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A Multi-functional Information Leitstand for Top-Management – A Proposal

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Zusammenfassung

Sowohl ein Bedarfssog als auch ein Technologiedruck und Initiativen der Softwareindustrie zeigen an, dass die Wirtschaftsinformatik einen neuen Anlauf nehmen sollte, Systeme für die oberen Führungsebenen zu entwickeln. Ein Grund ist beispielsweise die wachsende Bedeutung externer qualitativer Informationen zur Entscheidungsunterstützung. Auch gilt die individuelle und aktive Kommunikation eines Unternehmens mit seinem Umfeld zunehmend als ein Erfolgsfaktor. Eine direkte Konsequenz ist der Anstieg der Arbeitslast des Managements und der für die Informationsverteilung zuständigen Funktionalbereiche. Daher müssen wir die Effizienz der Informationslogistik steigern. Da eine Vollautomation kein Ziel ist, das in absehbarer Zukunft erreicht werden kann, empfehlen wir einen semi-automatischen Ansatz – wir bezeichenen ihn als Multi-funktionalen Informationsleitstand. Das vorgeschlagene Konzept beruht auf einer Vielzahl Erfahrungen, die wir bei der Entwicklung eines Redaktionsleitstands sowie eines Leitstands für die Verteilung von Stakeholderinformationen und eines Befragungsleitstands sammeln konnten.

Stichworte

Informationsverteilung, Informationslogistik, Leitstand, MIS, Stakeholder Information System

Abstract

Demand pull and technology push as well as recent initiatives by market-leading software companies seem to indicate that the science of information systems needs to take a new run at the upper layers of management. One of the reasons is the growing importance of external and qualitative data for decision-making. In addition, companies need to communicate more actively with their stakeholders. As a direct consequence, the workload of management and functional departments in charge of information dissemination has increased. Thus, we need to power up the efficiency of information logistics processes. Acknowledging that full automation cannot be a goal of the foreseeable future, the paper focuses on a semi-automated approach – what we call the Multi-functional Information Leitstand. The concept we propose is based on a number of experiences we made while developing an Editorial Leitstand as well as others for distributing stakeholder information and consulting trusted third parties.

Keywords

Information Dissemination, Information Logistics, Leitstand, MIS, Stakeholder Information Systems

Inhalt

1 Introduction

Both demand pull and technology push factors signal that information systems development for planning and controlling on the top-management level should be revisited. Some reasons for this can be found in Mertens (2003). The following list comprises the most important triggers for our research activities:

1. Extracting information from operational systems and condensing them adequately for different layers of management has always been a major concern of electronic data processing. Traditionally, this sort of problem was addressed by Management Information Systems (MIS) research. Another goal is collecting and filtering external data, transferring them to the proper functional areas, storing and eventually retrieving them. This is an important function within the large field of knowledge management. Thus, the root of the problem lies in delivering the right amount of information to the right recipient. Already eight years ago a profound worldwide empirical investigation of Reuters Business Information (1996) found that 44 % of a total of 1,300 managers think the costs of gathering information exceed the benefit. More recent studies like an analysis by Farhoomand and Drury (2002) prove that the results of Reuters might still be valid.
2. Following creativity theory which states interesting insights into a problem may be achieved when turning it inside-out, we also focus on disseminating information from the firm to its environment. Addressees are stakeholders who either influence the company's performance or get influenced by it according to Freeman (1984). We are nearing Stakeholder Information Systems (SIS) that partly use the same data as MIS.
3. Yet another idea is to take advantage of the internet-based concepts and tools originally developed for online market research and give managers the opportunity to consult experts and trusted third parties ahead of making a major decision. Here we can also find some similarities with quantitative risk analysis.

Quite a few intermediate forms have emerged in between the wide range of "full automation" and "personal fulfillment of tasks", where humans and computers jointly work on achieving their common assignments. Characteristic examples are process control, production planning and control, work places of logistics dispatchers as well as help desks typical for customer care departments. The technical means for these intermediate solutions is the leitstand (LS).

Over the past couple of years, the mentioned requirements have found their way into various concepts for information leitstands that have been investigated following a design research approach introduced by Nunamaker et al. (1991). These are:

1. an Editorial Leitstand (ELS) to collect external and qualitative management information, which has been incorporated into the software bundle SAP Strategic Enterprise Management (SAP SEM™),
2. a Stakeholder Leitstand (SLS) to disseminate relevant information to stakeholders of all kinds,
3. a Consultation Leitstand (CLS) to efficiently request know-how and opinions from experts while working on a particular problem.

Experience showed that some functions of these different leitstands were indeed overlapping. All of them contain functions that present overviews of available information sources, access specialized search engines, store information and offer mechanisms to filter streams of data. Like skills are required for operating the leitstands. In addition, interesting areas for improvement were discovered. Results of a poll conducted using the CLS may be fed into the ELS and compared to external studies of market researchers and financial analysts.

Building on these synergies it seems advantageous to aim at the one, integrated leitstand. This paper commences with describing the individual leitstand concepts. Subsequently, we will derive the principle of a Multi-functional Information Leitstand (MLS) as a framework for joining all of them.

2 Editorial Leitstand

2.1 Purpose

Combining internal and external as well as qualitative and quantitative information to support decision-making is getting more and more crucial, especially for environmental scanning as shown by Choudhury and Sampler (1997). Today, we can quickly accumulate external data by means of the Internet as investigated by Hackathorn (1999). Before integrating them into a planning and controlling system, however, these data need to be edited as their quality and quantity are subject to change. Not intending to merely exacerbate the information overload problem, we need a tool to help us with gathering this kind of information and supplying it to the proper recipient afterwards.

Our approach is the ELS for management information, which partly adapts processes characteristic for publishing companies.

2.2 Principle

Due to the fact that the ELS filters and refines crude data to produce management information, it may be compared to an industrial manufacturing process. Typical functions for

information delivery have been identified and put into logical relation using a value chain analogy (figure 1).

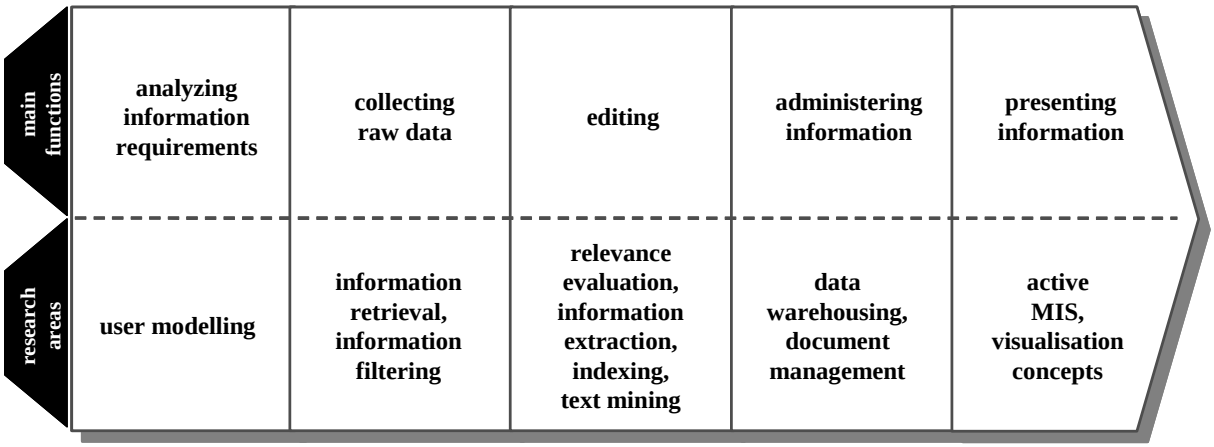

Figure 1 Value chain of information logistics

Meier (2000) explores the research areas listed on the bottom pane in more detail describing the state-of-the-art in both academics and business.

2.2.1 Analyzing information requirements

The information requirements analysis serves as input for subsequent queries to external data sources. In addition, it is an indispensable prerequisite for actively distributing decision-critical information. Its purpose is to find out who needs what sort of information at what time. It can be split up into the following sub functions:

1. Allocating information to recipients
2. Setting triggers for information delivery
3. Identifying possible content

In general, we can separate individual recipients and groups of recipients. Nonetheless, generating a profile for each single decision-maker would impose too much of a burden. The ELS, therefore, offers the possibility to address either individuals or roles and thus allows for “ready-made” information packages for typical management functions.

Another element of a profile is the point of time when data is supposed to be collected or presented to the user. The system distinguishes between calendar-based triggers representing recurring events (e. g. daily, weekly, monthly) and signal-based triggers. The latter one summarizes values of internal and external metrics moving beyond pre-set threshold levels (e. g. number of orders, complaints or market share) as wells as results of data mining activities. One more external cue is an unusually high number of press releases on a certain topic. Going one step further we can imagine combinations of internal and external indicators to signal deviations.

2.2.2 Collecting raw data

This next step is all about supporting the search for potentially relevant documents on the Internet. A starting point is suggesting the right source, preparing and processing queries as well as storing the results for later refinement. A special case is regular monitoring of contents.

Selecting the right information source can be compared to a company choosing a supplier. On the one hand side we have relevant data on information suppliers that serve as a foundation for decision-making. On the other hand we have pre-defined rules. Appropriate criteria the system looks at are categories of content, frequency of updates, language, regional aspects and costs of the information provided.

In addition, the component may generate source-specific queries. These consist of retrieval parameters and search terms considering individual syntax requirements of the sources. A thesaurus is provided to quickly find synonyms for key words stored in the personal information requirements profile.

Furthermore, the systems checks for copyright compliance. More or less automated, it retrieves all necessary meta data required for a citation and alerts the user in case some is missing.

Pursuing the idea of real-time knowledge delivery proposed by Davenport and Glaser (2002) small units of information may be bought from news agencies or market researchers via Micro Purchase and presented to the manager at the very moment he has to prepare a decision (as presented by Mertens and Cas (2003), Mertens et al. (2001)).

2.2.3 Editing

The purpose of this step is to filter incoming documents for interesting facts and assign them to internal data according to their context. This complex task requires a text-based analysis and cannot be fully automated for the time being. However, there are a couple of areas where the system can help with preparatory work and assist a human editor using text mining techniques as examined by Meier and Beckh (2000).

To help users with finding the right key words for documents, the ELS suggests categories for a possible mapping. These are not only confined to words that are part of the document. By calculating a similarity index the system knows where similar documents were assigned to in the past and makes recommendations thereupon.

Information will be extracted in two different phases. First, potential extracts need to be identified and subsequently they will have to be captured. Before doing so, the document will be semantically analyzed. Furthermore, time-based relative terms like “last month” will be transformed to absolute statements like “January 2004”. A rule base enables the ELS to also recognize terms relating to certain events, e. g., a “cooperation” with its attributes “type of

cooperation", and names of the participating companies. The underlying module learns these rules by monitoring actions of the editor. Firstly, he has to define what an event is. Secondly, he fills the corresponding data fields by copying parts of the text with the help of context-sensitive capturing. The system stores these activities and tries to derive new rules. Soderland (1997) gives a more detailed explanation of the kind of applied rules.

2.2.4 Administering information

Most data warehouse projects use the star scheme as the underlying data model for internal quantitative data. Thus it needs to be checked whether external qualitative data can also be stored in a similar fashion.

An internal metric, e. g. revenue, always relates to a product, a region, a customer segment etc. However, this does not apply to a press release. In case of two clients merging, this information has to be mapped to both companies. Another reason for the widespread application of the star scheme is its advantage when it comes to data aggregation used with top-down analyses and slice-and-dice operations. Again, these do not work with qualitative information. The two statements "PharmaStar sold $10 million in Brazil" and "Biohealth founded new plant in Brazil" can both be mapped to "Brazil". An aggregation, however, does not make any sense.

Within the ELS this problem is solved by the means of an enhanced star scheme. The additional elements are "comment and index tables" for qualitative information that refer to the same "dimension tables" as the "fact table", which covers the quantitative data (see figure 2).

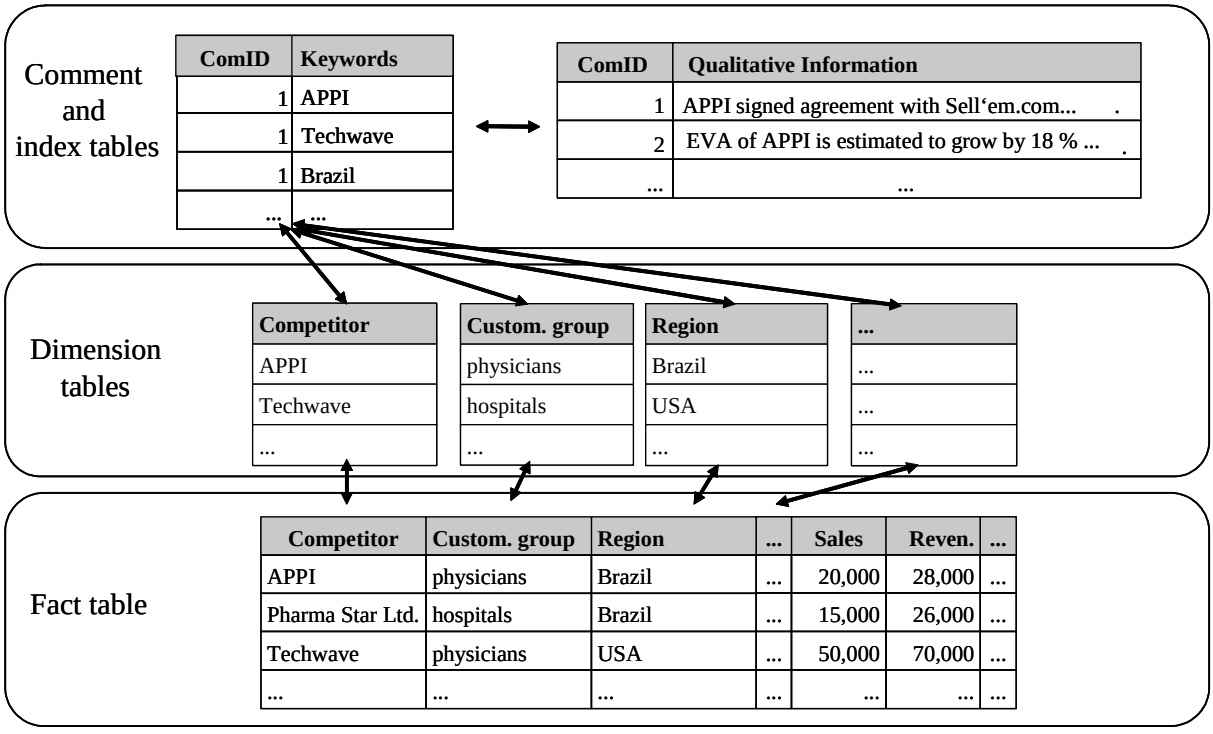

Figure 2 Enanced star scheme

2.2.5 Presenting information

Both active information dissemination (push) and passive technologies (pull) have their right to exist in modern management information systems as Mertens et al. (1996) stated. Critical problems (e. g. a significant slump in sales or loss of market share) should be directed to the responsible executive immediately. In order not to increase the information overload problem it is paramount to pre-define what is to be treated as critical. This is relatively straightforward for quantitative data using either threshold levels or more sophisticated data mining techniques. However, the situation gets more complicated once we turn to qualitative data. An interesting approach that has been realized with the prototype is the so-called “newspaper analogy”. The traditional paper-based media are a widespread source of information (especially for managers), contain both types of data and present them in a well-structured form: headlines and summaries, on the one hand, give a brief overview of incidents. For those more interested in the details, panels offer background material and comments on a particular situation. The reader may navigate through the paper by section or with help of cross-referenced articles. The electronic version enables us to assemble bits of information according to individual demand and lets readers execute queries against the full text base.

3 Stakeholder Leitstand

3.1 Purpose

Ever since the relationship between a company’s value and its reputation was discovered, stakeholder information systems have been continuously gaining importance. CFOs have broadened their scope of active communication from financial analysts and journalists to other stakeholders, as published by Edelman, Inc. (2002). In other words, everyone having an interest in the company might add to its value and should therefore be communicated with.

On the same token, improving the process of information logistics brings about the possibility to streamline processes in the area of middle and upper management: One SLS of a major German stock listed company originated from the speaker of the board of directors having found out how much time he spent talking to analysts over the phone. Based on the Pareto principle it made sense to actively supply 80% with personalized information and only take care personally of the remaining 20%.

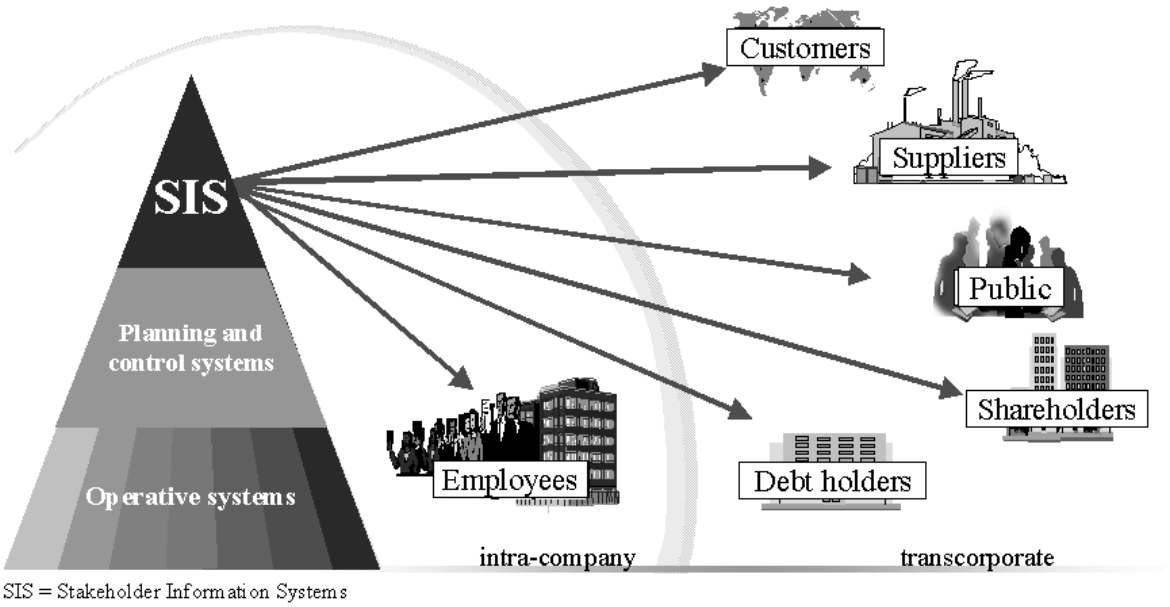

Figure 3 Positioning of SIS

SIS amalgamate ideas from public relations all the way to functions like customer and supplier relationship management as well as employee, investor and creditor relations (stakeholder relationship management) as presented by Mertens and Stößlein (2004).

A futuristic vision could be that SIS replace today's advertising campaigns, which have been losing importance according to a recent study by Mercer Management Consulting GmbH (2003). Budgets are re-allocated toward personalized communication. Austrian energy-beverage maker Red Bull spends 70% of its marketing budget on getting a hold of the teenage target audience this way.

3.2 Principle

The project AIDAR described in Stößlein (2004) primarily covers information logistics for stakeholders. Neither strategic and organizational nor economic issues are omitted. Special emphasis was put on the design of a knowledge base, containing categories of information requirements of stakeholders linked to roles and company characteristics. Furthermore, we have evaluated our concepts with prototypical applications, both in laboratory studies and in practice.

3.2.1 Analyzing information requirements

Our analyses build on magazine articles, polls, news, published interviews, case and success stories of companies and academic publications. For that reason Stößlein (2002) analyzed the stakeholder information presented on the websites of 245 companies. The application of such business cases assures the research stays close to the practice.

The SIS makes use of situation models, role concepts and user profiles (figure 4).

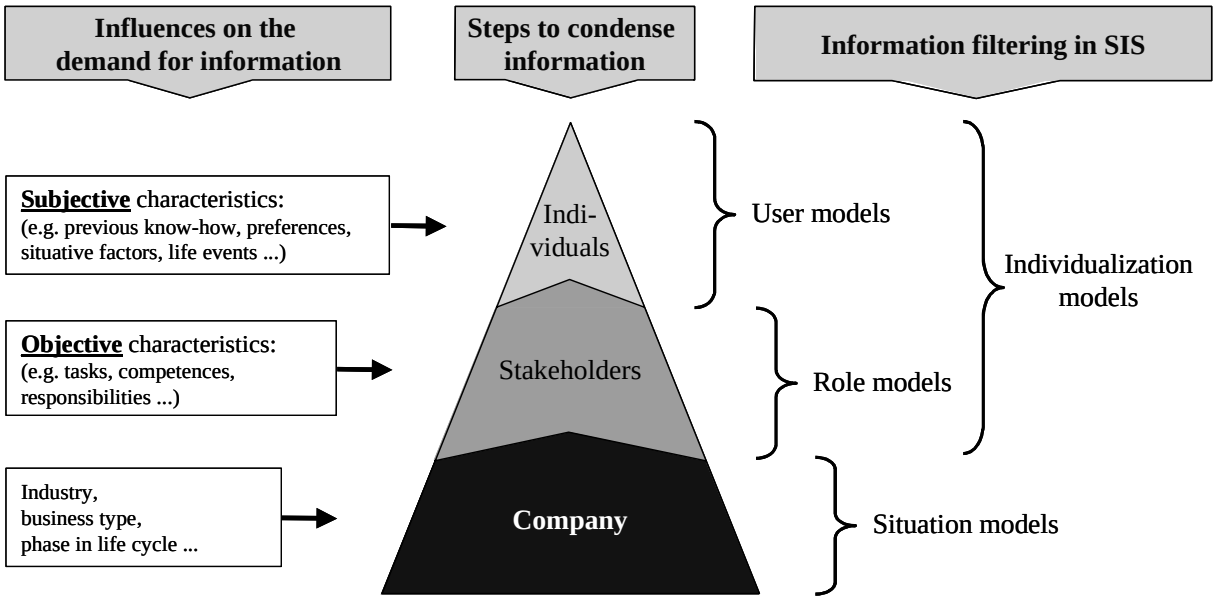

Figure 4 Pyramid of personalization as realized in SIS

The situation model defines what information a company must offer to stakeholders. The term situation encompasses the industry the company is a part of, the phase of the life cycle and other factors.

The subsequent application of the role concept narrows down the messages a stakeholder gets in his initial portal to information he really needs based on the role's description. This again depends on impartial factors like job descriptions and know-how. The user profiles personalize the starting portal according to personal preferences.

We summarize our results in so-called "intelligent" checklists. They represent a foundation for developing portals, messages and questionnaires and may be adapted to the situation of the company, the role as well as the user.

The starting point for information logistics toward stakeholders are legal reporting duties (figure 5). An example is the disclosure of financial data and the stern requirements imposed on companies by the Sarbanes-Oxley Act passed in 2002.

To comply with this is especially difficult for small and medium sized enterprises which get overwhelmed with the multitude of legal information requirements. A study discussed by Katzensteiner (2003) revealed only very few websites fulfill legal requirements. More often than not, a statement is missing who is authorized to act as proxy.

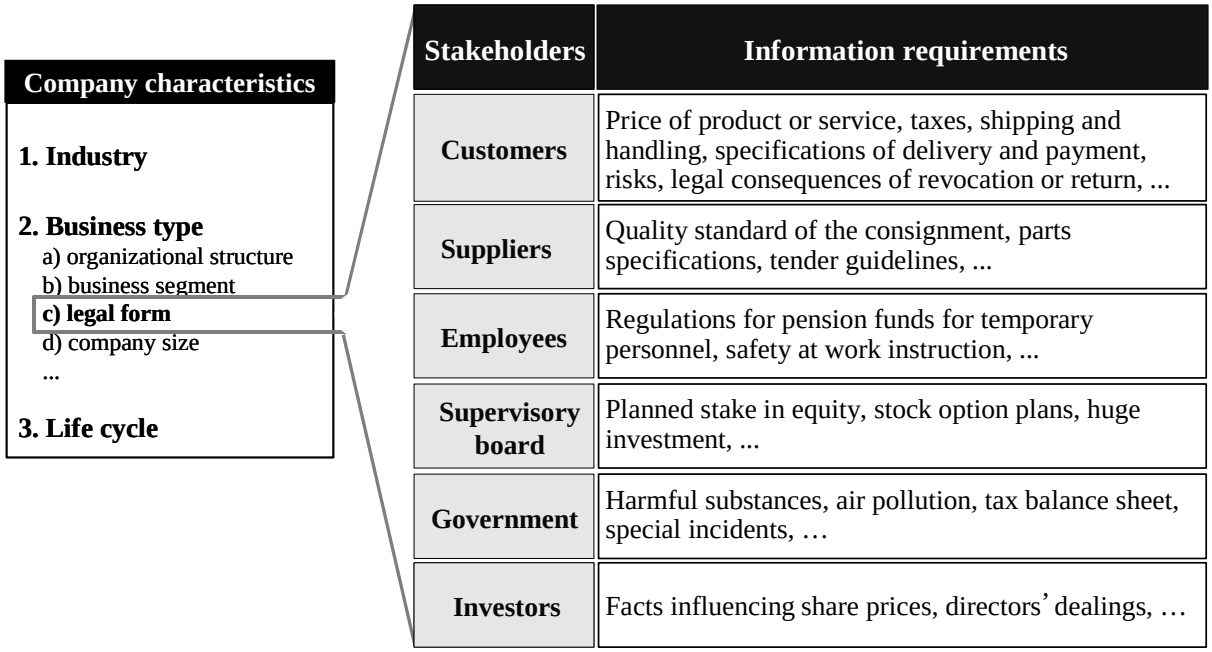

Figure 5 Examples of information duties in the chain of information logistics

The system contains typical triggers and related contents for messages to various interest groups. An important part of this is communication at times of crisis when managers simply are in lack of time to notify all involved parties as well as journalists and investors.

Let us picture a bus full of tourists getting involved in a motor vehicle accident (trigger). An event like this will almost certainly make it to the headlines. There will be speculations around whether the driver had gotten overtired or regular maintenance and tune ups were neglected. Journalists have high expectations toward getting the latest news on how it happened and what security measures were taken. Families of the travelers want to know about their relatives among the vicitims.

3.2.2 Collecting raw data

The SIS connects to internal and external data sources. The "hook" fills templates for portals and messages while the data source directory knows where information is supposed to come from. Besides others, it extracts financial data formatted in XBRL (eXtensible Business Reporting Language) and texts from external sources in ICE (Information and Content Exchange) format.

3.2.3 Editing

In case of a crisis an employee can use the SIS to generate special messages. He first needs to put down the current situation faced by choosing from a drop-down list and the respective role. The system now presents a "ready-made" notification including headlines and text templates. The user is now able to edit this message "to taste" and mail it.

3.2.4 Administering information

The results of the stakeholder information requirements analysis are stored in a knowledge base. We used a combination of relational and objective-oriented database systems in order to implement the dependences. Furthermore, an inference machine (Amzi! Prolog+Logic Server) helps to adapt both information categories and design elements to situated and individual preferences. The enquiries of stakeholders are classified and forwarded to employees by applying text mining techniques, e.g. as stated by Passerini et al. (2004).

3.2.5 Presenting information

The SLS personnel is enabled to set up role-based portals and messages including business content. Furthermore, we started to add adaptive elements to the system that build on explicit and implicit feedback. An administrator can already call up standard reports prepared by the subcomponent “Analyzer”. The “Scout”, a component currently under construction, tries to discover so far unknown relationships by applying data-mining algorithms. We also consider harnessing agent technologies for an adaptive presentation.

4 Consultation Leitstand

4.1 Purpose

As the name implies, this leitstand serves as a means to quickly gather expert opinions to back up forecasts or be able to better gauge the risk involved with a decision. The risk analysis of Hertz is the starting point. The basic idea is to obtain multiple input values for a computation, e. g. an investment calculation. Instead of churning out one single target value a simulation module presents the results again in terms of variances. Management can now see how unsure these experts were when formulating their opinion and thus get a “good feeling” about the risk involved.
Eventually, we face a typical behavior often witnessed with management: Before making rigorous decisions the executive consults trusted experts to ask for their opinions and estimates.

4.2 Principle

A generalization of the above introduced idea leads us to the following decision-support system concept: as an example we will walk through the fictional restructuring of the spare parts logistics of a health technology manufacturer in his South American export market. The strategic question is whether or not the Quito-based distribution center should be closed

down and hospitals in Ecuador be supplied from Bogotá in the neighboring Columbia. Academic disciplines like Information Systems, Operations Research and Logistics Management already provide a wide-range of instruments to support typical logistics analyses. Besides, the situation has managers require additional material upon e. g. reliability of traffic infrastructures in various South American countries and experiences with the cultures involved.

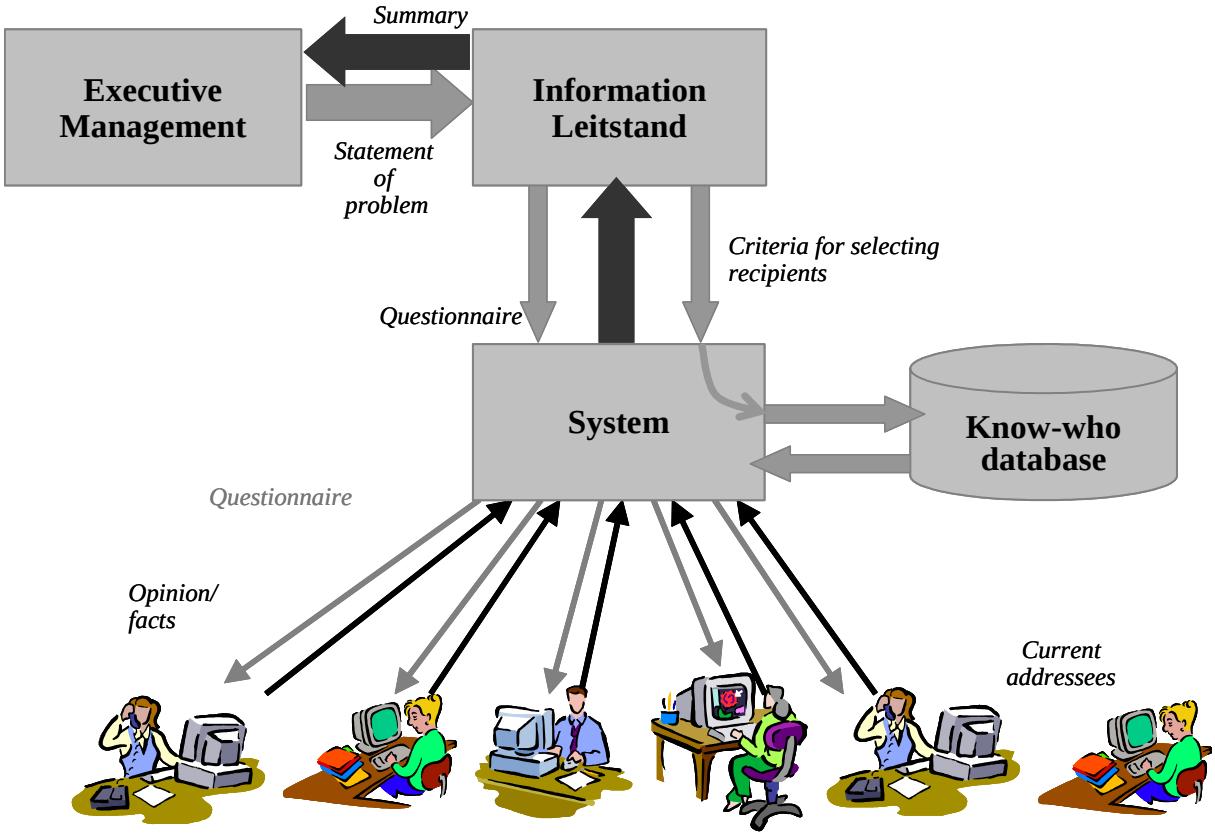

Figure 6 The generalized risk analysis of Hertz

For this kind of decision it is helpful to maintain a "know-who database" on competencies. This maps areas of knowledge and experiences to key members of current staff and former employees. The system may now query these data using a combination of parameters. In our case we could seek persons with at least half a year's business experience in either Ecuador or Columbia.

As a first step, the leitstand would have to transfer the pending decision-problem into an online-questionnaire that is to be transmitted to appropriate recipients. "Questionnaire-Engines" developed for online-marketing activities could take charge of this. Then, the experts will give their opinion in a formalized way as Yes-No combination or a more detailed rating. They might also indicate they have some kind of extra information that could be of further assistance.

The leistand staff considers the answers and summarizes the results of the little "opinion poll" for the management. Repeating this process all over again regularly with the same questions would pave the way for moving toward a Delphi approach.

5 The pieces put together: the Multi-functional Information Leitstand (MLS)

Besides the fact that all three principles employ the idea of a leitstand, they also share common functions as well as requirements toward personnel.
The following list of commonalities suggests that joining the three leitstands into one single, enterprise-wide concept will let us reap some beneficial synergies.

5.1 Commonalities of the Leitstands

5.1.1 Shared functions

These functions are part of ELS, SLS and CLS:

1. Metadata on sources (source profiles, Know-who collections) need to be prepared as well as role and user profiles must be set up and maintained.
2. Information requirements have to be transferred into queries or search terms.
3. Quantitative results of a search need to be refined using statistical methods.
4. Qualitative results need to be edited to extract summaries, eliminate double entries and redundant passages, group like messages or refine unstructured texts for storing (e. g. by setting descriptive parameters).
5. The system must be based on an adaptive architecture and be able to “learn” appropriate sources, addressees and modes of presentation.
6. The goal is to identify events that trigger information logistics processes.

5.1.2 Shared requirements towards personnel

These shared functions lead to joint requirements towards staff working with the information leitstand. In general, every time the computer cannot move on all by its own, the user will have to assume control. These kinds of problems will occur when new decision-situations arise or when new topics and sources come up. Thus, the main requirements are:

1. They must oversee internal and external information sources and build up corresponding directories.
2. They have to be aware of information requirements of individual recipients and business functions. Therefore they need to know their way around role concepts and user profiles.
3. They must be able to translate verbal information into machine-readable form.
4. Their writing style must allow to produce summarizing reports for managers using text components from information bases.

5.2 Concept of the Multi-functional Information Leitstand

Figure 7 characterizes the MLS as a “turntable of information”. Depending on role and concrete situation, the information needed at a particular site will be connected to multiple heterogeneous sources.

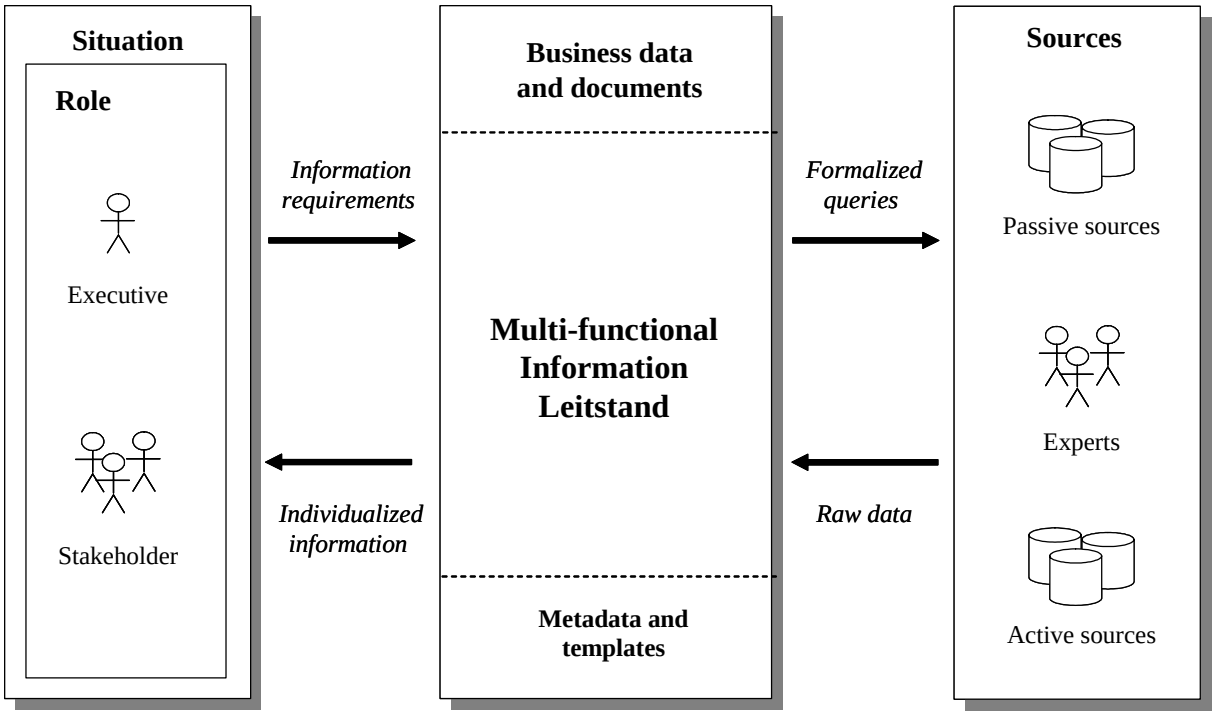

Figure 7 The MLS brings together sources and points of actions

Besides preferences, situations as well as related tasks and competencies make up the demand for information. The MLS transforms this demand into formalized queries and fires these against selected sources.

We differentiate two kinds of sources. Passive sources deliver only once upon request. Buying a market research document online just-in-time may be an example. Conversely, active sources permanently deliver information that match pre-set profiles of interests, e. g., news tickers that can be subscribed to either for free or for a monthly fee. Yet another type of source is the human expert who will help preparing for decisions or communicating to stakeholders.

5.2.1 Functions

The following table lists basic functions of an MLS with their respective use cases:

Basic functions	Use case
Collecting, organizing and storing information requirements	Preparation of information retrieval for 1. Typical decisions 2. Messages to stakeholders
Configuring and adapting company-specific knowledge bases	Maintenance of 1. Role and user profiles 2. Metadata of sources

	3. Report and message templates
Transforming information requirements into machine-readable form	1. Queries to internal data sources and external information services 2. Ad-hoc consulting of experts
Billing and settlement activities	1. Micro purchase of external data 2. Processing transactions with an information market 3. Management of indirect costs
Filtering relevant content	1. Extraction of relevant facts from large databases and documents 2. Refinement of polls and studies according to best statistical practices 3. Summarizing of texts
Mapping descriptors of an internal classification scheme	Adding key words to results of queries
Submitting individualized messages	1. Sending exception alerts to executives 2. Informing stakeholders
Generating individualized portals	1. Management portals 2. Employee portals 3. Stakeholder portals

Table 1 Basic MLS functions

5.2.2 Architecture

By grouping these basic functions and the respective data we get to the architecture of an MLS as represented in figure 8.

The multi-stage information filtering principle of the MLS offers interfaces to sources and points of action (management and stakeholders). A report and message generator that extracts and connects relevant facts stands at the core. Furthermore, there exist metadata of sources and actionpoints, templates for roles, reports and typical messages as well as for business data and documents.

The classification of sources explained above (active, passive sources and human experts) corresponds to three interface components on the source-side. Passive sources require a query component that interprets settings stored within a user profile and translates them into the syntax required by the targeted source. The questionnaire engine has a similar function, but instead of using the source profiles it gets its data from the know-who database. A given demand for information in a user profile will be first transformed into a questionnaire. Thereafter the system forwards it to selected people and automatically re-collects and evaluates the answers.

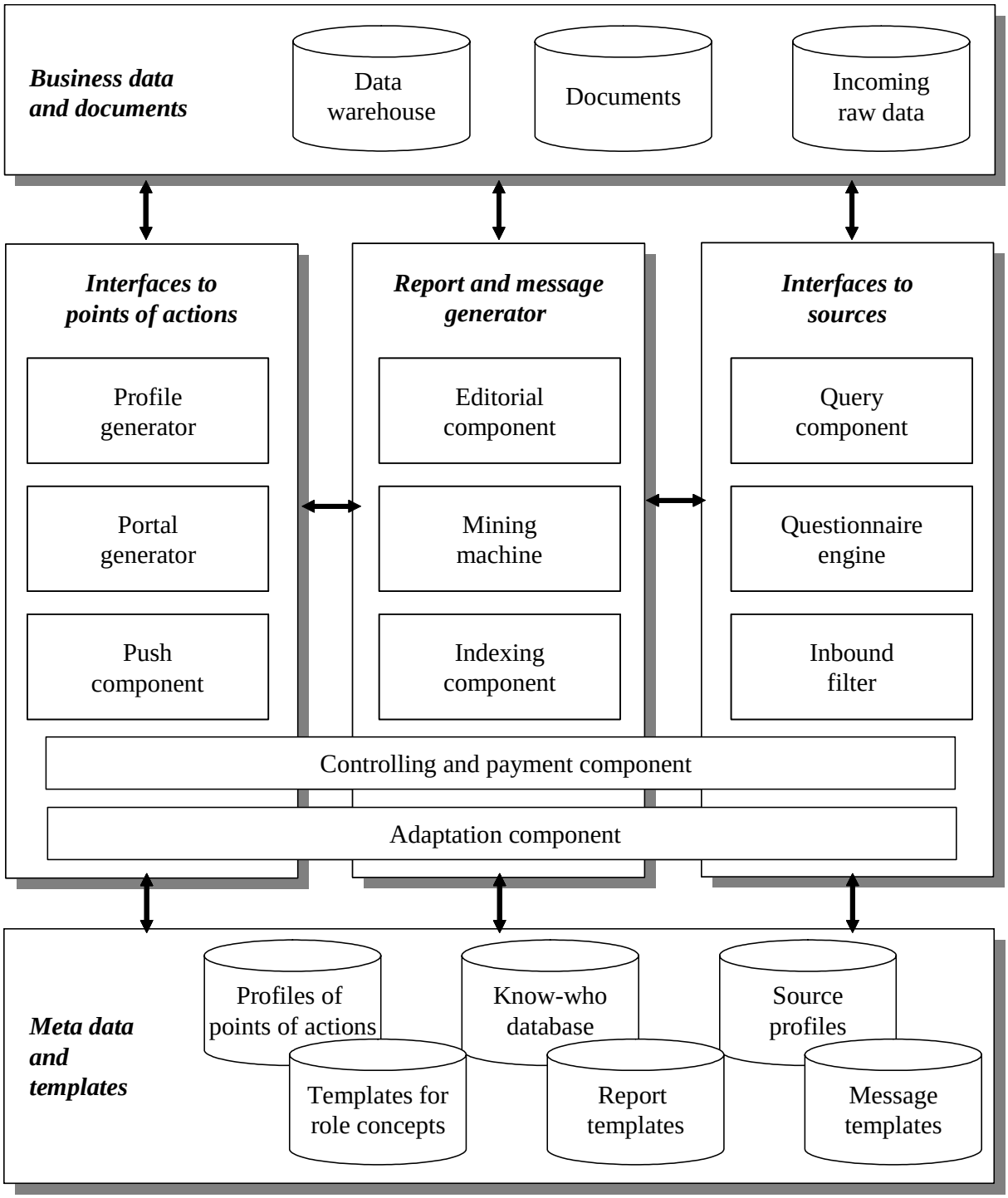

Figure 8 MLS architecture

The category of active sources requires an inbound filter that matches pieces of information found within the incoming data stream to requirements of single users or groups of users, e. g. defined in role models.

In urgent cases gathered information may be directly forwarded to the point of action. Normally, an incoming data folder will take care of storage of crude data. It is this folder that supplies the various components of the report and message generator. The editorial component summarizes messages from different sources and formats them in a standardized way. A mining-machine helps with exploring the hidden secrets within the data.

After the mining runs an indexing component saves relevant facts according to an enterprise-wide classification scheme. This has to be derived from the underlying data model of the data warehouse in conjunction with descriptors used with a document management system. Based on this, a profile generator produces user profiles that build upon each other like overlapping layers. The lowest layer contains basic profiles of external and internal addressees. Step-by-step the profiles will be refined with help of role definitions for certain functions. Eventually we reach the outer layer composed of personal preferences of single information recipients. Depending on the type of information delivery – push or pull – information elements will be either put down into a stakeholder portal or immediately sent to the requester via a push component.

A controlling and payment component overlays all mentioned areas. On the one hand it is used to pay for externally purchased bits of information. On the other hand it allows to bill internal departments and points of action for their requests. This enables us to at least get an idea of the system's performance toward efficiency and economic benefits.

Another cross-functional component serves to adapt the system to the permanently changing information requirements and source profiles.

6 Conclusion and future work

The MLS primarily aims at improving the cost-benefit ratio of information logistics. It serves to reduce the information overflow and enables companies to leverage resources for information collecting and refining. The latter is achieved by bundling assets formerly tied up in individual, isolated tools (the three leitstands). It is thus possible to

1. make better use of the specialized know-how of staffing the leitstand,
2. reduce maintenance of metadata structures,
3. get around procuring redundant pieces of information,
4. spot and remove any inconsistency more quickly.

As the separate elements have proven to be effective in various environments (e.g. the ELS is part of SAP SEM), the depicted system would not have to be designed and developed all the way from scratch. Instead, it represents a synthesis of these existing modules into one single entity. This fact also underscores the feasibility of such a project.

As was indicated throughout his paper, it will be necessary to classify triggers, roles and industries for an effective personalization of content. Despite some other research projects in this area, the involved legwork is lengthy and tedious. There are no low-hanging fruits.

It also became clear how important the enterprise-wide classification scheme is. Ontologies and reference modeling techniques for management information could prove to be helpful at this point.

However, one major obstacle to implementation could be the well-known acceptance barrier. Tasks and responsibilities from various functional departments would be amalgamated into the MLS and might cause nays-saying or even turf wars.

As is always the case with information logistics applications, calculating the return-on-investment will not be easy but should not deter us from trying – an interesting and important area for future research.

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