

IS Architecture and Organisation in Concert – A Human and Business Perspective on Architectural IS Design

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Abstract

In order to achieve coherence between IS architecture and organisation, a perspective which emphasises human and business issues has been formulated and adopted in action research projects in two Swedish organisations. The main aim of this research has been to articulate a perspective and develop a method that helps organisations to design an IS architecture in concert with their business activities. This paper discusses some key features of this perspective as argumentation for the need of looking at IT in a broader sense than traditionally has been done.

1. Introduction

The ever growing use of information technology (IT) in organisations leads to an increasing co-operation between computerised information systems (IS) as well as increased dependence on IT in organisations. IT makes organisations become more effective and competitive, IT improves product quality, and new products and services are developed thanks to IT innovations. Despite these benefits, many organisations experience severe problems concerning their IS architecture. The IS architecture is becoming more complex as the amount of IS within the organisation grows. Without planning and design activities the IS architecture runs the risk of being uncontrolled and difficult to overview. IS have difficulties to interact and share data with each other. IS sometimes restrict activities that users wish to accomplish. Thus, the business is not fully supported by its IS (e.g. Veryard 1994).

IS architecture is here used to describe how several IS are related to each other and to the business units that use them (e.g. Zachman 1978). The concept should not be interpreted as synonymous of software architecture. IS architecture embraces relations and communication between several IS, but look at each IS as a black box (Andersen and Opdahl 1995).

It is not unusual that IS are developed or bought one at a time, without any main strategy for the IS architecture of the organisation. Instead, the IS architecture is evolving in an ad hoc manner, which might result in overlapping IS with bad structure that make them hard to redesign or exchange (Axelsson 1998). Some IS become information islands unable to communicate with other systems (Tapscott and Caston 1993). The IS architecture is poor due to too much integration or no integration at all.

1.1 Empirical Problems Regarding Architectural IS Design

A reason for IT investments not being profitable is found to be the lack of coherence between organisation and IS architecture (Henderson and Venkatraman 1993). To reach desirable balance, an IS architecture that ease and support business activities has to be designed. Thus, architectural IS design and business development are two strategically important activities,

that need to be handled co-ordinately. The IS architecture is of great importance for the organisation (Earl 1987, Brancheau et. al. 1996).

There are different IS strategies formulated to avoid situations where the IS architecture evolves uncontrolled. The degree of centralisation or decentralisation advocated is one way to classify such strategies (Opdahl 1996). Another commonly used distinction is to separate between data-driven approaches, such as information resource management (IRM), and business-oriented approaches (Allen and Boynton 1991).

During case studies in six organisations, adopting either a data-driven strategy or a business-oriented strategy, we found many problems caused by a misfit between chosen IS strategy and business strategies (Axelsson 1995a, 1995b, 1998, 2001). The IS strategy was often adopted without any consciously made business analysis. Instead, the IS strategy was brought into the organisation by consultants who were hired to accomplish the architectural IS design. A conclusion from the case studies was that IS strategies formulated in a generic way need adjustments to suit a particular organisation. Many organisations were, however, afraid of such adjustments since they feared that this would risk the success of the IS strategy. Thus, the IS strategies were often followed in a dogmatic and inflexible way (ibid.). The case studies resulted in empirical findings about both successful and unsuccessful ways of managing architectural IS design. Many of the studied organisations obviously had a technical perspective when designing their IS architecture. Technical issues were prioritised ahead of organisational issues, like responsibility for information or user acceptance. Retrospectively, though, organisational problems were much harder to solve than technical problems (ibid.).

As a result of these findings, a human and business perspective (HBP) on architectural IS design was formulated and tested in two organisations. The main aim of this work was to develop a perspective and a method that help organisations to design an IS architecture *in concert* with their business activities. This paper discusses some key features of HBP as argumentation for the need of looking at IT issues in a broader sense than traditionally has been done. It is important to be able to view IT decisions as integrated parts of other strategic business decisions, and it will become even more crucial as inter-organisational IS and electronic commerce is now becoming almost every organisation's concern. A poor IS architecture is bad enough today, but will be devastating for organisations in a near future. The paper aims at highlighting these issues and argues for the need to put human aspects in front of technology when designing the IS architectures for tomorrow.

1.2 Architectural IS Design – A Definition

Architectural IS design is here defined as design activities that result in an IS architecture. During architectural IS design an IS strategy may be followed. Design activities can also be supported by a method. Architectural IS design is accomplished separated from, although in constructive co-operation with, information systems development (ISD). Architectural IS design is an on-going, iterative process. Strategic IS planning (SISP) is a widely used concept for activities such as (Earl 1996):

- aligning investment in IS with business goals;
- exploiting IT for competitive advantage;
- directing efficient and effective management of IS resources;
- developing technology policies and architectures.

Architectural IS design covers these activities as well, but also embraces activities on a tactical (O'Connor 1993) IS planning level. Such activities are for example prioritising and scheduling development efforts, establishing action plans, software and hardware migration, IS personnel training, etc (ibid.).

2. IS Strategy: Supporting or Shaping the Business?

In order to avoid architectural problems many authors have argued that IS relations must be treated in a strategic way (e. g. Earl 1987). *Strategy* is a commonly used term which has been given many prefixes; IT strategy, IS strategy, IS/IT strategy, information strategy, etc. Earl (1989) makes a distinction by defining IT strategy as concerning *how* information needs should be fulfilled and IS strategy as a way to understand *which* information needs there are.

In this paper the concept *IS strategy* is defined as a perspective of IS architectures, guidelines according to that perspective and examples of an ideal architectural IS design. HBP, described here, is an example of a perspective that can be used in an IS strategy. The perspective is concretised through guidelines. Examples of an ideal architectural IS design view the perspective and are reached by following the guidelines prescribed by the IS strategy. When an IS strategy is put into practice (during architectural IS design) a certain IS architecture is designed.

Strategic alignment has been discussed in scientific journals and books for many years (e. g. Earl 1987, Henderson and Venkatraman 1993, Lederer and Sethi 1994, Simonsen 1999). Strategic alignment implies that different strategies, plans and goals in an organisation should be aligned. This is sometimes called linkage, fit or co-ordination instead of alignment (Reich and Benbasat 1996). Formulating IS strategies and plans in accordance with business strategies and plans is a vital activity in order to achieve IS that help organisations to become more efficient and competitive. Many studies have, however, showed that this is hard to accomplish successfully (ibid., Earl 1987).

Lederer and Sethi (1994) distinguish IS strategies that *align* to business strategies from IS strategies that *impact* business strategies. IT innovations such as Internet, inter-organisational IS, etc. create new opportunities for businesses to evolve and change. IS strategy then becomes an important instrument to enable and develop business activities in the future and should therefor be impacting instead of following business strategy (ibid.). Hence, IS and business strategies are given different priority and significance. Traditionally, alignment has been emphasised but several studies have during recent years shown that IS strategies and business strategies are to be treated as mutually dependent strategies. Both IS- and business strategies are changing over time and IS strategies can therefor both align to and impact on business in a longer perspective (Burn 1994, Smits and van Poel 1996). Both IS strategy and business strategy are important for the success of organisations.

This discussion views the importance of coherence between IS architecture and organisation emphasised in this paper. We argue that organisational structure is one of several phenomena that should be in coherence with the IS architecture. Other important phenomena are business goals, plans and strategies, distribution of responsibility, business activities, organisational languages, etc.

3. Research Approach

HBP has been formulated and tested in action research projects in two Swedish organisations. The author has together with participants from the organisations developed and implemented a method for architectural IS design, that builds upon HBP (Axelsson 1998). The two organisations are the Swedish Maritime Administration and the paper-mill Duni/Finess. The projects were accomplished in 1997-98. At the Swedish Maritime Administration, the hydrographic department with ca. 140 employees was involved in the project. This department is responsible for producing nautical charts of all Swedish waters. It has a highly trained and specialised staff and a complex IS architecture. Most of the work tasks are computerised and new digitalised products are developed thanks to IT innovations. The studied paper-mill belongs to the multinational Duni concern. The paper-mill had at the time of the study ca. 150 employees. The production is mainly concentrated on table products (i. e. tablecloths, napkins) and hygiene products. This is a typical process industry with many different IS supporting various steps in the manufacturing process.

HBP was formulated by an abductive approach where both own empirically findings from previous research projects and existing theories in literature were used as inputs. Through this interaction between induction and deduction (i.e. abduction) the perspective was grounded in theory as well as in practical settings. During the action research projects, the author was involved in real architectural IS design projects in the two studied organisations. The author was responsible for developing and testing a method to accomplish an architectural IS design in the organisations. Method development and testing activities were accomplished in an integrative way. To be able to achieve this, the project group had frequently meetings where the underlying HBP as well as method issues, such as procedures, notations, and concepts, were discussed and refined in an iterative way. Attached to the project group there was a reference group consisting of managers. In this group results were presented and discussed, in order to make sure that the results were intelligible and meaningful outside the project group. In the reference group, HBP was also discussed on a conceptual level.

All meetings were reported in logbooks and these notes were used as empirical data. Besides these working meetings, interviews were conducted with users, IT personnel, and managers. Document studies were yet another data source.

4. A Human and Business Perspective on Architectural IS Design

Methods not only affect the outcome of the process by their recommended actions, but also by their underlying perspective (Jayaratna 1994). Methods are never neutral. They encourage method users to focus upon certain things and to disregard other things. Method users must be aware of this perspective and agree upon it. Therefore, it is important that method developers describe made decisions and what the underlying perspective comprises. HBP was formulated together with a method for architectural IS design in two real organisational settings. In this paper the perspective is described and discussed in order to explain the underlying assumptions of the method. Empirical findings from the action research projects are used to exemplify the discussion.

4.1. Motives for a Human and Business Perspective

It is difficult, and sometimes impossible, to analyse an organisation, its problems and strengths without a structured approach to support these actions. This is a reason for claiming that architectural IS design should be conducted with a method approach. The IS architecture

should be designed from methodological and documented analyses in the same way as single IS (often) are.

If this need of structure in the architectural IS design process is neglected the IS architecture may evolve in an ad hoc manner just like single IS sometimes do. Architectural IS design is not always conducted as an explicit activity (Lederer and Salmela 1996), but rather as an informal activity integrated in the ISD and systems maintenance processes. Focus is then on finding suitable solutions to urgent problems. There is no long-term planning, priorities may often shift and therefore become obstacles in the ISD process. Architectural IS design is then an invisible activity. Its results do not become evident until problems arise due to unconsidered architectural IS design decisions. The IS architecture is not designed in advance, instead it evolves as a consequence of ISD (Axelsson 1998).

HBP do not advocate architectural IS design in this ad hoc manner. Instead, architectural IS design is considered as an activity separated from, although in constructive co-operation with, ISD. Architectural IS design decisions are guidelines for ISD. Architectural IS design demands support from methods and IS strategies. There are many methods for strategic IS planning and other activities embraced in architectural IS design (e. g. Lederer and Sethi 1994). Many of these methods have a data-driven approach; for example Business Systems Planning (Zachman 1982) and Information Engineering (Martin 1989). There are many critical reviews of these and other methods (e. g. Henderson and Venkatraman 1993; Beath and Orlikowski, 1994; Davenport, 1997; Checkland and Holwell, 1998).

These literature reviews along with our empirical findings indicate that there are many shortcomings in existing methods for architectural IS design and strategic IS planning. The critic has regarded both the content of analysis, the underlying assumptions, and the co-operation forms in the methods. Some methods are mainly focused on IT issues and miss analysis of business needs, goals, strategies, and connections to other development projects. The perspectives behind the methods are sometimes very narrow and technical. Other perspectives are not visible at all in method descriptions.

Some methods advocate a certain IS strategy (for example a data-driven strategy), which means that these methods rely on the assumption that the same IS strategy is possible to adopt in all kinds of organisations. Some methods regard architectural IS design as an activity conducted only once and therefore miss the iterative and cyclic nature of architectural IS design. Architectural IS design is often conducted by one group of actors, preferably the management. This implies that the analysis becomes narrow and only representing one perspective of the organisation. Methods' co-operation forms sometimes make it difficult (or impossible) for certain groups of actors to participate, which affects the extent and quality of analysis. This critic shows the need for an explicitly formulated perspective on architectural IS design.

HBP was formulated and tested as a solution to problems concerning lack of coherence between IS architecture and organisation. These problems were, as mentioned above, identified in case studies in six Swedish organisations that had conducted architectural IS design by adopting a data-driven or a business-oriented IS strategy (Axelsson 1998). If the general goal of architectural IS design is to reach an IS architecture that supports the organisation to conduct their business in a successful way, then the architectural IS design should take its starting point in the business and its needs. The six case studies showed, however, that organisational issues often were forgotten or neglected during the architectural IS design in favour of technical issues (ibid.).

In every organisation there is variation in opinions regarding IS, IS strategies, usefulness of the IS architecture, etc. This variation can be an advantage. The key issue is how the organisation notice, allow and practically handle this variation. It is important to create joint understanding about the IS architecture as a phenomenon and explain the opinion and contribution of each actor. Therefore, we started the process at the two organisations with seminars where all participants discussed their motives and expectations of the architectural IS design project.

A strong motive for adopting HBP is that actors should have a common point of departure for the architectural IS design, even though they have different reasons, goals, and expectations when entering the architectural IS design process. The actors represent different parts that together have to fit into the overall perspective of the organisation. Therefore, HBP is not based on a specific group of actors. Instead, the perspective is formulated to help organisations identifying different views and then co-ordinating these views into a workable entirety.

4.2. Starting with Business Analysis

When adopting a data-driven approach on architectural IS design the reality is modelled in an early phase of the design process. This is often called reality mapping (Lyytinen 1987). A data model views phenomena in the organisation and this data model is used as a basis for future ISD. This approach is commonly used but it has also been criticised as difficult and unfeasible (ibid., Goodhue et. al. 1992). This is an example of how an IS strategy impacts the order of activities in architectural IS design.

When adopting HBP on architectural IS design it is important to conduct a business analysis *before* any choice of IS strategy. A thorough understanding of the business; its activities, goals, problems, and strengths is needed in order to be able to make a well-grounded choice or formulation of strategy. The choice of IS strategy, or more correctly the choice of the organisation's future IS architecture, should be preceded by a strategy-independent business analysis. Such an analysis points out existing organisational and technical change needs that have to be addressed by an IS strategy.

At the two studied organisations the architectural IS design started with a strategy-independent business analysis. This analysis also included the existing IS architecture of the organisation. The analysis was textually and graphically documented. During this analysis the participants were also creating a joint understanding of IS architecture as a phenomena. From this analysis decisions were made about feasible architecture principles. There were many factors effecting these decisions; such as how business was conducted until then, business goals, existing IS, economical resources, investments in the existing IS architecture, security issues, etc. The architecture principles were concretised when the appropriate way of action was chosen. This choice could theoretically either be to use an existing IS strategy which supports the identified business needs, or to combine principles from two or more existing IS strategies, i.e. to formulate a business-unique strategy. In the studied organisations we formulated a business-unique strategy with inspiration from principles in some well-known strategies. After that the planning of accomplishment and strategy realisation started. A significant difference in this way of action, compared to the organisations studied in the six case studies mentioned earlier, is that the six organisations started in this last phase, without having done any strategy-independent business analysis or choice of IS strategy (Axelsson 1998).

4.3. The Importance of Organisational Languages

Every organisation has several overlapping organisational languages; i.e. concepts and phrases that are central in this specific organisation. Some parts of the organisational languages are shared within the entire organisation while other parts are only meaningful to a department or a professional group. An IS contains a formal organisational language which is constructed of a specific organisational vocabulary and rules for language actions. The origin for viewing IS as conducting language actions is found in language action theory (Winograd and Flores 1986). One motive for viewing IS in this way is to avoid a reality mapping perspective where systems and users are seen as merely objects (Lyytinen 1987).

ISD often implies that organisational languages are changed to some extension. The languages are an integrated part of the organisation and therefore these changes also concern the organisation. Thus, ISD implies business development. Since architectural IS design as well as ISD are supposed to support the organisation, it is extremely important that these changes in organisation and organisational languages are conscious and desirable. Previous research has, however, showed that changes in organisational languages and the concepts used in IS often came as negative surprises when new IS were implemented. The organisational languages became unclear, misunderstandings occurred, and users did not accept their new IS (Axelsson 2001).

Thus, HBP emphasises the importance of explaining and analysing the organisational languages during architectural IS design. This was done during the business analysis in the beginning of the architectural IS design process. This analysis revealed differing concept definitions within the organisations, lack of commonly agreed definitions of critical concepts, misinterpretations of computerised concepts, etc. The analysis was very fruitful since it helped the organisations to notice and solve these problems.

Analysing used concepts early in the design process should increase the possibility to develop an IS architecture that supports the organisation in a desirable way. This is yet another reason for not viewing architectural IS design as a technological matter only.

4.4. Participation of Affected Actors

User participation during ISD has been claimed as important for the outcome and acceptance of resulting IS for a long time (Greenbaum and Kyng 1991). User participation is equally important during architectural IS design since actions supported by IS are effected by the resulting IS architecture. There is, however, an important difference between ISD and architectural IS design. Architectural IS design creates an enterprise-wide IS architecture and, thus, managers with responsibility for strategic decisions and knowledge of goals and visions are important participators in this work. Managers are often not enough engaged in architectural IS design (Lederer and Sethi 1988), although they obviously have an important role to play. Instead, managers often delegate IS/IT issues to the IS department since they believe that they have to be technology experts to be able to make a contribution (Sannes 1996).

HBP emphasises three actor groups that are important in a successful architectural IS design process; users (analysing existing and future IS and business actions), managers (analysing goals, restrictions, systems ownership, business language rules, etc.), and systems developers (analysing technological solutions, possibilities and limitations of the IT infrastructure, systems maintenance, etc.). During the architectural IS design at the studied organisations participants from all these groups contributed. The activity level of each group differed during the phases in the design process depending on what issues were focused. Though, it

was important to make all these affected actors participating, co-operating, and sharing knowledge in order to design an IS architecture in concert with the business.

5. Conclusions

Theoretical frameworks or models that help us to understand architectural problems and point out the importance of striving for IS architecture and organisation in concert have been proposed by for example Henderson and Venkatraman (1993) and Lederer and Salmela (1996). Henderson's and Venkatraman's (1993) model consists of four domains for strategic decisions; business strategy, IS strategy, organisational structures and processes, and IT infrastructure. From the model it is possible to derive different perspectives on strategic alignment. These perspectives build upon the premise that IS strategy either aligns to or impacts on business strategy. The coherence is dynamic (ibid.). This implies that coherence between IS architecture and organisation is not a happening, but a process of continuous adaptation and change. The IS strategy can both support and shape the business strategy depending on situation. This conclusion is important for HBP on architectural IS design, since it implies that there exist no generic priority between different strategies. Instead, this should be decided in each specific situation and context.

Lederer's and Salmela's (1996) theory of strategic IS planning proposes a top-down approach where internal and external environmental issues as well as planning resources are input to the planning process and alignment is the outcome (the result) of the planning process. Lederer and Salmela, together with many other authors, describe strategic IS planning as a top management activity. This is a difference compared to HBP, where several groups of actors are involved. Lederer and Salmela (ibid.) have done an extensive review of literature concerning strategic alignment and IS architecture issues. This is an unquestionable strength with their work. The model is, however, rather rational in its illustration with no visible iterations. This is, as we see it, a lack with this model. Instead, HBP emphasises the iterative and cyclic nature of architectural IS design.

HBP was formulated in order to point out the strategic relationship between IS architecture and business actions. The business logic, consisting of business actions performed by actors with responsibility and information needs, has to be analysed before an IS architecture is designed. If this fact is neglected, architectural IS design is separated from business development and merely treated as a technical issue. This implies an increased risk of making IT decisions without business connection. Conflicts may then arise between business needs and IT possibilities. Instead, IS architecture should be in concert with organisation to reach full potential out of the architectural IS design process.

HBP is therefor built on the following key features:

- Architectural IS design is performed in a methodological, strategic and conscious way.
- Neither IS strategy, IS architecture nor organisation are taken for granted in the design process.
- Users, managers, and systems developers are affected by the IS architecture and should participate actively in the design process.
- Organisational languages should be analysed during business analysis in the beginning of the design process.

- Coherence between IS strategy and business strategy is determined by the organisational context.
- Architectural IS design results in an IS architecture and organisation in concert.

HBP has been developed and tested in two organisations but needs further exploration. HBP has to be tested in inter-organisational settings, since architectural IS design involving several organisations puts further demands on analysing human and business issues.

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