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Which standards' characteristics increase system flexibility? Comparing ICT and batch processing infrastructures

Tineke M. Egyedi*, Zofia Verwater-Lukszo

Faculty of Technology, Policy and Management, ICT Department, Delft University of Technology, Jaffalaan 5, P.O. Box 5015, 2600 GA Delft, The Netherlands

Abstract

Most large information and communication technology (ICT) systems develop in a piecemeal fashion. Their complexity and evolution is difficult to manage. They lack flexibility. This contrasts sharply with system design in the batch-wise processing industry, where flexibility has always had a high priority. In this industry, the S88 standard plays an important flexibility-enhancing role.

This paper compares the two fields of technology and explores which standards' characteristics increase system flexibility. It examines whether flexibility objectives in both fields differ and what constitutes a 'flexible standard'.

Four standards' characteristics turn out to be important: degree of specificity, level of abstraction, system level, and degree of simplicity. These characteristics seem to be necessary for flexible systems, but whether they are sufficient cannot yet be said.

Keywords: Standard; Flexibility; LTSs; Information technology; Batch processing; S88; OSI; Internet

1. Introduction

Large infrastructure systems operate in dynamic environments. They must remain responsive to changing needs and demands, which require active maintenance and sometimes more radical system change. However, the maintenance of such large systems, let alone their evolution, poses many problems. The information and communication

* Corresponding author. Tel.: +31 15 278 6344; fax: +31 15 278 3741.
E-mail address: t.m.egyedi@tbm.tudelft.nl (T.M. Egyedi).

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technology (ICT) system of a large Dutch government agency illustrates this point [1]. The agency consists of several quasi-autonomous larger and smaller organisational units. Its ICT infrastructure has evolved in a piece-meal fashion. Bit-by-bit, stand-alone, local provisions have been coupled and integrated with networked functionalities. Of the 350 software systems, 150 are generic and used throughout the organisation (e.g. word processors). Two hundred software systems serve a specific, special purpose and are only used by certain people. With respect to system maintenance, the people involved identify a number of problems. In particular:

- the short life-cycle of IT products. IT products have a relatively short life-cycle. The average time for a software upgrade is about three years. This amount of time almost matches the time needed to roll out IT products in such a large government organisation (i.e. from idea to working implementation). As a result, there is a continuous pressure to upgrade the IT infrastructure.
- different local needs. Different IT configurations at the local level make it difficult to rollout IT products organisation-wide. To succeed, local adaptations are made, which further increases the differences between local configurations.
- unsustainable software design. Too little attention is paid to sustainable software design, e.g. software developed in a certain programming environment does not automatically run in another (user) environment.
- unexpected interaction between software. New applications sometimes affect existing ones in unexpected ways[1].
- provider dependence. The organisation is sometimes locked into (closed source) software, such as the off-the-shelf software of a monopolist or the tailor-made software of a smaller provider. Also, in the latter case system maintenance can become very dear.

The case illustrates that where information systems are updated, frequently, the resulting system grows increasingly complex, as does the maintenance process itself [2]. The complexity and further development of the ICT infrastructure become difficult to manage. The ICT system lacks the necessary flexibility, by which we mean the ease with which a system can adjust to changing circumstances and demands [3].[2] The system entails openness to change.

Lack of flexibility is also evident in other fields of technology, in particular where large technical systems (LTSs) are concerned. LTS is a term used in Thomas Hughes' system theory [4]. It tries to capture the complexity of the countless number of interrelated components and subsystems. The term comprises technical as well as socio-technical artefacts (e.g. institutional and regulatory provisions for artefact use and production). It includes, for example, the organizations, companies and institutions that develop around

[1] For example, unintended changes can occur when adding an application that shares the ODBC component in Windows.

[2] The term 'flexibility' is defined in management literature in terms of 'the ability of a resource to be used for more than one end product [2]'. Because we take systems rather than end products as our research unit, we prefer a broader definition.