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THE UTILITY OF QUALITATIVE MODELING IN ARCHITECTURAL EVALUATION

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Abstract

The continuous change that organisations have to deal with today calls for a radical shift of thinking from striving towards stability, to accommodating continual change. Under these conditions, organisations always find that they have to integrate diverse and complex applications across the whole enterprise. This mandates a move away from applications-level view, and towards true architectural thinking that thoroughly researches the context, and the architectural features of the integrated whole. This paper discusses these issues and points out to the utility of qualitative modelling in supporting the systems architecting process.

Keywords: Systems architecting; enterprise application integration, qualitative methods, grounded theory

Introduction

Our research is concerned that much of the current literature on Enterprise Application Integration focuses on integration from a predominantly technological perspective (see Themistocleous and Irani 2001), with little attention to the strategic impact of such systems on the enterprise, or the process of deciding on integration in a way that lends flexibility to the end product. Application integration decisions can seriously damage the agility of the enterprise's information systems infrastructure that has to adapt to changing conditions. This research proposes a shift from focusing on applications and technologies towards more global views, which focus on the emergent architectural qualities of the artefact as a whole. We propose that an explicit "architecting" step that incorporates reasoning about the enterprise's application portfolio to respond to change is vital. This paper reports on concepts that drive our current thinking in the area of using architectural notions for the development of integrated enterprise applications. The paper starts by establishing the relevance of architectural concepts to Enterprise Application Integration (EAI), the paper then spells out the authors' notion of what architecture should be and the benefits of adopting an architectural approach to EAI. The paper then outlines the authors' angle of attack on the problematic of employing architectural thinking in EAI.

New Imperatives in Information Systems Development

Today, change is acknowledged to affect the overwhelming majority of organisations, forcing them to change their aims from supporting stability to supporting emergence (Truex, et al. 1999). The word emergent is used by Truex et al. (1999) to stress the state of being in "continual process, never arriving, but always in transition". The implication they draw is that the traditional goals and assumptions of traditional information systems development are no longer appropriate or valid. For example, one should not assume that user satisfaction is achievable (this echoes our earlier positions, e.g. the fixed-point theorem of Paul 1993). In summary, the fixed-point theorem assumes that there is a point in time when all stakeholders' views on an information system converge, giving rise to mutual understanding, and hence satisfaction with a particular type of system. This is simply false by the evidence of countless observations of the reality of information systems today. Truex et al. (1999) also dispute the traditional ISD notions of the necessity of lengthy, formal analysis of requirements, leading to complete, abstract specification. Instead, we should acknowledge that user satisfaction is improbable, that requirements are continually negotiated and re-negotiated, that IS development should be viewed as continuous, rather than consisting of a series of one-off ISD projects; and that IS efforts should be primarily oriented towards adaptation and maintenance.

The effect of this view on the economics of the life cycle is that the life cycle cost curve changes considerably. The shift is from a curve characterised by high early and late cost gradients (due to considerably greater cost of initial analysis and design, and the later costs of scrapping the system and replacing it by a new one), to one that still has high costs (but much less steep), but at the beginning only.

Two Additional Ingredients

This research wholeheartedly agrees with the view put forward by Truex et al. (1999) summarised above. However, there are still vital ingredients needed. The first is the question of against what criteria should new adaptations be evaluated? Whilst it is true that continuous development is a necessity, and surely a number of ways in which they put forward will help the transition in ISD goals, there is still a need for imposing some kind of discipline over the continually evolving informational artefact. This is simply because the emergent properties of the evolving artefact might not be conducive to the agility of the organisation in the long run.

For example, in Enterprise Application Integration (EAI), it is not possible to integrate applications successfully across the enterprise as a whole if only a worm's eye view of the implications of such integration on other parts of the organisation, and indeed its wider context, is maintained. In fact, we need to continuously assess adaptations proposals, both *ex ante* and *ex post* to decide on whether to proceed or not, in which direction to proceed, and to learn from the experience. This position resonates strongly with Gilb's evolutionary model (Gilb 1988), where a flexible, open architecture is devised early and then later modified on the basis of experimentation with deployed increments of the system. This makes the integration process much more flexible in the face of changing organisational circumstances. This research points out here to the critical importance of a sound increment evaluation activity.

The second necessary ingredient is that although change is endemic, it is not the case that it happens at equal rates, equal speeds or equal scales for all the elements in a system. We begin by illustrating the second ingredient, that is, of differentiating the components of an enterprise system by their relative stability.

The Architectonic View of Systems

In a book about buildings that adapt over time, Brand (1994) refers to the layers of change in buildings. Brand identifies six layers in a building that change at different rates. From the slowest to the fastest these are: Site, Structure, Skin, Services, Space Plan, and Stuff (meaning things like furniture, decorations, light fixtures and appliances). Figure 1 below illustrates this view.

The view presented in Figure 1 is fundamentally normative, i.e. it is based on a study of the types of changes that typically affect buildings, after construction and delivery to clients, as a result of adaptations by their users. Buildings that accommodate change gracefully, are the ones that please their users most and remain useful for longer. Adaptable buildings accommodate unforeseen uses and circumstances because the layers that make them up are loosely-coupled. These layers *slip past* each other: changes to one layer do not necessitate changes to others. Note here that the low coupling is not at the level of individual bricks and other individual constructional elements: rather, the de-coupling referred to is at the level of categories, collections or layers, of such elements. The constructional elements are categorised according to the degree of susceptibility to, or speed of, change that they share.

Our use of the term architectonic is based on a view congenial with Brand's: that is of the architectural theorist and critic Kenneth Frampton. Frampton (1995) uses the term "Architectonic attributes" to refer to the *light* versus *heavy* characteristics of constructional elements. He uses vernacular examples, such as the Greek temple, to show how the architectonic attributes of various construction technologies have been used to retain traditional symbolic values that are germane to certain cultures. In other words, the architectonic nature of the artefacts that he is interested in (buildings and urban layouts) is a fundamental reflection of the culture.

The above analyses spell out the fundamental relevance of both context and culture in determining the layered model of artefact (as in figure 1 above) and in the fundamental architectonic profile that they exhibit. This leads us to argue for the foundational importance of a comprehensive analysis of the organisational culture (which we can also regard as the problem domain model) in any properly conducted systems architecting activity.

The Architecting Problematic

We can now pose the problematic of the process of systems architecting using two terms. The first relates to operationalising the proposal, juxtaposition and evaluation, reflection and modification cycles. This corresponds to Schön's (1983) model of reflective practice, characterised by cycles of reflection and solution modification. The key issue here being how to investigate the context, and then represent and elaborate it in a way that can be used in evaluating the solution, and effecting the evaluation in a disciplined way that increases the fidelity of the solution architecting process. The second term relates to conducting the above cycle in a way that illuminates the process of establishing the architectonic nature of the problem domain, so it can be mapped onto the informational artefact, as faithfully as the situation allows. The assumption here is that if we succeed in this, then it is possible to design systems with parts that change harmoniously with the way the original problem domain changes. In this way, we can achieve a greater degree of *continuity* between changes in requirements and the technical solution itself (Meyer 1988).

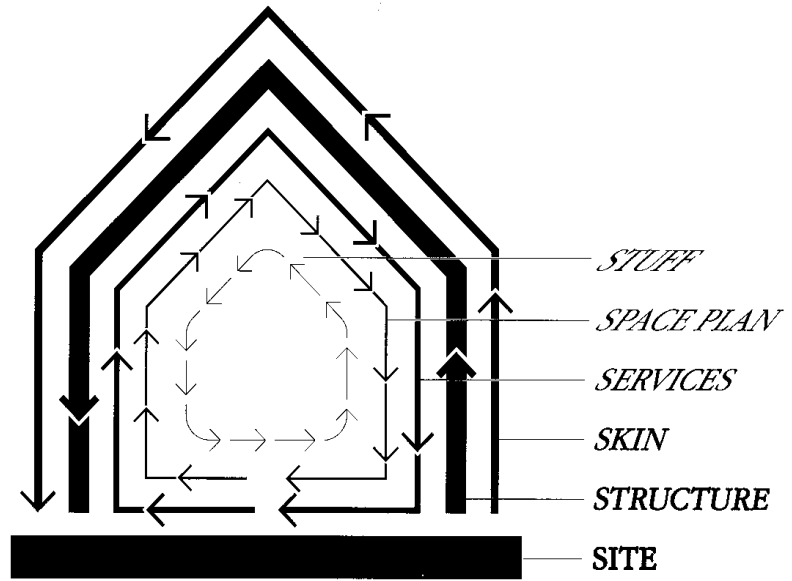


Figure 1. Shearing Layers of Change (Courtesy of Phoenix Illustrated

In this way, we can achieve a greater degree of *continuity* between changes in requirements and the technical solution itself (Meyer 1988).

To characterise the context, we need to adopt a highly systematic and rigorous approach to establishing the relevant conceptual primitives that constitute the building blocks in characterising the context. This result will also be highly useful in constructing evaluation frameworks against which putative architectures and their resilience vis-à-vis the context may be assessed.

A Research Direction

Our proposal to deal with the above problematic is to put emphasis on the architectural evaluation to support the architecting of adaptable, enterprise-wide systems. This research suggests qualitative research methods as the fundamental operationalisation mechanisms for evaluation during system architecting. We have given elsewhere the details of how this might be carried out in (Galal, et al. 2000). The prime contribution of qualitative research in this area is that it enables the development a model of the context of the informational artefact. Against this context, one can juxtapose putative architectural proposals in general, or specific application integration proposals. This is both to assess the potential of a new proposal, and to assess the merit of an already existing deployment, in a way that informs the next architecting move.

A domain model gives a representation of the context against which system architectural proposals can be evaluated, for example using system-wide scenarios (Galal and Paul 1999). Figure 2 below shows one such representation for an e-commerce system.

Research Issues

One research issue that confronts us here is that the development of a domain model like the one we give above using Grounded Theory is very time consuming. In fact, it smacks of complete, comprehensive analysis before we start anything. Our comment is that this analysis relates to the generic task context of the organisation, and not the requirements of any specific application. As such, it is likely to remain useful, and valid, beyond any single application integration activity.

The other issue is how to reflect application integration proposals in terms that are compatible with the qualitative model above. One guess is that it might be possible to characterise each application in terms of its user-functionality, and in terms of its technical requirements (interfaces, infrastructure etc.) from the rest of the applications in the organisation.

Conclusion

This paper has outlined our position as regards the enterprise-wide integration of information systems; arguing that an architectural view point is critical to integration activities that aim at supporting a dynamic organisation. Such architectural thinking mandates paying close attention to characterising the context of the informational artefact (read enterprise-wide systems), and to the ways in which putative applications are evaluated against an emergent architecture. We explained that our current research direction involves using a proven method from the social sciences (Grounded Theory) to conduct rigorous contextual-qualitative analyses to support the systems architecting process.

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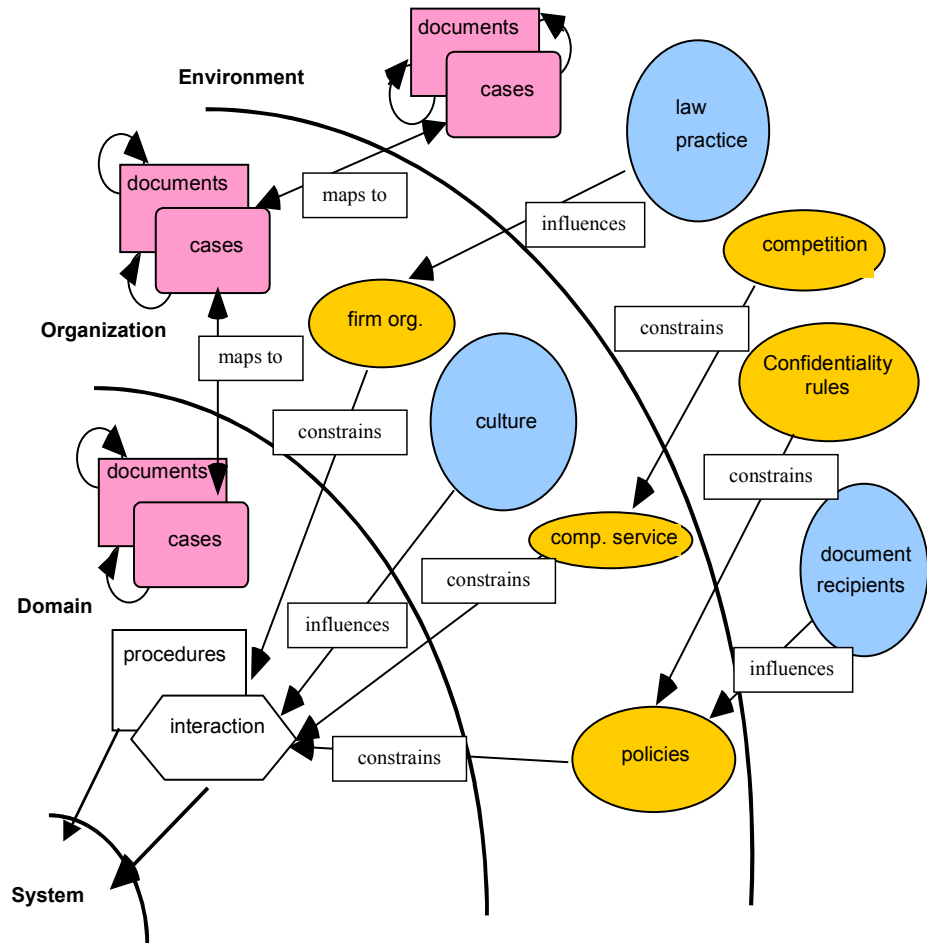


Figure 2. A Domain Model for an E-commerce System than Can Be Developed Using Grounded Theory Procedures