Methods MIMSI 37

Integrating Health Information Systems: A Critical Appraisal

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Summary

Objectives: The aim of this paper is to critically assess some of the underlying assumptions behind these initiatives and analyze the dominant expressions, forms and mechanisms of integration.
Methods: This paper employs a discourse analysis to elicit the notion of integration of information systems and its consequences for electronic patient record systems.
Results and Conclusions: An alternative strategy is outlined, encouraging a more decentralized, multi-vocal approach acknowledging the productive role of related and duplicated information and preserving the existing variety of information systems.

Keywords

Health information systems, integration, electronic patient records systems, business process re-engineering (BPR)

1. Introduction

There is literally a jungle of information systems supporting health care providers today. This abundance of different information systems is the mirror image of the enormous variation in health care work along several dimensions: level (hierarchically organized spanning from primary health care to large hospitals), geography (municipalities, counties, districts, nations and regions), professional groups (nurses, secretaries, physicians and physiotherapists to mention a few), agencies (patients, health providers, public health authorities and insurance companies) and specialization (for instance, cardiology, neurology, radiology and immunology together with service functions such as laboratories). Given this large number of partly overlapping, complementary and interdependent information systems, it is hardly surprising that considerable efforts have been poured into a tighter integration of these [1, 2]. Indeed, the integration of health information systems is currently something of a truism, a taken for granted ambition. As pointed out almost ten years ago:

> "The necessity for integration of systems and communication of information in [the health care] sector becomes evident when studying the variety of interested parties, the multitude of applications and their importance" [3, p. 1].

This paper aims at examining the background and motivation for tighter integration. The field of science and technology studies contains numerous accounts of how taken for granted "facts" should be recognized as constructed rather than given; a "fact" is a quality of a statement produced through involved strategies and alliances [4, 5]. Not to be mistaken for an argument against integration as such, the aim of this paper is more specifically to critically discuss the different mechanisms and manifestations of integration. Based on this, the paper outlines constructive principles for integrated health information systems.

The pressure for and tendency towards tighter integration of information systems within and across organizations is not particular to the domain of health care. It is part of a much broader trend in public and business organizations and need to be analyzed accordingly. The empirical illustrations in this paper are thus drawn both from business organizations (especially so-called Enterprise Resource Planning systems such as SAP R/3 and Baan) and health care (focusing on electronic patients records systems; for a more detailed account consult [6, 7]).

Section 2 contains an attempt to unravel important assumptions underlying the ambition of integration in health care. This involves pointing out the affinity with the rise of 'process-orientation' in business organizations. It also includes comparing integration with the basic, human activity of maintaining order, an exercise that gains its attraction from applying a socially constructed notion of the fundamental categories of purity and dirt [8]. Section 3 outlines the variety of expressions of integration, focusing especially on the differences in the level of autonomy among the modules and information systems. Again, the affinity

with the situation in business organizations is illuminating. In the concluding section 4, an alternative that advocates a more decentralized approach is outlined.

2. Why Integration?

The key reason for the pressure towards tighter integration of information systems is the more general transformation in business organizations to streamline, interconnect and compress their value chain or their business processes [9-11]. The essence of the idea may be depicted as follows:

Poorly co-ordinated and largely independent work processes are integrated in an effort to remove redundant operations, sort out ambiguity and cut back on secondary, administrative overhead. As the information systems were also initially poorly co-ordinated, it follows from this transformation that they also need to be more tightly integrated.

The sharpest expression of this mode of business logic is found in the Business Process Reengineering (BPR) movement of the mid 90s (Hammer, 1996). In a nutshell, this is a transformation from a (largely) individual, sequential ordering of the work tasks to a (more) collective, shared mode of working.

When Hammer initially launched and outlined the basic ideas of BPR, he strongly emphasized the importance of making radical rather than small-step changes. In response to the rapidly growing resistance against this appeal to radical changes, he later altered his rhetorical strategy now emphasizing the 'process' orientation:

"Originally, I felt that the most important word in the definition was 'radical'. The clean sheet of paper, the breaking of assumptions, the throw-it-all-out-and-start-again flavor of reengineering – this was what I felt distinguished it from other business improvement programs. This also turned out to be the aspect of reengineering that captured and excited the imagination of managers around the world. I have now come to realize that I was wrong, that the radical character of reengineering, however important and

exciting, is not its most significant aspect. The key word in the definition of reengineering is 'process': a complete end-to-end set of activities that together create value for a customer" [10, p. xii].

This immediately carries over to the health care sector:

"Far more challenging is the implementation of new clinical and administrative processes throughout the organization. The most progressive [integrated delivery networks] have begun to develop new enterprise-wide processes for providing easy and uniform access to health services, for deploying consistent clinical guidelines, and for coordinating and managing patient care across multiple care settings … Integrated information technologies are essential for supporting such enterprise-wide processes ... [and they] have to mesh smoothly with operational workflow and human organizational systems" [2, p. 367].

Similarly, in a recent discussion of the prospects of tighter integration of health information systems, [12, p. 49] points out that:

"[S]hared care depends critically on the ability to share information easily between care providers. Indeed it is the present inability to share information across systems and between care organizations automatically, that represents one of the major impediments to progress toward shared care and cost containment … Strategically there is a need to take a more business process view of health care delivery and to

identify structures to support these processes."

The backbone of the future, tightly integrated IS is expected to be the electronic patient record (EPR) systems. EPRs have repeatedly been identified as "essential" [13] or "at the heart of the application of IT in health care" [12, p. 50]. It has, however, proved remarkably difficult to achieve "seamless" integration and to establish more than fairly isolated pockets of use [14, 15].

The ambition and aspiration of enhancing health service efficiency through tighter integration and with EPRs at the heart was quite clear in the formation of the early stages of the EPR introduction in Norway (consult [6]). In the underlying policy documents worked out by the highly influential research council in the late 80s, these effects are crudely estimated to:

"save 10% nurses' time, 10% of the physicians' time and 20% of the secretaries' time ... then the hospital will save about 4,2% of the total labor costs"

In accordance with this, the early initiatives for EPRs aimed at full integration:

"Create a common platform for a multitude of customized EPRs; Powerful enough to support all health-related information and legal aspects; General enough to serve as a basis for a wide variety of hospital information systems."

A less explicit, yet influential, reason for integration is the way this reproduces the deep-seated need for maintaining order. A
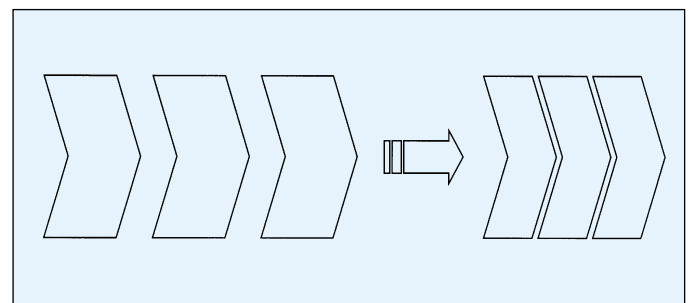

Fig. 1
The idea of streamlining the business process to remove slack and overhead

large collection of poorly integrated information systems appears as "untidy", spawning efforts of re-establishing order. Drawing on Douglas' [8] account of the socially constructed nature of our perception of purity and dirt, the thrust behind the efforts to re-establish purity is by evoking the dangers of dirt [8, pp. 35–36]:

"Where there is dirt there is a system. Dirt is a by-product of a systematic ordering and classification of matter, in so far as ordering involves rejecting inappropriate elements… In short, our pollution behavior is the reaction which condemns any object or idea likely to confuse or contradict cherished classifications."

Maintaining order then translates into the ongoing effort to keep it pure, that is, tidy or clean, by preserving the given categories and avoiding the transgression fragmentation it would produce. All you have to do is to construct your opponent as "dirty" because [8, p. 113]:

"a polluting person is always in the wrong … [and] unleashes danger for someone."

Hence, any attack on the sacred will evoke strong reactions to defend it. To illustrate, in the requirements specification worked out in 1996 by the vendor of the EPRs in collaboration with the five largest hospitals, the danger of "pollution" due to special purpose information systems is recognized. This produces 'dirt' – an undesirable state of affairs of fragmentation – as:

"There is a tendency that the specialist functions create their own information system to store and systematize data. These systems are only to a limited degree integrated or available in a uniform interface in Norwegian hospitals today."

This accordingly leads up to formulating a main goal of the EPR project in Norway, namely full integration as a way to do away the 'pollution':

"to give access to, and produce the documentation that exist in the paper-based patient record today. The EPR should replace many of the special purpose information systems that exist in the wards."

3. Integration in Action

The notion of "integration" of information system is ambiguous in the sense that different approaches and proposed solutions exist. In an effort to span this variety, [16, pp. 36-37] outlines three key dimensions:

1) Distribution: hiding the geographical distribution, for instance through an object-oriented extension of remote procedure calls like Object Management Group's CORBA architecture
2) Heterogeneity: hiding differences in platforms, programming languages and data models – as well as differences in perspective
3) Autonomy: the extent to which the components are self-sufficient or are delegated a role only as components in a larger hierarchy

The dimension of autonomy is possibly the most differentiating aspect of integration. In principle, it is perfectly conceivable to integrate largely independent components by carefully specifying the interfaces but leaving out the internal implementation details [2]. In practice, however, there is a strong bias towards more central, monolithical and hierarchical solutions [7, 17, 18].

Again, the more general case of integration of information systems in business organizations illustrates the situation. Ever since the 70s, business organizations have struggled with the fragmentation of their collection of information systems [18]. Despite prolonged efforts, it is fair to hold that "integration has been the Holy Grail of MIS since the early days of computers in organizations" [19, p. 23].

No wonder, then, that the recent interest into Enterprise Resource Planning (ERP) systems – promising the integration of business functions like orders, sales, logistics, in-

ventory, accounting and personnel – hinges on exactly the same aspirations. As [17, p. 123] argues, we

"need to understand the problem [ERP systems] are designed to solve: the fragmentation of information in large business organizations".

Hence, ERP systems are perceived as a contribution towards a more process-oriented organization [11] and are compellingly attractive as "the promise of an off-the-shelf solution to the problem of business integration is enticing" [17, p. 121].

SAP R/3, the dominant vendor of ERP systems and the world's fourth largest software company, advocates their system as a way to streamline the 'process' orientation as illustrated above in Figure 1:

"SAP R/3 overcomes the limitations of traditional hierarchical and function-oriented structures like no other software. [All the functions] are integrated into a workflow of business events and processes across departments and functional areas" (see URL: http://www.sap.com).

[8] accounts for how our perceptions of purity – and hence tidy, integrated information systems – draw upon strong and deep-seated sentiments of human nature. [20] gives a less elaborate but equally fundamental account when he points out how centralized solutions tie in with (managerial) needs for control as a key strategy to cope with anxiety and risk.

The ambiguity arising from the differences in autonomy in the integration is very clear in the discussion around the introduction of electronic patient records (EPR) systems in the five largest hospitals in Norway. There has never been any disagreement over the ambition to "integrate" the different information systems modules in the hospitals, but there is an ongoing tension around the level of autonomy that should be granted to the different components.

Currently, there are a number of already existing, deeply entrenched types of systems, the most important ones being pa-

tient administrative systems (PAS), systems for laboratory tests and possibly picture archiving systems (PACS) in addition to a wide variety of more locally developed specialists systems that need to be integrated with the EPR system. The issue, then, is the extent of these systems' autonomy.

A particularly vivid expression of this is the unsettled debate around the relative autonomy of the PAS. Dressed up in debates about whether PAS or EPR should be the so-called reference system, the issue is exactly about the autonomy of the PAS module [7]. Over time, the autonomy of the non-EPR modules is eroding as the EPR vendor is also developing modules for PAS. The danger of a lock-in situation with one completely dominant vendor is readily recognized by the hospitals. As one of the hospitals' project leaders admitted:
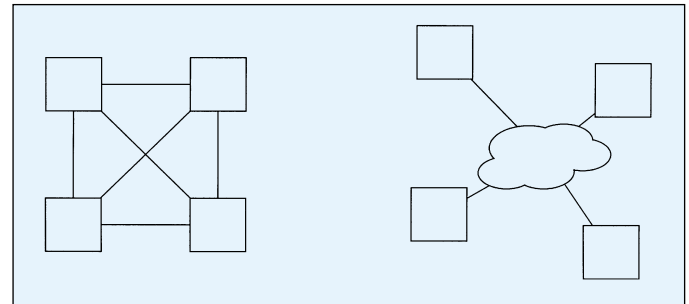
> "We recognize that our strategy is short-sighted, but the alternatives would strain our budgets too much."

The danger for the hospitals is that the rising development costs for the EPR filters away competition basically leaving one, dominant vendor who accordingly is delegated extensive flexibility which is exercised in pressuring the vendors of the other modules. It remains to be seen whether the vendor succeeds in its – remarkably outspoken – strategy of product differentiation to provide all the major modules for an integrated health information system.

An approach, particularly strong in the health care sector, to the second of the dimensions of integration listed above (heterogeneity) is based on "solving" the problem through purifications, that is, modeling and abstractions [21]. To illustrate this mode of thinking [15, p. 16], explains that it implies:

> "establishing a canonical electronic medical record structure with supporting data abstraction processes to provide consistent views of medical information independent of underlying database structures (...) [which allows] a common API for heterogeneous datasources".

This emphasis on the role of the conceptual model with associated interfaces has also been heavily advocated by the European standardization organization, CEN TC 251 [22].

An impetus for this thinking comes from the logic of network economics, namely how to scale. The argument is compellingly simple: as the number of translations grow exponentially with the number of components, the only strategy is to work out a kind of "Esperanto" (that is, a standard) (see Figure 2). The challenge, of course, is to curb the complexity inherent in the generalized solution [21].

4. Conclusion: Alternative Strategies

I have tried to demonstrate how the general consensus on the "obvious" benefits of tight integration of information systems is in parts founded on unwarranted purifications and assumptions. Studying the use of partly overlapping, partly integrated and partly independent information systems (see for instance [7]), emphasize a number of productive roles for non-integration. For instance, the fact that PAS and the EPR systems are not tightly integrated allows the coding of diagnoses to be phrased in two versions: one geared towards clinical practice (EPR) and the other towards the reimbursement schemes (PAS) that Norwegian hospitals are subject to. Had the coding been perfectly unambiguous to facilitate tight integration of PAS and EPR, this would have spawned substantial addi-

tional work to maintain the two roles played by coding.

In addition, when deciding to integrate, the traditional bias towards centralized solutions with little autonomy for the other components needs to be curbed. A more decentralized approach to integration is more likely to encourage robust, independent components that communicate through well-defined interfaces. The current status in Norway illustrates the dangers of and tendency towards a lock-in situation akin to the 70s with IBM as a dominant player. A sounder and more evolutionary alternative would be to cultivate the existing large classes of information systems – PAS, laboratory systems, EPR and potentially also PACS – and integrating these with extensive autonomy and independent vendors [23]. Without resorting to a technical fix, the versatile tools for modularization and encapsulation such as XML and CORBA supports such an approach, if only the strategic importance of preserving multi-vocality is recognized.

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