Journal of Web Engineering, Vol. 4, No.4 (2005) 313-338

IMPACTS OF WEB SYSTEMS ON THEIR DOMAIN

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Received August 25, 2004
Revised May 31, 2005

In web systems development, the business environment and processes not only drive the identification of system needs, but this environment and processes are also in turn fundamentally changed by the introduction or evolution of the system. This means that a web system during development will be highly volatile with a complex set of inter-dependencies with the various domain characteristics. We report on a detailed analysis of the literature related to these dependencies, and in particular the impacts that a Web system has on its environment. We also present a framework that encapsulates the dimensions of impact on both the internal and external business environment. From this analysis we show how different facets of the domain of a system are impacted in different ways. As the scale and immediacy of these impacts increase we need to become more predictive of these impacts in taking them into account during the development. Our analysis will provide organisations with the basis for moving towards this increased level of predictiveness. This analysis will also provide the organisations with a framework for developing strategies for joint development of system and business processes.

Key words: web systems; domain; impact; characteristics; organisation; business environment; internet; intranet; extranet
Communicated by: M Gaedke & L Carr

1 Introduction

A key characteristic of many Web systems[a] (as well as various other software systems) is that the introduction of the system has a fundamental impact on the nature of the business processes and business models, which are being supported by the system. In other words, the business environment and processes not only drive the definition of the system needs, but are in turn fundamentally changed by the system. These changes are such that not only are the system requirements change, but the very nature of the problem that was being addressed is changed. In effect, the business "problem" defines the nature of the technical system "solution" that is desired, but the solution itself changes the characteristics of the problem space (this will be discussed in much more detail below). This can be

[a] Whilst we use the term *Web system* throughout this paper, we recognise that this terminology is still somewhat ill-defined within the literature (which includes terms such as Web applications, web-based systems, online systems, as well as a host of domain specific terms such as B2B, B2C, etc.). In this paper when we use the term *Web system* we are referring to those system which utilise web technologies as an integral element of a functionally complex system which typically incorporates interfaces beyond the organisational boundaries.

described as solutions and problems being *mutually constituted* – a concept well understood in the area of social informatics [53] and requirements engineering [10].

Whilst this concept of mutual constitution – or its expression as a technical solution leading to substantial changes in the problem space – is typical of almost all systems development, it is particularly significant with Web systems. This is largely because of the scale and immediacy of the impacts that web systems can have on their domain. Whilst most computer-based systems development exhibits these characteristics, either the process impacts are sufficiently obvious to be taken into account relatively easily during initial development, or their scale is sufficiently constrained to allow them to be initially ignored and to then be addressed once the system has been implemented. It may be argued that this is the basis of Business Process Re-engineering (BPR) – i.e. a system is put in place, it has an effect on its environment, and then we post-hoc re-engineer the business processes to give a better fit to the now-in-place system). With Web systems (or rather the class of development for which Web systems form an exemplar) the scale of impacts on the problem domain is sufficiently large and immediate that they should not be overlooked during the initial system development. The impacts also extend, in many cases, beyond the organizational boundary, and are therefore more visible externally (and as such affect relationships with external stakeholders).

An alternative way of viewing this issue is that in systems development where the scale of system impacts on the business processes is less, we can afford to be somewhat reactive in our response to these impacts (indeed, BPR is largely a reactive process). We can build the system, identify the impacts and then reengineer the business process (and maybe even aspects of the system) to obtain a better "fit". As the scale of the impacts increases, we need to become more predictive of these impacts and take them into account during the initial development. In other words, we need to be able to anticipate what the likely impacts will be and factor them into a joint development of the system and the revised business processes.

Whilst there has been a significant body of work looking at specific impacts of Web system, this has not been drawn together into an overall framework. This paper presents a framework that encapsulates the dimensions of impact in the *domain of context, domain of mutual influence and domain of effect.* This analysis will provide organisations with a framework for developing strategies for joint development of system and business processes. It will also serve as value-added knowledge for the companies in understanding the strengths, weaknesses, opportunities and threats that may affect their system, organisation and stakeholders (e.g. trading partners). These dimensions and their characteristics are derived from a comprehensive analysis of the literature across a wide range of disciplines.

In essence this analysis of the literature, and our consequent framework, address the following research questions:

> *In the development of a web system, what are the system characteristics that impact on the organisation's business environment (system, organisation and stakeholders) and what is the nature of these impacts?*
>
> *Are different domains impacted in fundamentally different ways by the introduction of web systems, and if so then what are the differences?*

In the next section, **Section 2**, we will discuss the research method that we have undertaken for this study. In **Section 3**, we will discuss the existing literature and web system types. In **Section 4**, we will discuss our terminology of domain of context, domain of mutual influence and domain of effect.

In **Section 5**, we will discuss the framework that we have developed and evaluate the facets of the domain that are being impacted by the development of web systems. In **Section 6**, we will also discuss the types of impact and the characteristics that impact on the boundary of the different environments. In **Section 7**, we discuss the implications this research will have on the organisations and also present a preliminary a case study. In **Section 8**, we conclude this paper and briefly present our future research plan.

2 Research Method

Content analysis and case study are the two research methods being employed in this study. In the first stage of the research, content analysis is used to identify inter-dependencies between web systems and their environment. Content analysis technique is used as the research method for making valid inferences from the identified research literature [42]. Content analysis as a research method is different to a basic literature review in that the researcher searches for predetermined themes and uses the material as data [59]. There are two types of content analysis technique, which are qualitative and quantitative. For quantitative analysis technique, appropriate statistical analyses on frequencies or percentages are used to determine whether significant differences exist relevant to the research question [37]. We focus on analysing the data qualitatively in that the primary aim is to determine the range of significant characteristics of web systems rather than a ranking of issues [37, cited in 59]. In analysing the data qualitatively, contents of practitioner and academic literature are coded in terms of predetermined and precisely defined characteristics [37]. The content analysis identified several characteristics of the system, organisation and the external environment that impact or are impacted by the development of web systems and the inter-dependencies of these characteristics and their environment. These findings are then used to formulate a framework which comprises of six dimensions of the web systems impacts. Appendix 1 contains a summary of the impacts that have been identified in the literature.

The generic types of impacts that have been collected and characterised from the literature become the basis of questions to be used in the second stage of data gathering, which is the case study. A series of industrial case studies will be conducted on organisations that have adopted Web systems for their businesses in recent years. The goal of the case study is to reaffirm from practice the types and levels of impacts that we have found in the literature and to develop a clearer understanding of the mutual dependency between application solutions and the organisational context of the web applications. Furthermore, there may be more specific (fine grained) types of impacts that will be discovered from the practitioners that could complement our findings from the content analysis exercise. In this paper, results from a preliminary industry case study is presented and discussed.

3 Existing Literature

In considering the impacts of web systems we undertook an analysis of literature from diverse disciplines including: marketing; management; logistics; engineering; information systems; information technology; and manufacturing. Each impact that is identified is then categorised along a number of different dimensions: the characteristic that causes the impact; the characteristic that is impacted upon; the type of web system which exhibits this characteristic; the extent of the impact; and whether the impact is considered to be positive or negative. Appendix 1 presents the examples of literature including references and the context of the framework that we will explain in the following sections.

3.1 Types of Web Systems

Many of the studies which identified specific web system impacts also specifically related these to particular types of Web systems. Whilst the definition of Web system varies, a useful working definition is a system that is designed and developed using a web based technology. "*Web systems are different from conventional software systems. They are developed in shorter timeframes, and with smaller budgets, meet a more generic set of requirements, and generally serve a less specific user group. They are often developed very quickly from templated solutions, using coarse-grained authoring tools, and by the efforts of a multi-disciplinary team*" [38].

E-business and e-commerce systems are considered as among the different types of web systems. E-commerce is defined "as the buying and selling over digital media" [35]. E-commerce is defined "*as an emerging concept that describes the process of buying and selling or exchanging products, services, and information via computer networks including the Internet*" [63]. E-business definition encompasses e-commerce and includes both front-and back-office applications that form the engine for modern business. E-business definition refers to a broader definition of E-commerce, which is not just buying and selling but also servicing customers and collaborating with business partners, and conducting electronic transactions within an organisation [63]. E-business is about the transformation of key business processes through the use of Internet technologies. It is about supply chain management, cycle time, speed, and globalisation [20]. Systems are also widely categorised based on their level of user access. **Internet** systems are typically viewed as public and global [63]. Conversely, **Intranet** system utilise a corporate LAN or wide area network (WAN) that uses Internet technology but is secured behind companies' firewalls. The term **Extranet** uses the Internet to link intranets in different locations [63]. Extranets provide secured connectivity between a corporation's intranets and the intranets of its business partners, materials suppliers, financial services, government and customers. Since an extranet allows connectivity between businesses through the Internet, it is open and flexible platform for supply chain management.

3.2 Impacts of Web Systems

Using electronic commerce tools such as Internet electronic data interchange (EDI), less costly extranets and intranets, web storefronts, web-based products, or service information can reduce the systems and transaction cost that the organisations will have to bear [47]. These tools enable the buyers and sellers to get shared information on updated information pertaining to inventories, orders and shipments. This is a positive impact for both parties as it eliminates the need to install and maintain expensive proprietary networks. This then leads to substantial cost savings which can effectively be passed on to the end user.

Web systems development can also pose negative impacts to the organisation and its systems. With new technology, such as web systems, new forms of threats are encountered regularly. These threats include intrusion and illegal access to proprietary data, virus attacks, denial of service attacks, and illegal acquisition or distribution of data that is copyrighted. Some of these problems are more critical with intranet system where there is often a lack of full implementation of firewalls and encryption technology. The threats that the organisation face also impact on the organisation's systems, whereby the systems need to be safeguarded with sophisticated security measures that support mutual authentication, fine grain authentication, communication integrity, confidentiality, non-repudiation, and authorization. Security poses a high impact on the organisation and the system development because there is no security technology that can secure the system effectively.

Most of the literature tends to highlight aspects such as the impact of electronic commerce tools on the reduction of business costs [47] and changes to business processes – particularly as they relate to aspects such as supply chains. These impacts can be both positive (such as increased customer satisfaction) and negative (such as increased vulnerability to security breaches). E-business interfaces are critical in any web system projects as it aligns the supply chain processes. However, it is also critical that organisations ensure that the different web applications and tools can be integrated seamlessly with the organisation's system and the system of its trading partners [7]. Any development of a new system, particularly web systems will pose a significant impact on the other system components that are already in place. Despite this, there has been little research on systemizing or structuring the nature of these impacts.

4 Domain of Context, Domain of Mutual Influence and Domain of Effect

As discussed above, a Web system and its problem domain are mutually constituted – i.e. have an inter-dependence such they impact each other. This problem domain involves characteristics of both the organisation hosting the system and external environment that relates to it. These characteristics can be grouped into several sub-domains, which are useful in understanding and reasoning about the inter-dependencies. These are shown in Figure 1 below.

The *Domain of Context* is made up of those characteristics of a systems domain, which provide a context for the system (i.e. affect the design of the system in some direct and immediate way). For example, both existing business processes and a legal regulatory framework may affect the design of the system, and are therefore part of its domain of context. As shown in Figure 1, *A* and *B* are characteristics of a systems domain that provide the context for *X*, which is the system.

The *Domain of Effect* is made up of those characteristics of a systems domain which are impacted upon in some direct and immediate way by the introduction of the system. For example, both existing workflows and customer expectations will often be impacted upon by the system, and are therefore part of the domain of effect. This is shown in Figure 1, where *B* and *C* are characteristics of a systems domain which are impacted by *X*, which is the system.

The *Domain of Mutual Influence* is the intersection of the domain of context and the domain of effect – i.e. it is made up of those characteristics of a systems domain which both impact the design of the system, and which are potentially impacted upon by the introduction of the system. Taking the previous example, existing business process are likely to be part of the domain of mutual influence (since they influence the system design, but will also be changed by the system) but legal frameworks will not (since, whilst they affect the system design, they are unlikely to be directly impacted upon by the system). As shown in Figure 1, the system design which is *X* impacts on *B*, which is the characteristic of the systems domain, the latter in turn impact back on *X*,. Hence both *X* and *B* are mutually impacted

Examination of existing literature highlights numerous characteristics which impact the system design, but which also are impacted by the introduction or modification of web systems. These typically relate to the business processes, systems, operations, structure and communication between the organisation's employees and with the various trading partners, such as customers, suppliers and manufacturers. Within an organisation, web systems often have a more direct impact. Studies that have been undertaken typically characterise impacts as either positive or negative (or strengths and

weaknesses) for the organisation, depending on the types, effect and level of impact each has on the organisation.

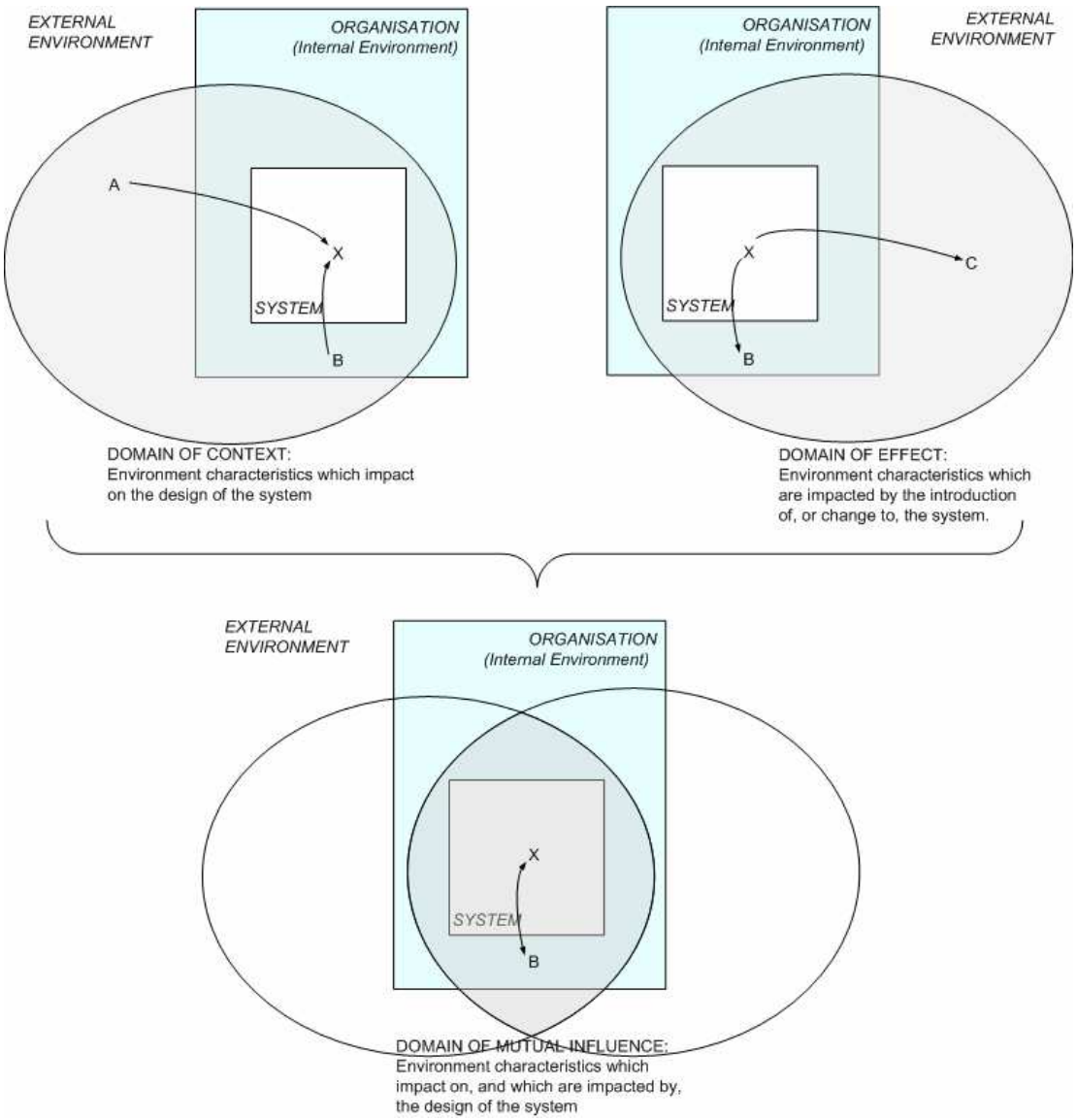

Figure 1. Domain of Context, Domain of Influence, Domain of Effect

5 Framework

From the web system impacts discussed in the literature (and summarised in Appendix 1) it can be observed that different web systems have different impacts on the business environment. In Appendix 1, these impacts are classified into six dimensions. The six dimensions of impacts form the first part of the Framework, which comprises the Domain of Context, Domain of Effect and Domain of

Mutual Influence that we propose in this paper. We have identified six dimensions of these impacts, as follows:

- **Characteristic which affect**: the system characteristic which has an affect on its domain, or a domain characteristic which has an effect on the system;
- **Characteristic which is affected**: the characteristic of system or it's domain which is affected
- **Types of Web System**: The types of system for which this impact applies: e.g. internet, intranet and extranet.
- **Facet of Domain**: Whether the characteristics that are impacting, and which are impacted upon, are part of the system, the organisation, or the external environment (e.g. O↔S indicates an organisational characteristic and a system characteristic which impact on each other).
- **Effect**: whether the impact is viewed as having a positive or a negative effect on business operations;
- **Level**: extent of the impact, e.g. high, medium, low.

These dimensions form the framework that we propose in this paper. Let us illustrate the framework with an example. As depicted at the top of Appendix 1, a shorter cycle time of product ordering and delivery is a **characteristic which affects** the time and speed of business operations. Time and speed is therefore a **characteristic** of the business environment which **is affected** by the introduction of a web system. This type of impact is typically most evident in internet and extranet **web system**s and most commonly affects the internal organisation **facet** of the **domain**. The impact on time and speed generally has a positive **effect** and high **level** of impact on the organisation [9, 63]. The dimensions of impact are explained in detail with examples in the section below.

In this paper we have identified five different facets of the domain which can have mutual impacts: the *domain of context*, the *domain of mutual influence*, the *domain of effect*, the *system* itself and the *organization* which hosts this system. Domain of context, the domain of mutual influence, the domain of effect can also be considered as sub domains but system and organisation are not. As shown in Appendix 1, facets of the domain are impacted in different ways. We explain below these facets and the characteristics of these facets that are impacted.

5.1 Domain of Context

As discussed in Section 4, the domain of context has an indirect impact on the organisation, system and trading partners. The decisions and business initiatives, such as the development of the web based system, have strong implication on how business activities will be conducted between these two parties. From the analysis of the literature (refer to Appendix 1), the characteristics of the domain of context that impact on the system and organisation include aspects such as: the level and type of competition; legal and ethical issues; web technology adoption and client uncertainty. For brevity, only 3 of these will be discussed below: competition; policy issues; and technology adoption.

Competition is a characteristic that impacts on the industry as a whole, and hence individual organisations and ultimately the systems under development. In the computer software industry competition plays an important role and has a strong impact on the corporations' strength and existence in the marketplace [64]. In this industry competitive intelligence comes from an up-to-date knowledge of environmental trends and competitive activity and a willingness to risk a current advantage for a

possible new advantage. A company in the current market needs to compete with both domestic and global competitors in order to survive [14]. Rapid changes in technology create an environment where competitors can change quickly. Web systems are an example of such technology, where their adoption has exposed companies to greater competition. Competitors on the Internet evolve rapidly and this makes it difficult for organisations to keep developing and changing their competitive intelligence [31]. In e-commerce and e-business, in order to stay ahead, organisations need to have a strategic focus on both the competitors (economies of scale) and customers (economies of scope). Organisations face a greater risk when they do not truly understand their customers at the one-to-one level, and unable to capitalise on its relationships by responding with appropriate products and/or services [31]. This can be done by capturing the value from customers. Value is measured at a single point of time. In e-businesses the value that the organisations create and control changes over time. It is therefore critical that organisations be vigilant in determining that the value they provide is not being eroded as competitors introduce new business designs, restructure their business models, and offer new value propositions. This poses a threat to the organisation's business viability as competitors aim to take over part or all of the customer's value system. Appendix 1 (row 21), shows that competition from existing and new firms have an indirect impact on the organisation's system.

The technologies underpinning web systems are still relatively new and changing rapidly. With electronic commerce, for example, the **legal, ethical and other public policy issues** that are necessary for supporting or controlling e-commerce applications are still evolving. The key legal issues relating to e-commerce are: privacy; intellectual property rights (copyrights and trademarks); free speech; consumer protection; and other legal issues (includes topics such as validity of contracts, jurisdiction over trades, encryption policies) and ethical issues [63]. Ethical issues particularly are difficult to define, as it is a branch of philosophy that deals with what is considered to be right and wrong. Appendix 1 (row number 22), shows that regularity framework affect on the unidentified system characteristic of the e-business system. The legal regulatory frameworks are therefore identified as a characteristic that provides a key context for e-business systems.

Web technology adoption between all entities (such as the organisation, customers and suppliers) impact on both the system and the organisation. Interview respondents in a study reported that interaction and market access are two key components of successful connectivity [25]. Web systems impact on how suppliers and customers interact and do business via the Internet. The network functionality of web systems allows the suppliers and customers to interconnect and rely on the "system-to-system connection". The respondents view e-commerce as a way to open and remove suppliers and customers. The Internet also allows companies to communicate and share information across the supply chain. Another component is market access, which is the companies' ability to access customers they could not reach before the introduction of web systems. It also enables companies to gain critical mass. Critical mass is the threshold of network suppliers and customers needed to make their business model successful. Companies use Internet adoption as part of their business model to bring other companies to their network, which then allows them to reach critical mass more quickly. On the Internet, information flows are multidirectional [30, cited in 25]. Web-based system allows e-commerce technology to provide information visibility throughout the supply chain. The system allows supply chain members to view real time data via the Internet and it offers value for someone who can deploy solutions effectively, link someone to their trading partners, and allow them total visibility to the supply chain. E-commerce technology has a positive impact on the supply chain as it allows information visibility, which in turn allows companies to integrate their system components on

production planning and scheduling and inventory control, and implement that through the supply chain thus later getting into just-in-time service/product delivery.

5.2 Domain of Mutual Influence

The characteristics of the *Domain of Mutual Influence* are those characteristics of the domain which affect the system, but which are in turn directly and immediately affected by the system (e.g. business processes, or – for most web systems – the external customers). Some of the key characteristics are discussed below.

Value exchange processes and activities between the organisation and its intermediaries are identified as a characteristic of the organisation that impact on the system. In e-business, process of intermediation and disintermediation presents specific e-business risks for traditional sellers [27]. For example; intermediaries such as brokers might easily disappear or re-appear in an e-business environment. This is because buyers might decide to use a middle person (intermediary) to increase their combined buying power and seek better negotiations with the sellers. Due to this issue, it is important to show who is doing what with whom as e-business is more flexible [27]. This will have significant impact on the e-business project if there is no differentiation in the value offered by the different entities. An important issue in e-commerce business model design is the assignment of value activities to actors.

Web systems also offer customers a distinct customer service value, compared to traditional business systems. The types of customer service offered via the web systems include answering customer enquiries, providing search and comparison activities, providing technical information to customers and allowing customers to track order status [63]. Most banks and financial institutions allow their customers to view their account balance, status of stock portfolio, loan application anywhere and at any time via an extranet. FedEx, for example, allows their customers to track their packages. Amazon on the other hand, notifies the customer by e-mail the acceptance of their order, the anticipated delivery dates, and later on, the actual delivery date. The Internet also allows customers to customise and order online. Dell Computer and Gateway 2000 provide the customers with pre-packaged specials and given the option to custom-build the computers of their choice. The customers are able to handle troubleshooting easily as these companies allow the customers to download manuals and solutions at any time. These types of customer service offer varied value to the customer. As shown in Appendix 1, the facets of the domain impacted are labeled as O↔S, which explains that the characteristics of the organisation facet and the characteristics of the system facet are mutually influenced.

Security is a critical characteristic as in e-business and e-commerce functions, web systems interfaces into business functions of a corporation. As a result of this, security of the business transactions and process need to be safeguarded. Security poses a high impact on the organisation and the system development because there is no security technology that can secure the system effectively. SSL however falls short in areas of storing a secured message in a queue for processing, relaying a message through third parties and tunneling a message over other protocols [45]. Access to proprietary data and in particular the scope and variety of information available through search engines are among the major issues that organisations need to focus on [47]. Currently, web-based selling and purchase tools have yet to fully address the security concerns. Replacing paper documents with electronic documentation has an undesirable impact on the organisation security. This is due to the possibility of permitting open links to proprietary data, and that electronic document lacks permanency and legal

legitimacy of paper. In Appendix 1 row 7, it shows that Security is a characteristic of the organisation which impacts on the system and in return it directly impacts back on the organisation.

5.3 The Domain of Effect

The Domain of Effect is made up of those characteristics of the systems domain which are impacted upon in some direct and immediate way by the introduction of, or changes to, the web system. For example, business workflows and customer expectations are characteristics that are often impacted upon by the system, and are therefore part of the domain of effect.

Traditional **workflow** environments concentrated on the internal business process, where work is routed from one user to the next [43]. Users and roles are regarded as static and processes are imposed on workers so as to ensure that the appropriate controls were maintained. This work practice is not applicable to the needs of the modern enterprise with outsourced processes and complex partnerships, and hence traditional models of internal control delivered via workflow is no longer relevant. Web-based workflow systems allow applications to 'wrap' resources of routing information via email, where a unique link is provided for them to login to the server and carry out the next step in the process. Web-based infrastructure provides a low cost mechanism to keep participants informed of required actions. The web system therefore impacts on the workflow process of the organisation as it changes the communication processes between one employee to another (or between the company and the supplier) and business operational processes.

A workflow system is ineffective unless the results are accessible to the people who are to carry out the processes. Web-based workflow systems such as WWWorkflow provide process mediation service that utilise tools that users already have and know how to use [2]. The authors state that in this system, the users interact using their Web browser and retrieve a list for which they are currently responsible for. This system is designed to interoperate seamlessly with Intranet applications. Organisations need to consider several factors that typically impact the workflow system, as to whether it offers the right solution for the job, which includes new work practices and processes, cultural impacts of the system, the technology platform and the implementation [18]. The implementation of a workflow system is influenced by the amount of change required by the organisation [18]. In addition, the greater the level of change in behaviour and process, the longer and more difficult the selection and the implementation of a workflow system will be [18].

Customer expectation is another characteristic that is directly impacted upon by the web system. B2B (business-to-business) e-commerce applications become enabling technologies that yields added value in a broader context (other than the technical context), which look on new competitive strategies and innovative organisational structures that impact on customer expectations [23]. Organisations worldwide are faced with growing competitive pressures through open markets and the shift from seller markets to buyer markets. They therefore seek to replace their (legal) applications systems with better, network-based architectures, which in turn impact on the customer expectations. The constantly spreading use of network infrastructure (like the Internet) entails new possibilities and adds a new quality to inter-organisational cooperation. With the Internet, companies may now cooperate locally and also globally with any company offering needed assets (knowledge and products) at best quality and lower costs to gain competitive advantage. The Internet facilitates a competitive strategy such as mass customization. In mass customization, a network of manufacturers, suppliers, and retailers is established. A tight integration of suppliers and coordination of inter-organisational production processes are critical success factors for a mass customization strategy. In B2B e-commerce, customers

(or suppliers, retailers, manufacturers) expect the system to offer individual products at prices comparable to mass production, and comparable short shipment times [23].

E-commerce also changes customer expectations in many different respects. It is detrimental that the development of e-commerce initiatives over the web systems are often established based only on the customers' needs and expectations, and not taking into account other aspects [51]. Jeff Bezos [58, cited in 51] stresses that customers today have easy access to information on products and prices and have the freedom to navigate from one website to another, thus "shifting the online commerce power balance from the trader to the customer himself/herself". The e-commerce system therefore impacts customer expectations as one is able to go through the product comparison, selection, and buying process in real-time.

The Internet influences and impacts on customer expectations in relation to several quality dimensions, such as accessibility, safety, communication, friendly interaction, tangibility (accessing network without problems) and reliability (consistency of performance and dependability) [51]. In an experiment conducted by Rotondaro [51], tangibility, for example, depends on the site's tools, that are the facilities it offers the customer to buy or search for products and prices. In this example, customers expect the website design to be user-friendly, easy to search and purchase, as well as to provide easy access to the site. As the web systems impact on the customer expectations, organisations therefore need to redesign their business model to conform to altered customer expectations and hence system requirements. They need to analyse their customer satisfaction and impacts on the customer expectations as the starting point for the development/redesign of the web system [51]. As shown in Appendix 1 (row 10), network infrastructure and the quality dimensions discussed above are characteristics of the system's domain that impact on the customer expectations (which is the characteristic of the Domain of Effect), hence labelled as S→DOE in the 'Facets of the Domain' Impacted column.

5.4 System

System is one of the facets of the domain that impacts or is impacted by the development of web system. In terms of the system, this facet of the domain includes system-related characteristics such as scalability, usability, navigation structure, system quality and personalisation of service and product offering.

The need to **personalise service and product offering** to customers, trading partners and employees lead to the system designer to personalize link, structure, content and behaviour of the web page [56]. E-commerce and e-business initiatives have a significant impact on the organisation's stability, as it increases competition thus pressuring system developers to develop web applications that offer distinct competitive advantage. The challenge is to build customisable Internet applications, such as developing a personalisable Internet application by including multiple interfaces and each being customised to a specific device [56]. The result of this is that it might provide different navigation topologies to different users, recommend specific products according to a user's preferences, or implement multiple policies. These personalisation tasks have an impact on the requirements of the system. An application is required to model the user and user preferences, build profiles, find algorithms for best linking options and others. The critical issue is however, to integrate all the personalisation features into a single design. It has been suggested that personalisation is approached from the design perspective so as to give users a more abstract – and hence more extensible - understanding [56]. This method can help to provide a framework for reusing designs and

design experience. Schwabe et al [56] introduces the Object-Oriented Hypermedia Design Method (OOHDM) for constructing web applications [57, 52], cited in [56]. Link personalisation for example, is useful for an electronic store such as Amazon, who may wish to provide customers personal recommendations of products that they prefer. A result of this personalisation is that the product directly accessible for one user may be different from those available to a different user and that certain users will have more direct access to certain information than the others [56].

Performance and **scalability** are issues that impact on web based system significantly. There are several factors that affect the scalability of a web-based system, such as the way the data and capacity are managed over the databases and network. If system capacity is inadequate, system performance can degrade substantially that leads to a loss of customers [4]. Poor site responsiveness (i.e., long response times) can also result in a loss of customers and revenue to competitor sites. The performance and scalability of a site are therefore vitally important issues that must be carefully managed to avoid blunders that risk a business' success This is particularly true for web based shopping system, which offers promotions on its site. In a web-based shopping system, robots are employed to monitor their web site's marketing and promotion activities [4]. Common use of robots includes determining a site's liveliness, measuring a site's responsiveness, and collecting a site's pricing information. Robots are another source request which could affect the system's performance. It is therefore important to distinguish these sources of requests from those of users when reporting on use behaviour and assessing scalability. Web based system that has large amount of response generations are therefore more impacted with performance and scalability issues.

Efficient data management is key in ensuring that the web-based system is scalable [40]. The internet presents a unique elasticity with respect to scale since the number of users accessing a site at any moment is largely unpredictable. Processing power, Input/Output bandwidth and storage all have to scale accordingly to meet the task and cost. A major event such as a press release can cause loading spikes large enough to deny access to a web site [40]. Sudden spikes can occur when newsworthy information leads to "flash crowds" [21].

A system such as a web-based shopping system can be impacted significantly by promotions and the input/out data. In a web-based shopping system studied by Arlitt et al [4], the application servers were a system bottleneck because they performed all the required response generations. In this study by Arlitt et al [4], it was reported that 2.7 times as much application server infrastructure is needed to support a system with 8% personalisation of cacheable requests, as opposed to 0% personalisation. This can be issue for sites that target many users and have wide fluctuation in workload intensity. One approach for designing a scalable e-commerce system is to deploy an application server cache that is large enough to store all of a site's responses (or static portions thereof). With this approach, a cache replacement policy is not necessary. This strategy is recommended due to the large difference in resources needed to serve a response from cache compared to generating a response on-demand. Web-based shopping sites must have adequate capacity to support peak periods.

In order to improve the performance and scalability of e-commerce systems, a thorough understanding of the system workloads have been conducted by Arlitt and Jin [5]. E-commerce provides businesses with a great opportunity to quantify the quality they provide their customers, since the underlying use of computer systems enables businesses to collect the data necessary for analysis. Many web-based shopping sites today are interested in personalising online shopping as a means of differentiating themselves from their competitors. There are methods identified for improving scalability by focusing on the most significant characteristics, such as the distribution of requests by

resource types, usage of the site during measurement periods, resource referencing patters and client request behaviours [5].

Dynamic data, insufficient network bandwidth and poor network design impact on the system's **performance** [12]. Performance is a critical factor and has a significant impact on the organisation's system efficiency, particularly for websites that receive hundreds of thousands of hits per minute. It may also impact on websites that receives a moderate amount of traffic if most of the requests are for dynamic data, which are expensive to create. There are techniques that can be implemented to improve performance at a Web site [12]. Multiple processors can be used to scale the CPU capacity of the system. The web page can be redesigned to provide more information close to the home page, so that less navigation is required to obtain critical information. System developers need to be selective of the types of web servers deployed so as to service a high request rates and techniques for routing requests to servers. Web servers provide two types of data, which are static and dynamic data. Dynamic pages can reduce web server performance as to construct dynamic data; the programs need to be executed at the time a request is made. This is unlike static data, which is stored at a server. Dynamic pages are essential at web sites, which provide data that change frequently. A technique for improving performance for dynamic data is to cache the dynamic pages the first time they are created. Web page design can have a significant impact on performance [12]. Web pages should be designed to convey useful information in a limited number of pages so that clients do not have to navigate through too many pages to obtain information that they looking for. If the pages are not carefully coded, retrieval of information unable to be viewed in the visible portion of the browser can cause the page to be held pending retrieval of size and placement information before the browser can deliver the page.

5.5 Organisation

In terms of the organisation, facets of the domain include things such as the organisational structure, communication process, operations and matters relating to people who work within the organisation context.

Streamlining **intra-organisational communication and collaboration** process between employees and management is a complicated task. It is therefore critical to deploy an intra-organisational system such as the intranet to facilitate such processes. The process of adopting and deploying a web-based intra-organisational system has a significant impact on the organisation's structure and technology (and system). Intranet is a web-based intra-organisational system that allows internal stakeholders to communicate and collaborate work processes. Organisations need to have a thorough analysis of impact that is caused by adopting the Intranet's technologies [61]. Intranet technologies and its management are complicated as it consists of aspects, such as Internet security, change of application platform, change of accounting operations, employee authorisation management, integration of workflow and information updating [61]. The success factors for implementing corporate Intranet are, security, internal control, tools and training, administration and management, legacy support, and basic network infrastructure [41, cited in 61].

In a study on 40 enterprises which have adopted the Intranet, it has affirmed the impact of critical factors of technology, organisation, management, and top manager-user on the success of Intranet adoption in an enterprise [61]. In technology factors, the author suggests that enterprises: (1) should create information security system; (2) ensure that their information quality by creating total quality method (TQM) and international standard system (ISO); (3) perform system integration by integrating Management Information System into Groupware Intranet so that old database can be transferred to a

new database by linking computer graphic interface (CGI) with Middleware. In management factors, integration and planning of total information sources play an important role in Intranet adoption. In organisation factors, the study shows that department cooperation and communication as the most important factor. It is therefore critical that enterprises combine information network with the relational network of reputation to create a virtual network organisational model. In addition, enterprises should also integrate the application of Intranet, extranet, EDI and electronic order system so as to provide a good platform for system integration.

6 Impacts and the Domain Boundary

Previously in Figure 1, we show that a Web system and its problem domain are mutually constituted – i.e. have an inter-dependence such they impact each other. This problem domain involves characteristics of both the organisation hosting the system and external environment that relates to it. These characteristics can be grouped into several sub-domains, which are useful in understanding and reasoning about the inter-dependencies. From the analysis of the literature, characteristics which are impacted upon, and which create impacts, have been identified. As discussed above (and shown in Figure 1) we can identify the domain of context, the domain of effect, and the intersection of these two – the domain of mutual influence. In order to identify where the various characteristics lie with respect to these domains we have developed the Impact and Domain Diagram (refer to Figure.2). Let us illustrate the diagram with several real world examples which were analysed from the literature.

As shown in the extracted table from Appendix 1, characteristics 1, 2, 3 and 4 are characteristics of the **organisation** domain, which impact on characteristic 5, which is a characteristic of the **system** domain. To illustrate this with an example, we employ a real-world example discussed in [63]. Adaptec, Inc. is a large microchip manufacturer supplying critical components to electronic equipment makers. The organisation needed to improve on its product delivery cycle time as it required up to 15 weeks delivering products to customer, while competitors took only 8 weeks. The longer delivery time was mainly caused by the need to coordinate design activities between Adaptec, Inc. headquarters in California and its three principal fabrication factories in other countries. In order to solve this problem, Adaptec, Inc. adopted extranet and enterprise-level supply chain integration software, which incorporates automated workflow and E-Commerce tools. E-mail was used to communicate with manufacturers across several time zones, thereby automatically starting the flow of raw materials. This in turn reduced invoicing and shipping times. Due to the organisation's need to reduce design cycle time, the implementation of the extranet and web applications impact on the organisation's system. The system developers needed to ensure seamless integration of these applications and tools. As the implementation of the extranet and web application tools were a success, it therefore impacted positively on the organisation as it benefited from the reduced time required to generate, transmit and confirm purchase orders [16]. In Figure 2, the bi-directional arrow between characteristics 1,2,3 and 4 with characteristics 5 shows that these characteristics are **mutually impacted**.

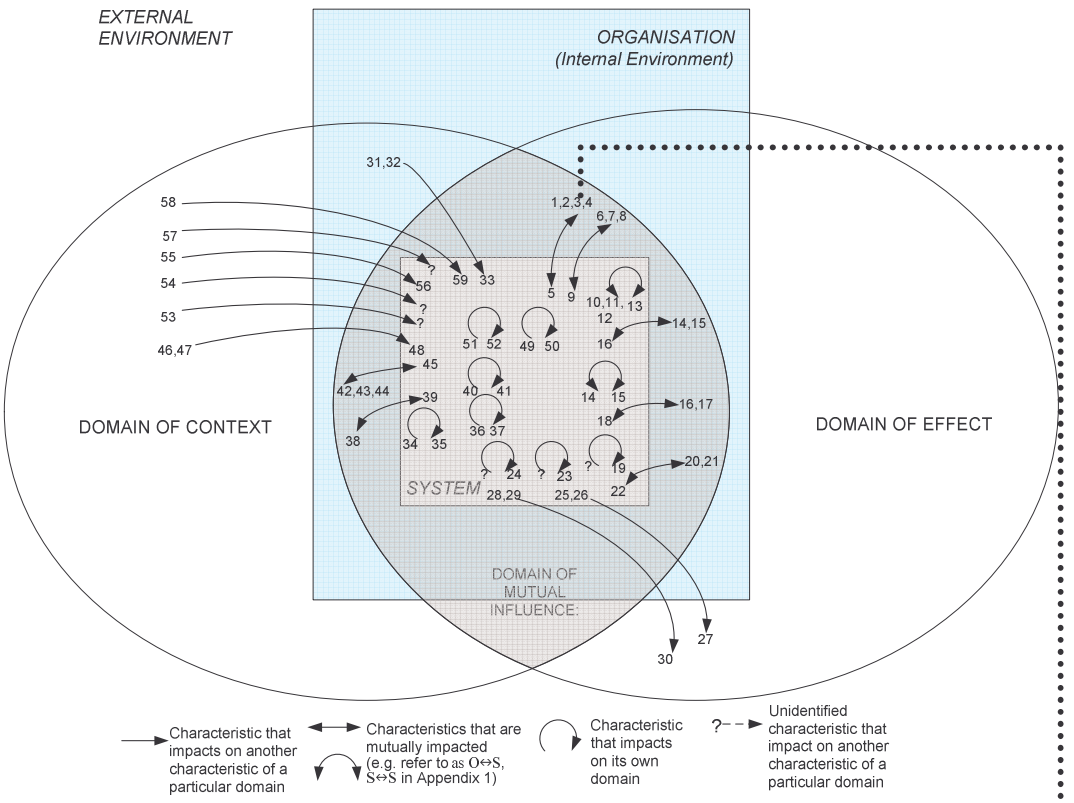

Figure 2. Impact and Domain Diagram

	Characteristics which affect	Characteristics that are affected	Types of Web systems	Facets of the Domain Impacted	Effect of Impact	Level of Impact	Sources
1	Goods and services delivery to market (1) Cycle time of product ordering and delivery (2) Ordering process (3) Multiple interactions within components (4)	Time and speed of org. decision-making process (5) Time of workflow process) Speed of workflow process Time (latency)	Internet/ Extranet	O↔S	Positive Positive and Negative Positive Positive	High (all aspects) High (all aspects) High (all aspects) High (all aspects)	Byrne (2000) Jones and Kochtanek (2002) Golicic et al (2002) Greenstein and Feinman (2000), Turban et al (2000)

Table extracted from Appendix 1

Integration of front and back-end office system (characteristics labelled 48 in Appendix 1, row 18) is a characteristic of the **system** that is impacted by the two characteristics of the domain of context, which are customers' orders and requests (characteristic labelled 46) and customers' requirement of viewing orders on their own system (characteristic labelled 47). For example, in developing a web system, which manages customers' complex transactions, Dell Computer's customers' need their orders to be integrated to their own system. The customer therefore forms the **domain of context**, which impact on Dell's e-business system development initiative. This also impacted on the

organisation as document management processes, which were previously managed solely on a local database system by the employees, will now need to be fully integrated to the network and delivered to the customers via the Internet.

With this e-business initiative, Dell made this database available to its customers' through customised Premier Web Pages, constructed and posted on the Internet by Dell [47]. As a result of this, the number of employees handling customers' transactions will also be significantly reduced. The Premier Web Pages are password-protected and are updated regularly to reduce the complexity of every purchase by displaying detailed specifications of the customer's previous transactions. From this example, this function may impact on the web system, particularly the **Extranet and Internet** due to several factors, such as integrating the front and back-end systems, ensuring system security and providing and delivering fast information and services. As the transaction information is available mainly on the Internet, it is very critical that the e-business systems are reliable and has high system performance. Dell's readily accessible transaction information streamlines the procurement process thus increasing the ease and speed of the purchase [46, 19].

In another example, Figure 2 shows that, dynamic data and rich media (characteristic 36) impacts on an organisation's system performance (characteristic 37). The one-directional arrow shown on Figure 2 illustrates that dynamic data is a characteristic of the **system** domain that impacted on another characteristic (system performance) of the **system** domain. An example extracted from the literature about Akamai Corporation is used here to demonstrate these impacts. As demand for high-speed Internet connections grown, the demand for bandwidth-heavy applications and media also increase substantially [63]. With the growing number of users and an abundance of rich media, the Internet is becoming extremely congested. Network control is therefore needed to manage the congestion. These problems lead to an initiative by Akamai Corporation to manage Internet traffic. Akamai used complicated mathematical algorithms to transfer Web pages from the closest Akamai-owned server to a customer's location, thereby passing fewer router hops. The result is that this process helps to eliminate Internet gridlock. In order to reduce network delay, Akamai Corporation perform caching and content distribution. From this illustration, it shows that system-related characteristics such as rich media and dynamic data may have a high impact on another characteristic of the system domain, which in this instance is the Internet congestion.

Conversely, system-related failure, such as network or server problems [12, 4, 11], change in government regulations and change in organisational structure [63, 34, 61, 23, 18] may also impact on the web system that is in development within the organisation's function, such as Dell's Premier Web Pages example explained above. The web system that is in development is therefore considered volatile whereby it is impacted by most of the characteristics, which also impact on other facet of domains.

7 Implications for organisations

From the framework and illustrated examples, we may conclude that it is critical for clients to know and articulate the characteristics of the business domain that are going to impact on their organisation. In order to be able to articulate these characteristics, organisations need to first be aware of these impacts. Appendix 1 presented in this paper serves as a guide for clients and web system developers to be aware of these impacts. Pertinently, the dimensions presented in the table depict the extent and level of impacts that the characteristics will have on the business domain. The extent and level of impacts dimensions will guide the web system developers and clients in evaluating if the web system can have

a positive or negative impact and also if they will pose a high, medium and low impact on the organisation. The framework presented will guide clients and web system developers to clearly visualise the different domain that can be impacted by the development of the web system.

This framework can also guide clients and web system developers in mapping the characteristics that are most likely to impact on the client's business domain. By mapping these characteristics, the clients and web system developers will be able to evaluate the aspects of the domain impacted by the system and imperatively if the domain is impacted mutually. Characteristics of the domain that are mutually impacted are the ones that need to be carefully examined as these characteristics have a reverse impact and it highlights that a web system project can impact on two domains.

7.1 Preliminary case study: A web-based movie-meal deal campaign

The data that was collected from the literature has become the basis for research questions to be used in a series of industrial case studies. The case study is targeted at web development companies that have recently developed web systems for their clients. The purpose of the case study is to identify and analyse specific impacts from the web system development projects. In particular the goal is to develop a clearer understanding of the mutual dependency between application solutions and the organisational context of the web applications.

7.1.1 Brief description of the web-based movie-meal deal campaign

As an initial part of the study, a preliminary small-scale case study was conducted on a web development company, DynamicWeb[b]. DynamicWeb developed a three-month web promotion campaign for a fast food company (the client). This project is a movie-meal web campaign whereby the client is promoting a fast food meal in conjunction with a movie. For this project, DynamicWeb developed a website for a variety of activities, particularly for people to participate in a movie-meal deal competition. In this competition, the customer of the fast food company purchased a fast food meal. On each fast food meal box, there is a code and the customer needs to submit the codes via the website or SMS (standard messaging system). With SMS, when the customer puts in her/his SMS entry, she/he also goes to the website to view the competition results. The web and SMS medium are therefore supporting each other. There are also people who enter the website not only to submit the codes, but to get more information about the movie, play online games, download items relating to the movie to their desktop, participate in online competitions and also get more information. When they submits a code, DynamicWeb collects considerable information from the people, particularly their email addresses as a method of contacting people to inform them if they have won the competitions. With the email addresses that the company collects, DynamicWeb is able to put this information in a database that forms part of a Customer Relationship Management (CRM) system. This system allows the client to communicate with their audience very quickly, easily and responsibly, according to their demands via an email marketing system, which is called Electronic Direct Mail (EDM) system. The EDM system also provides measurability so that the client is able to analyse the people's activity and interactions on the web. DynamicWeb provides the client with a platform that allows the client to develop loyalty campaigns. For the campaign, the in-house developed CRM system is integrated with the email system. The information collected from the email responses are then stored in a database system. With this initiative, the client and DynamicWeb are able to customize the email

[b] The name of the development company has been changed to preserve anonymity

communication and develop ways to control their database, analyse the data and use it online wherever they are.

7.1.2 Results of the web campaign

At the end of the three-month campaign, DynamicWeb reported that they have received a high response for their online competitions. For the first online competition, the EDM Publisher system has received a response rate of approximately 40% to the emails that were sent out. For the final competition, they received a 38% response rate. This exceeded the expectations of both DynamicWeb and the client. For the movie-meal deal promotion, about 37,000 people submitted the codes via the web. DynamicWeb was also able to gather approximately 53,000 people on the database. The information stored on the database system serves as valuable data that will be used for future promotional campaigns. The web promotion campaign impacts indirectly on the sales revenue of the fast food company as the web campaign attracted people to purchase meals from the fast food company and participate in the various online competitions. The other impact characteristics will be discussed in the next section.

7.1.3 Analysis of results and its implications on the characteristics that were impacted

The promotions had a significant impact on the client's overall marketing campaign and were regarded as success. The web users who participated in the competitions, promotions and activities on the website received good value in terms of the offers given. The client benefited from this project significantly as they are able to get a comprehensive database of the people who participated in the campaign promotions. All the characteristics illustrated in Appendix 1 were discussed with the project manager of DynamicWeb. The project manager identified a number of characteristics which he felt were significantly impacted on by the introduction of this specific Web system, including: security; scalability; and system performance. DynamicWeb built most of the web systems in-house; therefore it has minimal impact on the client. In terms on the web campaign's impact on the client's system's security, the level of impact on the client's system is low. This is because in order to protect the client's document and proprietary data, the project manager assigned appropriate security levels to the system and back up was made to ensure data are not lost or corrupted. In terms of system scalability and system performance issues, the level of impact for the system is medium as the website did not have large scale query facilities. System-related integration issues such as integrating the EDM system with the CRM system and integration of the front-end and back-end systems were not critical.

In relation to the impacted characteristics that are presented in this paper, the impacts discussed above in this web campaign project are mostly low-level compared to what highlighted from the literature. This is due to the size of the web system that was being developed as the web campaign was not a large scale project and the systems involved, such as the CRM, EDM and the database system are developed in-house. Furthermore, the servers that managed the website and database systems are located physically and virtually in the DynamicWeb's premises; hence the impact on the client's system is minimal.

7.2 Limitation of this case study and Future Work

The case study presented above is a small-scale industrial study. As it is a small-scale case study and its focus is mainly on the front-end system, only several of the characteristics that were highlighted in the literature are related to this project. Ongoing work will attempt to address this limitation by

focusing on organisations that have recently developed web based enterprise systems which have had a direct impact on their trading partners, such as the suppliers and customers. This initiative may enable us to discover more specific and fine-grained impacts and characteristics that will be discovered from the organisation. It is expected that this will complement (and confirm) the literature survey and hence the model and framework that we have developed in this study.

8. Conclusion

In this paper we have described a framework for structuring information about Web impacts. The application of this framework in collating specific impacts is described elsewhere [10]. This framework is designed based on key characteristics of these impacts, and can support specific reasoning about these impacts. For example, once a data repository has been populated with information on potential impacts, it becomes possible to address questions such as: "if we make a change to the security support in the design of an intranet, then what aspects of the business operations might be most significantly affected?"

Ongoing work is focusing on commercial case studies which will be providing us with significant data on business impacts which can be structured according to this framework. This can subsequently support organisations in developing strategies for the co-evolution of web systems and business processes. The nature, extent and dimensions of the impacts identified from the organisations will serve as value-added knowledge for the companies in understanding how to best manage their Web development projects.

A prototype tool is currently being developed from the repository of the knowledge captured in this paper. This tool aims at allowing industry users (for example, web system developers and their clients) to easily query for information such as the web systems impacts and their domains. The premises of the tool are to help identify and assess the impacts and their extent, and to identify characteristics typical to various web systems, such as the Internet, extranet and intranet. This tool will also increase awareness of risks involved in design. Pertinently, it will assist in strategic decision making of various stages of web systems development.

Acknowledgements

The authors wish to acknowledge the support provided by the Australian Research Council under grant no. DP0211461.

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Appendix 1: Characteristics of the business environment that impact and/or are impacted by the web system

The following table summarises the characteristics of the business environment that impact on, and/or are impacted by, a web system. The numbers in brackets ( ) displayed on each characteristic correspond to the numbers in Figure 2.

Key: Facets of the Domain Impacted

O↔S: Organisation characteristic that impacts on the System characteristic but which is in turn directly impacted by the system. Hence the organisation and system characteristics are mutually influenced, thus identified as being the characteristic in the Domain of Mutual Influence

S↔S: System characteristic that are mutually influenced by another system characteristic

O→S: Organisation characteristic that impact on System characteristic

S→S: System characteristic that impact on another system characteristic

S→ DOE: System characteristic that impact on characteristic of the Domain of Effect

DOC→S: Characteristic that provides the context for the system which impact on the system.

Explanations for Level of Impact:

High: Significant Impact. Impact that change the business model, business process, customer-supplier relationships, value offering, organization structure and system

Medium: Impact that change some parts of the business model, business process, customer-supplier relationships, value offering, organization structure and system

Low: Minimal impact. Impact that do not drive significant change to the business model, business process, customer-supplier relationships, value offering, organization structure and system

	Characteristics which affect	**Characteristics that are affected**	**Types of Web systems**	**Facets of the Domain Impacted**	**Effect of Impact**	**Level of Impact**	**Sources**
1	Goods and services delivery to market (1) Cycle time of product ordering and delivery (2) Ordering process (3) Multiple interactions within components (4)	Time and speed of org. decision-making process (5) Time of workflow process) Speed of workflow process Time (latency)	Internet/ Extranet	O↔S	Positive Positive and Negative Positive Positive	High (all aspects) High (all aspects) High (all aspects) High (all aspects)	Byrne (2000) Jones and Kochtanek (2002) Golicic et al (2002) Greenstein and Feinman (2000), Turban et al (2000)
2	Supply chain intermediation and disintermediation in (6) Access levels differentiation (7) Customer value (8)	Value Exchange (9)	Extranet	O↔S	Positive	Medium for all aspect EXCEPT High for value offering	Gordijn and Akkermans (2001), Gordijn et al (2000) John et al (2002) Turban et al (2000)

	Characteristics which affect	Characteristics that are affected	Types of Web systems	Facets of the Domain Impacted	Effect of Impact	Level of Impact	Sources
3	Service personalization (10) Robots to monitor promotion activities (11) Multiple response generations (12)	Scalability (13)	Internet/ Extranet	S↔S	Negative	High for System	Arlitt et al (2001), Arlitt and Jin (2000), Challenger et al (1999), Fielding and Taylor (2000)
4	Real time access, easy to use interfaces, interactivity (14)	Usability (15)	All	S↔S	Positive	Medium (all aspects)	Hansen (2002), Teo et al (2003), Morris and Turner (2001)
5	Collaboration and communication support (16) Interface between systems (17)	Communications interface (18)	Internet	O↔S	Positive	High (all aspects)	Peng (2002) Fielding and Taylor (2000), Turban et al (2002)
6	Unspecified system characteristics	Navigation structure (19)	All	S→S	Positive and Negative	Medium (all aspects)	Scharl (2001), Conklin (1987), Schwabe et al (2001)
7	Security threat to org. proprietary data (20) Internet infrastructure security threat (21)	Security (22)	All	O↔S	Negative Negative Negative	High (all aspects)	Murray (2003), Osmonbekov et al (2003) Chakrabarti and Manimaran (2002)
8	Unspecified organisation characteristics	Intra-organisational communication & collaboration (23)	Intranet	O→S	Positive	High (all aspect) Low for all aspect EXCEPT Medium for organisation	Tang (2000) Michael (1996), Ciborra (1996)
9	Unspecified system characteristics	Business Process (24)	Intranet/ Extranet	S→S	Positive	Medium (all aspects)	Fowler (1998), Coltman et al (2002), Giaglis (1999), Scheer and Habermann (2000 Swatman et al (1994)
10	Network infrastructure use (25) Quality (26)	Customer Expectation (27)	Intranet/ Extranet	S→DOE	Positive and Negative	Medium (all aspects	Gaedke and Turowski (2000) Rotondaro (2002)
11	Document routing, retrieval and approval process (28) Process of ordering (29)	Workflow process (30)	Intranet/ Extranet	S→DOE	Positive Positive Positive and Negative	Medium (all aspects	Miers (2001) Ames et al (1997) Cunningham (1999)

	Characteristics which affect	Characteristics that are affected	Types of Web systems	Facets of the Domain Impacted	Effect of Impact	Level of Impact	Sources
12	Change from mass production manufacturing to demand-driven manufacturing (31) To attain a more efficient purchase method (32)	Material Purchase Method (33)	Extranet	O→S	Positive	Medium (all aspects)	Turban et al (2000)
13	Information accuracy, currency, output timeliness and relevance (34)	Information Quality (35)	All	S→S	Positive	Low for all aspect EXCEPT Medium for value offering	Negash et al (2002)
14	Dynamic data, complex web page design (36)	System Performance (37)	Internet	S→S	Positive	High (for all aspects)	Challenger et al (2002),Challenger (2000)
15	Management and improving org.'s relationship with customer and supplier (38)	Relationship Management (39)	Extranet/ Internet	O↔S	Positive Positive	Medium (all aspects) Medium (all aspects)	Dignum (2002)
16	Data accuracy, reliability, system flexibility, ease of use (40)	System Quality (41)	All	S→S	Positive	Medium for all aspect EXCEPT High for System	Negash et al (2002)
17	Web adoption cost (42) System acquisition cost (43) Transaction cost (44)	Cost (45)	All	O↔S	Positive	Medium (all aspects)	Osmonbekov et al (2002), Kalakota and Whinston (1996), Ardagna and Francalanci (2002)
18	Customers' orders and requests (46) Orders to be viewed on customers' own system (47)	Integration of front and back-end office system (48)	Extranet/ Internet	C→S	Positive and Negative	High for System (medium for trading partners and organisation)	Dignum (2002)
19	Interoperability problems of different web applications and tools (49)	Integration of different web system applications (50)	Internet	S↔S	Positive and Negative	High for System medium for organisation)	Bohner (2002), Jin et al (2002), Bussler et al (2003), Gaedke and Turowski (2000)
20	Customisable and personalisable web application (51)	Personalisation of service and product offering (52)	Extranet/ Intranet	S→S	Positive	Medium for System	Schwabe et al (2002), Schwabe and Rossi (1998), Rossi et al (2001)
21	Competition from existing and new firms (53)	None reported	Internet	C→S	Negative Negative	Medium (all aspects) High (all aspects except System)	Wheelen and Hunger (1998), Chan and Peel (1998) Ing et al (2000)
22	Legal, ethical, govt regulation (54)	None reported	All	DOC→S	Positive and Negative	Low (all aspects)	Turban et al (2000), Mason (1995)

	Characteristics which affect	Characteristics that are affected	Types of Web systems	Facets of the Domain Impacted	Effect of Impact	Level of Impact	Sources
23	Supplier and Customer Interaction (55)	Facilitation of supplier-customer interaction (56)	Internet/ Extranet	DOC→S	Positive Positive	High (all aspects) High (all aspects)	Golicic et al (2002), Hoffman et al (1995)
24	Web Technology Adoption (57)	None reported	Intranet	DOC→S	Positive	Low for all aspect EXCEPT Medium for organisation	Jones and Kochtanek (2002)
25	Uncertainty of business environment (58)	Information visibility facilitated by speed and connectivity, evolving and changing business process (59)	All	DOC→S	Negative Negative	Medium (all aspects) Medium (all aspects)	Golicic et al (2002) Achrol (1997)