Information-infrastructure as a basis for business process redesign: results of a case study

INFORMATION-INFRASTRUCTURE AS A BASIS FOR BUSINESS PROCESS REDESIGN: RESULTS OF A CASE-STUDY

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Abstract

In spite of efforts spanning years many organizations have not been able to adequately adjust their information processing to the client and market of the 1990s. Especially in organizations with a turbulent environment techniques like information planning prove to be of only limited use to effectively mobilize the rapidly increasing potentialities offered by information technology (IT).
In this article a new approach of the application of IT is discussed. The central concepts are information-infrastructure and Business Process Redesign (BPR). A case-study was done at an engineering-works in the Netherlands to test the usability of the approach.

keywords:
information management, information-infrastructure, business process redesign

1. Introduction

The growing possibilities for IT offer both new opportunities and risks to organizations. Recently successful attempts to increase the organizational flexibility and effectiveness with IT have been described (eg. Hammer 1990). However, most of these cases seem to be incidental IT experiments, instead of the results of a structured IT-management.

With regard to IT-management information planning (IP) has steadily become the ruling paradigm during the past two decades, although it is still far from common place especially in small organizations (eg. Hagmann et al 1993). Information planning can be defined as a formal approach to develop a structured project plan for information development based on the organization strategy, via an information architecture model. Numerous methods, eg. Business System Planning (BSP), Information System Planning (ISP) and Information Engineering (IE) are based on the IP-concept (Theeuwes 1986). However, with the increased experience with these methods also some disadvantages became clear (Lederer & Sethi 1992, Earl 1993). Some of the criticism is focused for instance on the practicability of the organization-wide analysis of information requirements, which is advocated by some of these IP-methods, and the usefulness of the products of the analysis like the integrated information-architecture models (de Jong & Gazendam 1991). As a reaction to the dissatisfaction with the information planning paradigm several researchers have approached information planning from a different angle.

The contingency approach advocated by Wassenaar and Louweret (1992) is an example of such an initiative. Depending on the characteristics of a business situation one out of four approaches for the design of an information plan is selected. Although this offers a useful alternative for the uncritical application of 'traditional' information planning methods it is still too much related to them. It does not incorporate the new concepts regarding coordination of IT-development.

In this article the theoretical foundation of a new paradigm is described which connects the concept of information-infrastructure to Business Process Redesign (BPR). The approach was tested in practice during a research project at Stork Brabant B.V., an engineering works in the Netherlands.

The structure of the article is as follows. In section 2 a brief description of our interpretation of the essentials of both information-infrastructures and BPR is given. The description of the case-study starts in section 3. There the business situation of Stork Brabant is described. In section 4 the application of the new approach and the results are discussed. The conclusion can be found in section 5.

2. Information-infrastructures and BPR

2.1 Information-infrastructures

Traditionally information-infrastructure has had a very technical connotation. The typical professional dealing with issues in this domain was the electrical engineer. Many people still interpret information-infrastructure in this way.
Here an information-infrastructure is defined as the common basis provisions with respect to the information processing. As such the concept has a central position in an alternative way to coordinate IT-development for the manager who wants to prevent "islands of automation", without blocking all automation initiative at the local level with a rigid top-down planning process.
Among both theorists and practitioners the attention for information-infrastructures in this sense is growing (Truyens et al 1990, Bemelmans 1991, Scott Morton 1990).
Bemelmans distinguishes the following constituent parts of an information-infrastructure:

- the common software applications
- the common data- and knowledge bases
- the common hardware and system software
- the common organizational provisions for development and maintenance of IT-applications

Main principle of the information-infrastructure paradigm is that the top managers in organizations should no longer bother about every new IT-trend or every local IT-application, but instead concentrate on the IT-applications which serve as a basis for others. The rest should be left to the autonomy of the local units. Development of an information-infrastructure thus implies that standards have to be set regarding such things as the accessibility of data (eg. via distributed data bases), communication between organizational units (network technology), or portability of IT (eg. via standards for hardware platforms).

Important characteristics of information-infrastructures are (Truyens et al 1990):

The relatively permanent nature
This implies the information-infrastructure has to be both open-ended and durable. It means that on the one hand the infrastructure can be expanded with new facilities or technologies without major problems while on the other hand it is not too instabile.

Transparency
The internal complexity of the structure should be hidden for the end-user.

The responsibility of management
Management has to confirm the common IT-provisions organization-wide to prevent that local units will undermine their integrating effect by developing their own infrastructure. What exactly is meant by "management" and "local units" can vary significantly. In large organizations the infrastructure will often have a hierarchical structure, reflecting the effects of standards set at eg. corporate, division, business units, factory level. At each of these levels a similar management problem occurs, though with different levels of detail.

Important issues regarding information-infrastructures are thus related to how, by whom and for whom the freedom to apply IT according to one's own views should be limited by strict frameworks and compulsory standards.
We stress that these issues are much more of a general management nature than a specifically technical one. Which IT-resources are common is not decided until the end of a decision process about the information-infrastructure itself, which is influenced by a complex of factors (eg. the power distribution between the top management and the local units, turbulence of the environment). The technological limitations are only one of them.

It will be clear that it is not easy to use the concept of information-infrastructure in practice, not to mention to see the relationship with the local IT applications.
Examples of questions which have not been answered so far are:

- How is it decided what should and what should not be part of the information-infrastructure ?
- What is the nature of the interaction between the local application of IT and the development of an information-infrastructure at the level of the higher management?

This article tries to connect information-infrastructure and local applications via BPR. In the next paragraph we briefly describe the basic principles of this concept.

2.2 Business Process Redesign (BPR)

Currently BPR and highly related concepts are so much in the focus of attention that some speak of a "management mantra" (Day 1992). From a wide range of disciplines people have contributed "what and how" publications (eg. Parker 1993, Stevens 1993). Among the best known impulses for a methodological approach of BPR is that by Davenport & Short (1990). In accordance with these authors we define BPR as the redesign of business processes with the use of IT. Examples of BPR in this sense are the transformation of a sequential into a parallel business process structure, with the use of distributed databases for coordination, and the change from independent to integrated production control eg. via the use of telecommunication networks (Hammer 1990). The following is a step-by-step approach for BPR derived from Davenport and Short (1990):

Step 1
Determine the goals of BPR (e.g. reduction of costs or lead time, quality improvement)

Step 2
Identify "candidate" business processes for redesign (the processes which have a critical influence on the profitability)

Step 3
Analyze the business process and identify opportunities to apply IT in the redesign process.

Step 4
Redesign and implement the business process

The two most important characteristics of BPR are that the transformation effort is concentrated on the most essential (so-called "high-impact") business process and that is analyzed to what extent IT can contribute in the redesigned process. Although Davenport and Short's step-by-step approach of BPR provides some direction many questions remain unanswered. Among these are:

- How can it be prevented that BPR is used in organizations in an unstructured ad-hoc way?
- What determines what an essential business process is?
- What is the best way to analyze a business process?
- Who are involved in the redesign process?

2.3 Improvement of the information processing: iteration between infrastructure and BPR

At this stage some issues related to information-infrastructures or BPR are still unclear. Yet it can already be concluded that the two concepts are complementary. The information-infrastructure can provide a holding ground for a well-considered and structured use of IT. In the business units BPR-techniques can be applied to tailor the IT application to the specific situation within the constraints set by the framework of the information-infrastructure. To achieve this the following cyclic approach is suggested, see Figure 1.

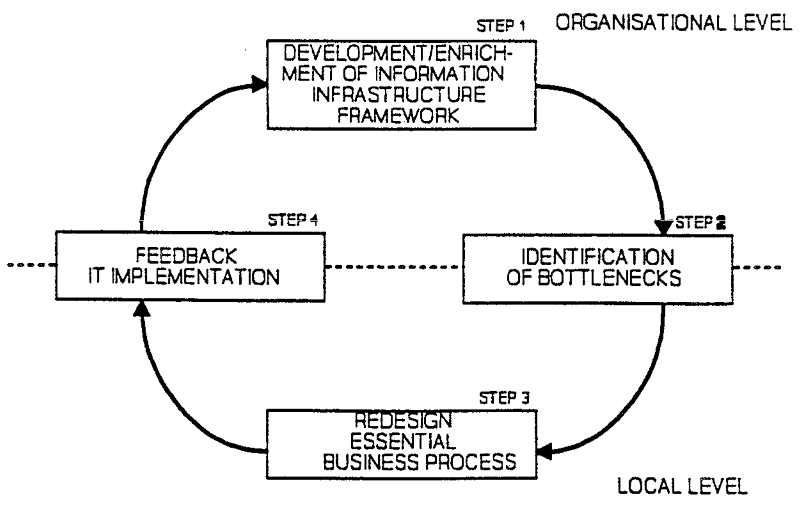

Figure 1: Iteration between information-infrastructures and BPR

Step 1
When going through the cycle for the first time one has to determine what are the main parts of the information-infrastructure. At this time only the most important structure aspects of an information infrastructure can be identified. We will call this an information-infrastructure framework. In the next cycles the framework has to be developed and enriched further. As mentioned earlier the information-infrastructure incorporates the common basis provisions for data and knowledge, software applications, organizational provisions and hardware (Truijens et al 1990, Bemelmans 1991).

Step 2
The information-infrastructure framework is used as a reference during the identification of 'bottle-necks' in the information processing. Examples of such bottle-necks are an insufficient accessibility of data bases, limited usability of data, incompatible network protocols. Within a bottle-neck the processes which are affected by these information processing problems have to be identified. Then priorities have to be set regarding the solution of bottle-necks.

Step 3
Is focused on the analysis and redesign of the activities of a "high-impact" business process within a bottle-neck. Constraints for the redesign stem from the elements of the information-infrastructure.

Step 4
The effects of the redesign efforts have to be analyzed on their contribution to further enrichment of the information-infrastructure. Examples of enrichment are an extension or specification of common data definition or the extension of organizational standards related to IT-development.

To develop more insight in this cyclical four step approach and the usability of the two concepts embedded in it it was tested in practice. In the case-study the cycle was gone through once. In the next sections this test will be described.

3. Stork Brabant B.V.: Business situation

Stork Brabant B.V. is part of Stork N.V., a multinational consisting of 85 independent business units. Stork Brabant is a machine manufacturer with approximately 600 employees. The company produces machines for printing and finishing of textile based on an in-house developed technology for rotation screen printing. The company developed a complete production line for textile printing, consisting of machines for mixing paint and for printing, drying, coating and impregnating textile.
Stork Brabant holds 50% of the world market for rotation printing machines. Two types of orders can be distinguished: orders for new machines and orders for components and services.

Stork Brabant occupies a prominent position within Stork N.V., among other things because of their capacity to innovate their business processes and their ability to apply IT for that purpose. In the past years major effort has been put in the effective use of EDI, CAD/CAM and automated production control.

Triggered by the international economic recession the management has become increasingly alert with regard to the continuity of the company, in spite of the results mentioned above.

Although the management is aware of the fact that IT is essential to the company's survival it is not clear how it should be managed. Several attempts have been made to develop an organization-wide information plan, without desired results.
Most important reasons for this failure as experienced within Stork Brabant were:

- the long time to completion of the IP-projects
- their large scale and disorder and consequently the lack of management support for the results of the analysis
- the lack of support within the organization for the execution of the plan
- the inability to transform the information plan to projects.

In spite of the disappointing results the desire to increase the insight in the opportunities to apply IT is growing. The management made clear that insight in the "basic structure" of the information processing is necessary to be able to apply IT rapidly and effectively. They agreed to try to apply the approach described in section 2.3.

4. Improvement of the information processing at Stork Brabant

Consequently the four phases as described in Figure 1 of section 2.3 would be gone through. During meetings with representatives from the company techniques were selected that would be used in these four steps. Knowledge and experience of the people involved were taken into account in this selection process as well as the characteristics of the control structure and information processing. Support for communication and analysis was distinguished from support for design. In the following we will discuss the activities during each step and explain the techniques that were used there.

4.1 Step 1: Basis for an information-infrastructure

During the first step an analysis had to be made of the common basis IT-provisions within the company.

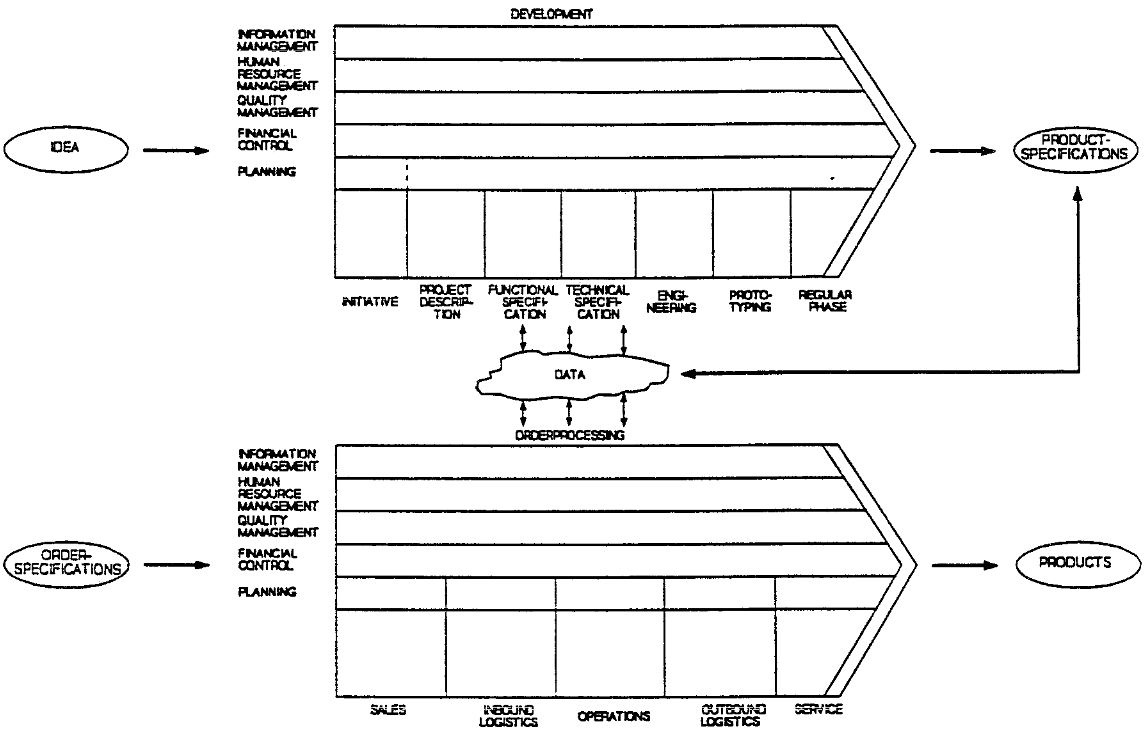

Figure 2: The two value-chains of Stork Brabant

During the meetings with the representatives from the department Organization & Information Management it became clear that within the company two main clusters of business processes could be distinguished, namely
- the order processing cluster
- the development cluster.

The order processing cluster incorporates the phases from order specification to customer acceptance of a product (eg. a Stork textile printing machine). The development cluster includes the phases from generating an idea to the delivery of the product specifications for a product. Figure 2 shows the two clusters of business processes as two so-called 'value chains' (Porter & Millar 1985). A value chain model shows supporting business functions in relation to the operational business processes. In each business process value is added to the product at hand. The value chain was selected and applicated because of the fact that this model is relatively easy to use and that various participants were familiar with it.

By applicating the value chain model in the Stork Brabant business situation it became clear that various information and communication relations exist between the two clusters of business processes. With the value-chain model it was possible to find common basis provisions in the area of information technology (i.e. software, data clusters en hardware). Examples are given in Table 1.

Since it is impossible to discuss all elements of the information-infrastructure in this article we will restrict ourselves to the data infrastructure from now on. The main reason for this choice is that in the case of the data infrastructure its function as a common resource is most clear.

By means of interviews and documentation it was established that within Stork Brabant its data infrastructure could be split up in 9 subsystems. Both the order processing and the development cluster use these kinds of data. Before the start of the field-study this did however to no extent imply that between the clusters one could speak of a clear and unequivocal use. A brief enumeration of the data clusters is as follows:

type	examples
software	production control management accounting sales information
data	client data order data product data
hardware	ether net VAX-cluster

Table 1. Examples of common basis IT-provisions at Stork Brabant

- Market data (e.g. data on market development, competitors) For: the development of new products
- Client data (e.g. data on address, agents, complaints) For: order acquisition, specification and transportation of products
- Supplier data (e.g. data on address, order, contracts) For : purchasing and outsourcing
- Offer and order data (e.g. data on delivery, invoice) For: order specification
- Product data (e.g. data on product structure, stocks) For: order specification, production
- Planning data (e.g. data on material requirements planning, production planning) For: production and purchasing planning
- Development data (e.g. data on patents) For: support of product development
- Human resource data (e.g. data on salary, contracts, knowledge and experience) For: personnel assessment and management
- Financial data (e.g. data on net sales, ledger) For: financial management

We give an example of the common use of these data. Product data are used within the development cluster as a reference for the specification of new types of machines. Within the order processing cluster these data are used for the production and assembly of parts of an existing type of machine.

4.2 Step 2: Identification and priority setting of bottle-neck areas

During the second step bottle neck areas in the information processing have to be identified and priorities have to be set regarding their solution. The infrastructure developed in step 1 serves as a framework during this analysis.

The identification of problems regarding the information processing and the consolidation in bottle-neck areas took place during meetings with representatives from the department Organization & Information Management and the Department/Sector-group.

The Delphi-method (Schnelle 1979) was selected to support this step. This method provides guidelines on how to organize brainstorm sessions and structure the communication. Basic principle of the method is that every participant develops his/her opinion independently. Presentations should lead to a consensus about the bottle neck area that should get the highest priority and the strategy to tackle it.
Eventually the participants accepted the following five bottle neck areas:

- **Cost accounting**
  Not enough insight exists in the cost accounting, especially with regard to development and orders

- **Market data**
  For effective development of new products better information regarding clients and competitors is needed.
- **Order related production data**
  An effective transformation of sales data into order specifications, an improved documentation of client specific data and a broader availability of historic order data is desired.
- **Product data for development**
  Control of the product specifications and the development documentation is not unequivocal nor efficient.
- **Service data**
  Registration and analysis of complaints, client specific product data, technical product data should be improved for a more efficient processing of offers and orders.

They reached agreement on the following three criteria to select one of these five areas:

- urgency (the importance of a bottle-neck for the company)
- feasibility (can the problems within a bottle-neck be solved in a short time?)
- turbulence (are the processes within the bottle-neck regularly subject to changes?)

With the use of these criteria the area of the service data was given the highest priority. Because of the shift in organization policy mentioned before the service function was becoming of increasing importance to Stork Brabant. The Service function already made a significant contribution to the gross sales and profit of the company. Customer satisfaction with Stork is largely determined by their service level. Moreover, within the service function an adjustment of the organization structure was at hand. The employees were 'open' to change. The importance of this last fact is easily underestimated. The political aspects of information system developments have not been completely neglected (see eg. Markus 1983, Beath 1991) but the attention they get from theorists is not in accordance with their influence on the (lack of) success of system development initiatives. According to Stanton et al (1992) inability to manage "stakeholder resistance" is the main reason why reengineering projects fail.

4.3 Step 3: Redesign of a business process within the bottle neck area Service-data

During the third step the activities of a high impact business process within a bottle-neck are analyzed and redesigned.

The activities in step 3 would consequently be directed at redesigns within the service function. Subsequently the content of the Service function and the selection, analysis and redesign of its most essential business process will be discussed.

Brief description of the Service function.

The existence of the Service function stems from the need to support maintenance of machines delivered by Stork Brabant. Examples of service activities are installation of new machines, solution of break-downs and training of new users. Both elements of the service function are part of the order processing cluster. Service activities form the last primary process in the order processing cluster. All primary processes are involved in the delivery of spare parts. Time and userfriendliness are crucial to the service level. IT is considered indispensable for significant improvements in these areas.

The essential business process and the problems related to it
The most essential business process within Service is the offer and order processing for service spare parts. It starts with the specification of required parts and ends with their delivery and incorporates most of the service tasks. Because of bottle necks in the storage, processing and use of data some process steps are very time consuming.

Analysis of the offer and order processing
The PBI-model (Bemelmans 1991) was selected for the analysis. The primary process "offer and order processing" consists of the specification of customer requirements, the warehouse activities and production. The control of the primary process can be split up in the planning and control of the stocks of service-parts, the production and purchasing planning the financial management and the client-configuration management. It was decided to restrict the redesign to the subprocesses "specification of customer requirements" and "client configuration management".

For the offer and order processing it was determined what information was needed for the primary process and its control and how to acquire the information. The necessary information consists of e.g. data on clients, spare parts, transportation alternatives and their costs. Automated information systems are used, but some data are processed manually. The PBI-analysis made clear problems with regard to the incompleteness, incorrectness or availability of information.

Redesign of offer and order processing based on IT
From the PBI-concept it follows that changes in the business process have to be combined with adjustments of the information processing. The redesign of the business process was aimed at improvement of the quality of the service activities, especially regarding the service time and the userfriendliness.

1. Improvement of existing subprocesses

An important change in the existing primary process consisted of the improvement of the requirements specification activity. The specifications for internal use have to be simplified. Additionally the client configuration control - of client specific data about the machines- had to be adjusted. This is related to the fact that in the future requirements specification will become more and more an external affair.
To enable the changes in the primary process and its control adjustments in the information processing are necessary. Internally data regarding subparts and the data group "client specific machine data" have to be reorganized. Both data groups should become available on-line.
Externally the availability of correct client specific subpart data is required.

2. Development of new subprocesses

A subprocess within the Service function which has to be developed from scratch is related to active consulting of the client.
IT is of major importance here. The existing machine data have to be organized in a more effective way, eg. to enable planning of subparts and maintenance requirements for a specific machine. This requires an extension of the existing order registration system with historic data and development of new system for machine error registration and contract registration.

4.4 Step 4: Feedback and enrichment of the information-infrastructure

In this step the effects of the redesign on the information-infrastructure are analyzed.

The redesign of the service process for offer and order processing resulted in feedback. Through the redesign in the service area one of the elements of the information infrastructure was enriched, namely the data infrastructure. The enrichment consisted of both specification of the existing data infrastructure and an extension with data sets, needed for the future. We will describe the enrichment of the data infrastructure with the examples from the preceding section: specification of customer requirements and development of contract management. The results from the data restructuring that was done there were fed back to the data infrastructure. This affected the "customer" data group. This group was split up in four parts, namely the 'customer data', customer specific machine and 'spare parts data', 'contract data' and 'performance agent/inspector'. Multiple units will rely on the already existing 'customer data' and the newly developed ' client specific machine and 'spare parts data' and the 'performance data'. Since the group 'contract data' is only used within Service it is not part of the data infrastructure.

5. Conclusions

In this article a new approach of coordination of IT-development is described. The concepts information-infrastructure and business process redesign (BPR) take a central position.
The approach was tested in a case-study. An important practical issue was the selection of useful techniques to support the various steps of the approach. The Value Chain model was selected to support the communication with internal consultants and higher management. Delphi techniques were used to support the group decision making, the PBI model for the detailed analysis of the control process within a bottle neck area.
Ofcourse it is clear that the limited degree of generalizability of the knowledge obtained in this case-studie is to some extent a disadvantage. However, at Stork Brabant the results of the research project appeared to be very useful, especially for the Information Management. On the one hand the case-study resulted in more insight in the opportunities of IT in an important Business Function (the Service Function) of the organisation, and on the other hand a practical

approach (with techniques) for the development of information-infrastructures was realized that fits well to the organisation. Further, the Information Management of Stork Brabant accepted the conclusions from this case-study as hypotheses for other research projects that are planned in near future. These hypotheses are respectively:

- integration of the information-infrastructure concept and BPR offers new opportunities to improve the information processing in organizations.
- a data infrastructure offers a good framework for determination of bottle neck areas and redesign of business processes.
- participation of various groups of stakeholders is of high importance; here the involvement of the top management (for the support) and the middle and operational management (for the detailed knowledge of the business processes) was particularly crucial.

Consequentially we recommend the approach for testing and validation in other business situations. More detailed recommendations for further research are:

- The concepts behind the information-infrastructure paradigm and BPR have to be analyzed further.
- Guidelines have to be established for the criteria that should be used when setting priorities regarding the bottle neck areas.

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