

# SOFTWARE ENGINEERING SYSTEMS AS SERVICES USING A BUSINESS-FOCUSED SERVICE FRAMEWORK

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**Abstract:** Investment in IT and software systems frequently fails to meet the expectations of the business customer. This has a consequentially negative impact on business performance and reduces the perception within the business of the value provided by systems suppliers. This has been a persistently stubborn problem for more than forty years even after decades of ‘product’ development. This position paper argues that for the likelihood of a successful business outcome to be increased we must first redefine our understanding of the ‘service’ concept and then apply it more widely, including and embracing the software engineering aspects. This will improve concepts such as software systems engineering, IT service management, service performance, change management, alignment, governance and maturity.

## 1 THE PROBLEM

Over a forty-year period there have been many surveys at frequent intervals by different organisations designed to understand the success rates of projects that deliver software or, more generally, IT systems. The most recent of these was the Standish 2009 Chaos Report (Standish, 2009). The consistency of their outputs make it clear that there has been little improvement in the likelihood of a successful business outcome from an investment in IT and software systems from the time such surveys were first conducted, i.e. from about 1970 – when “software engineering” was in its infancy.

The many survey results show that success rates have remained stubbornly low at around 30–35% throughout the period. This is despite the fact that during this time there has been a massive investment in frameworks, standards, methodologies, techniques, development tools, QA tools, etc. aimed at helping with requirements gathering, specification, design, programming, integration, programme and project management, operational IT management, security, regulation (legal compliance), and so on. Clearly, as Boehm (2003) has observed, software engineering has been “value-neutral”, which is not appropriate outside the research laboratory.

According to Boehm, “Major studies such as the

Standish Group’s CHAOS report ... find that most software project failures are caused by value-oriented shortfalls” (Boehm, 2003). So, if the practice of software engineering is far from reliably providing value to the clients it aims to serve, is there something in the underlying paradigm that is not right? We take the position that software engineering, which is often defined in terms of the development of software *products*, is too product-oriented. By this we mean that the result of systems development in processes accepted to be part of software engineering is usually seen as a (complex) artefact whose fitness for purpose can be assessed against stated requirements. We propose that an alternative, but not mutually exclusive, conceptualisation of the executable outputs of software engineering be that of *services* – with the many and various connotations that the term implies.

For brevity, to argue our position, this paper concentrates on how service-based software engineering might more directly provide value to the business community. We focus on what, in a service-oriented view of software engineering, is likely to make outcomes of systems development projects more likely to succeed in bringing business value. The notion of ‘service’ is often seen in terms of the co-creation of value – so exposing the relationship between supplier and client more than in a product-orientated worldview. Thus, this paper

looks at the relationship between what we will term the IT service provider and the business that is the IT service provider's customer and use the focus on that relationship to consider how the success rate can be improved.

## 2 BUSINESS NEED AND VALUE

The major advances in IT have been product-related, i.e. the mainframe, the PC, database technologies, the emergence of the enterprise resource management systems, the internet/world wide web, mobile communications, etc. We tend to focus on the product element of a business solution and have often failed to develop the service element demanded of these products. This is most noticeable with the advent of the COTS solution where the software engineering lies with the solution provider and implementation becomes an issue of integration.

Our position that the service concept be more prevalent in software engineering is primarily due to the concerns highlighted by the aforementioned reports regarding (i) the failure to reliably deliver value to businesses which rely so much on IT and (ii) the efficacy of software/systems engineering. In this context the distinction between 'product' and 'service' we espouse is not merely one of academic semantics. Nor is the distinction meant only to usefully differentiate between a product being the result of building to some kind of specification by which the client determines a boundary to a system and a service whose boundary (or boundaries) are determined by a provider. The most important reason for the distinction is that, arguably, most business systems are not built from scratch but are the result of extending, integrating and augmenting existing elements. Typically we are creating added complexity, sometimes in a non-linear manner. This contrasts with the increasing urgency of business need especially where competitive pressures are severe.

The abovementioned surveys show that reasons for failure are usually expressed as (a) the inability of the business to adequately define its requirements and success criteria or (b) the failure of the supplier of systems to deliver (OGC, 2005). Where either happens there is usually poor IT management, poor IT governance, and poor alignment of business and IT. Current methods are just not good enough. Add to this the urgency of the change and the complications of legacy systems, databases, etc., the ability of software engineering to add business value and deliver it quickly can be severely limited.

By suggesting new practices (below) that extend the ideas of the service concept, we argue that improvement comes from the introduction of a service culture combined with a business focus. We ask, if software engineering is to benefit from new notions of service, whether a new IT service model is required.

## 3 RELATED WORK

The following review of recent work highlights the extent to which the problem we have posed is acknowledged and demonstrates how it is of concern to the industry.

The notion of 'service' is already in software engineering, e.g. in SWEBOK (IEEE, 2004) regarding requirements, testing, and operations. And, of course it is present in notions of service-orientation (McGovern *et al.*, 2006) and software as a service (Turner *et al.*, 2003). However, is not fully at the forefront of software engineering, as we believe it needs to be. Rather than aiming for whole-business alignment, by their focus software engineers are seeking to align systems with business objects. For example, the Zachman framework for enterprise architecture (Zachman, 1987) is described as an architecture that represents the information systems' artifacts providing a means of ensuring that standards for creating the information environment exist, and (TOGAF, 2010) is an architectural approach to managing the complexities of the artifacts of enterprise IT by The Open Group.

Some are finding that these concepts are inadequate for new technologies e.g. during the design of a value web (Zarvic *et al.*, 2008), in a business process management (BPM) context (Karagiannis *et al.*, 2007), for governance in a service-oriented architecture (SOA) setting (Schepers *et al.*, 2008), and alignment in a mobile e-service case (Pjipers *et al.*, 2008).

Some suggest a closer alignment with business. (Velitchkov, 2008) points to the vast array of development/management methods and the generally accepted view that IT, and hence software engineering, is failing to meet business expectations. He suggests that fault lies in the lack of business and IT alignment, problems with IT strategy and inadequate control mechanisms. As a solution he advocates furthering the object modelling approach, combining the domains of enterprise architecture and IT strategy. Others also focus on enterprise architecture and advocate its use as a corporate planning tool by the inclusion of business model

components like goals, products, markets, or competitors (Winter and Schelp, 2008).

There is a risk that approaches such as this underestimate the dynamics that are at play and press ahead in the belief that all business requirements can be coded product-style ignoring the relationships that the IT service provider and the business need to establish to co-create value.

The notion of services in the context of IT operations is well developed and is commonly referred to as 'IT services management'. What can software engineering learn from this in terms of delivery? Services account for 75% of the economy of industrialised nations, and IT services have been responsible for delivering change to every part of organisations for decades and yet there has been little attempt at internal standardisation or process definition (Galup *et al.*, 2007). They state: "there is a need for research that investigates the wider economic and social ramifications of IT service management especially as it relates to globalisation ...". Addressing specifically the lack of standardisation among the IT service management methods, some (Winniford *et al.*, 2009) note "confusion between IT service management (ITSM) methods, business services management (BSM) methods, CoBiT and IT governance and conflation of terms and practices". They further suggest that identifying good and bad methods of handling the cultural issues in IT organisations should yield a set of best practices to benefit any company embarking on a service management improvement project.

There is a growing recognition that one solution/level of service does not fit all organisational cultures (Leonard, 2005) (Ramakrishna and Lin, 1999). Much is published illustrating the inadequacy of today's 'IT management tools' advocating varying degrees of consolidation or integration. (Ben-Menachem and Gelbard, 2002) acknowledge the importance of forms of personal communications skills in the context of IT service delivery though they fail to comment on the impact that the rate of technological change would have on the integrated toolset. Prompted by the 2008–10 economic crisis (Feltus *et al.*, 2009) suggest that IT governance and IT alignment can be improved by defining a common responsibility matrix that extends across all methodologies by enhancing the COBIT RACI method but their focus remains IT

Business models are changing as a result of opportunities made possible through technology. Organisational and cultural issues as well as any problems with the relationship between the business

and IT service/software systems provider are most noticeable in these situations. An analysis of IT failure in the public sector (Cohen *et al.*, 2007) serves to highlight these difficulties. A recent supply chain example is also helpful (Holweg and Pil, 2008) in understanding the emergence of complex adaptive systems and non-linear dynamics.

IT and software systems are now at the centre of most businesses responding dynamically and incrementally to change; yet we try to enforce a customer–supplier relationship with a generally inadequate service discipline using linear methods (e.g. lifecycle models) more suited to 'blank-sheet' development.

#### 4 EXTENDING THE IT SERVICE MODEL

From the above we can conclude that in most cases the business needs are not being met even when using models of IT service. The currently available IT management tools and prescribed skills, such as in the UK's 'Skills Framework for the Information Age' (SFIA, 2003), even when fully deployed, are not adequate. Nor are they adequate for identifying any shortcomings and introducing improvement. What then should be done?

Firstly the scope of the problem must be

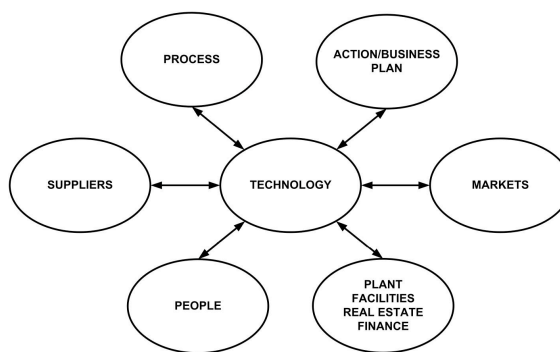


Figure 1 Context for IT

broadened to address business needs rather than just system requirements. A context diagram is given in Figure 1. Three of the dimensions (people, process and technology) get mentioned quite frequently in the more IT-focused constructs and the limitations in terms of method and language that this has imposed on board level discussions about business opportunity is problematic. Businesses today are typically whole ecosystems where product is sourced, process is outsourced, and where there are

different channel partners. Defining the stakeholder groups for process and systems design can be complex and technology, with software engineering, sits at the centre.

By changing the context for systems development so that it is positioned at the centre of a business ecosystem we can improve the range and focus of IT services such that a successful business outcome is more likely. New services will be added to the conventional IT service model so that it is able to meet more of these needs. This can be achieved without losing the benefits of any existing investment in the IT management toolset. The definitions of IT service differ widely. We can assume that a business will need to develop (or change) its business model by exploiting IT (business engineering), define and design the processes that will be needed to undertake its business according to the new business model (process engineering), execute those processes (process execution), and receive IT services and resources to facilitate its information flows (IT

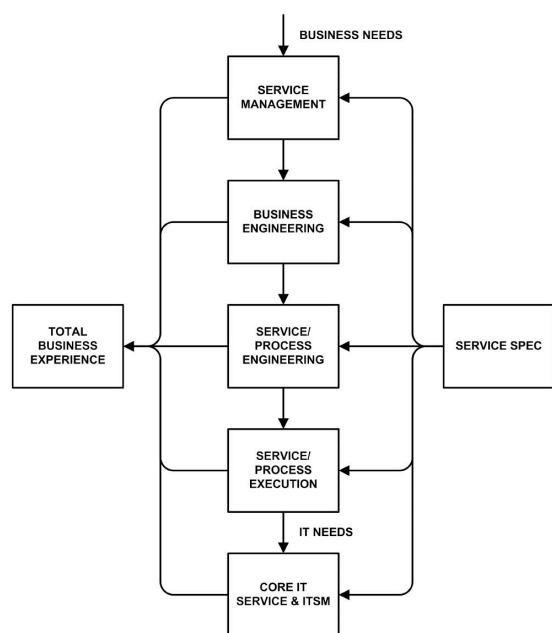


Figure 2 The Service Stack

service management (ITSM), core IT services and the IT infrastructure). The input to this lowest level has been the IT requirements specification and hitherto this has been the IT focus as can be seen by the term 'IT service management'. We refer to the whole as the Service Stack. Service management must encapsulate the management of all of the services in the service stack and be business-focused. This is illustrated in Figure 2.

At each level there will conceivably be an

opportunity for a degree of software engineering. From this diagram of the service stack we can see that the service specification will need to define the nature of all of the services to be delivered. By expanding the scope of what we have come to call service management we avoid the pitfalls that many organisations have fallen into when outsourcing their IT and failing to recognise their continuing need to innovate. The output may contain a number of architectural artefacts but it will also consist of business outcomes and perceptions, which is depicted in Figure 2 as TOTAL BUSINESS EXPERIENCE. It consists of a complex mix of quantitative as well as qualitative measures that together provide a more realistic indicator of service quality. We can consider how close the experience is to what was specified, or how close the experience is (and so the actual skills and processes are) within the service delivery organisation to what would be considered to be ideal for a given business. These skills and processes have been identified and classified and not surprisingly they are much broader than those we see in, for example (SFIA, 2003), which are focused at the lowest level.

As well as profiling the skills and processes and assessing the business experience in the way described it is necessary to look at the effect this has on the business. The identification of gaps in service will be assessed on the basis of the service stack and by looking at any service gaps as described by a service excellence model (Miller, 2008), an abstract version of which is shown in Figure 3. This SEM provides the planning and delivery context for the IT services. We are able to assess what is delivered not just against the SERVICE SPECIFICATION and the BUSINESS NEEDS and EXPECTATIONS, but also against the BUSINESS PLANNING requirements.

Whilst a SEM can be applied to any business-to-business relationship it was derived specifically for IT services providers and systems developers to help them to understand the nature of the relationship with their business. It is an aid in helping to identify where in either the service planning or service delivery a lack of process or skills is having a negative impact on the business. It is a development of an earlier business-to-consumer service quality model (Parasuraman *et al.*, 1985). We know that a stronger focus on the business need, the appropriate range of services, attention to skills profiling, and closer alignment with the business is likely to yield more successful business outcomes. The total business experience as a concept is a measure of excellence. Both gap analysis and the total-business-experience measure are specific to a business rather

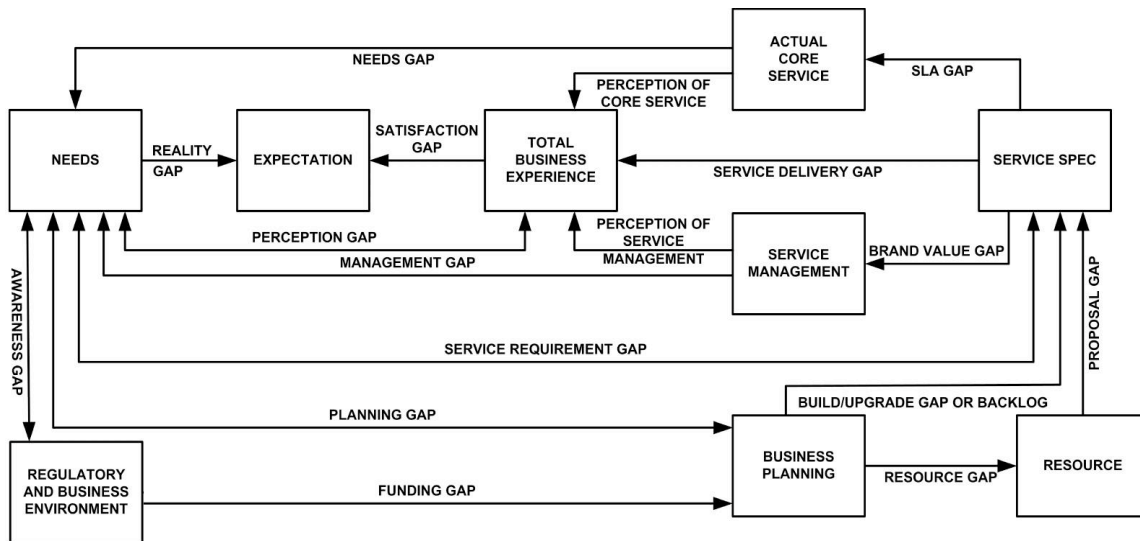


Figure 3 The Service Excellence Model

than being absolute. In this way the service to various business groups can be compared according to their needs and services can be more effectively tailored to meet the needs of each business.

Profiling the service provision using this approach is so far proving to be a sound basis for service improvement programmes and a more realistic form of assessment from both the business and the service provider perspectives especially where change is taking place. This realistic measure of performance also allows us to improve other IT concepts such as change management, alignment and governance.

Much is written about the alignment of IT and business but as we have seen this now presents huge difficulties and efforts have not led to improved business outcomes. An alternative approach is to identify and eliminate gaps between the business need and the services provided. A lack of any gaps in a service excellence model would indicate a close alignment. Change management and governance are concerned with assigning responsibilities. The detailed classification associated with profiling the skills and assessing services enables us to more comprehensively understand the obligations and responsibilities required to plan and initiate change, manage its process and manage the end state. It goes beyond the corporate governance currently implicit in software engineering and facilitates transformational business change.

As installed solutions and services become more complex, rather than relying on a requirements specification as the start point, there is likely to be an increased dependence on SEM gap analysis. Whilst few business people could develop a detailed specification of their requirement, most are able to

articulate what business needs are not being addressed.

Gap analysis is being used to determine the choice of technical solution (Papazoglou and Heuvel, 2007) and at the design level, the characteristics of services (Sampson and Froehle, 2006) have been applied to the design of the human computer interface for on-line systems. The service science movement has recognised how measuring service quality as the gap from expectations and perceptions are not only often more realistic but also more informative than simply measuring satisfaction (Pinhanez, 2008). These characteristics are based on early work on customer contact theory but the way in which these are being adapted for on-line systems have something in common with the 'closeness' concept and the skills classification developed for profiling and improving IT services (Miller, 2008), drawing both from software engineering and also from social science disciplines.

## 5 CONCLUSION AND FURTHER WORK

Despite the usefulness of the software engineering body of knowledge, the evidence of many surveys is that there is little correlation between the use of current tools and a successful business outcome.

In order to more successfully meet the needs and expectations of the business customer, software engineering must de-emphasise products and recognise the business need for services and adopt a more service-oriented approach to meeting these needs. We must revise our understanding of the established concepts of IT service management,

service performance, change management, alignment, and governance. By doing so we recognise the need to dramatically improve the likelihood of a successful business outcome yet we are able to retain any investment in IT management tools. The service stack concept for IT services and the service excellence model also enable us to consider how the business and IT relationship is changing over time and so we are able to revise our concept of maturity to enable us to provide better ways of managing emerging technologies and new IT industry structure models.

If organisations can improve their success rates by 10% then based on Gartner estimates of worldwide IT spend in 2010 this could be worth \$320B globally (Gartner, 2010).

The business-focused IT service concepts outlined in this position paper have been used successfully as a framework to both assess service and identify additional needs. Work is underway to investigate further how software engineering can exploit these concepts to achieve improved business outcomes.

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