Problem Frames Approach to Web Services
Requirements

Anju Jha
Computer Science and Engineering
University of New South Wales
+ 61 (02) 98697716
anuj@cse.unsw.edu.au

ABSTRACT
The aim of our research is to capture and describe business to IT problems in the context of business requirements for Web services. As a means to align Web services initiative with the business strategy, we propose a research methodology to capture the business objectives of an organisation from strategy to implementation. We use Progression of Problems to understand the strategic objectives, business needs and the business context. We have experimented our methodology on Amazon Web service. We found it easy to understand the business strategy and the business needs of Amazon.com using our methodology.

Categories and Subject Descriptors
D.3 Problem Frames/Progression of Problems

General Terms
Management, Verification and Documentation.

Keywords
Requirements, Progression of Problems, Problem Frames, Web services, alignment, capabilities.

1. INTRODUCTION
Web services technology represents a new generation technology that promises enhanced ability to collaborate and provides opportunities to generate greater business value without installing extensive IT infrastructure[1].

In order to make Web services more responsive to the strategic objectives, the requirements engineers need to take a deeper look at the firm’s business strategy, business needs and how to create an alignment between the firm’s business strategy and Web services capabilities it offers to the outside world.

Researchers are interested in issues such as the effects of adoption of Web services infrastructure and selling Web services as capabilities to the service consumers on the organization’s business strategy, business goals and business objectives [2].

We propose a research methodology that is used to understand Amazon’s business strategy strategic objectives. Progression of Problems is used to understand the strategic objectives and the business context.

The rest of the paper is structured as follows. Section 2 discusses the background to our research. Section 3 describes our adopted approach. Section 4 describes our methodology and section 5 provides an example. Finally, section 6 presents an evaluation our research work and section 7 offers conclusion.

2. BACKGROUND
Requirements (RE) is all about describing a clients’ problem domain, determining what desired effects the clients want to exert upon that domain (requirements) and specifying the external face of the proposed systems to enable those desired effects to occur and to give designers a specification to help them build the proposed system [3]. Davis describes requirements as “(1) a condition or capability needed by a user to solve a problem or achieve an objective (2) a condition or capability that must be met or possessed by a system ----- to satisfy a specification, or other formally imposed document” [4].

Web services is often seen as a capability that an organization would deploy to meet its business objective. A capability is defined as a named piece of functionality (or feature) that is declared as supported or requested by an organization that requests Web services.

Much of Requirements Engineering research concentrates on the ‘late-phase’ requirements engineering and focuses on producing a requirements document to pass on to the developers[5]. Less attention has been paid to describe real world problems and business objectives of the organization. An understanding of real world problems is important for following reasons:

Systems are no longer viewed in isolation; they are seen as ‘enablers’ of business solutions[5]. But deploying innovative solution without aligning it with the business objectives/ strategy leads to failure of the IT initiative[6].

To bridge the research gap, we propose the following research questions:

RQ1: Is it possible to describe a business to IT problem in the context of business requirements for Web services?
RQ 2: Is it possible to describe the business requirements and context of an organization adopting Web Service appropriate requirements engineering framework? This research question leads sub research questions: Is it necessary to describe the business and problem context for Web services? Research shows that a good grasp of the business context and domain context of Web services is needed before describing the specifications[7].

In section 3 we propose Problem Frames approach that can be used to 1) separate strategic goals and context from operation goals and context and 2) understand the business strategy and the business objectives of an organization from strategy to implementation.

3. OVERVIEW OF PROGRESSION OF PROBLEMS

According to Jackson [8], a progression of problems captures the context and requirement of an IT problem and provides a means to represent domains and their requirements that are distanced from the machine. That is, these domains may not have a direct interaction with the machine but the requirements for that machine are nonetheless felt that “deep into the world” [8]. Jackson explains the relationship between requirements and domains: “By analysis of the requirement RA and domain DA, a requirement RB can be found that refers only to domain DB, and guarantees satisfaction of RA. This is the requirement of the next problem down. Eventually, at the bottom, is a pure programming problem [RM in fig. 1]” [8] (p.103).

Davis [9] has recognized that problems go deep into the world and states there is a dilemma between what and why because ‘what something does’ as opposed to ‘how it does it’ is entirely a matter of perspective. He rightly identifies that one person’s ‘what’ is another’s ‘how’, that ‘how’ is someone else’s ‘what’, which is someone else’s ‘how’. Jackson has formalized, i.e. modelled, this dilemma through a progression of problems. Davis’s dilemma can be explained with reference to figure 1.

![Figure 1. Progression of Problems, adapted from Jackson [8], p.103](image)

For interested parties in domain DA, in figure 1, such as senior executives, RA is their ‘what’ and beyond that – RB to RM – is their ‘how’. Middle management in DB view RB as their requirement, i.e. their ‘what’ and ‘RC’ as their ‘how’, and so on. The inverse should hold true, though often it is ignored. That is, those people at the interface of the machine in domain DD (domains can represent anything physical in the real world – people, departments, machines etc. – and abstractions of that physical reality, but not conceptual models) ought to view everything back to RA as their why. This would then provide justification for what they are doing and explicitly trace to why they are doing it.

4. RESEARCH METHODOLOGY

We will employ Jackson’s Progression of Problems [10] to capture the business objective/strategy and the business context of the organizations from strategy to IT implementation. The steps in our methodology are now introduced and can be better explained in fig 2[11].

![Figure 2. Requirements Engineering Research methodology (adapted from [11])](image)

The steps of our methodology are:

**Step 1: Understand the organization’s business strategy and overall objective**

This step will involve understanding of an organization’s business strategy. Porter states that strategy involves “choosing a different set of activities to deliver a unique mix of value”[12]. Tregoe et al.[13] define strategy as “the framework, which guides those choices that determine the nature and direction of an organization.” The expression of an organization’s business strategy is its IT-oriented capabilities[14]. These capabilities alignment-oriented capabilities are continuous source of value to an organization and cannot be copied by the rivals. These have a direct impact on firm’s performance and can improve strategic alignment.

**Step 2: Use Progression of problems to describe the organization’s business objective and the business context from strategy to Implementation.**

We will use Osterwalder and Pigneur’s e-BMO to get the description of the organization’s strategic objectives from 4 perspectives: Service Innovation, Customer Relationship, Infrastructure Management and Financials. It will help answer -
what’, ‘why’, ‘how’, ‘how much’ and ‘who’ questions. The e-BMO aims at describing what a company offers, who it targets with this, how it can be realized and how much can be earned by doing it.

The dimensions that we feel which are important in understanding the strategic objectives and the business context of an organization offering its capabilities wrapped in Web services to the outside world are[11]:

Service Innovation: It describes all the service capabilities by the organization. This element is composed of the Value Propositions the firm has to offer to specific target Customers Segments and the capabilities a firm has to deliver to different customers. An organization must ensure that it has the requisite capabilities to underpin the proposed value. Capabilities are reusable patterns, which offer services to the target customers.

Customer relationship: describes the way in which an organization goes to market and get in touch with its customer and makes the Web services capabilities available to the customers. It is comprised of the following elements:

New Business Opportunities: This refers to new business opportunities that are offered to the customers.
Feel & Serve (Channels): This refers to the way an organization reaches an organization. An organization makes its channel strategy quite clear. It needs to have a plan as to how it will deliver services to the customers. If it sells services directly to them over the Internet, it needs to provide customers information as to how to access these services in real time.
Trust & Loyalty: It is essential to establish ‘trust and loyalty’ between the business partners. There should be clear licensing agreement and privacy policy between the trading partners, which should adhered to.

Infrastructure management: Describes the value system configuration – that is necessary in order to deliver an organization’s offering and to establish and maintain customer relationship. It comprises of service provisioning (how services will be provisioned). The Infrastructure pillar comprises of 3 elements.
Partner Network – It deals with how the activity configuration will be delivered among the partners of the organization.
Resources – In order to create value an organization needs tangible and intangible assets.
Value Activity – The main activities and process required in order to do the business

Financials: The financial perspective is rather important for any web initiative. Financial aspects can be understood, as costs required to get the infrastructure and to create value and revenues generated and the difference between revenues and costs determines the profitability of the organization.

We will use Progression of problems to describe the four major activities in the organization from strategy to implementation. Progression of problems will be used to capture the business objectives that are distanced from the machine.

5. AN EXAMPLE

Amazon.com is a B2C (Business-to-Consumer) online store that operates globally. It sells a variety of products such as books, DVDs, CDs, software and toys. It started as a book retailer but then branched out later into the online sales of other products. Amazon provides a range of other services, including information about books, interviews with authors, books and recommendation from customers and other media links to other websites.

Section 5.1 introduces the Amazon case. We have constructed the Amazon Web Service case from [15-19] because we could not find an appropriate exemplar in the RE literature.

5.1 Amazon’s Web Services

Amazon uses Web Services to enhance its core business – online retail sales. Amazon offers interesting features in its renowned online catalog.

Amazon’s Web Services program is a business unit within Amazon.com that exposes the service capabilities Amazon uses to power its own e-business to a wider market. Amazon offers Web Services to mainly three categories of customers: developers, associates and sellers and vendors. We will focus on associates only.

5.2 Step1 of the Methodology: Understand Amazon’s business strategy and overall objective

Amazon’s mission is to increase market share by exposing their products to end-customers, enabling them to boost sales as competitors emerge and also to form partnerships with business rivals. This allows Amazon to control – to an extent – the activities of its rivals should they wish to expand and add more capabilities: Amazon can offer services as capabilities direct to associates. The online retailers that were once Amazon’s competitors can become its partners. For Amazon it is a long term strategic lever, connecting its business partners as directly as possible to sources of innovation and creativity. Amazon has created a Web API that allows associates to incorporate Amazon’s features into their website. An API is a programming mechanism that allows an application or system function to make itself available to other applications. An API provides a built-in interface to its associates in return for a referral fee on every sale made by the associate.

5.3 Step 2 of the Methodology: Amazon’s business objective and the business context from strategy to Implementation.

We will employ Jackson’s progression of problems to study the Amazon’s strategic-level objectives in adoption of Web services and its business context. We present a suit of Progression of Problems from strategy to implementation with interconnections and dependencies between them (See Figure 3).

Progression of problems:

In table 1 we have provided details of the Organisation’s mission, its high-level strategic objectives and context and low-level operational objectives and context. This table is derived from eBMO (fig2) and helps us construct our suit of Progression of Problems. Progression of Problems is used to describe alignment between Amazon’s strategy and IT capabilities it chooses to offer to the outside world. These capabilities act as catalyst in creating value for the Web service capability user and the provider. These Web service capabilities provide enriching experience to the customers. Progression of Problems is used to understand Amazon’s ‘why’, ‘what’, ‘how’, ‘how much’ and ‘who’ strategy behind offering its core capabilities to the customers.
Table 1: derived from eBMO

<table>
<thead>
<tr>
<th>Mission</th>
<th>Strategic Objectives/Operational objectives</th>
<th>Context</th>
<th>Progression of Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Service Innovation</td>
<td>Strategic Objectives: 1) Service Innovation 2) Target innovative services to the target customer. 3) Value proposition to the customers 4) Value capabilities offered to the Associates. Operational Objectives: Embed Web service capabilities into the Associate shop front</td>
<td>1) Amazon.com 2) Amazon Web services. 3) Associate 4) Web Services 5) Associate Shopfront</td>
<td>POP (1)</td>
</tr>
<tr>
<td>2) Customer Relationship Management</td>
<td>Strategic Objectives: 1) Improve Customer Relationship 2) New channels are offered by Amazon web services. 3) Trust and loyalty between Amazon.com and Associates 4) New Business Opportunities to the Associates. Operational Objectives: Embed Web service capabilities into the Associate shop front</td>
<td>1) Amazon.com 2) Amazon Web services. 3) Associate 4) Web Services 5) Associate Shopfront</td>
<td>POP (2)</td>
</tr>
<tr>
<td>3) Infrastructure Management</td>
<td>Strategic Objectives: 1) Infrastructure Management 2) Resources offered by Amazon Web services. 3) Resources made available to Network of Partners. 4) Value activities to make capabilities available Operational Objectives: Embed Web service capabilities into the Associate shop front</td>
<td>1) Amazon.com 2) Amazon Web services. 3) Associate 4) Web Services 5) Associate Shopfront</td>
<td>POP (3)</td>
</tr>
<tr>
<td>4) Financials</td>
<td>Strategic Objectives: 1) Increase profitability 2) Have a Low cost Model 3) New revenue streams to the associates. 4) Low cost capabilities offered to the customers Operational Objectives: Embed Web service capabilities into the Associate shop front</td>
<td>1) Amazon.com 2) Amazon Web services. 3) Associate 4) Web Services 5) Associate Shopfront</td>
<td>POP (4)</td>
</tr>
</tbody>
</table>

**Service Innovation Progression of Problems:** This describes all the service offerings by the organization. This element is composed of the *Value Propositions* the firm has to offer to specific target Customers Segments and the capabilities a firm has to be able to fulfill to meet the needs of the targeted customers.

The service innovation is described with progression of problems diagram. In fig 5 Progression of Problems (1) we delineate Amazon.com’s *value proposition* to the target customer segments and the capabilities it has to offer in order to drive its service innovation. The outcome of the product/service will be marketed through the customer relationship management.
The main objective of Amazon.com is delineated in the 1st layer of the progression of problems. Amazon wants to differentiate from its business rivals by starting Amazon Web services (AWS) program that provides easy access to Amazon.com capabilities to Amazon’s business partners. The 2nd layer requirement depicts Amazon’s value proposition. AWS differentiates and innovates by offering Amazon capabilities to the target customers – associates for a referral fee on every sale made by the associates. The 3rd layer shows that the Amazon Web Services program aims to cater the needs of its target customers - Associates. Associates are independent operators that direct customers to Amazon for a commission. This has proven to be a highly scalable business for both Associates and Amazon. Associates can embed Amazon products directly into their site. At the 4th layer a host of capabilities are offered to the associates, which they can select and embed in their shopfront. Some of Amazon’s powerful reusable capabilities provided to
an associate’s business are product details, customer review, extended search and remote shopping cart.

At the 5th level is a purely programming concern where Amazon Web service capabilities are embedded into the Associate shop front.

Customer relationship Progression of Problems: describes the way in which an organization goes to market and gets in touch with its customer and makes the service available to the customers.

The Customer Relationship pillar is described with progression of problems diagram (see Figure 3 Progression of Problems (2)). In PoP (2) we describe how Amazon.com offers new business opportunities to create enduring customer relationships with its business partners by getting a feel of what the customer’s needs are and how Amazon addresses those needs. The 1st layer shows that Amazon.com’s objective is to establish better customer relationship with – developers, associates and sellers and vendors by offering them services to drive sales and increase profits. Here we will focus on associates only. Amazon offers WS to associates for referral fees on each sale made. Associates are independent operators that direct customers to Amazon for a commission.

At the 2nd layer, Amazon makes it channel strategy clear. It relies on making sales through Associates. It reaches its customers via the associates. Amazon relies to direct the sales referrals to Amazon. When the customer purchases items through the Associate shop, she gets redirected the Amazon.com website for checkout and processing. Amazon.com delivers the final product to the customers address.

At the 3rd layer, the Amazon makes it clear that its relationship with Associates is based on trust and loyalty. It has created a web API, which it makes available to the associates. The Amazon API provides a built-in interface to its Associates in return for a referral fee. The Associates and Amazon are bound by a licensing agreement though. Associates have restrictions on what one can do with the data and cannot pass as their own.

The 4th layer shows that Amazon, in order to fulfil its desire to improve its customer relationships with its customers, aims to offers new business opportunities to the associates. Associates can embed Amazon products directly into their site.

At the 5th layer, if relationship between Amazon and Associate is established, they can embed Amazon Web Services capabilities into the Associate shop front.

Infrastructure management: Describes the value system configuration – that is necessary in order to deliver an organisation’s offering and to establish and maintain customer relationship. It comprises of service provisioning (how services will be provisioned).

In fig 4 (Progression of problems (3)), the 1st layer shows that Amazon.com has a sophisticated IT infrastructure that uses Web services to distribute its capabilities within the company itself and outside business contacts, including retail partners and the third-part developers. The 2nd layer shows that Amazon.com makes resources available through AWS program. It offers its APIs to the associates that allow associates to incorporate Amazon’s features into their own website. An API provides built-in interfaces to its associates in return for a referral fee on every sale made. The associates use Amazon APIs to streamline their own channels. The 3rd layer shows that Amazon has thousands of Associates using its APIs. At the 4th layer the associates streamlines its activities by driving the customers to Amazon in return for a commission. The customers can buy from Amazon without leaving the associates site. The checkout process is taken care by Amazon.com, which has an extremely sophisticated logistics in place. The associates can make use of Web services infrastructure to streamline their own processes. At the 5th layer the associates embed Web services in the associate shop front.

Financials: The financial perspective is important for any IT initiative. Financial aspects can be understood as costs required getting infrastructure to create value and revenues generated and the difference between revenues and costs determines the profitability of the organisation.

In figure 3 (progression of problems (4)), the 1st layer indicates that Amazon.com has fleshed out Web services to drive sales and increase profits. At the 2nd layer, Amazon.com, through its AWS program offers a commission-based model to the associates at negligible cost. The associates have an opportunity of generating a revenue stream (see 3rd layer) can set up their shop front using Amazon’s capabilities (4th layer) at virtually no cost except in implementing the Web services. The associate gets a referral fee for every sale made via its website. The idea of generating revenue streams at no cost instigates the associates to embed Amazon WS capabilities on their shop front (see 5th layer).

The operational objective is the same in every POP because once the requirements engineer gets an answer to “why”, “what”, “how”, “who”, “how much” they are offering Web services capabilities to the customers, he goes about offering the customers the capabilities that they can embed in their own website.

6. DISCUSSION AND EVALUATION

As a means to align Web services initiative with competitive strategy, we propose a requirements engineering methodology to capture the business objectives of an organization from strategy to implementation. The research methodology that we propose provides a roadmap from business strategy, to the strategic objectives in four dimensions: innovation, customer relationship management, infrastructure management and financials. The four dimensions provided in the eBMO provide a conceptual framework that provides linkage to the business strategy and the strategic objectives. What is the service innovation?

We use Progression of problems to understand the strategic objectives, business needs and the business context of an organization. We found that Progression of Problems provides the “why”, “what”, “how” and “who” explanation to the requirements engineers for offering Web service capabilities to the customers. Progression of Problems was found useful in exploring the strategic of a firm from strategy to implementation. It provides a mechanism to link the business strategy to the ICT system.

38
Progression of problems, however, has its limitation. It can be used to describe high-level strategic objectives and the business context at an abstract level, it provides no means to describe the low-level requirements. In our future research work we will apply Problem Frames to describe the low-level requirements and Web services context. Problem Frames were found useful in describing real problems that were more specific and closer to the machine. Firms might be tempted to ignore the first half of our research methodology, where we have provided a means to explore the strategic objectives and jump straight to the description of capabilities using Problem Frames, but we think that in order to create an alignment from strategy to implementation, we need to first understand the business strategy and strategic objectives and then jump to the description of Web services as capabilities using Problem Frames. However, we contend that Progression of Problems just provides an overview of strategic objectives in four dimensions mentioned in this research. Our research is in its incipient stage. We intend to look at strategic objectives from four dimensions in detail.

7. CONCLUSION

In this paper we present a requirements engineering methodology that draws upon Balanced Scorecard as well as the eBMO model. This methodology (1) is designed to support the business strategy of a firm that is leveraging web services initiative. (2) Creates an alignment between the strategic objectives from strategy to implementation. (3) Describes Web services capabilities using a requirements engineering framework. In order to make web services successful it needs to be aligned with the business strategy and the strategic objectives. We use Progression of Problems to understand the strategic objectives, business needs and the business context of Web services.

REFERENCES