas in exactly the same way. All employees could rely on this data and dispense with personal workarounds in the future.
- Employees could understand each other across countries and departments.
- The quality or function of your business processes would no longer depend on the availability of a few key people.
- New software would do what you hope for and would be integrated into the current system landscape immediately.
- Attributes relating to products, customers and projects would be maintained centrally whereby the relevant knowledge would be present (single source of truth) and then reliably distributed in a time-saving way to all applicable systems.

Information modelling creates the context for common understanding.

Wishful thinking? Does this ideal situation seem a long way off, and the journey to get there rocky and arduous?

This white-paper shows you how to change your environment and reposition it in the required direction. The basis for this is surprisingly simple: standardised and clearly defined terms and structures form the basis of understanding and clear communication. In turn, these are the prerequisites for achieving the aspirations stated above.

Understanding and communication require a common context

Do you know what ‘4711’ stands for? Or ‘4812’? Without a context, all you can do is guess. In this context, guessing means assuming something based on your own personal context, which is made up of your expectations, your education and your current environment.

If you thought of eau de cologne in the case of the first number, this proves how successfully this *brand name* is marketed. The second number is the height of Mount Vancouver in Canada. In the context of postal services, a person in Switzerland might guess that the number was a postal code; in mountaineering circles, it might be assumed that the number relates to the height of a mountain. Unless a common context is established, we never know what an author intends by a statement or how we should interpret it in order to develop the same understanding – the same applies to the interpretation of data values.

Two practical examples from our experience show possible consequences of the simplest misunderstandings in this context:

Are you familiar with such misunderstandings from your own practice?

- A customer wanted to order a replacement part for a product over the phone from the customer service department of a company. The customer was told by the customer service assistant: ‘The part you wish to order is not available for this device’. Why? The part required was entered in the customer service system under a different name from the one used in the product description on the public website.
- Using different names for the same thing (part of a component in a device) in two departments always led to misunderstandings and intense debate within the company. Following the clarification and standardisation of terms, one employee commented: ‘Since using the same name, we have had far fewer arguments in meetings.’

Taken in isolation, these examples are mundane and almost trivial. However, if you extrapolate these to a large number of poorly used terms and thousands of employees, you end up with a significant number of wasted working hours – not to mention possible risks to your company's reputation, a poor working environment, disreputability and poor service quality.

The more important a term is in a company, the more relevant a clear definition and use of this term becomes. Unfortunately, however, it is usually the most important terms that are clarified and standardised the least often.

How many different terms are used for the same thing in your company?

For example, how would you clearly and uniquely define the term 'customer' in your company in two sentences? Would your definition be accepted by your colleagues in other departments? Would the following definition from Oxford Dictionaries online apply unreservedly in your company: 'A person who buys goods or services from a shop or business'? Probably not.

Terms often vary not only on one level but also between levels (see Illustration 1). Terms specified by IT tools are most often adopted. People get used to them, and after a certain time, the term becomes the new word for the specific thing. Anyone who has worked in a department for long enough knows that an *account* can also refer to a supplier, buyer, dealer or lead. It just depends on the respective task you are working on.

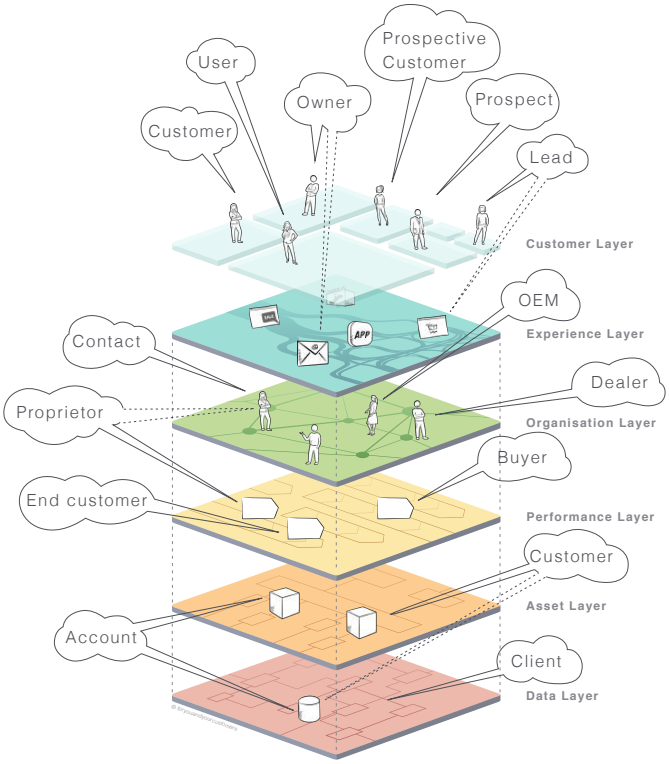


Illustration 1: The term 'customer' can have different meanings depending on the remit and company level.

Overloaded by the variety and complexity in this case, an apparently sensible and simple solution is selected: the term proposed by the standard software for 'customer' is adopted – *account* or *customer*, for example. Anything and everything else which represents something like 'customer' is meant here. However, this approach creates more problems than it solves, as the differences between user, end customer, buyer, prospective customer and dealer may be crucially important in terms of handling in channels and processing by organisational units and processes. Advertising campaigns, logistics processes, settlement, discounting or customer support may be different and may be processed by different people in different departments via different channels using different tools.

The lack of differentiation and therefore structure in data makes more complicated processes and programs necessary. This leads to higher production, operating and maintenance costs for software, lower acceptance and inefficient use and to an increase in the probability of error.

Standardised and well-documented terms and structures prevent a great deal of pointless effort and improve the quality of your work.

Before we offer a solution for the development and documentation of standardised terms and definitions, a brief digression into the theory is necessary. What is data? What is information?

From data to information

Data is structured symbols and signals that can be managed (stored and manipulated). Data per se has no meaning for us as human beings.

Data are managed, and information is interpreted data – it is used.

Information is interpreted data, which – conversely – has a meaning: it is used by us.

Misunderstandings arise over data when different users interpret the same data in different contexts.

Example: Why do you understand the meaning of these three data fields?

Berner	Stefan	1955

You recognise ‘Berner’ and ‘Stefan’ as surname and first name. You probably reach the conclusion in the context of this text that they are the surname and first name of the author. You have probably interpreted ‘1955’ as the year in which the author was born.

Do you know what information is required to interpret data?

Berner	Stefan	1955
Peter	Martin	8479

What do you understand when you consider the following two lines from the table?

You only recognise ‘Peter’ as a surname from its position below the first surname. ‘8479’ is certainly not a year so that calls your initial interpretation into question.

Not until you are aware of the agreed context can you interpret the data values in line with their use or the author’s intention. Not until you have the context consisting of field names, entity names and relationships between entities can you understand what these data values are saying and what they mean.

Employee ---------- lives in ---------- **City**

Surname	**First name**	**Postcode**
Berner	Stefan	1955
Peter	Martin	8479

Summary: Data values on their own make no sense and therefore have no use. Only our interpretation creates information from data that we can use. Such interpretation happens automatically with everything that we perceive or take notice of – immediately, unavoidably and based on our current personal context. The more similar the environment of two people, the more likely it is that they will apply similar interpretations – that is, understand each other.

It is imperative for unambiguous communication, that the rules on how data should be interpreted (i.e. context) are commonly defined for all the stakeholders. The contextual information in the example below (shown as a graphic diagram in Illustration 2) enables all users to interpret the data in the same way.

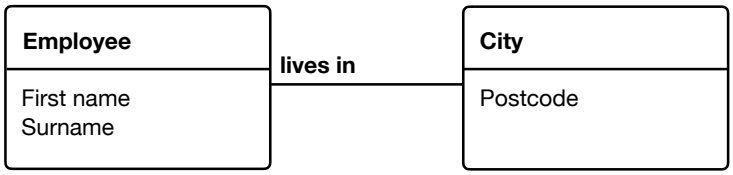


Illustration 2: Context represented in the information model.

The model creates information from data – it is an information model.

Information model

The information model is the missing link connecting the user's world with the IT world.

Data models are known in the context of information technology. Relational, object-relational or pure object models are tools that have proven their value and have been used to describe the data aspects of software products. As good as these models are for managing data, they are not usually suitable for communication with customers or users (see Illustration 3).
They:

- are too technical in terms of presentation
- use too many IT terms
- are not detailed enough or are inaccurate in terms of content meaning.

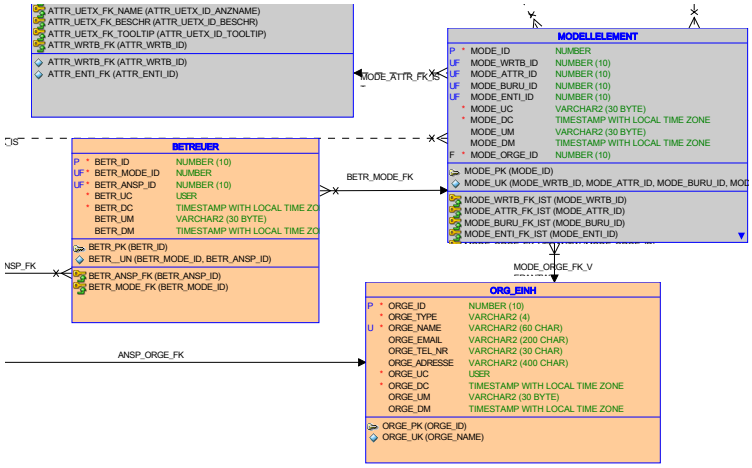


Illustration 3: Extract from a data model.

It is not surprising that employees from individual departments or management feel unable to or refuse to read, check, evaluate or accept these documents. These are documents for implementing requirements in technical artefacts. These are not documents that record requirements in a non-technical, understandable way.

The information model closes the gap between requirement and implementation in an illustration that can be understood by both sides (IT and the individual department). These types of models are usually referred to in IT as 'conceptional data models'. In addition to the fact that in many cases these are too superficial and too technical in terms of design, the name *data model* does not take into consideration the fact that the information (i.e. interpretation of data), should be described and not just the data (i.e. representation of information as manageable, technical elements).

The information model is not a new invention. It makes use of tried-and-tested methods and models from IT and reapplies these on a semantic level. It is a form of the entity relationship model. It is based on a mathematical, clearly defined, relational model (see [codd]). A high quality information model differs from data models in its strict compliance with the following rules:

The most difficult part of modelling is understanding the content.

- *All* nouns and verbs express exactly what is meant. They can and must always be taken literally. They are formulated in the natural language of the stakeholders. They are understood and accepted by *all* the stakeholders *without reservation*.
- For *every* term there is strictly *one*, preferably limiting, definition or specification in the context of the company concerned.
- *All* relationships between entities are described in both directions with an association: a verb possibly with a preposition.
- It contains no information technology terms such as *index, key, mutation_user, field, view, int, column, 1:m, table, varchar,* etc.

These restrictions may seem obvious to you, but an analysis of a large number of models in practice shows that they are rarely observed. Not until you try to apply these requirements strictly will you discover how difficult semantic modelling is. It should be noted that the models (diagrams, drawings) are not, in principle, difficult to create. It is

the content – the mapping of reality in a model – that causes problems. The rules described above help ensure that content quality is high.

The elements of the information model are briefly explained below and summarised using an example. For a more detailed description of the information model, see [*berner*].

Entity

An entity is the structural description of a concrete or abstract thing in reality, information about which we want to manage in our observed system. It represents the digital representation (see below) of the real thing. In contrast to entity occurrence, reference is also made to entity type.

The entity describes what attributes (features, characteristics) of a real thing we are interested in, what relationships the thing has to other things and which attributes differentiate one instance of the thing in real life from every other instance. A description and ideally a few examples are also given for an entity. This description includes the definition, purpose, use and other aspects of the thing (see Illustration 4).

Book edition
Title ISBN10-No. ISBN13-No. Front/Back cover text Issue date Language Cover image

The aim of an edition is to provide a reliable text for the reader from a manuscript. To this end, the spelling is corrected and updated, language use is adapted where appropriate, a cover design (image, title, front and back cover text etc.) and publishing information (ISBN, copyright etc.) are added.
'Print run' is an alternative term used in publishing houses. If the format and content of a publication (a manuscript) is no different or only slightly different from previous editions, the term 'print run' is used.

Illustration 4: Entity with attributes.

An important aspect of an entity is its unique name. An entity name defines a term in a company for just one thing. This term should be the only term permitted when communicating about this thing (subject to translations into other languages). Once it has been defined, it should no longer be used for other things (or for similar things, like – for example – book, book run, manuscript or publication). Given the significance of the name for the company, it must be chosen well. 'Well' means that the name should trigger an initial association among most readers, which reflects the defined meaning as closely as possible.

A specific example or an instance of an entity is called an entity occurrence (for example, the book edition with the *title The Name of the Rose*, the issue date 22 April 2014, the *ISBN 978-0544176560*, in the language English. An entity occurrence comprises all the values of all attributes of an entity type and consequently fully describes a specific thing from real life in our environment.

Examples of entities:
specific things: book edition, owner, city

abstract things: confirmation, project assignment, bank account

Attribute

An attribute describes just one feature/characteristic of an entity.

An attribute is the description of a characteristic (property) of an entity. The definition of an attribute includes the affiliation to an entity, a unique name in the context of this entity, the permitted value range and a verbal explanation. Indicating a few typical example values for an attribute is recommended for a quick understanding (see Illustration 5 for examples).

Good quality attribute descriptions must obey several rules. For instance, like the entity name, the name should be chosen so that it triggers an association that reflects the definition as closely as possible (explanation and value ranges). For example, an attribute name such as *product number* is inappropriate if the so-called number can be 'AX-31588-F'. In this case, *product description* or *product identifier* would be less misleading.

Observation of the first normal form is crucial in terms of the quality of your data.

Attribute name	Entity	Parameters	Explanation
Title	Book edition	Text, max. 500 characters	Title of publication/manuscript
ISBN10-No.	Book edition	10-digit number in accordance with ISO 2018	International Standard Book Number according to ISO 2018. Unique for non-periodic editions.
ISBN13-No.	Book edition	13-digit number in accordance with EAN/GTIN	Extended ISBN10-No. corresponds to EAN no. for product
Issue date	Book edition	Calendar date	Date on which this edition was published
Front/back cover text	Book edition	Free text, max. 3,000 characters	Short description of contents on cover flap.
Cover image	Book edition	Image	Image/graphic printed on cover (front, back and spine)

Illustration 5: Example attribute descriptions.

As a further important sign of quality, first normal form (1NF) attributes must obey the relational model. This means that an attribute can include just one value that makes just one statement about just one aspect. In our opinion, violation of the 1NF is the main cause of misunderstandings, complicated programs, complex workarounds, misuse of data fields and performance issues in software systems. Unfortunately, this occurs frequently.

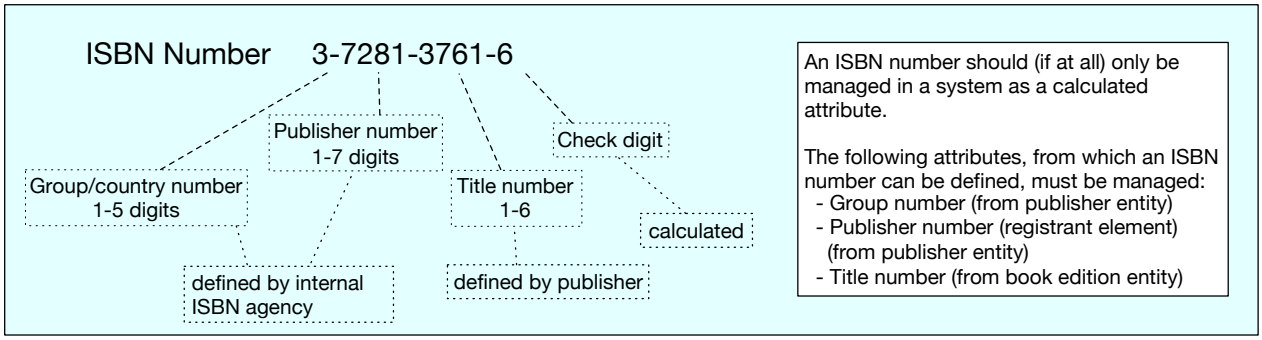


Illustration 6: Example violation of first normal form.

Any composite item number, any (supposedly) smart coding and many status attributes violate this rule. ISBN numbers, for instance, are a typical example of a composite attribute that violates the 1NF. They are a source of many problems for sure.

Relationship / association

A relationship links two entities semantically. Reference is also made to an association which associates two entities. This indicates the relationship between them, how the two entities interact with each other .

The verbs linking entities are the key to understanding a setting.

A line expresses that two entities are linked. A crow's foot indicates that several characteristics can be linked. Dashes indicate optional relationships, and solid lines indicate mandatory relationships. The verbs in the relationships are crucial to understanding

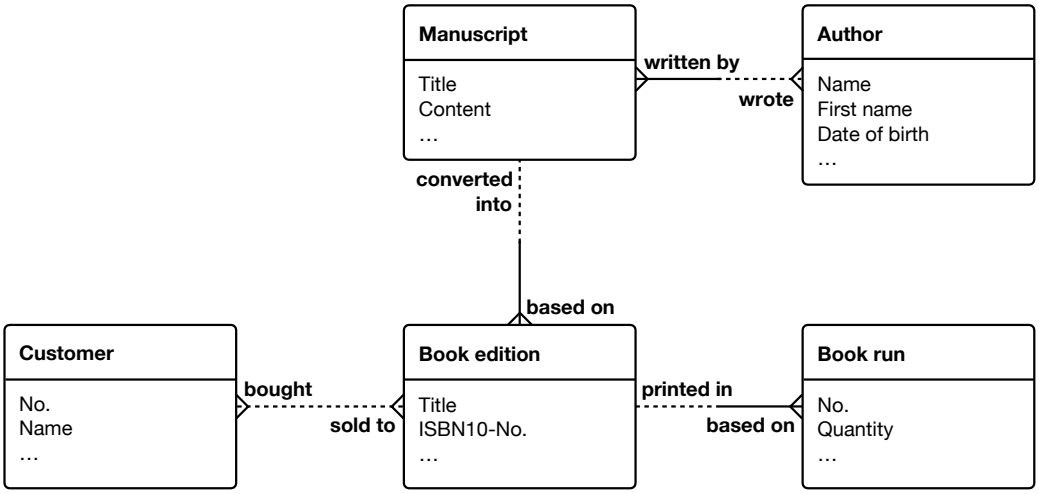


Illustration 7: Extract from an information model.

and clear communication. They indicate what one occurrence of an entity has in common with one or more occurrences of another entity – not only that a relationship exists, but what this relationship means.

The example in Illustration 7 reveals that a manuscript was *written* by one or more authors and that a customer *bought* one or more book editions. The relationship documents the purchase and not, for example, that a customer *looked at* or *made a note of* a book edition in an online shop or that the customer *borrowed* it from a library.

Unfortunately, relationships without verbs, as in Illustration 8, are common in modelling practice. This means that, according to our definition, such a model is *not* an information model. In the truest meaning of the word, the relationships are *meaningless*. They only state that one entity is linked to another (or how often they are linked). The meaning of the link is left to individual interpretation by the reader.

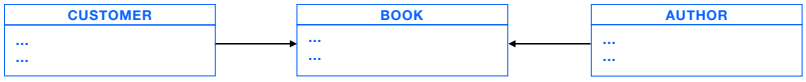


Illustration 8: Extract from a data model with meaningless relationships.

Along with good names for entities and attributes, relationships provided with verbs are the key to a (consistent) understanding of a model and, by the same token, of the real world it maps.

Key

Each occurrence of an entity corresponds to an example of the respective thing in real life. Just like real things, their digital representatives must also be uniquely distinguishable. Consequently, two identical entries can never appear in entity occurrences. This requirement is a further key pillar of the relational model (see [codd]). In other words, the values of an attribute (or a group of attributes) in an entity must be nonrecurring – that is, unique. This attribute or group of attributes is called the ‘entity key’.

Examples of keys in the model in Illustration 7:

Book edition:	ISBN-10 No.
Book run:	Link to book edition together with run number.
Manuscript:	Title together with author(s).

Example of an information model

The graphic representation of an information model serves as an information map of a company.

Information models for a company may contain several hundred entities depending on the number of areas considered. The overall view (see Illustration 9) serves as a basic information map of a company printed out as a poster.

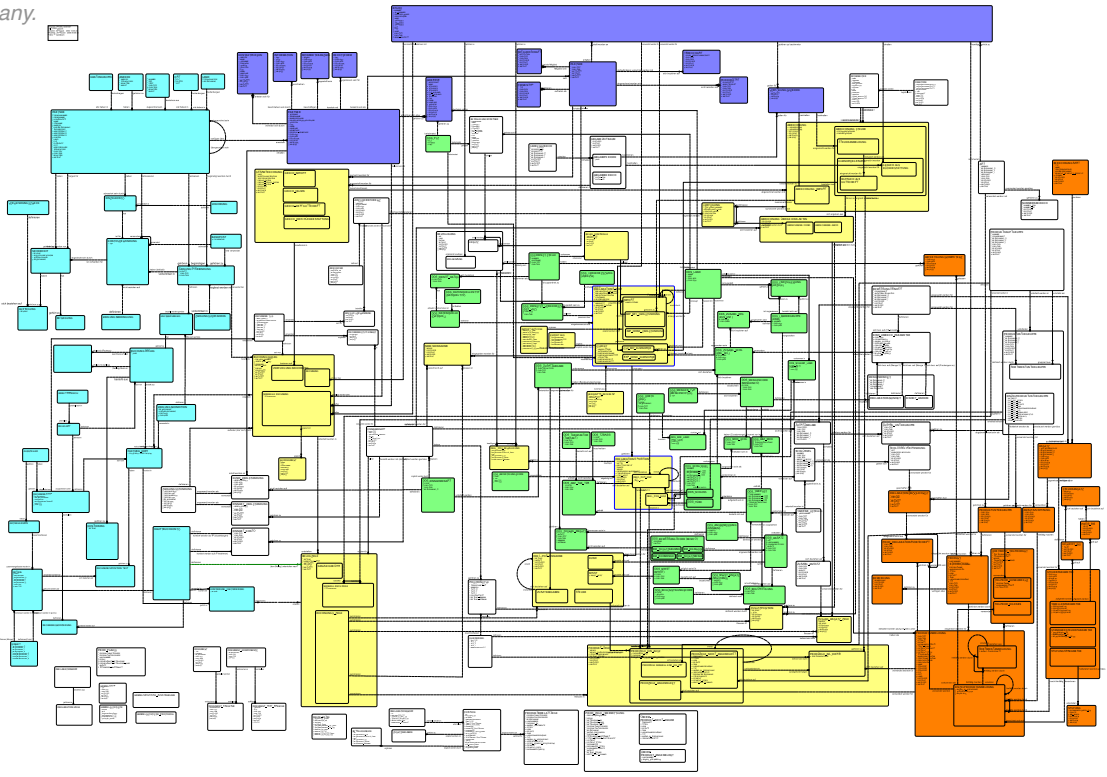


Illustration 9: Example of a larger information model for a taxation application.

Good names enhance quality

Reference has already been made on several occasions in the preceding sections to the need for good names. Plato determined that something that cannot be named cannot be spoken about. Finding good names often takes time. 'I know exactly what it means' can only be checked if the person can communicate what it is that they supposedly know exactly. As long as no representation and no name is found for the *knowledge*, the uncertainty of misunderstandings will remain.

Experience shows that aspects which have been discussed for a long time often lead to uncertainties and misunderstandings among experts in everyday use. On the other hand, long discussions about good names promote common understanding in the same way negotiations in the run-up to a contract are often more important for future cooperation than the contract itself. It is sometimes worth spending the time over several meetings in order to find the *right, well-thought-out* names. You can learn how the people attending these meetings see things, how they think and what ideas they have – that is, you understand people better. If this understanding is also documented in the form of good names, this can produce long-term benefits well after a current IT project has ended.

Ask yourself again: How much time does it take to find the right, well-thought-out names for something?

Types of information

In order to do justice to the different meaning and use of information, a distinction should be made between types of information:

- Information as products
- Information about products and other things in the real world
- Information about processes and processing
- Information about virtually everything
- Information on different levels

Information as products

Intangible (digital) products consist solely of information.

Mention is often made today of digital products. Strictly speaking, these are virtual or intangible products. An intangible product consists purely of information. There have been such products ever since trade began. Nowadays, with digitisation, other types and forms of distribution have come long. These include tickets, bank accounts, money, music, images and software functions.

A ticket is a document (printed or in digital form as an image or as a set of data in a database, application) which gives the holder permission to complete a journey using a particular means of transport from a certain place to another within a certain period of time. The product which is advertised, purchased and used is *not* the ticket but rather the use of a transport service. The same applies to an account: the now obsolete bank book or savings book was not the account but simply the bearer of information relating to it (i.e. balance, transactions).

For every intangible product there is generally a data carrier (ticket, document, licence, stamp, bank note, set of data) which permits or guarantees its holder something. This data carrier is often erroneously called the product. You can see that this not correct from a fictitious advertising slogan of a transport company: ‘Promotion today: multicoloured, crease-resistant, tear-proof tickets.’

Information *about* intangible products (digital twins) is explained in the next subsection. Intangible products are usually handled via the same supply and value chains as tangible products. How they are handled in terms of advertising, supply, marketing, sale, guarantee and payment collection barely differs from the handling of tangible products. If an intangible product is supplied on a physical data carrier (ticket, chip, memory stick), there is no difference from tangible products.

Digital products are generally modelled as a special type of product in information models.

Information about products and other things in the real world

Digital twins are information that describes an object from the real world.

What is stored in databases and managed in systems is information *about* real-world objects (i.e. entities), not the objects themselves. Intangible products are an exception to this. This digital representation of real-world objects is referred to as a digital twin.

Information about an object can originate from many sources or perspectives. Example: Information about a product from all its life cycles can be managed, including planning, development, production, sale and after-sales service. Information about everything that is worth knowing (products, customers, suppliers, laws, organisation, locations, employees) is managed in various software systems of a company – for example, ERP, PLM, PDM, CRM, PIM, MDM or EXCEL. The information has life cycles like its represented ‘sibling’: it is generated, distributed, compared, migrated, checked, approved and archived. A digital information supply chain (DISC) is required to deal with

Information about things requires a digital supply chain, just as its real ‘siblings’ require a supply chain.

its route through the entire company. This ensures that the information fulfils the purpose intended.

A collection of information about a real-world object that is separate from the system, processes, location and organisation is also called a 360° view here. This means that all information about the object is available and its use is guaranteed beyond various interfaces, software systems, technologies and media disruptions. The term is used most often for customer data and means that we know not only the static properties (name, age, address), but also information from day-to-day business (orders, products used, projects, payments, etc.) and have access to this at all times.

A 360° view of an object is a system-independent description of all the properties of its digital twin.

Terms such as 'legacy data', 'master data' or 'dynamic data' are not appropriate when considering information. They say something about the stability, origin, maintenance and use of information. These aspects may be important for mapping information requirements in systems and databases. Data origin, the nature of maintenance and use and access options are irrelevant with regard to data meaning and have therefore lost nothing in the information model.

A description of information about products is the central outcome of information modelling. The useful and efficient processing of information in the form of processes, application scenarios and organisational structures cannot be planned until a precise description is given of all the information units and their contexts.

Information about processes and processing

When working with information, information about this work is required – so-called control or meta-information. In what state is information about my real objects up to date? Who changed what and when? Who has to complete which tasks and by when? Where and in what form is this information used consecutively or simultaneously? Who has access to the information in what form and in what state?

Meta information is kept, managed and used in workflow tools. It should be described and kept separately from information about objects. In most cases, the documentation of metadata (naturally also as an information model) is sufficient in the context of process description.

Information about virtually everything

Big data is a term that is often mentioned a great deal. This term refers to collections of data with the most varied origin, form and quality. From the linking of these data, findings are derived which are intended to help provide an individual service more efficiently. Generating findings means nothing other than interpreting data and their connections in a context – in other words, creating useful and useable information from data.

'Data is the oil of the 21st century.' But as in the case of oil, the success story does not start with the basic material. Only the products derived from it offer benefits and gains. Only when we know the *meaning* behind statements like 'why childless car drivers respond better to advertisements for chocolate when it is raining' are we in a position to draw specific benefits from such data. Correlations can be coincidental; they never provide the causal link – that is, the reason for the connection. They only give us clues about where we should search for contexts.

Big data is the raw material. Only a good interpretation of contexts provides usefulness.

Statistical analysis can be made of many data sources completely independently of semantics. In other words, technically understandable documentation of data sources is not mandatory. However, as soon as findings are generated from analysis, it is necessary to document which interpretable statements can be derived from which data values. In a nutshell, an information model – which defines the context in which the result data obtained should be interpreted – is mandatory.

Information on different levels

In order that standard terms and structures are used in a company and that these are also interpreted consistently, information models are essential on several organisational levels:

- The *company-wide information model* defines all the terms used in most specialist areas and in consolidated perspectives at management level.

  Examples: Organisation, product (categories), customer (segments), prices and costs.

- *Subject-specific information models* define terms that are used by one or more specialist areas.

  Examples: Finance, logistics, development and production, and marketing.

- *Project-specific information models* define terms that are used exclusively in the context of individual applications.

  Examples: Warehouse management, transport and online shop.

Responsibility for company-wide and subject-specific information models should lie with a central body (see ‘Organisation and maintenance of company-wide information management’). Responsibility for project-specific information models should lie with the respective project. IT provides modelling expertise and support where necessary. The IT department has a duty to check these models.

The highest-level information management team must ensure that the quality of all models is guaranteed and that they all match the models on the next highest level. It must always be ensured that parts of a project-specific model, for example, can be adopted in other models.

The information model in Exploded View

The information model is the foundation on which the building called digitisation stands.

'The Exploded View ensures that the deeper contexts and challenges of digitalisation are made visible and comprehensible for all stakeholders in the company. Using the method ensures that specific tasks can be discussed, addressed and agreed. Spatial visualisation not only ensures an overview, but fosters a better understanding of the idea and the concepts as well as of many details, which can be created and considered in a wider context with the help of other tools and the Exploded View.' (from [möller])

The information model is the main tool on the data layer of the Exploded View. It is produced during an analysis of requirements on all other levels and following completion of the analysis forms an indispensable basis for all activities and solutions of the other levels. Their standardised and binding names and structures form the foundation on which the whole building called 'digitisation' will be built.

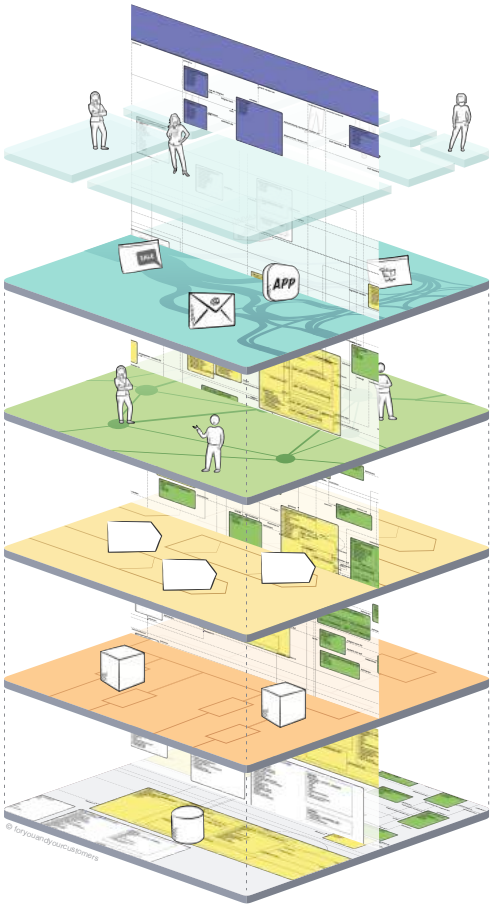


Illustration 10: Information model in Exploded View.

The information model will be used on every level of the Exploded View. Terms and their definitions come into being at each stage of requirement specification, and each stage uses terms that already exist and amends these where necessary. In this respect, the information model is also the static equilibrium of the building. In other words, it has an effect everywhere and all elements are based on it.

As soon as a stable information model exists which includes all the requirements of all levels, the previous (actual) descriptions of all levels must be reviewed. What influence do the findings from the information structures have on the current perspective of the levels? How can we use this new information map to organise our world better, travel through it and communicate it to our customers?

Customer Layer

Analysing requirements on the customer layer relates to customer journeys and, consequently, to customers, products, points of contact and channels. It is not enough to define a single term *customer*, *product* and *channel*, which then subsumes the entire reality (see Illustration 11), for an example from a project in which a structure of around 15 entities is produced from one term *customer*.

A customer journey requires clear definitions and differentiations of the term 'customer'.

The customer journey for an occasional retail customer is different from that for a regular customer who regularly places large orders or for a dealer which, in turn, sells goods to end customers.

A differentiation must also be made between products: offers of fresh goods, services or machines lead to completely different customer journeys. An aircraft carrier is sold differently from a designer T-shirt or an Alpine cheese.

Before you can start a customer journey, you must clarify the terms you use on this journey. Once a term has been clarified, it can be used again in the same sense for all other projects (also on other levels of the Exploded View). If a term is interpreted in a

new way or a variation of a term is found, these must be defined under new names in the information model.

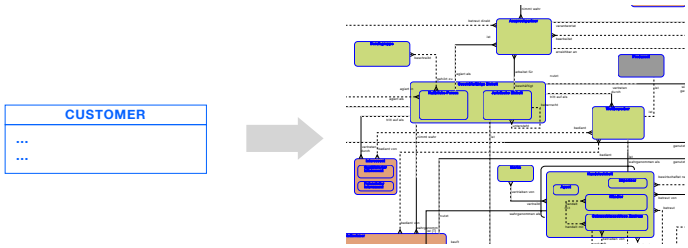


Illustration 11: Example – customer.

When developing a new solution, the information model influences several aspects of the customer journey:

- Standardised and self-explanatory terms should also be used for customers (sic!) (examples: customer segment, customer benefits, customer experience, competitors and customer information).
- Differentiated terms can influence the customer journey: different types of customers are handled differently where appropriate.
- Complex customer journeys can be simplified using information structures.

Experience Layer

This layer concerns how a customer journey is mapped on sales and marketing channels. The aim in the information model is to link the possible combinations of customers, products and channels.

Terms which have been defined on the customer layer are amended and refined on this level. Information is added for marketing tasks (campaigns, media assets, customer relationships, etc.).

The model grows. If you have done the modelling work correctly on the customer layer, you will experience hardly any surprises. The model will not undergo any further fundamental changes. Dividing an entity up into several entities, documenting new relationships and adding attributes are developmental extensions.

For the new solution, clear terms help make channel assignment and use more differentiated.

Organisation Layer

This layer concerns people, responsibilities, organisational form and corporate structure. The information model is supplemented by entities and their connections from departments, business divisions, responsibilities, business locations, production facilities, companies, dealer networks, etc.

Which element uses, generates or changes which information elements?

Evolved organisational forms have usually been created along previous country borders, technology frontiers and media disruptions. In a modern, rapidly changing political and technological environment, departments, hierarchical structures and business locations no longer have the same meaning as before. A comprehensive view of an object cannot be established or maintained in one individual department at one business location alone.

An information model is an extremely helpful resource for transforming evolved structures into meaningful and flexible organisational structures. Entities can be visually linked to an organisational structure using colour coding (see Illustration 9). Which area has authority over the content and maintenance of an entity? Who is primarily responsible for the content of information objects? The closeness of relationships between entities is a good indicator of which entities *belong together* in some way and should therefore have shared responsibility.

When developing a new solution, an information model can influence the new organisational structure:

- Hierarchical command-and-control organisational structures which have been divided up according to business location, technology and media are identified as ineffective and disruptive.

Which area has authority over the content and maintenance of an entity?

- Semantic criteria (linking of information building blocks, purpose and use of information) can be optimally linked with modern organisational forms (flexible, decentralised, cross-linked, creativity- and results-oriented).
- The stability of the information model (see below) makes it a good basis for forming organisational structures along the information structures.

Performance Layer

This layer represents the professional service (products, services, knowledge, skills). Information is required in order to carry out any work. The results of any work are specific – namely, real products; and information about these services and products is produced at every stage. The use of and changes to information about a product must be described in the processes used to create real products.

Services and their provision use and generate information.

Additional processes may be necessary for the supply chain of information about real things (digital information supply chain). As information about products is often as important today as the actual products themselves, it is worthwhile paying particular attention to the processes for using and changing this information.

Business processes are an important element on the performance layer. Each process uses information as a preliminary condition and generates information as an outcome; they transfer the system from one consistent state to another. These consistent states are defined in the information model. If the information objects and states are known for the preliminary and subsequent conditions prior to creating processes, it is easier to complete this task efficiently.

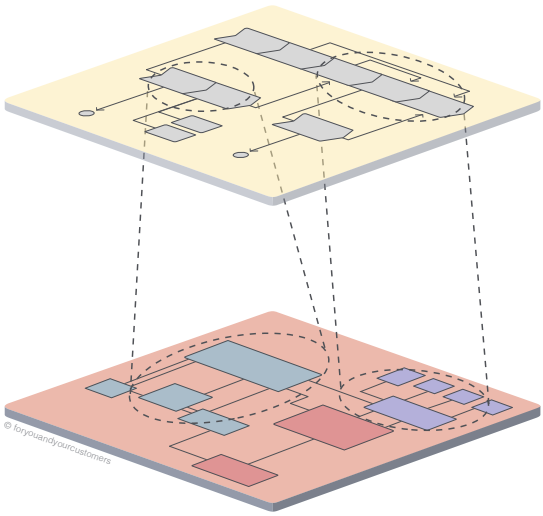


Illustration 12: Process landscape thematic map.

Standardised and clearly defined terms and information structures lead to simpler processes and ensure that these processes function across all levels. The structure of the information is described in the information model. It does not have to be replicated in the processes by means of complex tests and dependencies. Such processes are un-necessarily complicated (see [bernerBPM]).

The elements on the performance layer (especially the processes) are placed like a thematic map over the information model map (see Illustration 12). Which element uses, generates or changes which information elements?

When creating a new solution, the information model has a significant influence on the description on the performance layer:

- The information model is a good basis for describing a company's services and tasks. Its stability ensures that descriptions are valid in the long term and can be flexibly adapted to technological changes.
- Processes are not characterised by media disruptions, technological frontiers or rigid organisational structures but by the efficient transfer of whole systems from one defined state to another.

- Clearly defined beginning and end states (in the form of entities, attributes and relationships) lead to processes that are easy to trace and keep track of.

Asset Layer

Applications map (specialist) information in (technical) data.

A company's resources and tools are described on the asset layer. In the context of information processing, we are primarily interested in IT systems. They provide the infrastructure (including storage, exchange, processing, protection of data), with the help of which we can use and change information easily and efficiently.

These tools map information from the specialist area as manageable data in one direction. In the other direction, they make the data available to users. In the process, technical data formats are converted into an interpretable representation that is ideally suited to current use.

This task of translating information (semantics, interpretable data) into data (storable data units) and vice versa is essential in terms of the quality of the tools and therefore the quality of the work performed. In our opinion, this is where the greatest potential for improving the IT and process landscape lies.

Interfaces to internal and external systems are also resolved on this layer. It must be ensured here that data has the same meaning upstream and downstream of the inter-face – that is, it is interpreted and used in the same way. Regardless of which system data is managed in, the information model describing their interpretation is always the same.

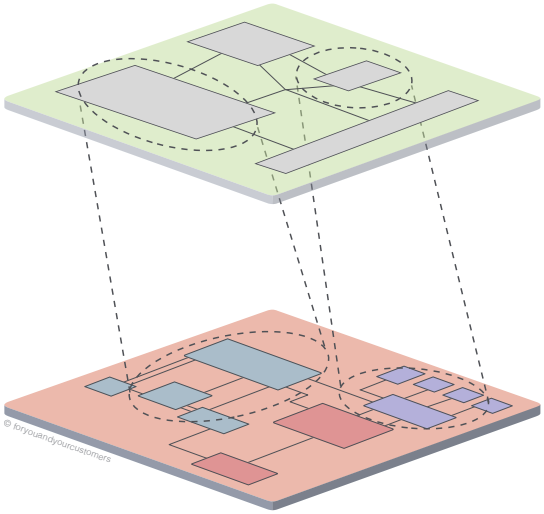


Illustration 13: System landscape thematic map.

The asset layer provides the information model with few new elements. However, elements on this layer, in particular IT systems, can be improved greatly if they use a common, clearly defined information basis. Concepts such as consolidation layer, enterprise data bus and master data management can only work if they represent a view of data for all connected systems and thereby information which reflects the correct company view as closely as possible.

For every software component, the system landscape (see Illustration 13) – which is layered over the information model – offers a clear and unambiguous indication of which information in it should be managed, exchanged and presented to users.

When creating a new solution, the information model has a significant influence on IT systems:

- All commonly used data (master data) correspond to the common understanding of the information they represent.
- Interfaces not only transform data but also *translate* their meaning where necessary.
- For each data element, it can be clearly stipulated in which IT system and in which version it will be required, used and managed.
- Applications in which information model structures are identifiable are easier to use, are accepted and lead to better quality results.
- If all informational requirements are covered by applications in a user-friendly form, employees will need fewer individual *workarounds*.

Data Layer

All relevant information in an environment are described fully and precisely on the data layer.

The entities are described fully from the information users' perspective. In other words, every attribute, every relationship, all keys and all business rules are documented in a detailed, comprehensible and unambiguous way. The information model is operationally complete; however, it contains no technical details of technology, storage or management of data.

It is the *single source of truth* for every application and all interpretations of a company's data. Since according to relational model theory there can only be one correct model for a specific requirement (subject to equivalence), with the information model, you have the only correct description of your requirements – provided you have proceeded correctly.

Information structures are the most stable part of a company.

As information structures are independent of technology, media, location and tools, they are one of the most stable characteristics of a company. Information structures only change if business models change, which – as experience shows – happens much less often than with technologically or organisationally motivated guidelines.

In addition to the information model, other elements are required on the data layer. These include a description and a comparison of the varying quality and use of data in different systems and organisational units. Furthermore, data models are needed – namely, the databases actually implemented and used.

Additional elements from other levels of the Exploded View – for example, governance processes and a suitable organisation – are required for constant maintenance and communication of information descriptions. Both these aspects are explained in greater detail in the next section.

Organisation and maintenance of company-wide information management

An information model for a company can be created in a few weeks – at least at the level of the company-wide information model. Use of the model, which is used for documentation purposes only, is limited. The risk that it will suffer the same fate as most documentation is great: the actual product and its documentation become disassociated from each other with each change and, after a few months, the documentation becomes unreliable to the point that it is no longer used. A model can only display significant and sustainable benefits if it is consistently used for actual work. This is turn requires it to be maintained and kept up to date. All business processes, interface descriptions, software packages, reports, etc. are also required to use the model as a basis.

Control of governance process information should be a core competence in every company.

The digital information supply chain requires organisational structures, processes and a description of the information to be processed. As the DISC can run through all areas and levels of a company, a highest-level authority must take responsibility for safeguarding it. An organisation which covers the coordination, monitoring and implementation of processes is necessary for defining, maintaining and implementing the processes and information structures of the DISC.

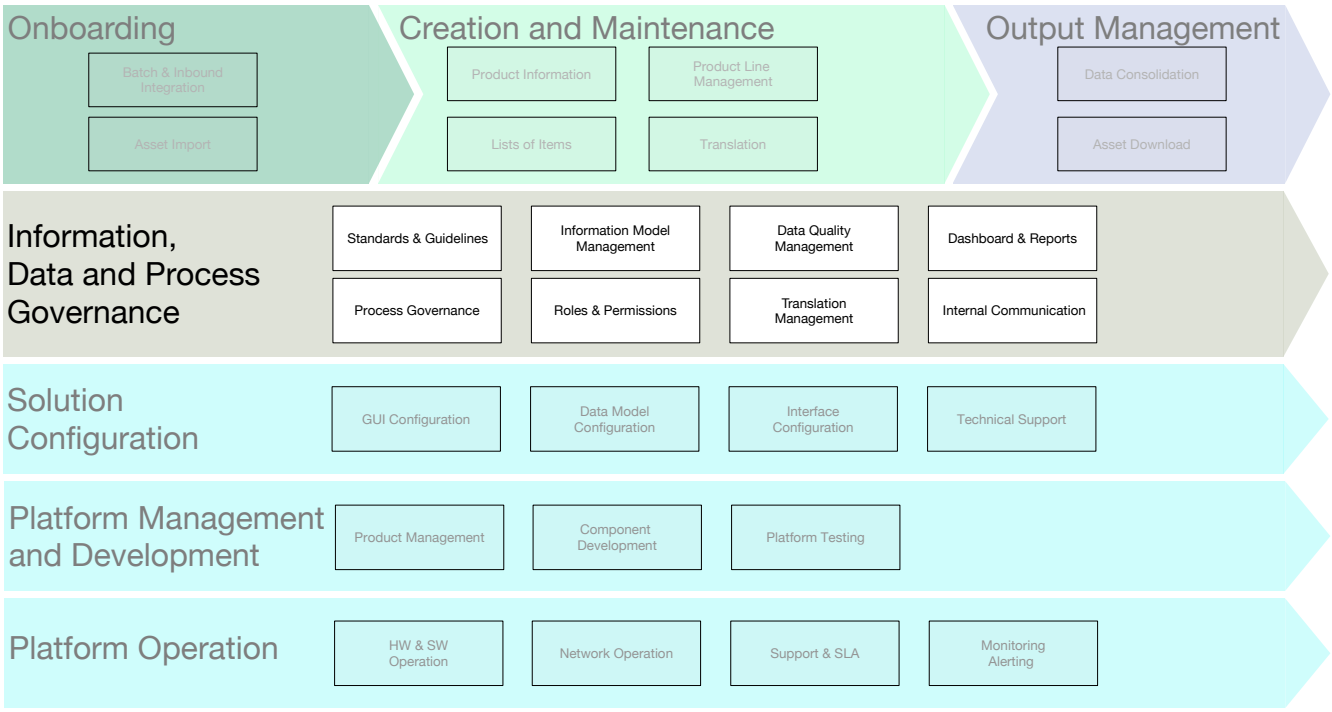


Illustration 14: Extract from a business process landscape.

Solutions to information problems are solved and responsibility taken for them in specialist-area projects (with support from modelling experts from information management). The cost–benefit question and unique and complete descriptions of a technical solution's specifications are clearly the responsibility of the specialist areas.

Information definition and management require individual organisational elements and processes. These must be specified, monitored and maintained by an information management board. They are part of a company's business processes (see 'Information, data and process governance' in Illustration 14).

These processes include the following:

- Maintaining information models
- Coordinating requirements for the shared models
- Distributing information models and their changes

- Monitoring the implementation of information in data and systems
- Managing roles and permissions for the management and use of information
- Monitoring data quality

Organisational measures are required in order to assume responsibility for shared models:

The information management board monitors the standardised use of information within a company.

- An information management board which plans, discusses and decides on changes to and extensions of shared models – all relevant specialist areas must be represented on this board by competent employees. This body requires competence across all specialist areas and should report directly to company management.
- A technical information management team which maintains, distributes and communicates models on behalf of the information management board.
- A data management team which – as a technical counterpart to and in close cooperation with the information management team – organises, orchestrates and monitors the implementation of information models in data models, databases, systems and interfaces.

The maintenance (governance) of the information model is not the task of the IT department. It is a central task of the specialist departments and management. A situation where many managers and specialist employees lack modelling competence should not lead to this important task being delegated to engineers. It is much more a case of acquiring the competence and engaging the services of IT employees with their experience in modelling methods for support. A large number of today's software problems are due to the fact that semantical structuring tasks are delegated to the IT department and carried out there by data management specialists. The lack of – and in many cases non-existent – communication between the specialist area and technical IT leads to a situation where both sides are able to do good work but the outcome is nevertheless unusable.

The information model in your company

The Exploded View white-paper describes in a simple way the rules and elements (levels, organisation, interfaces, processes, tools) with which a company can be run successfully in a digitised world. The information model describes the basic information units required for this. Only when all the stakeholders know, understand and use the prescribed terms, contexts, processes and rules will the result become a meaningful whole.

Surprisingly simple ...

A simple, and in many parts, well-known method ...

is the basis for a consistent, easy and valuable description of all your information requirements. A well-defined model with seven elements and a few rules is needed:

- Each entity and each attribute has a strict definition and a unique name. Entity names are used solely to designate the entity they represent, also colloquially.
- Each attribute makes just one statement about *one* aspect (1NF).
- Semantically, attribute values are meaningfully functional and solely dependent on the full entity key (2NF and 3NF).

The structural part of the model is simple, and its use is widespread. Knowledge of relational data modelling should be a prerequisite among competent IT specialists and business analysts.

Surprisingly diverse ...

… helps you solve a large number of problems and brings great benefits ...

are the benefits of the information model on all levels and in all areas of every company:

- Understanding and communication are improved. Misunderstandings are minimised.
- Organisation and processes are structured according to comparable criteria.
- All IT system specifications are formulated clearly and unambiguously.
- The quality of data is improved.

The information model is universal and useful for every area of application. To date, it has been used for the manufacture and sale of products in different industries; for organisational, administrative and legal matters; as a meta-model for methods; and outside the business world for substantiating the term ‘responsibility’ in a master’s thesis on the topic of ethics.

Surprisingly hostile ...

… but is still not easy to introduce.

may be the reaction of many people to the information model. How can that be the case? When the solution is so close at hand, looks so simple and offers so many advantages, why isn’t it used more often? What is preventing us from working so clearly on projects that we understand each other and do the right thing? We believe there are two main reasons: Firstly, the significance and the numerous advantages of a good information model are hugely underestimated. Secondly, producing one requires hard work and creative thinking. As a result of underestimating the benefits, the motivation to take on such work often appears to be lacking.

- The biggest problem is alleged mutual understanding. ‘What is the point of long discussions when we all know what is meant?’ Changing this view requires a willingness to unlearn on the part of employees.
- An information model creates clarity and demands decisions. The former may jeopardise an individual position; the latter requires an individual clear opinion.
- Modelling means abstracting. Not all stakeholders have sufficient ability to abstract or

the intellectual and communication skills required to produce and evaluate this form of knowledge documentation.

- Disclosing expertise and transparency across areas jeopardise one's own position as an employee or department.
- Virtually all IT development methods begin with processes; this is what most computer scientists have learned. It is easier to talk about processes than about structures. Unfortunately, this order leads to suboptimal information and data models, which – in turn – make processes created too early more complicated.

The information model as part of your company's DNA

DNA contains all the information for the building of an organism. Together with a few standard chemical processes, an organism is created and kept alive using the information from DNA.

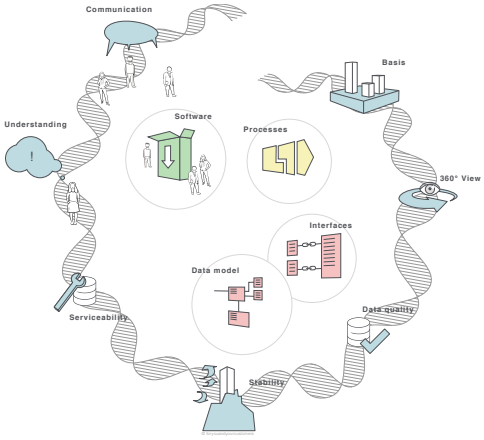


Illustration 15: What benefits can an information model offer your company?

Are you aware of the basic information building blocks in your company? Are you in a position to adapt basic structures in your company? Where are your company's features and processes documented? Is the documentation available in a simple enough form that all the employees in your company, with the knowledge of a few rules, are able to pull together and keep the company alive?

Like DNA, an information model is surprisingly simple in its design and, at the same time, is extremely powerful in terms of the diversity of structures that it can represent

(see Illustration 15).

Advantages and benefits that an information model offers a company

An information model defines standardised terms and structures. It creates understanding and a common language across areas and countries. An understanding of individual work and communication between all stakeholders is increased, and fewer misunderstandings arise. Software, which actually represents the structure of the company, can be evaluated or created in a targeted manner and will be understood and accepted immediately by all stakeholders.

The information structure of the whole system provides an overview of contexts and dependencies and leads directly to simplified processes and simpler, low-error programs. Different views (e.g. BI and OLTP) of the same information are supported by the same understanding of the real world.

Companies differ in the definition of their information building blocks and structures.

Information structures are the most stable aspect of a company. The clear separation of semantics (information) from technical implementation (data, programs) leads to easier serviceability and better data quality.

Regardless of which aspect of digitisation you want to improve, there is no way round an analysis and documentation of your information structures. They help you produce simple, consistent and sustainable solutions. These can set you apart from your competitors.

About foryouandyourcustomers

With its established methods and experienced experts, foryouandyourcustomers provides you with expert support for the digital change. We adopt an integral perspective to analyse, advise, accompany and design, paying close attention to the expectations of our customers as well as their digital maturity and opportunities. To do this, we develop and operate suitable PIM, MDM, e-commerce, CMS, CRM and many other systems.

Organisation

It was immediately clear when we founded foryouandyourcustomers that we would become an extraordinary company and a role model. The Group currently comprises 14 cells, each with their own CEO and employees. We do not have headquarters.

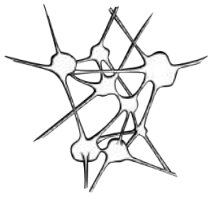
Synarchy is the organisational form at foryouandyourcustomers. It is our declared objective to blend humanness with business activity.

Services

Each of the cells develops its own portfolio according to its skills and customer needs. Taken together, these services form a broad spectrum. Hardly any of the customers receive support from just one cell; so the services are constantly combined and develop a high level of quality.

We use the information model in almost all our projects. We are constantly developing it, ourselves and our customers.

Contemporary Business



Contextual Commerce

Customer Insights

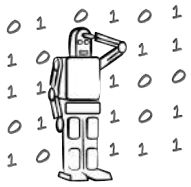
System Integration & Architecture

Experience Management

Digital Information Supply Chain

Relationship Management

Data Driven Business



Contact

Please feel free to contact the authors of this white-paper: Stefan Berner, Jonathan Moeller and Stephan Mueller. Alternatively, you can contact the location closest to you. Visit our website for all contact information www.foryouandyourcustomers.com.

Appendix

Contact and publisher

This white-paper was prepared for executives and employees in companies that are seeking to actively shape the digital change. We believe that this contribution can be an important source of inspiration for their work.

We would be interested to hear about your experiences with the information model. Please tell us about your experiences. We would be happy to keep you abreast by email (perhaps once a year) of the latest developments in our methodologies.

You can contact us at informationsmodell@foryouandyourcustomers.com or by post at foryouandyourcustomers AG, Bahnhofstrasse 4, 6340 Baar, Switzerland.

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Thank you!

Thanks you to all colleagues who through their questions, constructive criticism and willingness to listen to my ideas and give feedback helped to produce this paper.

Special thanks to Jonathan Moeller and Stephan Mueller for their input and the many inspiring discussions about methods and their use. A big thank you to Linn Spitz for her help with the illustrations and to Hannes Weikert for his valuable editorial and organisational contributions

Stefan Berner
Baar, April 2019