Chapter 8
Coping with Complexity:
Exploring Modularity and Flexibility in IT Infrastructure Adaptation

Johan Sandberg
Umeå University, Sweden

ABSTRACT

This chapter explores issues associated with the implementation of Enterprise Resource Planning (ERP) in process industries and the inherent tension between control and flexibility in IT infrastructures. A qualitative case study of the alignment between organizational elements and the ERP system was conducted. The study illustrates the complexities involved with IT infrastructure adaptation and the extensive organizational consequences accompanying process and data standardization. The main contribution to the body of knowledge on IT infrastructure is a suggestion that fit between the inherent standardization an ERP system conveys and processes in the host organization are key aspects, hence implementation is more likely to contribute with desired effects in relation to stable and universal processes. A prerequisite for accomplishing limitation of the scope of ERP systems to these processes is a truly modular system.

INTRODUCTION

Enterprise Resource Planning (ERP) systems have been widely adopted in large organizations recently, due to their claimed ability to improve business processes through the promotion of "best practices" and standardization of key processes (Davenport, 1998). However, a company implementing ERP is faced with the options of either adjusting its processes to conform to the "ERP way" or adjusting the ERP system to support the company's specific needs (Hong and Kim, 2002). Further, it is difficult to assess in advance how an ERP transition will evolve. On the one hand, it is often assumed that ERP implementations represent radical changes (Lozinsky, 1998), so technological, business, organizational and individual changes must all be dealt with simultaneously (Bancroft *et al.,* 1998; Schneider, 1999). On the other hand, it has also been suggested that ERP packages should be implemented in phases, so that organizational members have more time to understand and assimilate the new software

DOI: 10.4018/978-1-61520-692-6.ch008

and business environment (Bancroft *et al.,* 1998). The element of IT infrastructures discussed in this chapter is an ERP-based solution and its associated modules. However, it should be recognized that this system is not an isolated artefact, but an integrated part of a larger infrastructure, and that large infrastructures cannot be changed instantly, but only piece by piece and over time (Ciborra et al., 2000; Star and Ruhleder, 1996). This is a complicating factor because when an infrastructure is subject to changes it has to be operational at all times to support the daily activities of the host organization, which severely constrains the introduction of new elements. Hence, the existing infrastructure – the installed base – has a strong influence on the scope for its future development (Grindley, 1995; Hanseth and Monteiro, 1998). Corporate IT infrastructures are thus often emergent (Truex et al 1999) since they are typically established through side-effects of, and spill-over from, the implementation of increasing numbers of installed base elements as well as their closer integration (Rönnbäck et al 2007). It has also been suggested that the complexity of information systems (IS) may increase due to ambitions to build perfect, universal solutions, which lead to systems that are more difficult to manage (Benbya and McKelvey, 2006; Hanseth et al 2006). In this context, ERP systems can be viewed as tools for control and integration, but their implementation may also raise many new issues regarding integration and unforeseen side effects (Hanseth et al., 2001). Indeed, they may provide paradoxical examples of reflexive outcomes, that is, the opposite result of what was intended, and of "technological drift" as a result of striving for increased control. While ERP systems can be viewed as tools for organizational control, they are also complex systems affecting not only technical aspects but also business processes (Ciborra et al., 2000, Hanseth et al., 2001). The introduction of complex systems has often been shown to have negative, unexpected side effects such as decreased instead of increased order and control (Hanseth et al., 2006). Limitation of these side effects is thus an important issue both in theory and practice. This defines the adaptability problem of IT infrastructure design: designers must produce architectures that can cope technically and socially with the growing needs for flexibility so that the IT infrastructure will continue to adapt and grow.

Companies in process industries often have heterogeneous requirements regarding the functionality of information technology (IT) due to industry-specific characteristics that differ from those of "typical" manufacturing organizations. This study examines the effects of an ERP system implememted in the Swedish dairy company *Norrmejerier.* The company is an economic association, jointly owned by approximately 900 farmers, which operates mainly in the northern parts of Sweden. Norrmejerier has chosen to implement a relatively small number of modules of the ERP system IFS, and to complement it with a large number of specialized applications that support the specific needs of the different business units. The implementation was prompted by a need to integrate organizationally and geographically distinct business units and their associated data. This was originally to be realized by replacing a large number of applications with a single modular ERP system. This strategy proved to be non-viable due to a lack of sufficient functionality, but the idea of integration persisted. Therefore, instead of maximizing the use of IFS modules an IT infrastructure in which the ERP system served as an integration centre for the different applications was formed – an architecture that can be described as a hybrid traditional ERP and best-of-breed (BoB) structure. IFS modules remain a substantial part of the IT structure, but not to the extent that was originally planned.

Modularity has been recognized as a useful feature for both product and organization design (see, for instance, Langlois, 2002; Sanchez and Mahoney, 1996; Sturgeon, 2002; Ulrich and Eppinger, 2003). In modular innovation networks, the product-lead firm serves as a system integrator,