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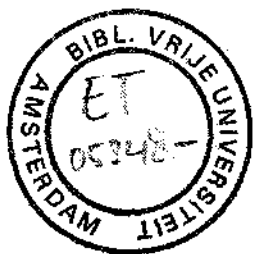
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Business Process Redesign and Information Systems Design: A Happy Couple ?

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ABSTRACT

This article focusses on organizations that deliver products consisting of information. These organizations have gained fewer benefits from the introduction of information technology than manufacturing companies. An explanation for this finding is that current information system design methodologies do not provide the appropriate tools. They are directed at analyzing and designing information systems for control and do not make a distinction between information handling processes that are part of the control system of an organization and information processes that are part of the production system.

The business process redesign approach that gets more and more attention offers a way of thinking and designing to overcome these shortcomings. Comparing business process redesign with information systems design makes the strong points of both visible. We propose an integration of business process redesign in the system design process as a solution.

SETTING THE SCOPE

The introduction of information technology in organizations does not automatically lead to performance improvements. To realize the possible benefits of information technology it is necessary to redesign¹ business processes (Thurow, 1991, Davenport & Short, 1990). Redesigning business processes means that information technology should not be just another means (e.g., a replacement for forms, card-trays, calculators and the internal post system) to execute the same old business processes, but should be used as an enabler for new process designs. Hammer (1990) points at this as follows: "They (organizations, HG) leave the existing processes intact and use computers simply to speed them up". Norton (1989) indicates that this kind of application of information technology does not really enhance the performance of organizations by writing: "New world technology plus old world management equals old world results!"²

As research shows (Davenport & Short, 1990, Hammer, 1990, Fortune, 1991), the introduction of information technology led to a greater performance improvement in manufacturing companies than in offices. The cause for this difference is that manufacturing companies, unlike offices, do indeed redesign their business processes when introducing information technology. In this article we elaborate this point some more. We will discuss why this difference in performance exists and, looking at offices, what business process redesign and information systems design methodologies can yield.

While business process redesign is a quite new area, a general accepted terminology is yet missing. Therefore we introduce definitions for the concepts used in this article in table 1. Besides this, we would like to broaden the notion of offices and manufacturing companies by defining information production and material production. Products delivered by organizations can be material, like cars or airplanes, or consist of information³, like insurance or mortgages. Production of the first kind we call *material production* and production of the last kind we entitle *information production*. The information products in most cases do have some kind of physical appearance of course, but the very added value lies in the information that is the output of the primary process. Material production organizations have business processes that transform materials while information production organizations have business processes that process information.

WHY REDESIGN BUSINESS PROCESSES?

To gain benefits from investments in new technology, either information technology or any other kind of technology, the performance of the business processes should be improved. This performance gain is either a higher productivity (efficiency) or a better effectiveness of the organization (Drucker, 1974). Looking at efficiency, research (Fortune, 1991) shows that productivity in information production is at best equal to the productivity of a decade ago, while in the same period material production achieved about 30% productivity gain. Other writers (Davenport & Short, 1990, Hammer, 1990) also point at this difference, but do not give measurements.

DEFINITIONS

- **Activity:** *A solitary kind of operation, using inputs and delivering outputs. An activity proceeds with no interruption. Executing an activity adds value to the inputs (cf. Porter, 1985).*
- **Process:** *A sequence of activities, delivering a product or service⁴ to an internal or external customer. The process starts with after the occurrence of an event, for example a request for a product and ends with the delivery of the product to the customer.*
- **Business process:** *a process delivering the products to customers of the organization. A business process will in most cases be cross-functional, i.e., pass through more organization units. Business processes can be material processing as well as information processing.*
- **Information process:** *A process that processes information for management purposes. In comparison with a business process that produces information, an information process has an internal customer.*
- **Information systems:** *The means to execute information processing.*
- **Information technology:** *All information handling and processing technology used for building information systems.*
- **Business strategy:** *The strategy the business pursues (cf. Porter, 1980).*

Table 1

Considering effectiveness, the figures also indicate a difference between material production and information production. In the same interval as described in the former paragraph, material production succeeded for example in shortening the delivery times (the time elapsed between an order for a product from a customer and the final delivery of the product to the customer) while at the same time increasing flexibility making possible client-specific products. Japanese electronics and car companies provide some good examples of this. In information production effectiveness improvements have barely been achieved. It looks as if the introduction of information technology did not deliver added value to information production companies but only has led to higher costs.

For an explanation of this we take a better look at the idea of added value. Porter (1985) writes: "In competitive terms, value is the amount buyers are willing to pay for what a firm provides them.". In other words: only if customers are aware of the introduction of new technology in the organization, this new technology provides added value; for if the introduction of new technology remains unaware to the customers, they won't be willing to pay more. This implies that introducing new technology will only give added value if the business processes that deliver the products are changed in such a way that the customers can be served better, or are charged lower costs. If the business processes stay exactly the same, the customers are not able to appreciate the investments the company has made.

An example to elucidate this point: a car manufacturer is working with day batches: every day the half-products are brought to the next station. There are 5 stations, leading to a production time of 5 days. The painting station is the station with the longest batch time, thereby defining the minimum batch time: this station takes 4 hours to die all the products and 4 hours to clean. If this company buys a new painting machine that only takes 2 hours to paint and 1 hour to clean, but leaves the business processes intact, the production time stays the same, the clients will never know of the new machine, so no added value is created and the investment will not pay off. What the company should do, is redesign the production process, for example to make it possible to have half day batches, resulting in a production time of 2 and a half day. That would be an improvement that customers appreciate (they receive their custom-made car earlier) and therefore creates added value.

WHY BUSINESS PROCESSES IN INFORMATION PRODUCTION ARE NOT REDESIGNED

The fact is that material production companies do redesign their business processes when they introduce new technology, whether it is production machines or information technology. Information production companies are among the companies that invested a lot in information technology. However, in most of the cases it didn't pay off. It did bring some benefits of course. For example, it wouldn't have been possible handle the increasing amount of transactions without automation of the back office of banks, but the value added has been minimal. Financial transactions still take tenfold of the time that's really worked on a product because the business processes are still the same as in the days of paper and calculator. In those days it was not possible to execute these processes faster, but now we have new technology at our disposal that can speed things up. Also, in contrast to material production, most financial institutions until now only offer standard products that clients can choose of and are not able to deliver client specific products.

Information system design methodologies do not make a difference between information processes (processes delivering information for management purposes) and business processes that produce information. This distinction should be made because the demands for the design of these processes are different. When designing business processes that deliver information products we would like to look at these processes as production processes and talk about them in production terms. Examples of aspects of business processes that we are interested in are production time, stock levels, delivery time and work in progress. Current information system design methodologies do not take these aspects into account. The (implicit) paradigm is that the information system is supplying information for managerial decision making (cf. Blumenthal, 1969).

Looking at material production one sees a large body of knowledge that supports the design of business processes. Operations management, logistics and materials management literature are examples of this. We use information system design methodologies to design information systems in material production. In material production these information systems are literally management information systems: systems to be used to control the business processes.

However in information production we do not have methods to design information systems that are actually production systems executing business processes. We use information systems design methodologies for designing management information systems as well as for designing information processes that actually execute the production of the organization. In our view this is the main reason for the problems we face now in information production.

This leads to the conclusion that current information systems design methodologies are based on another philosophy than what's needed for business process redesign. The methodologies do have their merits for designing and building information systems, but should be supplemented. Let's explore the differences between these methodologies and business process redesign some more, to get more insight in the possibilities for improvements.

BUSINESS PROCESS REDESIGN VERSUS INFORMATION SYSTEM DESIGN

It will be clear that we are in need of methodologies that support the (re)design of business processes in information production. As we indicated before, current information system design methodologies are not suited for this. The view on business process redesign as presented here is based on different sources (Davenport & Short, 1990; Hammer, 1990; Harrington, 1991; Keen, 1991; Scott Morton, 1991; Tapscott & Caston, 1993). We have extracted the main points of business process redesign as discussed in these sources. The characteristics of information systems design stem from diverse sources too (Arthur Young & Company, 1987; DeMarco, 1979; Gane & Sarson, 1979; Martin, 1989; Olle, 1992; Orr, 1981; Yourdon, 1982). Along with these paper sources, case studies in both fields support the views. In the following paragraphs we do not make explicit references to the literature sources⁵.

Comparing business process redesign with the current information system design methodologies reveals the following differences (table 2).

	<i>information systems design</i>	<i>business process redesign</i>
1 area of interest	information processes	business processes
2 process concept	function / activity	cross functional process
3 process view	circular	linear
4 role of information system	management control	user support
5 role of designer	expert	participation

Table 2

1. Area of Interest

Building information systems and redesigning business processes involves analysis and design of different problem areas. To depict the difference we distinguish four areas of interest in which analysis is needed to design business processes and information systems. The areas are connected since a demand in one area asks for a solution in another area. The areas are depicted in figure 1, indicating the demand-support relations between the areas: demands in an area need solutions in the level(s) beneath.

The areas of interest are defined as follows (figure 1):

- **Business strategy:** the definition of an explicit strategy is necessary to be able to redesign the business processes. The strategy is the basis for making design choices. Without an explicit statement considering the strategy of the organization, design choices can not be made. An example we ran across in one of our research projects is the simultaneous execution of activities as part of the same business process. Information technology makes this simultaneity possible. It will be clear that the extra coordination needed to synchronize the activities will higher the total costs of the business process. In addition in some situations extra costs occur because of the unnecessary work that's done because the two parallel activities are always executed both, also in cases the sequential activities would stop after the execution of the first activity.

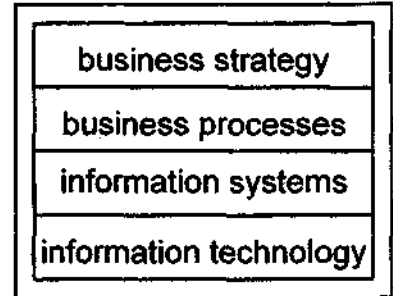


Figure 1

If the strategy is to have a short production time, every possibility to execute processes in parallel should be used to shorten the production time. If, on the other hand the company follows a low cost strategy, it could be better to execute the processes in sequence because of the lower costs.

- **Business processes:** defined in table 1. Be aware that these business processes can be material as well as information production. We are talking here about the processes bringing forth the products of the organization, the processes that add value by transforming raw materials into products and delivering the products to the customers.
- **Information systems:** the means to execute information processing. In material production these will be information systems to manage the business processes, in information production, these systems will also be the production system of the organization.
- **Information technology:** the technology used for building the information system. All technology that processes information one way or another is meant.

Business process redesign methodologies do hardly support the design of information systems but cover the upper two levels. The results of business process redesign will be (global) specifications for the information system.

Present information system design methodologies are focused on the analysis and design of information processes. Some methodologies point to the fact that business processes can be changed when introducing new information technology, but don't give tools for structured analysis and design thereof.

So we can conclude that concerning the areas of interest, the methods are complementary. Business process redesign focusses at the business processes and assumes the necessary information systems can be provided and information systems design covers this area.

2. Process Concept

Both business process redesign and information system design are looking at processes. The concept of a process in business process redesign is mostly referred to as cross-functional process. With the help of our definitions we state that a process in business process redesign is a series of activities providing a product to a customer, whereby the different activities may be executed by different organizational units. These units are in most organizations functionally organized, explaining the term cross-functional.

In information system design a quite different concept of process is used. It is oriented towards a singular information processing function, performed by a single organizational unit. Every singular function or task is analyzed and designed as if it is a complete, self-contained unit. This does indeed reflect the way of thinking that has been dominating industrial engineering since the introduction of scientific management by Taylor (Davenport and Short, 1990). However, this view completely goes by the fact that the demands on organizations and that capabilities of IT have changed drastically. Working with a scope of a single function leads to optimization of the single functions, but this does not automatically mean that the process as a whole will be optimized. Working this way leads to sub-optimization of business process performance. There was a purpose in the earlier days to work this way: coupling of tasks leads to a greater need for coordination and communication that could not be supplied then. However, the advances in information technology have brought means to facilitate communication and coordination and therefore the need to restrict analysis to singular activities or functions is diminished.

To succeed in redesigning business processes, it is absolutely necessary to have a complete overview of the business processes, from product development to financial administration, so we can conclude that current information system design methodologies are not suited for designing business processes handling information.

3. Process view

Process modelling tools of current information systems methodologies give instruments to make models of the process within the area of the study. Well-known examples of these modelling languages are flow charts and data flow diagrams. Notwithstanding the usefulness of these process models for information systems design, the models are not suited for business process redesign. This stems from the fact that the models have another view of processes than what's needed for business process redesign. Most of the models have possibilities for circular processes, arising from the need to discover similar processing.

This means that there can be activities whose output goes back into an upstream activity as depicted in figure 2 (a very simple example).

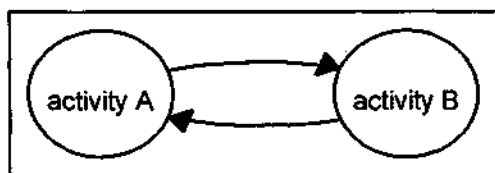


Figure 2

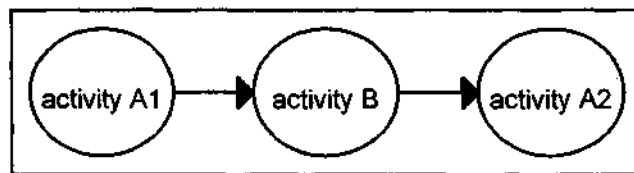


Figure 3

This view is inappropriate for business process redesign because it does not make clear how for example the total time of the process to be executed is build up of the times of the different activities and how the different activities are coupled. For business process redesign a linear view of the process is most appropriate: a view that starts with an event that takes place in the environment of the organization and ends with the completion of the handling of the event being the delivery of the product. This means that for business process redesign instead of the model depicted in figure 2 the model of figure 3 would be more useful. This model depicts the stream of activities in order, giving the necessary cross-functional process overview.

Another important shortcoming of currently used process models is that they leave out physical details like the location where an activity is executed to get a "logical" or conceptual view. Also the means used to execute the activities are important to model when redesigning business processes. Current process models do not provide solutions to these needs. Experience with models geared towards these needs (Gerrits, 1993), shows that not only the business analyst gets a better picture of the business process, but that also the employees working in the process get a better view of their process. This enhances the validity of the models and paves the way for users to get involved.

4. Role of information system

Most current information system design methodologies and as a result also most information systems, are based on the view of an information system that is used to control processes. Information processes make models of the business processes so that control can be executed. In this way, information systems are a means to obtain indirect control, as opposed to direct control, i.e., a manager that supervises processes by visual inspection. Since the industrial revolution, companies have grown too large to be controlled by visual inspection, so information systems are needed to support the management. Essentially, information systems used in this management control way, make it possible to distinguish between the place and time of occurrence of facts concerning the business processes and the place and time that the responsible managers use these facts to control the business processes. One could say that the main user of the information system was the management, and that the other users were expected to fill the system with data to get controlled.

Business process redesign leads to a revaluation of the user of the information system. No longer the management control that is needed is the leading design principle, but the user of the system. This user, in information production most of the times an expert, a knowledge worker, needs to be supported as good as possible in doing his job. That's the leading principle in business process redesign when designing the business processes and information systems. The reason will be clear: only when the workers in the business processes will perform better than before, the added value will increase and only then the investments will pay back.

Attendant effect is that more exact information is supplied for management control. Research shows that information systems that are set up to control business processes and employees are susceptible for incorrect use. Users will feed the system with information that reflects what they think their boss expects. The input into the system not necessarily has to reflect the facts in reality, because it makes no sense to supply that information when the only effect will be to have problems with the boss. On the other hand, information systems that are set up to support users, have data that does reflect reality, because the users need that data to do their own jobs. They are not putting in data for their boss, but for themselves and hence the quality of the data is better.

5 Role of designer

In information system design the designer tends to have an expert role. The designer is the person that has got the knowledge to transform the demands of the users of the information system to be, also the less structured demands, into a specification that can be used to build the needed information system. Most users can not make specifications themselves nor factually validate the specifications made by the analyst. This makes the analyst / designer having the expert role. It will be clear that the possibilities for redesigning processes are limited in that situation, because the people that have the knowledge of the business processes can not really participate in the design.

For business process redesign to be effective, this knowledge of the employees working in the business processes should be mobilized. Only then, new ways of executing the processes can be found. The best way to do this is to set up workshops consisting of employees working in the business process and covering the whole process. The role of the business process designer is to stimulate the workshop to bring up ideas concerning possible improvements and to point at new capabilities of IT that can be used. The users redesign the processes themselves and the designer just facilitates the design process.

COUPLING BUSINESS PROCESS REDESIGN AND INFORMATION SYSTEM DESIGN

We pointed at the fact that business process redesign is needed in information production to ensure beneficial application of information technology. We discussed the shortcomings of current information system design methodologies to support business process redesign, and described the merits of business process redesign and information system design. Both have their strong points and both are needed to implement redesigned business processes in information production. Therefore coupling business process redesign and information system design seems to be profitable.

Information system design is mostly started with some form of information planning. The business strategy is used to plan the information systems design projects. The business strategy as described in the information plan forms the basis for prioritizing business areas that need information systems development. Doing so, strategy is used to point at the most important, areas of the business. See for example Critical Success Factors (Rockart, 1988), Business Systems Planning (IBM, 1981) or (Olle, 1992). For business process redesign this approach has a pro and a contra. The pro is the definition of the business strategy, that absolutely is needed to execute business process redesign. The contra is that this approach does not guarantee the identification of the most important business processes because it is

functionally oriented, and business processes are mostly cross-functional. We conclude that information planning might be adjusted to come to meet the demands of business process redesign, but leave it now as a topic of further research⁶.

As information planning is most of the time followed by information systems design, there's no explicit focus on business process redesign. One could say that after the areas to be analyzed are defined in information planning the project team jumps to the information processes leaving the business processes as they are. Introducing a business process redesign phase as a front end to the information system design process, would overcome this shortcoming (depicted in figure 4).

The products of the information planning phase are (cf. Olle, 1992):

- strategy formulation
- business areas
- information technology plan
- project plan
- resources plan

These products provide valuable input to business process redesign, except the definition of business areas as we indicated before. Assuming this shortcoming is solved, step 1 and 2 of the 5-stages business process redesign approach of Davenport and Short (Davenport & Short, 1990) have been executed. Improvements in the transfer from information planning to business process redesign can be made by using the same business process modelling language in information planning as will be used in business process redesign.

After indicating that business process redesign should follow information planning, a possibility would be to extend the analysis phase of system design with business process redesign. A separate business process redesign phase seems most appropriate because of the following reasons.

- Business process redesign needs another team of participants than system analysis. For business process redesign to succeed, it is necessary to have a project team that reflects the complete business process. This means that in the project team for the redesign phase, employees of all functional areas the process crosses would be present. For information systems design this group may be split up for the design of subsystems.
- The working methods of business process redesign are different. To redesign the processes discussed, participating design in a workshop approach works best. The big difference with regular process design is that an overview of the *complete* process is available and that it is possible to get direct feedback on ideas for improvement that go beyond the borders of the individual activities. The interview approach that most information systems design methodologies propose, is not an appropriate tool for this.
- The design process is a creative one that can be frustrated by the mostly rigid methods used in information systems design. The formal structured models of information system design methodologies confront employees with

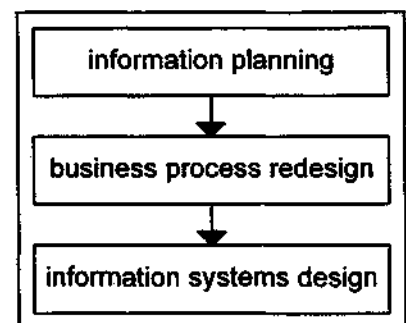


Figure 4

models they not always fathom because they don't depict the business processes but the information processes, thus disabling them to actively participate.

- The expertise needed to guide the redesign process needs other specialists like business analysts instead of technical experts.

Therefore we prefer a separate business process redesign phase, situated between information planning and information system design. In figure 5 the inputs and output of the proposed business process redesign phase are depicted. In business process redesign the business process will be analyzed in more detail. The global description of the information planning phase will be refined, to be able to validate the models of the current situation and to design new processes.

The business strategy will be translated in design criteria to be used in business process redesign. This should lead to measurable criteria regarding different aspects. Examples are financial criteria and logistical criteria, as for example the cost should be down 50 % and the production time should be less then 1 day.

Explicit attention should be paid to new capabilities of information technology. In information production, e.g., imaging and work flow management software might provide the means to implement redesigned business processes.

The outcome of business process redesign will consist of various designs. The new process and activities of course but also a new organization structure and management structure and new activity and task definitions and eventually new employee demand. The most important part for information system design is the demands for the information system. These will serve as input for system design. Depending on the specific situation, this description of the demands will more or less ease system design because a part of the analysis will already be done. The information system project will take these demands to design and build the needed information systems.

CONCLUSION

It was argued that on one hand business process redesign is needed to increase the benefits of the application of IT in information production. On the other hand, current system design methodologies are not suited to support this. An integration of business process redesign and information systems design is proposed. This integrated approach discovers all the areas that are needed to analyze: business strategy, business processes, information system and information technology. Business process redesign is positioned as a separate phase between information planning and system design. For being successful and efficient, it is absolutely necessary to adjust information planning, business process redesign and information system design to each other.

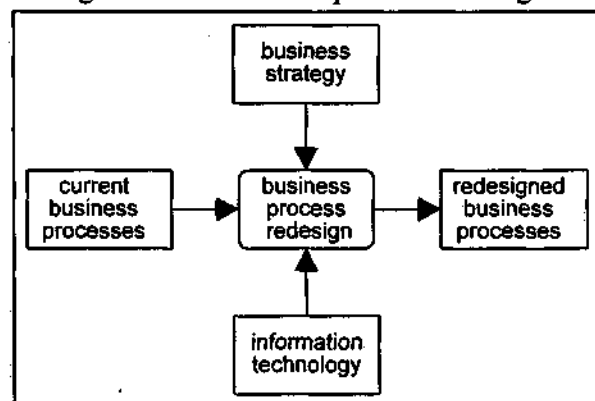


Figure 5

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¹Various writers use different terminology to denote the same concept. Examples are business process re-engineering and business process improvement. For sake of clarity we only use the term business process redesign in this article.

²Though one could argue that organizations need to learn how to utilize new technologies, and that the learning process implies simple applications of technology in the earlier phases.

³We will not make a difference between information and data in this article because that is not really needed for our discussion.

⁴In the rest of the article only the word product is used for both concepts.

⁵Because we try to give general viewpoints of business process redesign and information system design, certain statements may not be valid for specific methodologies.

⁶A detailed investigation of the goal of the definition of business areas should be one of the research objectives. Different interpretations exist, one being the definition of business areas an instrument for alignment of business strategy and information strategy, the other one perceiving this definition merely as an means to decompose the problem area.