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The Conception of an Information System

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ABSTRACT

This paper presents an insight into the way in which one might approach the conception of an Information System (IS). It identifies the major elements and their inter-relationships in the formation of information systems. The elements are business functions and management functions which are influenced by internal and external forces, and application functions which are created within information systems to serve the delivery of those functions. The paper proposes a clear distinction between management functions and business functions in a target environment and their serving application functions. It explores the relationship between these elements in reducing the uncertainty of identifying a relevant problem situation and determining the requirements of an appropriate intervention that would be transformed into an information system to alleviate the problem situation. It suggests focus questions for identifying and gathering systems requirements, which will effectively serve targeted business functions in a target environment.

INTRODUCTION

Information systems lie at the heart of our ability to communicate, either effectively or poorly, in an organised way. However their conception remains a mystery which, understandably, eludes many professionals in our industry today, and even more so, their clients. In the 'information age', information systems will represent the knowledge infrastructure, an asset that will sit alongside other more traditional assets such as plant and machinery to provide the 'fuel' for efficiently and effectively operating an enterprise.

So what is an information system and what 'insight giving' properties does it possess that might assist us in conceiving it?

The purpose of this paper is to capture the authors' beliefs, values and assumptions about the nature of information systems and how to manage their conception. These core beliefs form principles which guide all considerations concerning the identification of a problem situation and the comprehensive gathering of requirements for the building of information systems.

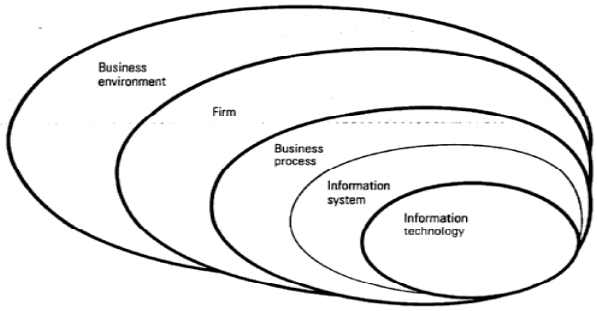
In this paper, we introduce special terms which are used to explain and give meaning to the concepts emanating from our beliefs, values and assumptions. These terms are defined in the appendix.

WHAT IS AN INFORMATION SYSTEM?

An information system is a complex phenomenon, which can be simplistically viewed as a *vessel*. This *vessel* is used to support and contain *items* in a certain structure. In real life for instance, a tangible *item* such as water can be supported and contained by a *vessel* such as a cup. In the same way, an abstract *item* such as a business function(s) can be supported and contained by a *vessel* such as an information system. A business function however, is no ordinary *item*, and an information system is no ordinary *vessel* either. Definitions (or descriptions) to exactly paint a mental picture of information systems, has so far proven difficult. Alter (1999), for example, describes information systems as "systems that use information technology to capture, transmit, store, retrieve, manipulate or display information used in one or more business processes" (p.2).

He diagrammatically represents information technology as a subset of information systems, which are within business processes held in a firm within a business environment (see Figure 1 below). The authors extend this definition by Alter to include the usage ideas of users who attribute meaning to the items of data that the information technology processes.

Figure 1: Information Technology and Information Systems in a Business Context (Source: Alter, 1999, p. 2)



In fact, Alter's definition is what the authors refer to as 'application system'. An information system is made up of both physical components (e.g. computer and communication hardware and peripherals), abstract components (e.g. software and usage ideas) and a variety of users. The physical components and their dependent software are referred to as the computer system. While the custom software built to serve a problematic situation in an enterprise, together with the computer system it runs on, is referred to as the application system. It is the usage ideas and the attribution of meaning by users to the application system's output, which brings an application system to 'life', thus according a system, the status of an information system.

The way the components are organised determines the structure (shape or form) of the *vessel*. However, deciding which way to organise the components in order to build the most suitable structure is not straightforward, and is in fact the source of the complexity inherent in information systems management.

The particular structure we decide to build in order to give the information system its characteristic shape will depend on the way in which we perceive the problem that we are trying to resolve or the need we are trying to satisfy. Neither the capabilities of the application system, nor the data it processes can be taken as given. These depend on what we perceive the problem situation to be and what interventions we choose in order to alleviate the situation. The resultant shape of each and every information system is therefore influenced by a high degree of subjectivity. This subjectivity gives rise to a number of uncertainties which must be addressed if we are to create a useful *vessel*. These uncertainties con-

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stitute the core issues of the management of information systems development, requiring a coherent framework to help make sense of the situation.

TARGET ENVIRONMENT

Complexity represented by subjectivity and variety is a hallmark of information systems management (see for example, Earl (1989); Wysocki and Young, (1990); McNurlin and Sprague, (1998); Galliers et al., (1999); Alter, (1999)). However, before we can put this complexity into perspective, we need to understand the environment in which an information system is conceived and implemented.

To appreciate the role of an information system in the wider context of supporting *items* such as business functions, we need to turn our attention to the area of interest where the *items* reside. This area of interest is what we refer to as the target environment, and is effectively an area of interest into which someone wishes to intervene. The *items* themselves are referred to as target functions, which are effectively logical groupings of a number of activities undertaken in the target environment. Target functions usually represent business functions, which are defined broadly as some thing(s) requiring attention or discussion.

In fact in every enterprise, the target functions will be synonymous with the products and services it offers its customers rather than as is usually implied, the processes and procedures used, which are actually derived from management functions.

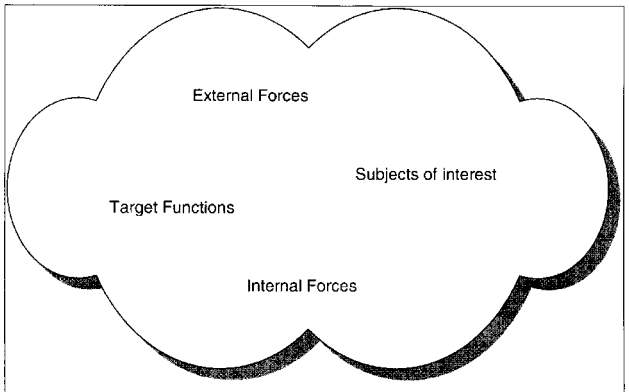

Figure 2: Target Environment

As shown in figure 2 above, the target environment will have a subject(s) of interest whose implications the management of the target functions would strive to achieve or avoid in order for the enterprise to thrive in the wider environment. Take note of the distinction made between a business function and a management function. In general, the management of a business function could change without changing the delivery of the business function itself. The subject(s) of interest will influence the type of activities and the nature of their management. For example, by changing certain management functions, a manufacturer could reduce the unit cost of production or employee work hours without changing the product, if either intention was the subject of interest. From this assertion, we can deduce that in a target environment, the purpose(s) of the management functions undertaken to accommodate perceived implications would be different for each subject of interest and therefore the suitable serving information system.

The activities comprising a business function will be undertaken through management functions to deliver the products and services that the enterprise offers its customers. In other words, the management of the activities will be aimed at achieving some goals related to the perceived implications of the subject(s) of interest. As such, a subject(s) of interest in a target environment will be the focus of attention, in a way, giving purpose to the way the target functions are managed. Changes to management functions form a rich source from which requirements could be gathered.

A target environment is continually affected by forces which exert pressure on it. In order to remain viable, the management of the business functions (ie. products and services) in the target environment have to respond to these pressures, which may be internal or external. Some common external forces are regulatory, shareholder interest, technological advancement and supply and demand, while internal forces include knowledge or the lack of it, politics and changes in strategic direction. All these forces create opportunities and threats.

An intervention in an enterprise is usually aimed at bringing about changes in management functions to improve the ability of the business functions to achieve certain goals. The changes to the management functions include:

- Modifying existing functions
- Removing existing functions
- Adding new functions and
- Organising the functions in a different way.

While business functions can be undertaken without the aid of any organised systems, their effectiveness can be greatly improved if they are supported by an appropriate information system.

In principle, an information system does not have to be computerised. However, the functions may need to be executed at a very fast pace. The volume of data associated with the business and management functions and the subject(s) of interest may be too large. What needs to be achieved may be too difficult or the coordination needs may be overly complex, and all beyond manual capabilities. Under such circumstances, a computerised information system could be of assistance. Additionally, computerisation could help improve customer perception of prestige or modernity of the enterprise such as we are witnessing with the mass embrace of the 'web' by enterprises.

FUNCTIONAL ALIGNMENT

The purposes for which business and management functions are served by information systems vary. Depending on the circumstances and purpose for undertaking the target functions, particular information systems will be more suitable than others. Determining the optimal form of an information system however, is a complicated undertaking and it is this complexity that most organisations fail to recognise when acquiring or building an information system. Unfortunately, the usual outcome is an information system which does not meet expectations, with the organisation itself having to change its mode of operation to suit the information system.

As internal and external forces influence the target environment, changes in the purpose of target functions become necessary. If these changes are not accommodated, their impact will spread in uncontrollable directions, affecting the enterprise adversely. In response to internal and external forces, the components of an information system, or more precisely, the application functions, often need to change or adapt in order to continue serving the business functions.

This means that, for the information system to be relevant over time, like a flexible *vessel*, it will need to be able to change its shape accordingly in order to accommodate this dynamism. This is done by organising the requirements of the information system into application functions, which are sufficiently flexible

to accommodate whatever future shape may be required of it to support the business functions over time.

As shown in figure 3 below, the alignment of the functions of an enterprise with its serving information system can be conceptualised as follows. Environmental forces influence the perception of actors in the enterprise, leading them to determine changes to existing or creating new products and services, and management functions. Customers consume business functions (products and services) that are delivered through business activities which are performed by actors who use processes and procedures derived from the management functions. The business activities and management functions are in turn served by application functions of the information system. The capabilities of the application functions automate, enable or support the delivery of the products and services.

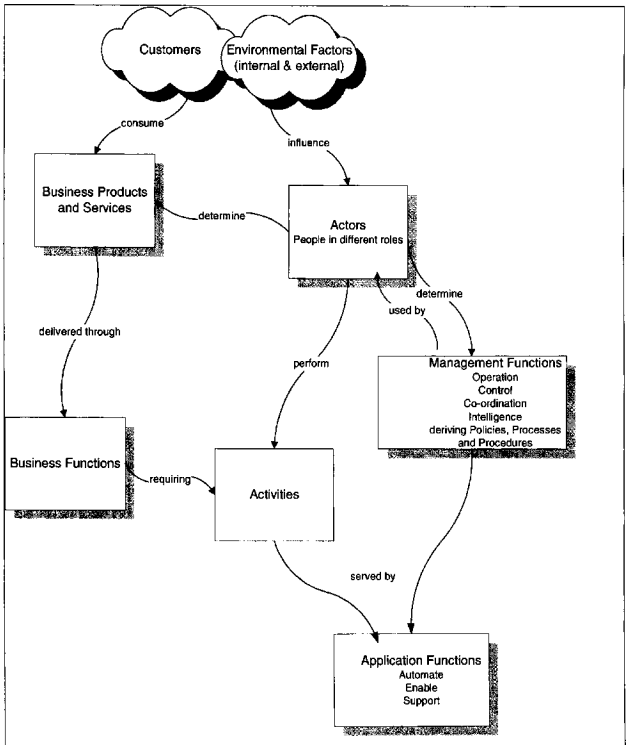

Figure 3: Alignment of Business functions with Application functions

Typically, the activities which make up a business function will have physical (manual or tangible) and mental (or conceptual) parts. While it is relatively easy to model the physical parts into abstract information system components through automation, the mental parts remain largely elusive. At best, the mental parts can be served by information systems through enabling or supporting capabilities.

The delivery of a particular business function, no matter what the subject(s) of interest, will cover activities which are concerned with managing issues of operation, control, coordination, intelligence and policy. When assessing business needs, it is crucial to identify which of these issues have been covered so that the others can be focused on and anticipated.

It is important to note that we have distinguished between business and management functions in a target environment, and application functions of the information system. This distinction is at the heart of understanding the services that an information system can offer. The business functions refer to the activities that are undertaken in the area of interest to achieve an identified need, while management functions refer to the policies, processes and procedures that are used to manage those activities.

Application functions on the other hand, refer to the capabilities that the computerised components of an information system must exhibit in order to serve the business functions in the target environment. Operational controls must be added to the application functions in order to guide and direct the usage of the information system in the target environment.

CREATING A BLUEPRINT

Identifying the requirements of an information system, which will serve a business function(s) or its associated management function(s) in a target environment effectively, presents us with a major uncertainty. The requirements will stem from a perceived problem, which inhibits the business function(s) from achieving its purpose. The perceived problem may in fact be an opportunity to do something beyond what is currently available or, as is usually the case, to do something which should be done but is currently unavailable.

The uncertainty at this stage is whether the perceived problem that is defined and pursued is in fact the relevant issue in the context of the target environment and subject(s) of interest. This uncertainty is an important source of risk that needs to be carefully deliberated and confirmed. If the problem is incorrectly defined, there will be a strong chance that the information system developed as a result of the requirements that were derived from the perceived problem, will not serve the business functions as expected.

A basis upon which this uncertainty can be deliberated is a blueprint of business and management functions in the target environment. In practice, such a blueprint forms a prerequisite to deliberating perceived problems and subsequently deriving requirements.

The blueprint is about 'making sense' of the target environment, and poses questions that help to identify:

- The activities that take place within the target environment
- The forces that influence those activities
- How the activities occur and why
- Who does what
- Where the enterprise sees itself going
- Where the enterprise would like to be (i.e. expectations) and
- What the enterprise is willing to do to get there.

As a result, the blueprint will contain contextual information about all the relevant business functions, their limitations, along with their interactions with each other in the target environment. Answers to such questions will influence what can be perceived as a problem, and as a result, the relevant requirements. In addition, the blueprint will also contain details of the interactions of the business functions with other systems in the external environment.

From this contextual information, we can then perceive problems, which in essence represent the lack of capabilities that in turn inhibit the target environment from achieving its intentions. These assertions can be confirmed by building scenarios to test out the perceived lack of capabilities either by simulation or with real life situations.

As is often the case, the existence of a blueprint is taken for granted, as if everyone who will be involved in the development of the information system knows what it is. In reality, each person in fact has a different conceptual model of the blueprint. In such a situation, the only hope is that the individual conceptual models carried by different participants will be similar enough to facilitate the necessary deliberations. In contrast, the blueprint will en-

sure the availability of a common knowledge base so as to stimulate debate regarding the options available at various decision points throughout subsequent development stages.

By the end of this stage, the foundation of the information system that will be developed will have been well and truly set. We would know the business functions and the subjects of interest and have an awareness of the internal and external forces at play within the target environment. We would also have deliberated on the implications of the subjects of interest and identified the relevant lack of capabilities of the business functions. The effectiveness of the resulting information system will largely depend on the relevance of insights and completeness of considerations related to this foundation.

CONCLUSION

Despite the mental difficulties of separating business functions from management functions and both from application functions in an information system, it is our belief that doing so provides an insightful distinction. This distinction is a crucial foundation for understanding the problem situation and considering how to organise a particular information system in order to best serve its targeted business functions.

In summary, an information system serves the purpose of supporting business and management functions in an organised way. However, this alone is not sufficient to warrant it an efficient and effective information system. It must also provide a convenient form of structure for serving the purposes of the business functions. Additionally, it must be constructed of components that will be responsive to the changes that the business activities and management functions have to undergo in response to environmental stimuli.

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Appendix

TERM	DEFINITION
Activity	The characteristic actions undertaken within a system or an environment to satisfy a certain aim or intention
Strategic Blueprint	A document that describes business functions in a target environment
Business function	A logical grouping of a number of activities undertaken in an environment to accommodate forces and subject(s) of interest in order to satisfy an identified need
Business need	Business needs can be identified from the intentions of an organisation, or at least, the business area of interest. The needs usually stem from the intentions for which activities are undertaken. Without the prior identification of intentions, all assumed interventions would be arbitrary and susceptible to not serving any needs. Business needs usually cover issues of operation, control, co-ordination, intelligence and policy
Forces	Issues that influence the selection of the activities that form a business function
Ideal model	An unconstrained view of the desired outcome of an intervention
Item	A metaphor, representing parts of or whole business functions, which need to be held together
Management function	Refers to the intentions (objectives) and how (processes and procedures) a business activity is undertaken
Purpose	The aim of a collection of activities within a business function
Requirements	Characteristics of an intervention intended to satisfy business needs and provide a desired capability. The characteristics usually cover what is defined, implied or anticipated.
Serve	A manifestation of the intentions of business needs and the purpose of business functions
Subject of interest	An expression of the essential focus within a target environment. This is usually expressed as key success factors, values and vision.
Target environment	The area of interest where an intervention is desired. This generally approximates to a part or the whole of an enterprise
Target function	A business function in a target environment
Usage idea	The uses to which an information system may be put
Vessel	A metaphor representing an information system as a container which holds business and management functions together
Computer System	The physical components of an information system
Application System	The aggregate of a computer system and custom built application software components
Information System	The usage of an application system

Table 1: Glossary of terms