... creates Information Spaces

Information Spaces

The Backbone of Efficient Business Processes

Whitepaper

by

Dr. Johann Ulrich Zimmermann

2016 April 20

E-Mail: info@i-inf.net
Web: www.i-inf.net

Abstract

Although business processes and the whole context of cooperation support are being supported intensively by software applications, we have to observe clear weakness regarding the representation of the associated information by these solutions. Amongst the problematic areas are (a) the missing or sub-optimal IT-technical linking of logically correlated information (loss of context) and (b) the insufficient semantic content of the represented information. Both issues result in drastic loss of usefulness of the enterprise's information. This manifests, for example, in a loss of overview, in significantly reduced assessability of information relevance, and in the inability of the IT system to offer high-grade services, such as the identification and delivery of truly relevant information, or the automation of sub-tasks. Here, information forms in the users' heads only, while leaving the IT systems as pure data keepers. But IT would be able to offer much more: it could realize data as information and exploit them in order to offer to the users the above-mentioned value-added, sophisticated services.

The solution: information spaces (IS). Learn in this document more about the characteristics of these spaces of integrated information, and about the significant potential getting lost from companies renouncing them.

Note for the reader: we recommend reading this document fully and chronologically. Please note also, that you can find a glossary on our website, which is explaining concepts essential occurring in this document: http://i-inf.net/eng/glossar.html .

Target group: decision-makers, IT-responsibles.

Keywords: information space, information backbone, informational integration, integrated information, business process chain, semantics, context.

1 Introduction

1.1 Business Processes and Information

Working procedures in a company, commonly called business processes, typically consist of a whole series of **individual activities**. They are executed in order to fulfill dedicated tasks, which, in turn, serve certain goals. These goals eventually result from the company's goals.

☞ The before-mentioned tasks can be services but can also serve the creation of any physical results in the broadest sense, such as within product development and manufacturing.

During the task execution, **information** is always important and often it's right in the center of interest. In the same way, tasks can be arranged in a **logical sequence** resulting in a process chain, the information pieces used and processed in the tasks correlate more or less tightly. Thus, each information piece is bound to an environment of other information pieces, its context, defining its focus of validity and relevance. This context is vital for the information's intelligibility by human or machine (see also the concepts of semantic and information).

1.2 IT-Use for Supporting Attainment of Goals

In order to be able to reach their goals more quickly, more reliably and more predictably, enterprises employ information technology (IT). Amongst others, IT supports the enterprises in planning, organization and execution of activities, in acquiring and organizing information, and in the representation/definition/documentation and verification of services or physical results. Furthermore, IT can assist in optimizing all of these processes by enabling the documentation of experiences and suggestions for improvements, which are the results of the reflection done by the involved persons.

2 IT-Werkzeuge im Unternehmen

Modern enterprises are using a variety of software applications. As a matter of fact, the exact selection depends on the type of business. Considering their application range, IT tools can be differentiated into universally applicable vs. specialized tools. Amongst the group of **universally applicable** tools, we find software for word processing or spreadsheet calculation, as well as databases, mindmapping tools, software development environments and CAD systems. Examples of more or less **specialized** tools are applications for accounting and merchandise management systems. Moreover, extended and customized variants of universal software are commonly applied for special purposes.

2.1 Universally Applicable IT Tools

Typically a document serves a certain purpose. This is also true in respect to documents created using **universally applicable IT tools**. While the user understands the meaning (semantics) of the contents, the IT does not at all. Examples are texts created using a word processing document, HTML web pages, CAD models, computer software programs.

In some working areas (we also call them domains) management software is used to insert the documents into higher ordering structures. Examples are PDM systems managing CAD models, and Software-Code management systems organizing software source code. Today, the applied structuring methods often do not meet companies' requirements anymore; companies have realized that the management of complete documents as atomic entities is too coarse. The documents' individual contents correlate logically and should also be correlated inside the IT. Examples: (1) assigning quality assurance information to individual design features in a CAD part, or (2) the contents of questionnaires for acquiring data whose structure is already stored inside a database.

So, there are business-relevant relationships between objects, but inside the IT systems these relationships are represented too coarsely or do not exist at all. From the IT viewpoint, these individual documents equal little islands, and due to the IT tools' universal character, the contained data are **almost completely devoid of machine-processible semantics**.

2.2 Specialized IT Tools

Specialized IT tools are applied within a well-defined range of tasks and competences and work with their own set of data structures. Within this range we find internally correlated (integrated) information, and to a certain degree systems know the meaning of the information processes by them.

However, also in this case, we are standing on an **island**; usually, specialized applications do not co-operate with other applications, which have created

their input information or which will further process their output information. If there is any communication at all, we have to use export and import functionality. Often enough, the user has to input the results of one process step into the next step's software application manually. These islands are larger than the ones we find when working with universally applicable tools, but they still are much too small, seen in respect to the overall range of information in many companies' process chain.

So, as to the specialized applications, we do find the desired detailed relationships and they are equipped with machine-processible semantics. However, they only exist in the range of individual islands. Multiple islands exists isolated from each other without any or without sufficient connections.

2.3 Dissection of Process Chain and of Business Information

While universally applicable tools usually are employed at multiple positions within the process chain, special tools tend to have their fixed location. However, no matter how which and how many universal or special tools are used: a single tools almost never suffices. **For this reason, companies split up their process chain from an IT point of view and utilize a certain choice of IT tools in each process step**. Therefore, from an information-oriented point of view, each tool is "responsible" for a **subsection of the informational network**, underlying the process chain.

3 Typical Shortcomings of Process Support by IT and their Consequences

3.1 Informational Islands

Splitting up the process chain and distributing the parts to different IT applications also **splits up the informational network** of the enterprise. **Informational islands** arise. The problematical aspect of this is, that informational relationships existing in reality are not represented inside the IT anymore and are thus lost for further IT processing. For example: which e-mail belongs to which topic in the context of which work step? This loss of correlation means a **loss of context** and thus **a loss of the information's semantics** within the IT system.

In a sense, this lost semantics will be re-defined within the special employed specialized applications, and is hidden in the software's source code. Where universal applications are used, there is no or almost no machine-processible semantics at all – it's solely in the users' heads.

3.2 Today's Approaches to the Shortcomings

This section presents some common examples without trying to address all existing solutions. Such examples have been chosen matching this paper's topic: the integration of work contents and work results that are relevant for users and processes to form a common, integrated informational formation, we call the information space.

Usually, enterprises document missing links between information islands only in a rough manner, e.g. by storing the documents in dedicated folder structures of the **file system**. The remaining relationships that couldn't be covered by this approach, do not exist inside the IT system, but only in the heads of the persons involved. In cases where workflow management systems (WfMS) are used, the WfMS assigns documents to processes, but does usually not consider inter-process relationships.

However, both approaches (file system, WfMS) are problematic for several reasons and we thus have to consider them to be makeshifts:

- The same piece of information may well be relevant in the contexts of more than one task, while the file system or WfMS support only one ordering structure.
- From an informational point of view, the rough manner of documenting relationships does not suffice to support the user in fulfilling his/her task in detail, which would allow for a **highly expressive** representation of the relevant information down to the **needed level of detail**.

Some software solutions supporting cooperation (CSCW, Groupware) are using the notion of a common information space. However, this implies several

persons accessing the same data, while in this paper we emphasize a space of integrated information, provided by software applications and utilized by persons and applications. Typical groupware solutions focus on the co-operation of users (e.g. by means of messaging, coordination of events or awareness functionality[1]), but not on their topic areas and not on their tasks as such. CSCW solutions deal with documents and hyperlinks. They do not support more complex, topic-specific relationships. This is also true for such CSCW products allowing for several users accessing parts of the same documents.

3.3 What's the Problem of Loosing Context and Semantics?

Many enterprises, whose processes – as regards contents – form a chain of tightly related steps, are struggling with the transitions right between these steps and also with the lack of context information for individual pieces of information (also called informational entities). This context information is well present within the respective process step, yet it's not accessible outside of it.

3.3.1 Why do we need explicit context?

Explicit context means: logical relationships between pieces of information will also be represented inside IT systems using explicit relationships.

Explicit context information stored in the IT system is important for being able to position information within the process chain. This defines the information's meaning (semantics) to a large part. Therefore, embedding information in its context is critical in respect to its usefulness. It happens in the user's head, but can also happen inside IT to a varying degree. The latter is the more important, the more complex the relationships between informational entities are. In these cases, the missing context in the IT yields a loss of overview. Data cannot be found anymore and de facto get lost.

Depending of complexity and nature of tasks, users and IT require context information of varying levels of granularity. We generally can expect to gain efficiency and most cases also effectivity, when we manage to bridge informational islands. Resulting from this measure, it becomes clear in which context an informational entity has evolved and where it is valid and of relevance. It can be found and interpreted more easily.

3.3.2 Current Situation

Common solutions are accompanied by a loss of context and loss of machine-interpretable semantics.

[1] Each user is informed which documents in the document pool the other users are working on.

Data converters and import/export functions are commonly incomplete – moreover, even the input data are already incomplete and often unsound (lack of data quality) and can therefore not be used as planned. Often, the meaning of source information is not deductible automatically. Finally, when software functionality is extended, also the set of interchanged data types has to be adjusted. As these adjustments of interfaces are always lagging behind reality, many manual data transfers are happening, which are very error-prone and time-consuming. And also after the data transfer, during the work in the destination software, precise feedback to the previous process step is difficult, caused by the missing relationships between data entities. This hampers improvement of the documents to be developed (and thus also the improvement of the business products).

An approach to solve these problems are standardized interfaces, or **interface standards**, providing data elements equipped with partially defined semantics. Many of such interfaces, however, are still suffering from a lack of semantics, varying implementations and rigidity. Nevertheless, provided the use of the right base technology, they can be an adequate means.

3.3.3 Why is machine-usable semantics important?

Basically, the IT's ability to support the human users increases and decreases proportionally with the amount of machine-usable semantics existing in the IT system's data.

- So, for instance, lost relationships have to be documented in natural language documents and users cannot be supported by automation. Staff members have to use some of their time to manually manage and reconstruct correlations. This can mean quite an effort in cases where several people co-operate.
- Automatic **assessability** of the **relevance** of information is extremely critical for re-use and exploitation of existing knowledge.

Examples of automatic exploitation of semantics:

- Offering of relevant information to the user (automatically or on request).
- Several applications are mutually utilizing and sharing data (e.g. for purposes of für browsing, modification, displaying or just to take them into account in the own processing). Relevant information is detected at runtime.
- Plausibility checks.

As already pointed out, **specialized** software applications (such as merchandise management software) do know context and semantics of the information they are processing. However, also in these cases, semantics is not part of the data, but part of the software's source code. In other words, also specialized applications do not process open and explicitly represented and universally machine-processible semantics. Instead, their data are typically

stored in binary formats. For this reason, third party systems are not able to read and utilize them – not at all or at least not without significant effort.

Therefore, in order to represent information equipped with a high degree of semantical content, we need to not only preserve its context but we also must provide **meta information**. The documentation of known types of informational entities and their meaning (meta description of object classes) provides for a semantic-preserving data transfer. Moreover, it is the basis of a partial or complete automation of data exchange, but also of selected tasks within the business process. If all software applications describe meta information in the same way, they are able to share information amongst each other. For a dynamic functioning of the information space, meta information has to be part of the information space, too. Thus, newly arising object types will be known to all applications, and will be usable without any changes of source code or configurations.

3.3.4 The loss of context and its consequences

Depending on the assignment of business information to individual software applications, few or lots of issues may arise.

Within informational islands

Depending on the amount of business activities to be performed **within** a single, specialized application, and on the quality of available IT functionality, the loss of context can be less problematic or even not exist. Put simple: if almost all of a company's activities are covered by a single and powerful specialized application, problems due to information islands are merely irrelevant.

However, problems will arise, if the specialized application's boarders hat to be crossed, because it is not able to cover the whole process chain, or if the application shall be replaced by a new one. Now, exports may performed only in a restricted, sub-optimal way or be fully unfeasible. The "island effect" is also of relevance, where further applications are used as major tools, such as is the case with office software used to create and handle documents that are important in terms of content and organizational aspects: now, the correlations are missing between the information handled by the specialized application and the information stored in the text documents on the file system.

In-between the informational islands

We have to expect major disadvantages in cases where during the isolation process (process of forming informational islands) correlations were lost, that are part of the work results (e.g. part of a product definition). In this situation,

information has to be exchanged between applications. De facto, however, only data are exchanged and interpreted freshly and differently by the receiving application. Depending on the quality of the data and of the interface this may happen in a varyingly satisfying way. Most often lost are direct application-spanning relationships in the data. They are created during the use of application B while data from application A are used as a basis to start from. Similarly, a part of the individual objects' semantics will be lost during the exchange step. It has to be restored by the human user, which means increased effort, but also error proneness and renunciation of partial automation.

Furthermore, it is impossible to transmit targeted notes and feedback between process steps. As a consequence, the process is less robust and less efficient than it could be, if the real-world-relationships between information entities would be mirrored inside IT systems. This is true for technical processes, such as the product development involving detailed product models for design, quality assurance and manufacturing. However, this is true also for non-technical processes, where work results of any kind have to be exchanged between applications. In the worst case – as particularly time-consuming and error-prone – this exchanges is performed manually be the user, e.g. based on paper documents.

The method of assigning information to process steps exclusively in the user's head is quickly reaching its limits. This is particularly the case for information generated using universally applicable software, less with specialized software. Upward of a critical amount of data, the amount of interrelationships is not clear and not manageable anymore. **Overview gets lost. In the best case, much time is spent searching for information, in the bad case, information will not be considered or not be found anymore. The consequences: multiple solutions of the same task or problem setting, avoidable redundant work; no chance to self-improve and self-optimize.**

Loss of organizational relationships

An increased loss of organizational relationships, as a matter of fact, hampers organizational processes, such as procurement, accounting, complaints management, correlation of correspondence and schedules. Thus, also in this respect, considerable potential for improvement may exist.

4 Conclusions

In this whitepaper, we pointed out that all information processed in an enterprise is correlated directly or indirectly. We also showed that enterprises can gain significant added value from applying and implementing a holistic view of this information inside their IT systems.

Therefore, the solution is **informational integration**: the integration of informational islands existing inside the IT systems to form a single coherent and open **information space**, serving as the backbone of the business processes.

What is an open information space?

An open information space consists of integrated information, covering the whole process chain, and leaving as few islands as possible. Information in context. The information space provides for the inclusion of applications of any kind, enabling them to utilize information from any other application that joined the information space, and enabling them to correlate own information and external information using highly expressive relationships – and on any desired level of granularity. To make this happen, information of known structure and meaning is exchanged via a common interface. This interface is able to flexibly transport any newly arising data types and their semantics.

Application-spanning linking (and data exchange in general) only works, if the semantics of the data objects is available and known. However, software applications of different vendors usually do not use the same object types – incompatible data management. For this reason, a global description of structure and semantics of the relevant object classes is a critical part of the information space (meta information).

So, the information space forms the foundation of business processes of any kind; really efficient work without it is hardly conceivable. The information space is the backbone of efficient business processes.

Software Availability

While process/workflow management and user co-operation are well-supported by commercial software, there is a lack of software providing the Big Picture of information, we call the integrated information space, as motivated and described in this document.

5 Glossary

Please find a glossary of the terms and notions used in this whitepaper on our website at http://www.i-inf.net/eng/glossar.html

