A roadmap
for integrating disparate services
in an educational and research portal

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To Louiza, Sarah and Assia for the space

Preface

This thesis is the result of my master thesis project carried out at Wageningen University and Research Centre. It is the final document of six months research.

This thesis is about roadmaps, service integration, and portals in a distributed education and research environment. Yes, you got it. It is about creating a roadmap for integrating disparate services in an educational and research portal. However, creating the roadmap is not an end in itself. The ultimate goal is creating a computing environment in which all available information and services are coordinated and made available to customers, without requiring the customers to interact with a multitude of systems. Such an environment is a critical enabler for organizations trying to achieve customer satisfaction, customer self-service, cost reduction, and the ability to adapt to a changing environment. The realization of such an environment requires more than technology to integrate disparate systems.

Acknowledgement

This thesis could not have happened without the help and contributions, encouragements, and feedback from a wide variety of people.

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I would like to say a big 'thank-you' to all the people who agreed to participate in the workshop and agreed to be interviewed by me for this thesis. This work would not have been possible without your contribution:
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Management Summary

This research project is a case study that aims to create a roadmap for integrating disparate services in an educational and research portal.

The research method that has been used to conduct this research consists of four phases: 1) a literature study resulting in a reference framework, 2) gathering and assessing the integration requirements against the reference framework, 3) evaluation of the assessment results and design of the roadmap, and 4) a proof of concept roadmap.

Service integration in this research has been subject to research on three perspectives; the people and process perspective, the technical perspective, and the roadmapping perspective.

The research on the people and process perspective has shown many environment factors (e.g. culture, power and control structures, etc.) that determine the progress and success of service integration at enterprise level. Furthermore, research has shown that understanding these factors will help developing mechanisms and structures that should drive, communicate and coordinate the integration effort. The main conclusion from the above findings is that any integration effort should start with integrating the people component first.

From the technical perspective, service integration needs a Service-Oriented Architecture framework (SOA) in order to deliver true service-oriented integration. This part of research has shown that while the SOA benefits are tempting, the paradigm shift of using true services will remain unmet in the near future as this will require dissolving monolithic applications into self-contained and well-defined business services. From a business point of view this is considered as “mission impossible” in the short-term. The trade-off is a co-existence between wrapped legacy applications and web services resulting in an incremental transition to SOA.

From the roadmapping perspective, roadmapping in the context of service integration provides an approach that fosters collaboration and helps building consensus about what customers need and what services should be offered to satisfy those needs. The major benefit of this framework is providing stakeholders a tool to create their own roadmaps.

The result of the above findings is a roadmap that integrates all three perspectives. The roadmap consists of three-level design; a macro-level, a meso-level, and a micro level.

Finally, this research has explored the links between the different perspectives of service integration as well as the value of roadmapping techniques to the service integration domain. This exploration shows that in order to create a roadmap for service integration, you need more than technology alone; you need to understand the people component and develop approaches to bring people and technology together.

Four types of recommendations emanate from this research. Strategic: develop an enterprise-level vision and strategy for service integration that is endorsed by the executive board. Organization: do not underestimate the people component. Business: integrate according to business needs. Technical: build a scalable integration architecture.

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1. Project Introduction

1.1 Introduction

This chapter comprises the following parts; an overview of the organization offering the project, a description of the research problem, the conceptual research design, the technical research design and execution, and a description of the validation and reliability of the research.

1.2 The Organization

Wageningen UR, short for Wageningen University and Research Centre, is a unique alliance between the Wageningen University (WAU) and the market-oriented Agricultural Research Institutes (DLO foundation). The purpose of this alliance is an organization that is connected to the society and a prominent player in the international private and public research and education market.

Wageningen UR is a knowledge centre that combines fundamental and applied research with innovative education in the areas of food, agro technology, production systems, nature and the environment. These disciplines are organised in five expertise groups, ensuring a rapid exchange of knowledge relating to a better understanding of the needs of society. Besides fundamental research, Wageningen UR is developing application-oriented solution for its customers in the national and international industry and the public sector. Wageningen UR's ambition is to rank among the best in the world by further developing into a knowledge institution that is able to combine the strengths of the fundamental and applied research, and natural and social sciences.

Administration activities, support, and facilities are provided by the staff departments and "Facilities & Services" department which the library and "Innovation, R&D" section are part of. The section Innovation, R&D and the Library are the main stakeholders in this project. The organization counts a total of 6.060 employees. Figure 1.1 illustrates a simplified organization chart.

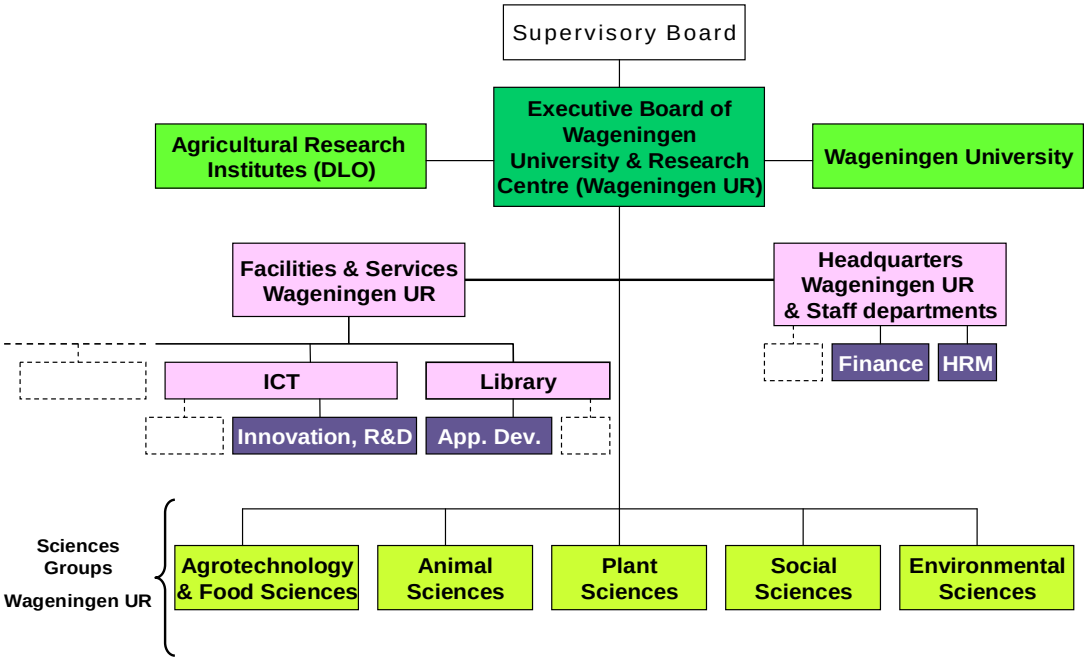

Figure 1.1: Simplified version of Wageningen UR Organization chart

As indicated in the strategic plan for the period of 2003-2006, Wageningen UR's ambition is to provide "*researchers, staff and students with a work and study environment conducive to collaboration, innovation, versatility and lifelong learning*" [WUR]. To meet this ambition, one of the initiatives has been launched recently. It aims to provide the different user communities with customized access to the available information and services. This initiative is the so-called WURweb, which is a portal aiming to integrate and make accessible disparate services and content from inside and outside Wageningen UR.

One of those service domains that need to be integrated into the WURweb portal are the library services. The library is considered as the content manager within Wageningen UR. The concerned services range from loan services to scientific knowledge sources, and more.

1.2.1 The Business Problem

Wageningen UR is a complex organization. This complexity is inherent to its mixed organizational structure, which is a result of a merger of not only two organizations with different structures but also with different cultures, different departments and services, and different ICT systems.

From the perspective of making services, information, and knowledge available and sharable through a unified access [Plumtree; Kalakota and Robinson, 2003], an initiative has been launched by the section Innovation and R&D to make this vision happen. This vision has resulted in the so-called WURweb portal initiative. It aims to offer a solution to the existing primary problem, which is a fragmented information and service offer that is based on an inside-out design [Robinson, 2003; Kalakota, 2003]. This offer is managed by different departments and organization units and results in a lack of customer focus, lack of streamlined processes, and lack of one face to the customer. The solution aims to offer a

role-based access to different user communities (students, alumni, university lecturers, researchers, employees, and business partners) through integration of existing services. A first effort in this direction has resulted in a personalized access (the so-called EDUweb [EDUweb]) to students' information and services (schedules, marks, etc), and lecturers' assistance for building courses. However, given the complexity of the organization and the disparate nature of the services to be offered, a second problem arises. This problem deals mainly with difficulties and obstacles that have been experienced in integrating the existing services. A first glance analysis has revealed that the following causes are at the origin of the service integration problem:

- Lack of clearly articulated strategy that needs to drive the service integration initiative from where it is to where its is expected to be
- Lack of a good preparation to deal with challenges, roadblocks, and resistance [Block, 2001] that arise down the road of this initiative. These challenges and resistance are mainly related to culture differences, and the power structure, which sometimes involves conflicting interests between Wageningen UR corporate and its organization units
- Difficulties to identify and prioritize potential services from the service domains available within Wageningen UR
- Lack of a readiness assessment of the involved architectural groundwork, which will support the service integration initiative
- Lack of a communication plan that promotes and sells the service integration initiative within the organization

As a result of the above issues, stakeholders (service providers) are reluctant to participate and collaborate effectively as they do not understand the opportunities for the whole organization and their departments or organization units. This research project is devoted to address this service integration problem.

1.2.2 The Research Problem and Context

The portal initiative within Wageningen UR covers many aspects (functional, organizational, and technological) that need to be addressed to achieve the expected unified perspective, which is the ability to unify disparate resources and services within a single environment. In such environment, self-service, working, and Learning has to be made possible. One of the critical aspects to success of the portal initiative is the service integration. As discussed in the previous section, the analysis of the business problem has made it clear that the approach dealing with the integration aspect is lacking a plan of approach that should guide the integration efforts within Wageningen UR. Therefore, this research will be devoted to create such a plan; that is a roadmap for integrating services in the Wageningen UR portal.

1.2.3 Parties Involved

As explained previously, this research project will focus on the service integration part of the Wageningen UR portal. The project will, on the one hand, involve the section "Innovation,

R&D" from the Wageningen UR department "Facilities & Services", the project initiator. And, on the other hand, the key stakeholders relevant for this research project, which will be acting in the role of service providers, i.e. the Library of Wageningen UR, the HRM department, the student administration department, and the knowledge units. The Library, which is my employer, will also be acting as a test case for this project. The sponsor of the project is Mr. Michael Hegeman; the head of the section Innovation and R&D. Michael Hegeman will also be acting in the role of a coach from Wageningen UR.

Change: The following parties have been added: Marketing and communication department, Research strategy group, Education policy group.

1.2.4 The Relevance of the Project

The business problem section has put to the fore that there is a need for a roadmap that, for Wageningen UR, should guide and coordinate the integration of services in the current portal initiative. The project is also meant to provide the section Innovation, R&D with insights into the different aspects and issues related to the integration of services that have to be identified and tackled in a complex environment like Wageningen UR. Furthermore, the project will contribute to deal with expected roadblocks (i.e. resistance, lack of commitment, lack of consensus, etc.) and in building the stakeholders awareness about the opportunities and the expected ROI for the organization at corporate level and the participating organization units as well.

This research project will definitely not be a theoretical exercise, but will be conducted as a case study. As a result, the innovativeness of the research is relative as it impacts Wageningen UR in the first place. The results of the research will bring innovative perspectives on the roadmap for the service integration topic within Wageningen UR. However, it is my intention to examine what adaptations and/or extensions to the Wageningen UR service integration roadmap are needed to broaden its general usage and usefulness and, hence, make the research results useful and relevant for professionals in the field.

1.3 Conceptual Research Design

1.3.1 The Project Focus

From the various perspectives (integration, collaboration, personalisation, etc.) involved in the Wageningen UR portal initiative, it may become obvious from previous sections that the focus of this research project is on the service integration perspective of this initiative. The research project will be conducted using a practical-oriented approach and will cover how to get from the current state of affairs to the envisioned end state.

The research will explain the complexity of this integration perspective by providing understanding of the service integration framework [Kalakota, 2003, Linthicum, 2001] as well as the roadblocks, key risks, and items that could impair the success of the integration efforts. This explanation will also include understanding of the human and technical resources, and the architectural groundwork.

Subsequently, the research will provide a step-by-step guide for the integration efforts. This includes the sequence in which to perform the integration activities as well as the issues involved in each step.

1.3.2 The Goal of the Research Project

The goal of this research project is to provide Wageningen UR with a roadmap that helps gain a better understanding of the development efforts required to realize a successful service integration program[1]. The roadmap is a guide aiming at the following:

- Explain the complexity of the service integration program
- Present a step-by-step guide for the entire program lifecycle of the service integration.

1.3.3 The Research Model

The General approach is illustrated in the research model [Verschuren, 2001] as shown in figure 1.2.

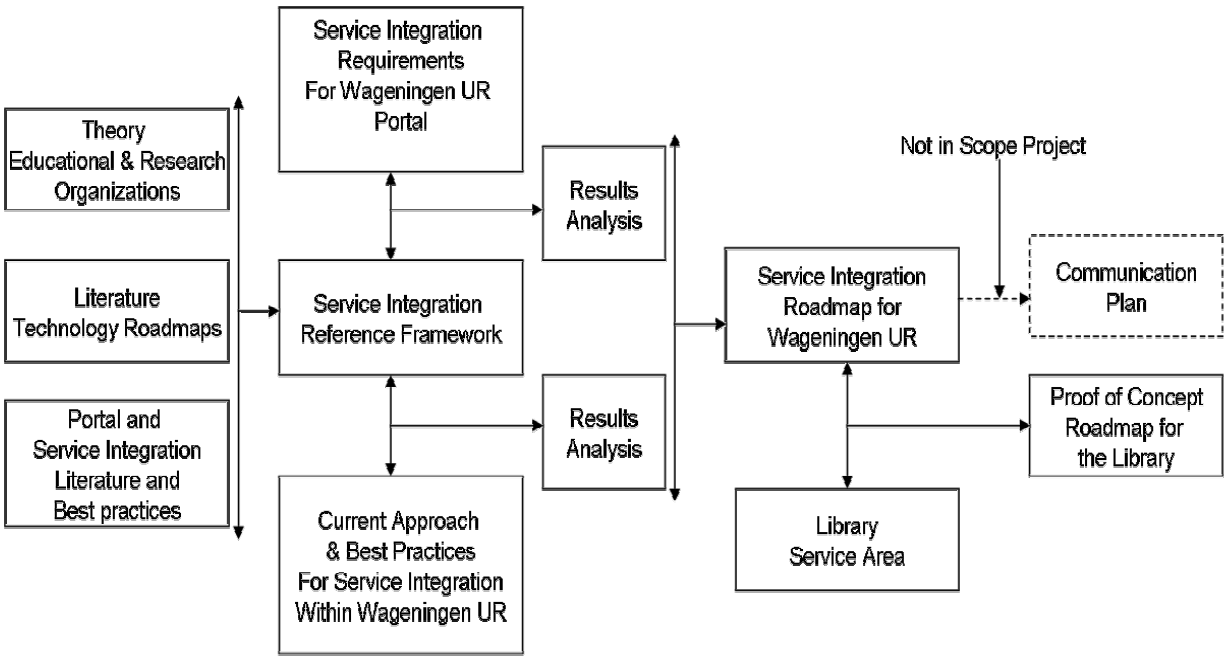

Figure 1.2: Research Model for the project

Note that the dotted lines represent parts of the project that are not included in this thesis. The reason is that the proposed roadmap has to be discussed and approved before launch. The time involved in this process may exceed the thesis project timelines.

[1] **Note:** the term program here is used instead of the term project. A program is more complex and is an ongoing process involving many projects

The research model as illustrated in (Figure 1.2) brings to the fore four main phases for carrying out this research.

- **Phase I: Research**; this phase consists of a research study aiming at providing the steps, and laying the foundations for the service integration topic in the light of an educational and research organization. The main deliverable will be a service integration reference framework.

- **Phase II: Analysis;** this phase consists of two steps. The first step is about gathering relevant information about **a)** the approach used and best practices gained so far in rolling out existing services within the portal, and **b)** the service integration requirements for the portal. The second step consists of analyzing both types of information in the light of the service integration reference framework. These analyses are called retrospective [Kostoff,-; Kostoff, 2001] and prospective, respectively. The main delivery of this phase will be bringing to the forefront the needs, the possibilities, the constraints, and the roadblocks.

- **Phase III: Roadmap Design;** using the analysis results from phase II, the roadmap will be designed. The approach consists of evaluating the results of both the retrospective and prospective analyses.

- **Phase IV: Validation;** this phase consists of validating the designed roadmap against the Library of Wageningen UR, which is one of the service providers. The delivery of this phase is a proof of concept roadmap for the integration of the Library services.

The project phases will be explained more in-depth in (section 1.4).

1.3.4 The Research Questions

Based on the research model, the central research question of this thesis is formulated as follow: **How to create a roadmap for integrating disparate services in an educational and research portal?** This research question aims to scope and guide the research. Further, specific sub-questions have been used to answer questions related to the Wageningen UR situation. The major derived sub-questions are discussed in the following section.

1.4 Technical Research Design and Execution

1.4.1 The respondents

Contrary to a survey, the choice of the respondents in this case study has been limited to key people within the organization. The criteria were based on the key positions they occupy within the organization (e.g. business managers, ICT managers), their heterogeneity as the respondents should be representative for the whole organization, and their eventual contribution to the current ongoing service integration (e.g. student services). The identification of the respondents has taken place in collaboration with my supervisors from Wageningen UR because of their horizontal knowledge of the organization. The primary list

of respondents has been extended down the road with more respondents as a result of recommendations from the interviewed respondents. All the interviews were conducted face-to-face.

1.4.2 Technical Design

The technical design of this research is slightly different from the original design. The differences are indicated using the word "Change" followed with the necessary explanation.

Phase I: Research

The organization: What this service integration entails, with respect to culture, power structure, shared values and strategy in an educational and research environment?

Sources	Retrieving Methods
Individuals: Key people from involved parties	Face-to-face interview
Media: Internet (publications on the Wageningen UR and similar organizations)	Content analysis
Documents: the most recent strategic plans of both Wageningen UR and a few related organization units i.e. R&D, Library, HRM, knowledge units	Content analysis

Change: New question: For the sake of completeness, the following research question has been added to tackle the technical perspective of service integration: Service Integration: What service integration entails, with respect to architecture and integration techniques and technologies? The following table has been moved from the question on "reference framework" to this new question.

Sources	Retrieving Methods
Literature: service integration and portals related publications	Content analysis
Media: Internet (published best practices from similar organizations on initiatives related to the topic of service integration and portals) and Magazines related topic	Content analysis

The technology roadmap: Which **roadmapping** approaches apply to determine the possible paths for service integration in a portal? **Change**: The word "roadmapping" has been added to the question to provide more precision about the type of approaches.

Sources	Retrieving Methods
Literature: articles on technology roadmaps and roadmapping	Content analysis
Media: Internet (publications on this topic)	Content analysis

Building a reference framework: What is involved in building the service integration reference framework?

Change: This question is now consistent with the research model as the idea behind this framework is to integrate the findings from literature research on the people and process perspective, and the technical perspective of service integration. The following table is added to answer the above question.

Sources	Retrieving Methods
Literature: articles on frameworks (e.g. integration, collaboration, etc.)	Content analysis
Media: Internet (publications on this topic)	Content analysis

Phase II: Analysis

Requirements: What are the Wageningen UR portal requirements for service integration?

Sources	Retrieving Methods
Individuals: Different people from involved parties	Face-to-face interview
Documents: available documented insights within R&D department	Content analysis

Current approach: Which approach, if any, has been applied so far to rolling-out the existing portal services?

Sources	Retrieving Methods
Individuals: key people being involved in the process of rolling-out existing services	Face-to-face interview
Documents: available documented insights about the approach	Content analysis
Situation: hands-on (portal interface and underlying architecture)	Observation

Best practices: What are the Wageningen UR best practices on service integration in a portal?

Sources	Retrieving Methods
Individuals: project members from similar former projects (i.e. project members from EDUweb project)	Face-to-face interview
Documents: available documented insights within R&D department and involved parties	Content analysis

General: What are the opportunities, constraints, impact, roadblocks, and risks - with respect to Wageningen UR policies, culture, and strategy – involved in this service integration program?

Sources	Retrieving Methods
Individuals: Different people from involved parties	Face-to-face interview
Documents: available documents on infrastructure and architecture	Content analysis

Phase III: Roadmap Design

Evaluation of result analysis: What is the best method to make a fit between the service integration reference framework and the Wageningen UR specifics?

Sources	Retrieving Methods
Individuals: involved people from R&D (i.e. this mainly regards getting answers to rising questions and issues during design) Change: This has been an individual work	Group discussions and face-to-face interview

Design: What are the roadmap steps that best fit the service integration in Wageningen UR portal?

Sources	Retrieving Methods
Individuals: feedback from key people from involved parties (**Note**: at this stage the design will have the status “confidential”, therefore it will only be available to people from R&D and the Library)	Group discussions and face-to-face interview

Phase IV: Validation

Refinement: What possible refinements could be made to the roadmap to make it more appropriate?

Sources	Retrieving Methods
Individuals: people from R&D and the Library	Workshop
Literature: publications on workshop techniques	Content analysis
Media: publications on the topic of Workshops	Content analysis

Change: The following question has moved from the design phase to the validation phase. This question is better answered after validation of the roadmap.

Verification: What are the criteria to determine the effectiveness of the service integration roadmap?

Sources	Retrieving Methods
Individuals: key people from involved parties	Group discussions and face-to-face interview
Literature: Publications on the service integration topic (i.e. success factors, lessons learned, and benchmarking) **Change:** Roadmap literature (i.e. effectiveness and success criteria	Content analysis
Media: Internet (Portal and service integrations software and solutions providers) **Change:** (roadmapping tools)	Content analysis

General sub-question

General Usefulness: What adaptations and/or extensions to the Wageningen UR roadmap for service integration are needed to broaden its general usage and usefulness for rolling-out an educational and research portal?

Sources	Retrieving Methods
Individuals: feedback from professionals in the field (yet to determine)	e-mail and face-to-face interview
Change: based on feedback from education and research professionals from Wageningen UR	

1.4.3 Technical Execution

This section describes the approach used to achieve the goal of this research project. It explains how the technical design has been executed. The execution of the research was based on the phases from the research model and related sub-questions.

Phase I: Research

According to the operational sub-questions defined above, this research has focused on three perspectives of service integration: the people and process perspective, the technical perspective, and the roadmapping perspective. To answer the research questions, relevant literature study has been conducted. However, notice should be made of the fact that while the technical perspective of integration and service integration in particular is broadly and thoroughly covered by literature, the people and process perspective is hardly covered.

Research on the people and process perspective consisted of literature on organization theory, corporate cultures, integration of human services, collaboration theory, etc. Research on the technical perspective consisted of literature on portals, EAI, enterprise integration, integration techniques and technologies, integration architecture, and integration topologies. Research on the roadmapping perspective consisted of literature on science and technology roadmaps and roadmapping

The above literature research has resulted in the service integration reference framework. The service integration reference framework integrates the people and process perspective together with the technical perspective and concepts of roadmapping. The service integration reference framework is further used to elicit and assess requirements from this case study.

Phase II: Analysis

Armed with insights from the literature study and interview questions, the interviews have been conducted with people from involved parties (See section 1.2.3) to elicit the requirements for service integration. The respondents have been selected based on their relevance for the research (See section 1.4.1).

The analysis was based on two different approaches: a retrospective analysis and a prospective analysis.

Retrospective analysis; this analysis focused on identifying best practices and lessons learned that are the result of the current ongoing integration of student services. The outcome of this analysis is assessed against the reference framework resulted from phase I.

Prospective analysis; consisted of eliciting the requirements for service integration in the portal based on the envisioned situation. This analysis focused on identifying the roadblocks that may obstruct forward progress as well as the available possibilities and constraints. The outcome of this analysis is assessed against the reference framework resulted from phase I.

The results from this phase are discussed in section 3.4.1.

Phase III: Design

This phase consisted of evaluating the analysis results from phase II. The analysis results are the set of findings that show similarities and differences between the Wageningen UR specifics and the findings from the reference framework for service integration (See section 4.1 for more details). These similarities and differences were further used to create the roadmap. The design of the roadmap has been continually subject for feedback from R&D people.

Phase IV: Validation

The validation of the proposed roadmap has been carried out through continuous feedback from the people of R&D during the design process. Further, a workshop has been organized to provide a proof of concept roadmap for the integration of Library services (See Appendix 4 and 5). The feedback that resulted from the workshop has been used to refine the design of the roadmap (See section 5.1).

The question of determining the criteria for effectiveness of the roadmap has been answered through findings from literature research and findings from the interview sessions.

1.4.4 Reliability and Validity

Validity

The validity of this research has been taken into consideration from the beginning of this project. Therefore, validation mechanisms were introduced. These mechanisms consist of the diversity and disparity of the respondents that were interviewed, the open nature of the interview questions, the continuous feedback from involved people (e.g. R&D), and the validation from the organized workshop.

Reliability

The reliability in this research is strongly related the degree of general usefulness of the designed roadmap (See chapter 8). Nevertheless, repeating the same research method in a similar environment where environment parameters are extremely different (e.g. centralized organization structure versus decentralized organization structure) might result in a different design. Hence, in this case study the research results are not too significant to conclude about the reliability of the research method.

2. Research Results

This chapter aims to provide the results of the literature research as well as an understanding of the service integration and roadmapping topics. The answers will provide a reference framework in the light of which the Wageningen UR case study will be conducted.

2.1 Introduction

Service integration is about providing better services to people by people. Therefore, although technology and architecture are critical elements of service integration, they are just part of the picture; success depends just as much as on the non-technical aspects such strategy, collaboration, politics, and management.

Furthermore, because service integration is not only about technology, it is hard. There are two ways to approach it. The first approach is getting to work directly without prior preparation and "terrain exploration" assuming that everything will go fine. But it may seem obvious that no one would choose to depend on luck in an endeavour with so much at stake.

The second approach is about planning and preparation. In this approach a lot of effort is put in up front so that by the time a decision has to be taken, the options and their related effect are analyzed. This does not mean, there are answers to all questions, but at least there will be understanding of the needs and the different possibilities and paths to achieve these needs. This research aims at exploring these needs and possibilities through viewing service integration from its different perspectives.

2.1.1 What Is a Service?

Services are ubiquitous. We encounter them in our everyday life in various forms, which appear in both manual and electronic forms. Services have always been subject to integration efforts within government and commercial organizations. The electronic evolution of services has enabled their electronic integration, the so-called e-services [Kalakota, 2003; Piccinelli, 2001; Sahai, 200]. According to Webster's Dictionary, a service is an *'act of helpful activity'.* Also according to Webster, service is *'performance of work commanded or paid for by another; effort inspired by philanthropic motives or directed to human welfare; useful labour that does not produce a tangible commodity; offering repair, maintenance, or incidental services'* [Simmons, 2002]. So, a service can be defined as an act of helpful activity that is provided by a service provider to meet a customer need. It focuses on the customer rather than the business function. In particular, whether a service is provided by a library clerk, lecturer, information specialist or automated system, a service provides something of value to a customer via an interactive course of action. It helps changing the capabilities of the customer [O'Sullivan, 2002]. Educational and consultancy services are clear examples of these changes in customer's capabilities. For example, customer support enhances the capability of the customer to use a product as intended, information technology services enable customers to meet business needs. Further, a service has the following characteristics:

- Simple; provides what the customer needs by following simple instructions. The customer is not expected to understand the internals of the needed service

- Predictable; results are within appropriate expectations. For example, response times, quality, etc

- Well-defined; provides usage instructions by telling the customer how the service works and what actions to take. For example, failing to enter the correct password after three times, the customer is refused access and has to contact the system manger or a webmaster. Another example is when a customer does not bring back loaned items will be fined x amount of Euros

- Self-contained; loosely coupled application components, where components have not any knowledge or understanding of each other

2.1.2 What is Integration?

Integration means many different things in different contexts. Therefore, it is useful to define what the meaning is of the concept integration in the realm of this research. Integration here is about bringing disparate services together through a portal. It is a binding process of many information systems together at both information and service levels, supporting information exchange in real time, and offering a single point of access. Integration aims to deliver a consistent and consolidated customer experience through all involved channels in the integration process.

2.1.3 What is Service Integration?

Service integration is a broad and vague concept that many definitions can be used to uncover its meaning. Based on the consulted literature, service integration is defined as the 'seamless' delivery of services, where customers may receive a range of services from different service providers without the need of visiting different locations, waiting periods, or other administrative barriers [Nancy, 2002]. Service integration is a combination of strategies to simplify and facilitate client access to services [Ragan, 2003]. Service integration is also the process that refers to the methods through which particular services are brought together [Cameron, 1995] in order to eliminate fragmentation, to avoid service gaps, and unnecessary duplications [Maxwell, 1990]. Service integration is so broad that it encompasses all the definitions above and may be more... it is aimed at leading to improved delivery of services. For the purpose of this research, I will develop the strategy achieving the integration of disparate services within a portal.

2.1.4 What Is the Rational for Service Integration?

The most common sense for service integration is the perception that service delivery takes place in a fragmented way as well as the increased awareness to better serve customers in a way that it positively impacts the bottom line. In general, service integration is deployed to make it easier for customers to access services by providing them with a single point of entry, which results in an increased satisfaction of customers and subsequently their

retention. Besides this common sense perception, there are two types of drivers that justify the need for service integration. These drivers are as follows:

Business drivers

Shrinking funds and increasing competition: Here educational & research organizations, in particular, are constrained to adopt a business-like attitude where process efficiency and customer self-service are becoming priorities. Therefore, service integration is a way that helps these organizations streamline their processes and reduce costs.

Breaking down silos of information across organization units: These silos often are the result of a decentralized organization structure and the transfer of processing to distributed platforms [Laroia, 2003].

Improved customer service and increased customer satisfaction: Consists of the need to pull customer information from disparate systems so that organizations achieve better insights in the needs of their customers and then adjust the service offer accordingly.

Eliminating redundant efforts: Organization silos brings with it situations where “the right hand does not always know what the left hand is doing”. Such situations mean silos of information that result in inefficiencies and duplication of efforts. Service integration is a way that helps tackle these redundant efforts and eliminate them.

Increased productivity: This occurs when information is brought to employees in a way previously unavailable (e.g. projects information, financial information, customer’s information, etc.)

Reduced time to market: In educational and research organizations, this mainly means the capability to quickly rollout new services through reuse and assembling.

Ability to adapt and change: This is one of the most important reasons to consider service integration. When done right by adopting a service-oriented architecture, an organization achieve the ability to manage change. This change takes many forms, including mergers, acquisitions, customer relationships, and outsourcing.

Technical drivers

Integration without tearing down systems: Service integration can be achieved without rebuilding legacy systems. Through interfaces exposing only the needed functionality, the existing systems do not need to be broken down.

Reusable and generic services: Service integration depends on business services and infrastructure services. These services, depending on their granularity, can be reused to build up new services

Reduce maintenance: In point-to-point integration, when a change occurs in one system, other connected systems also need to be changed. However, the maintenance time and cost is reduced to a minimum when services are loosely coupled.

Reduce development time: Through reuse and assembling, the need to rebuild things over again and thus reinventing old wheels is eliminated.

Infrastructure investment protection: This is mainly the result of building infrastructure services down the road to the integrated enterprise.

2.1.5 Features and Capabilities of an educational and Research Portal

A portal is central to education and research organizations. The portal is the integrating mechanism that aggregates technology services with internal and external information sources and services. In this section I will briefly define what is a portal and cover the features and capabilities that support working and learning in an educational and research portal.

What is a Portal?

There are many available definitions and there is so much written about portals, so it does not make sense to repeat a lot of content that does not belong to the realm of this research. However, for the sake of clarity and completeness, yet a few words about portals. A portal, as used in this document, can be defined as a single point of access to aggregated content and services through a multi-channel interface in a secured, customizable and personalized fashion.

Furthermore, just the same as with the definition of portals, there are many different types of portals and it doesn't seem that there is any agreement about a naming convention of the existing different portals. As a result, confusion about "what type is what" is bigger than ever before. To name just a few of them Commercial portals, Consumer portals, Knowledge portals, Community portals… and the list can become quite lengthy. From the literature I have examined about this subject [Guruge, 2003] [Portals] [Cutter], I personally prefer the following taxonomy because of its high-level view of the portal landscape and also because it shields all the details that might be confusing. This taxonomy is illustrated by figure 2.1.

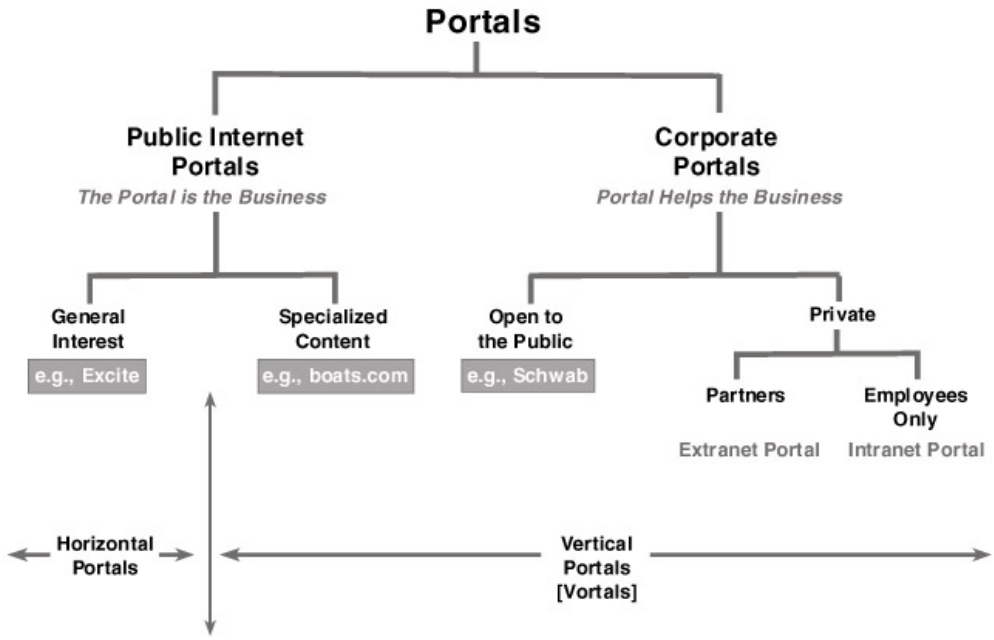

Figure 2.1: Types of Portals (source: [Guruge, 2003])

To briefly comment on this figure, we distinguish two basic categories with a clearly identifiable differences and different goals.

Public portals, in this category we distinguish the portals of general interest such as Yahoo. Here, the organization's primary business is the portal itself. They are generally available for the big public and bring together people, content and services from various sources in a personalized fashion. The other subcategory is the portals of specialized interest or content. They service a public of very specific interest; an example of such portal is cars.com.

Corporate Portals, unlike public portals, are corporation specific and so is the content, services and applications. The portal is made open to the public in the case that it promotes the corporation's products and services and provides a self-service for the corporation's customers. The portal may also offer access to selected partners such as research companies, member education organization, etc.

An extension of this basic taxonomy is the concept of **vertical** versus **horizontal** as illustrated in figure 1. The main difference is that vertical portals support a relatively narrow subject area and are designed to attract a public of a specific interest. These portals are also called "Vortals". Examples of this type of portals are CRM portals, HR portals, etc. Horizontal portals on the other hand, cover a broad and various subject areas. An example is amazon.com which started as a vertical portal and has moved to a horizontal portal as it now covers more and more areas than merely selling books.

This introduction introduces a pressing question, which is: where does the educational &research portal fit in this taxonomy? The common organizational structure within education & research organizations, Wageningen UR in particular, consists of autonomous units and departments with their own portals, vertical portals. An organization-wide or campus-wide portal should integrate information and services from existing portals. This comes down to

support multiple vertical portals in conjunction with a horizontal portal, often referred to as "mega portals," [Phifer, 2000]. BUT, there should be one and only one horizontal portal with an architecture solution that provides the correct integration between the vertical portals and offering seamless interaction for users. Considering the portal taxonomy above, our educational &Research portal is rather a horizontal corporate portal that shields the vertical portals, which represent the different organization units.

Portal Features and Capabilities

Portals are designed to provide easy access to information and services that are targeted to a specific target group or user. Three key features are at the origin of the portal capabilities.

- Presentation
- Personalization
- Integration

Presentation: Consists of a dashboard separated into presentation areas corresponding to the services available at the portal. These services are provided to the presentation area by portlets (also called gadgets, web parts, and channels) or connectors.

Personalization: Defines the modification ability of the portal in order to meet the needs and preferences of the user. We can distinguish two types of personalisation; a) explicit personalisation, which is the most popular variant. According to the user profile or role content and services are made available for access. Additionally, customisation provides users the possibility to tune their profile by eventually including and/or excluding content and services. b) Implicit personalisation; this consists of automated methods, also called agents, that based on the user behaviour determine user preferences and serve up content.

Integration: Is a key feature of a portal. It can be seen as a simple aggregation of different sources and services brought together on the screen. These services are brought in from a variety of web and non-web sources using portlets or other types of integration like EAI and B2B.

Furthermore the portal also should be able to find, notify, synchronize information, present it according to the user's role, and permit collaboration with participating users. To meet these requirements the portal must provide a wide range of services. These services fall under the functional and non-functional requirements of the portal (See Appendix 1 for more details).

Finally, the educational and research portal is in the first place an enterprise portal as the primary audiences are researchers, lecturers, and facilities staffs who all are staff members. In addition, the portal supports students, business partners and business clients. The portal should encompass a wide range of services in order to support and satisfy the needs of these different audiences.

2.2 Service integration: People and Process Perspective

This section aims to provide answers to the research question: ***What service integration entails, with respect to culture, power structure, shared values and strategy in an educational and research environment?***

2.2.1 Introduction

Change is becoming a continuous way of life. Environmental factors such as shrinking funds, the decreasing role of government, the revolution in information technology and new mindset of customers and employees, all factors requiring from the education & research organization in general and Wageningen UR in particular a new mindset in order to deal with these complexities and the unknown.

In this era of shrinking funds, IT budgets have shrunk and every expense is subjected to heightened management scrutiny [Lawlor, 2003]. Organizations can not justify a large expense of an integration undertaking without a phased approach to funding and deploying integration. Strategic thinking and planning seems to be gaining importance as an instrument for exploring the paths to achieve success and sound decision-making. High education & research organizations are not exceptions as to the impact of these changes. These changes are mostly dominated by the ongoing development in Information Technology, the sustainable shrinking funds obtained by the government, and the ongoing competitiveness for wining new customers and retention of the existing ones.

In the following sections, I will provide what service integration entails from the people and process perspective.

2.2.2 Shared Vision and Common Goals

The common business sense demands from every profit or non-profit organization to articulate a clear vision behind each effort that involves contribution and investment from its organization parts. The vision should form the foundation from which all other strategic actions emanate. The vision statement should express the following [Collins, 1992]:

- Core values and beliefs; a philosophy of business and life and principles that are to be held inviolate (e.g. Continuous improvement, Culture of intellectual curiosity, etc)
- Purpose; the fundamental reason for an organization to launch an initiative
- Mission; a clear finish line and a specific time-frame. Once the mission is completed a new one is set

A shared vision provides a context within which people can make decisions along the way of any undertaken initiative. Without a shared vision, organizations risk to degenerate into departmental “silos”. As a result, disparate agenda’s, turf wars, and empire building become prevalent. Additionally, it also becomes impossible to maintain a strong sense of community as well as to work for common goals and towards the strengthening of the entire organization.

The integration's success will depend, to a large extent, on the clarity of the shared vision and whether it has incorporated all the reasons that make the service integration happens.

2.2.3 The Alignment Issue

As stated in the introduction of this chapter, technology is just part of the picture and the question to answer here is "*why organizations are not getting real business value out of technology?"* Hoque [Hoque, 2002] answers this by writing *"Companies that repeat the mistakes of the past will never reap the rewards of the future"*. Indeed, most organizations are poised to embrace new technologies even before succeeding to achieve alignment on the technologies they already have. In the following I will briefly discuss two major alignment categories, which are business/technology alignment and inside-out/outside-in alignment.

Aligning Business and Technology

According to Henderson and Venkatraman [Henderson, 1993] in their strategic alignment model, there are four dominant alignment perspectives (strategy execution and technology transformation on the one hand, and competitive potential and service level on the other hand) with two driving forces: the business strategy as a driver and the IT strategy as the enabler. The latter seems to have the most in common with the case of this research in particular. The service level perspective aims to build a sound service organization through integration of services and delivering the customer offer through the portal. In this perspective, the role of business strategy is providing directions and priorities. For this perspective to be successful a sound and agile technology infrastructure is needed as well as an alignment of both business and technology with the processes that support the business. This means zero disconnect between three key areas [Hoque, 2002]: a) business, which refers the business objectives and drivers, b) process, which refers to the things an organization does, and c) technology, which refers to the application that support the processes. This strategic fit is geared toward creating value for the customer and by doing so it serves, in return, the bottom line.

Alignment brings real balance between business and technology drivers and solves the old debate about what comes first, business strategy or technology.

Aligning Inside-Out and Outside-In

With Internet the customer demands and expectations have changed. Therefore, there is a need to understand customer needs and priorities and aligning internal processes accordingly for a consolidated and consistent offer of services. Here rises the question: what services an organization needs to offer to achieve customer satisfaction? The answer does not lie in expecting high education & research organizations to change their value proposition and become customer intimacy [Treacy, 1993]; they should be, to a certain degree. But, Instead, they should take into account the customer's input and consider it as valuable [Fließ, 2002].

Ravi Kalakota [Kalakota, 2003] distinguishes two viewpoints in the real world. These viewpoints are called:

Customer centric; consists of an outside-in design whereby service delivery is based on a sound understanding of what customers really want

Process-centric; consists of an inside-out design whereby service delivery is driven by what managers think the customers want

Both viewpoints are necessary but in the typical case of education & research organization, the silos culture and the related technological infrastructure in place reveal a different reality, which makes it difficult to support the customer-centric perspective. The process-centric design has originated from efficiency and productivity goal and the decentralised organizational structure. This design has resulted in fragmented enterprise systems, which are not integrated. Integrating theses systems afterwards is an expensive and difficult undertaking. However, keeping in mind the organization's value proposition should provide the solution for aligning these processes accordingly. Services are representing the customer value and are also the point of convergence of customer priorities, business priorities, and technology capabilities (see Figure 2.2). Service integration should be based on aligning the three perspectives and thus aligning the outside-in perspective and the inside-out perspective on existing capabilities and the expected value for the organization.

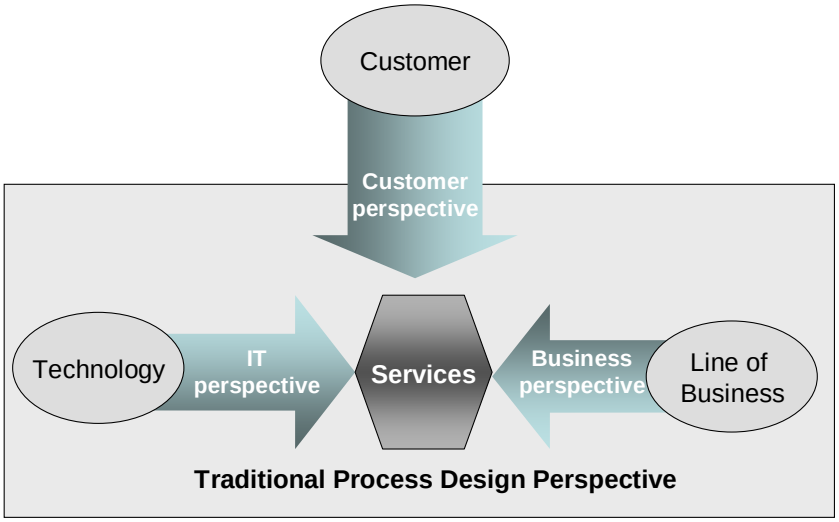

Figure 2.2: New Process Design, Taking the Customer's perspective into consideration (source: [Kalakota, 2003])

2.2.4 Culture

Although management people at the top of organizations like to think that everyone in the organization is working towards the same overall goals, the truth is that this is rarely the case. This goes especially for decentralized organizations like education & research organizations where the organizational structure is based on autonomous units and departments. Despite the fact that the decentralised model works well for large organizations, its downside is the emergence of "silos cultures", which represent a barrier to share strategies, plans and information [Kincaid, 2002].

Based on a research on “Corporate Cultures” cited by Blatzer [Baltzer, 1991], I have selected three key questions among others related to the culture issue and specifically to “how things are done in an organization”. These questions are:

- *“How are decisions made?”* Does top management makes all decisions or are managers and staff empowered to make decisions?
- *“What is the reaction to new ideas?”* Are new ideas quickly acted upon or rejected? Or are they subject to “analysis paralysis”?
- *“What is the cost of failure?”* What are the consequences when things go wrong?

Further, in the same research mentioned above, the author categorizes organizations into four different cultural types: traditional culture, consensus culture, futurist culture, and profit centre culture. Table 2.1 provides answers to the culture-related questions based on the organization type:

ISSUES (Questions)	**ORGANIZATION CULTURE**			
	FUTURIST	PROFIT CENTER	CONSENSUS	TRADITIONAL
Decision-making	Mid management recommends and top management decides	Decisions made at top of each profit centre	Groups decide; buy-in is important	Top management decides
Reaction to new ideas	New ideas met with range from enthusiasm to indifference	New ideas good if relate to unit goals; valueless if relate to another unit’s goals	New ideas okay is there is consensus	New ideas are studied; lots of committees
Cost of failure	Failure cost low	Failure cost moderate	Failure cost high because group is involved; larger investment	Cost of failure high

Table 2.1: Corporate Cultures (source: [Baltzer, 1991])

Success or failure of IT innovation in an organization can be a direct result of the organization’s ability to understand its corporate culture and to develop strategies to work within that culture. For example, according to Baltzer, in traditional organizations where top management decision is required, cost of failure is high, and new ideas are subject to lengthy analyses, IT innovation projects in this type of organizations are slow and steady. For these organizations, strategies involving awareness programs and establishing steering

committees, developing strategic plans, and taking small implementation steps (result must be proven before large investments) reveal successful for achieving results.

In a consensus culture groups are empowered to make decisions and new ideas are well received when there is consensus and buy-in. IT innovation projects in this type of organizations are most successful when there are awareness programs and steering committees long before the start of the project.

In a profit culture, however, decisions are made based on the bottom-line. In this type of organizations, the only thing that matters is demonstrating the immediate value of technology.

Finally, in a futurist culture where organizations take risks achieving and maintaining leadership in what they do. In this type of organizations, preparation and planning strategies are considered too lengthy and take too much time. The focus here is introducing innovation in highly visible and strategic areas.

Culture dictates how individuals and groups behave in an organization. Therefore, design of processes related to IT innovation needs to be based on a sound understanding of the organization culture.

2.2.5 Stakeholders

Stakeholders are individuals and groups who have a stake in the outcome of the service integration effort. They are impacted by the new governance structures and processes that service integration brings with it. Stakeholders have power and influence to either facilitate and collaborate or block and resist the innovation efforts [Brick, 1999]. The primary stakeholder groups include:

Executive board

They have the ultimate authority and responsibility over the success of service integration. They are responsible for providing resolution when major conflicts arise.

Service providers

They are also called domain owners. These groups have direct impact on the success of service integration. Without their compliance with the program requirements and collaboration with other stakeholders, the integration is doomed to fail.

Influencers

This group is not directly involved in the service integration effort but provides guidance and influence. It mostly has an advisory role within organizations

Target audiences

They consist of internal and external groups. They are the actual customers (users) and they should be involved in the process to provide and ensure acceptance and success

2.2.6 Collaboration

Service integration and collaboration are related in the sense that success of any integration effort involving multiple parties relies primarily on the collaborative effort of the parties involved. Prior to discussing the usefulness of the collaboration aspect in the realm of this research, let's provide a definition of what collaboration is. The Webster's Encyclopedic Dictionary defines collaboration as follow: "*to work together, especially on work of an intellectual nature*".

Mattessich et al defines collaboration as a mutually beneficial and well-defined relationship entered into by two or more organizations to achieve common goals. The relationship includes a commitment to mutual relationships and goals; a jointly developed structure and shared responsibility; mutual authority and accountability for success; and sharing of resources and rewards [Mattessich, 2001]. *Kruizinga (CIBIT)* defines collaboration as a means for organizing work done within an organization. In this case, emphasis is put on new concepts like empowerment, the networked organization, and the virtual organization to achieve effectiveness within organizations. He refers thereby to the work of Michael Porter, Michael Hammer, Charles Handy, Tom Peters, and Peter Drucker who try to persuade organizations that traditional organization methods and hierarchical decision-making are not appropriate and effective ways to manage organizations in today's world [Kruinzinga]. Therefore, organizations should foster and intensify collaboration as an effective way to get things done in a joint effort where disparate groups are involved. In the literature, collaboration is used interchangeably with 'communication', 'coordination', and 'cooperation'. *Kruizinga* has defined these concepts as an integrated set of collaboration from the process perspective. Furthermore, Kruizinga approached collaboration from two other perspectives, which are task- and time/place perspectives as well as an integrated perspective integrating all three perspectives together. The task perspective determines which components make up the group's task. The process perspective, on the other hand, involves communication, cooperation, and coordination (See Appendix A2.1 for more details).

Collaboration from the process perspective is about organizing the group's communication, the group's coordination as well as sharing information, resources, and providing support to one another.

Finally, the time/place perspective aims to resolve problems inhibiting collaboration as a result of different time and/or different place. In such situations, technology can help solve the issues related to this collaboration perspective. Groupware technology is such an example that offers solutions.

Additionally, collaboration as it is defined here is a long-term, well-defined relationship entered into by involved parties to achieve common goals. It involves all the aspects from the collaboration perspectives discussed above. Involved parties come together in order to accomplish something that they can not do alone.

According to *Mattessich* there have been 20 factors that determine the success or failure of a collaboration effort. These findings have been based on a re-examination of hundreds of scientific studies about successful and not-so-successful collaborations to learn what made the difference. Those factors fall into six general categories: general environment, membership, structure and process, communication, purpose, and resources [Mattessich, 2003] (See Appendix A2.2 for more details)

Problems inhibiting collaboration processes can appear along the road of the collaboration process. According to *Kruizinga* the emergence of these problems is observed in different perspectives. Analysis of collaboration problems is best achieved when starting with communication processes.

Finally, Collaborative processes are indispensable to any joint effort, service integration in particular. They are an effective way to creating new and improved service delivery by pooling resources and efforts to address the gaps between involved parties and to decrease fragmentation [SFYS].

2.2.7 Power and control Issues

Enterprise integration unlike traditional system development involves the issue of power and control. This is particularly true for educational and research organizations as a result of the decentralised structure. Decentralised organizations are organised in organization units with some level of autonomy with regard to budget spending priorities, information systems, and decision-making. An enterprise integration, on the other hand, is depending on those organization units, which further have different agenda's, and even sometimes different core business and conflicting interests. Power and control issues [Aiken, 1975; Japha, 2001] here can be regarded from two different perspectives: 1) the power or the ability to influence the acceptance and success of the integration initiative, and 2) the issue of control or ownership of business functions and content, which may involve giving up control over own services [Cameron, 1995] to some third party.

The Power issue mainly involves **funding** and the **influencers** within an organization. Funding is a critical factor, since integration is a difficult sell. This is true for organizations where ICT departments only control overhead and infrastructure spending, and where software development and maintenance efforts are funded by organization units. In this case, integration can be presented as infrastructure innovation or have to wait till a business-driven initiative makes integration a necessity. However, within organizations where ICT departments control all ICT spending, integration initiatives have better chances to succeed.

Influencers are the people who have influence, authority, and enjoy respect within the organization and who finally can make the difference in whether the integration initiative gains the attention it deserves. This is considered to be critical when integration needs to be taken seriously.

Additionally, another form of resistance to integration deals with the so-called "turf wars" [Doyle; Verespej, 1998] as integration in some cases addresses questions of ownership and control over business functions and content. As a result, some people or organization units may feel threatened by the idea of integration and the collaboration it requires. Knowing

about the existence of these barriers helps developing an appropriate strategy to make integration successful.

2.2.8 People and Skills

Skills and responsibilities

Service integration requires skills that should involve a mindset that goes beyond the departmental projects skills. These skills should be identified at the outset of the program.

The CIO's role: Today, where IT systems represent the business, there is an increasing demand from IT departments to be, first and foremost, business departments. This shift requires increased business knowledge, improved ability to influence and negotiate [Reich, 2000]. The challenge for IT departments in general and CIO's in particular is the growing business focus besides a technological background. This business focus consists of the ability to:

- Identify opportunities for business innovation as a result of new technologies and coordinate with the business strategy accordingly
- Identify the required skills needed for enterprise initiatives
- Speak the language of the business to translate technology trends into business innovation and communicate the information to business executives in a language that they expects from their peers
- Get into the minds of the business leaders to find out the exact business drivers of business success and puts the technology infrastructure in place to deliver business value
- Unify services across multiple organization units and departments. According to Dawn Lepore *"Most unit heads need to have a much focused perspective. CIO's must also be focused; additionally, they must be able to consider the business as a whole"* [Lepore, 2000]. Indeed, the vast majority of services that different organization units and departments are making available are designed for customers outside departments' borders. Therefore, unification is needed in order to increase the visibility of an organization offer of services.

The role of the CIO becomes increasingly important as (s)he should participate in developing strategy by identifying opportunities for IT innovation through watching trends, evaluating their impact on the bottom line, and explaining the impact to the business executives.

Additionally, besides the CIO's role, Altman argues that the following skills are necessary for an integration team [Altman, 2003].

Program Manager: The Program Manager should have a good business perspective and need to be someone who understands the components of service integration, its rational, and its risks. The program manager should also keep track of simultaneous projects that

make up the program. This role should be assumed by an insider. The CIO is good candidate for this role.

Project Manager: A project manager brings relevant experience to the management of each individual project. Several project managers may be assigned to different integration projects at the same time. The project manager is responsible for release schedules and coordination of incorporation of the developed services. The project manager is also responsible for leading project team checkpoints and status meetings.

Integration architect: The integration architect requires skills in distributed computing environments. (S)he is responsible for determining which type of integration should be applied to integrate the services at hand. The architect should also be knowledgeable about old existing technologies and new technologies, and more importantly (s)he should be aware that the architecture needs to be flexible as change will continually occur. In order to ensure alignment of the architecture with the business, regularly review should take place every six month or annually [Altman, 2003].

Data Architect: Service integration also involves development and maintenance of the enterprise's data architecture. The same data within an organization may take several forms, for example one system may use the format *yymmdd* as a birth date, while another system may use *dd-mm-yyyy*. The enterprise view of data needs reconciliation between various representations of data within involved systems. This data is subject to processes of extraction, transformation and loading (ETL). The data architect should have a data modelling background with the ability to recognise differences in context and being able to find suitable abstractions that capture differences and commonalities of meaning in the different contexts. The required abstraction is called semantic modelling or meta-data. Data architecture is a joint effort between the data architect and representatives from business lines.

Developer lead: The lead developer in close collaboration with the integration architect, data architect, and developers from other business units is responsible for developing the integration interfaces according to the agreed upon standards.

Services administrator: This responsibility should take care of keeping the integrated services alive. This involves taking care of, for example, the integration broker software, and administration, tuning, and troubleshooting.

Communicator/Trainer: Because of the collaborative nature of service integration, communication and training take a critical role of ensuring buy-in between various departments and organization units. Therefore, communication and training is the responsibility to translate the abstract and complex concepts in a message that is understandable by target audiences. Analogies and examples from real business situations help make communication and training successful.

The above skills, roles, and responsibilities are, from my point of view, necessary to orchestrate successful service integration. Service integration is becoming a priority for realizing the value of IT investments. This reality has resulted in ideas that even plead for an

integration competency centre [Altma, 2003; Hollander, 2002] that should oversee and govern integration across the organization.

2.2.9 Change Management

Service integration offers organizations tremendous benefits as stated previously. To make service integration happen, the people component is critical to its success. Unfortunately, this component is often overlooked in the rush to start the integration quickly. The people component is about helping people changing their behaviour, which is often at the origin of the integration roadblocks. These roadblocks stem from managerial issues, such as resistance [eAI, 2000; Block, 2001]. A change management program should go hand in hand with the service integration program to help transform the behaviour of different stakeholders throughout the organization. The vision and technology may be perfect but if buy-in is lacking, the program is doomed to fail. The change management program includes communication campaigns, training, expectation setting, and follow up [EI]

2.2.10 Governance

Enterprise integration failures are caused by the current EAI methodologies and practices that are developed from project-level experience [REI]. Such a tactical integration approach, which is based on project by project basis, falls short when it comes to enterprise integration. Service integration at enterprise level will depend on coordinating the multitude of projects, and putting together their deliveries in order to achieve the service integration benefits.

What is needed is a strategic approach for service integration that should resolve the deficiencies (e.g. communication, coordination, and the total picture) of the tactical approach. Such an approach is a governance structure that organizes the integration initiatives in two levels: a program-level and project-level. The program-level interacts with and reports to the executive structure within the organization (e.g. CEO, Executive Board). This is also the place where the responsibility of business strategy lies and where projects priorities are set. From the technical perspective, this is where integration architecture and technology standards are determined. The project-level, on the other hand, becomes a matter of execution and reporting as long as they adhere to the agreed upon architecture and standards. Figure 2.3 illustrates this governance structure.

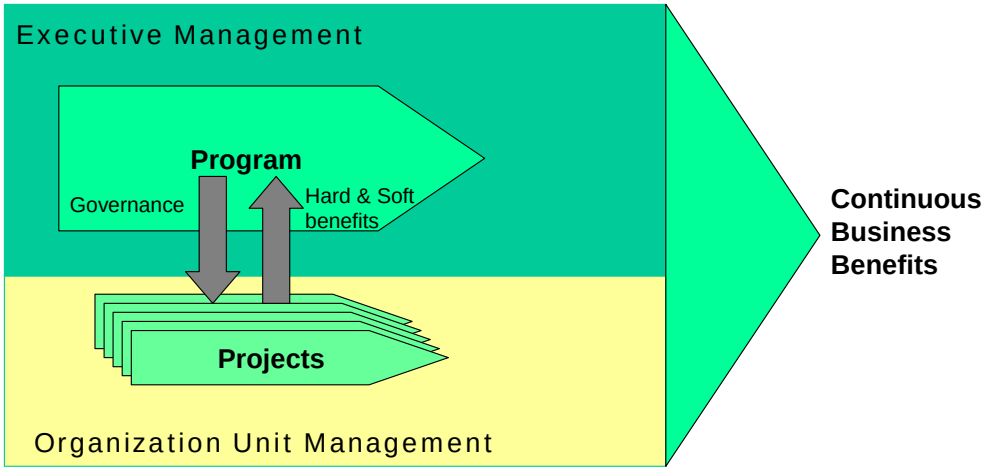

Figure 2.3: Governance structure: Program and Projects Interaction (adapted from source: [REI])

Conclusion: This part of the research has revealed that service integration, when considered at enterprise-level, is more than technology alone. The people and process perspective is of utmost importance as it is one of the pillars of service integration. The people and process perspective involves many factors ranging from behavioural aspects to managerial aspects, which include all the aspects discussed above and even more ...

2.3 Service Integration: Technical Perspective

This section aims to provide answers to the research question: ***What service integration entails, with respect to architecture and integration techniques and technologies?***

2.3.1 Introduction

In the introduction section of this thesis I have provided a general definition of the notion of service integration. In the following section the notion of service integration will be uncovered from an architecture and technology perspective. The notion of integration, in general, has been around for a long time within organizations in different forms. Integration took forms of data (also called information) integration, application integration, portal integration, and process integration that mainly consisted of business process reengineering [Elzarka, -]. Another powerful form of integration has emerged recently and is gaining momentum. This form is called service integration. The idea consists of creating integration services that act as a buffer between business processes and heterogeneous systems across the scope of the organization. In the following section I will, for the sake of comparison, briefly describe the different forms of integration as well as a brief description the architecture sketch.

2.3.2 Shallow vs. Deep Integration

Portals allow us to view a multitude of systems, both internal systems and external trading community systems, through a single-user interface. Portals provide the architectural groundwork that permits avoiding the back-end integration problem by adapting the user interface of each system to a common aggregated user interface (e.g. a web browser). The result is an integration of participating systems without the need to integrate these systems within or between the organizations using the so-called deep integration. In this case the applications themselves do not share data and are integrated in the sense that they are available from a single point. This type of integration is called shallow integration [Sullivan, 2003]. Linthicum call it Portal-oriented integration [Linthicum, 2003]. This type of integration will be discussed in the following section.

2.3.3 Integration Categories

Integration forms vary from internal application integration (EAI) to external integration (B2B). While every form is designed to serve different goals, both forms share, from the technology point of view, common patterns [Linthicum, 2003]. For example, both forms share technologies like transformation, routing and so on. EAI has been around for a long time as

there always has been a need to share data for one or the other reason. However, the shift in thinking about integration is its opportunities in supporting strategic business initiatives such as web visibility, Customer relationship Management (CRM), and streamlining processes.

Additionally, each organization has its own integration needs, which can not be fulfilled by applying a universal integration technology or solution. Therefore different approaches are needed to answer different integration needs. Linthicum distinguishes the following integration categories: information-oriented, business process integration-oriented, service-oriented, and portal-oriented (See Appendix A3.1 for more details).

Information-oriented integration is an integration form that is limited to exchange of data between two applications or two databases

Business process-oriented integration: is an integration form with a higher level of abstraction. It manages the movement of data and the invocation of applications/services in the correct order in order to support the management and execution of processes that exist within an organization or across-organizations.

Service-oriented integration represents the paradigm shift in the integration land. This category of integration is not new as this form of integration has been around in the form of distributed objects (e.g. CORBA, COM) and component-based software. However, the difference lies in the underlying architecture (e.g. SOA) and the use of internet. Furthermore, true service-oriented integration requires changes to existing systems (legacy systems) and even a rebuilt from scratch thereof in order to provide service-level access to remote services and to take advantage of the new paradigm. This downside remains a difficult sell within organizations because of the costs it incurs.

Portal-oriented integration is an aggregation of content and applications in different windows.

2.3.4 Enabling Technologies

I have devoted the previous sections of this technical perspective of service integration to the integration approaches. In this section I will provide an overview of the enabling technologies that provide assistance in solving the integration problem.

Middleware

In general terms middleware is a mechanism that allows one entity (e.g. application, database) to communicate with another entity. Linthicum [Hohpe, 2003; Linthicum, 2001; Linthicum 2003] identifies two main different middleware models. These models are:

Point-to-point: Uses a simple pipe (channel) to allow an application to communicate with another application. Despite its simplicity, this model lacks a processing middle-tier and it lacks the ability to bind more than two applications. Examples of point-to-point middleware are Message Oriented Middleware (MOM) (e.g. IBM's MQSeries), and Remote Procedure Calls (RPCs) (e.g. DCE)

Many-to-many: Including one-to-many. This model links many applications to many other applications. This capability makes this model the most appropriate choice that provides flexibility and scalability. Many technologies support this model.

Among middleware technologies that support both models are message-oriented middleware (MOM), integration servers, application servers, distributed objects (e.g. CORBA, COM), database-oriented middleware through Call Level Interfaces (CLIs) (e.g. ODBC, JDBC). (See Appendix A3.2 for more details).

The relation between the integration middleware and integration types is illustrated by table 2.2.

Middleware types	**Integration types**			
	IOI	SOI	BPOI	POI
Database-oriented	X		X	X
Message-oriented	X		X	
Distributed objects		X	X	
Web Services		X	X	X
Application Servers		X	X	X
Integration Servers	X	X	X	X

Table 2.2: compatibility between integration middleware and integration types

Integration standards

XML: [Marchal, 2001; Morrison, 2002; XML] has gained a wide acceptance and that makes it an industry standard. Its value for the integration problem domain lies in its wide acceptance and the general agreement that it provides a common format to allow the exchange of critical business information. Secondly, the common data-exchange format provides simplicity and encapsulating of both metadata and data. This format allows source and target systems to communicate via XML-compliant messages when they both can read XML. However, as Linthicum argues rightly, XML is not an alternative to middleware (application servers, integration servers, etc.). It is nothing more and nothing less than a format that still needs middleware technology to move it between integrated systems. In other words integrated systems need to read and in some cases produce XML

XSLT: Is a language that consists of transforming one XML document into another. And as systems, in the integration problem domain, have each their own semantics, the exchanged messages need to be transformed when they move from one system to another. Besides transformations that impact both schema and content, XSLT can provide other transformations such as comma-delimited files, PDF's, HTML, and other standard formats. (Figure 2.4) illustrates the transformation process. The potential of XSLT is that it provides a

standard transformation mechanism that has wide acceptance. This relieves the integrators from relearning new transformation technologies and from changing everything when moving to another vendor. This said; XSLT does not provide the solution to all integration needs because of its limitations that are mainly related to performance and security (text-based messages) issues.

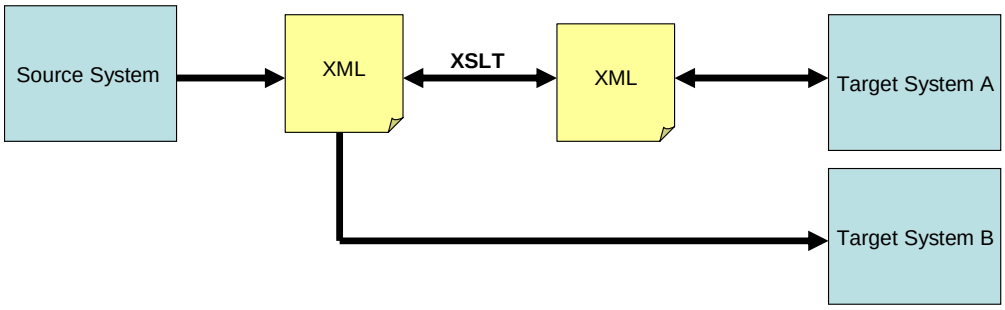

Figure 2.4: XSLT transformation in the exchange process of XML messages

Web services: Web services are considered as the biggest paradigm shift in the integration landscape [Samtani, 2001]. The idea offers the ability to create new services by aggregating existing services that may reside locally or remotely on the internet. However, the idea of web services is not new when comparing it to the idea of distributed objects. The difference lies in the underlying architecture and the use of internet. Web services have the potential to not only exchange information between different services but also invoking services that are encapsulated within legacy and new services as well as creating composite services. Web services lend their existence to three foundation standards; SOAP, WSDL, and UDDI. Figure 2.5 illustrates the interaction between web services components. (See Appendix A3.3 for more details).

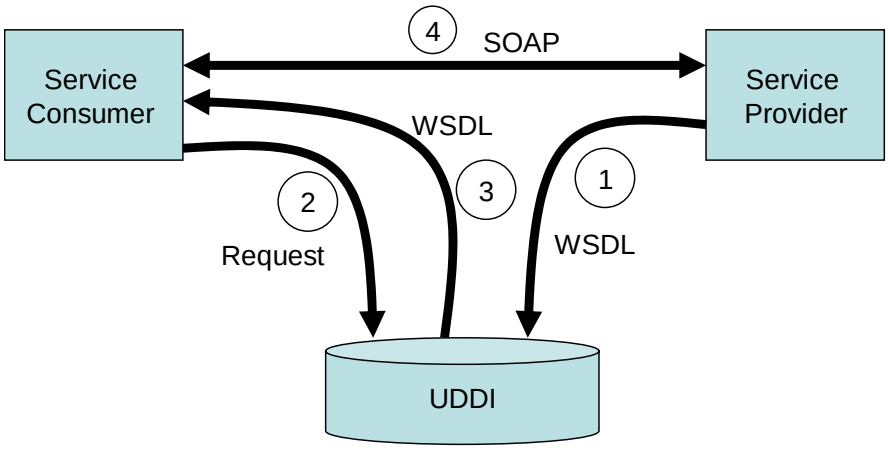

Figure 2.5: Web services components and interactions

Web services are a good fit for the service-oriented integration. However, web services are not yet mature enough to offer the overall solution for all integration problem domains. There are, currently ongoing developments that try to enrich web services with lacking answers to functional and non-functional requirements like transactions (e.g. WS-Transaction), security

(e.g. WS-Security), and performance. Besides web services that are a good fit for service-oriented integration, there are other standards that focus on higher abstraction level of integration, which is the process level integration. Among these standards are ebXML, and BPEL4WS. (See Appendix A3.4 for more details).

Portlets: From a user's perspective a portlet is a window in the portal page that provides a service or information (e.g. calendar, news feed). From an integration perspective a portlet (also called gadget or channel) is a pluggable web component managed by a portlet container that generates dynamic content. Portlets [Fred, 2003; Schaeck, 2003] interact with web clients indirectly through portal servers, via a request response mechanism implemented by the portlet container. Portlets are designed to be aggregately in a portal page (See Figure 2.6). Furthermore, because of lack of industry standard portlet specifications, portals have been suffering from interoperability problems. As a result, exchanging portlets between different servers was not possible. This situation has recently changed with two approved portlet standards. These standards are the Sun Microsystem's Java Portlet Specification (formerly JSR 168) and Web Services for Remote Portals (WSRP) from OASIS. WSRP defines a common interface and protocol for creating pluggable, user-facing, interactive Web services. JSR 168 portlets can be exposed as WSRP-compliant Web services. This standardisation will allow one department's portal to access a portlet residing on another department's portal server [Hildreth, 2004]. The latter is very useful when a meta-portal (as it is the case in Wageningen UR) needs to integrate information and services from vertical portals (department portals)

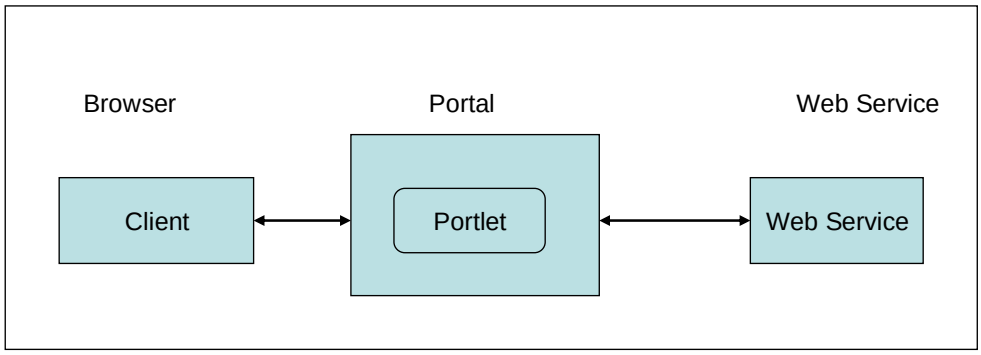

Figure 2.6: Interaction of the portlet between the user interface and a web service

2.3.5 Architecture

Portals by themselves do not create value. However, similarly to the effect of the invention of the steam engine in the eighteenth century on the industrial revolution, portals are accelerating the adoption of digitized services [Kalakota, 2003]. This digitization of services and related value creation takes place behind the scene by an architecture that integrates, aggregates, and delivers services to the customer via the portal interface. The architecture issue is determinant for the success of the service integration and thus also of the portal. Furthermore, building such a promising architecture is facing the challenge of the existing processes, IT systems, and skills within an organization. Hence, the following question: which architectural formula helps realize the service integration without tearing down the existing systems? In the following I will discuss the answer to this question.

Integration as an afterthought

Education and research organizations like many other decentralized organizations are suffering from the effects of “stovepiped” architectures that inhibit enterprise service integration. The stovepiped architecture has not been created intentionally. For the most part, each application was created with a specific purpose in mind, without taking into consideration integration needs in the future.

Viewed from the perspective of a department or organization unit, managing these stovepiped architectures those supports own core business is a way of life. Viewed from the enterprise perspective, the problem becomes apparent when there is a need to share information and services. The “quick and dirty” way to handle these needs is through building direct interfaces that externalize the desired functionality. This quick and dirty way is what most IT departments know. As these quick and dirty interfaces increase in amount as a result of enterprise needs, the integration landscape gets more entangled and complex (see Figure 2.7).

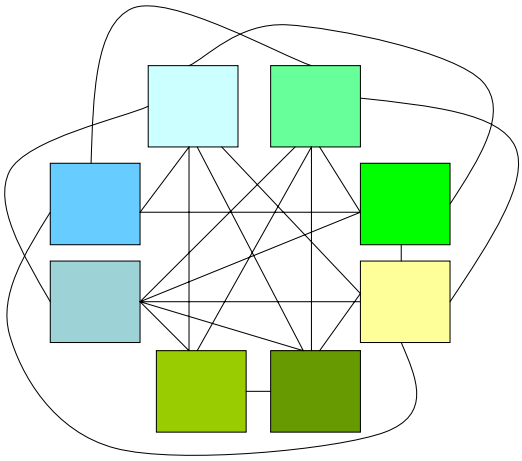

Figure 2.7: Point-to-point integration as a result of “integration-as-an-afterthought”

An architecture Formula for enterprise service integration

An alternative to the above sketched situation, which is the result of lacking an architecture formula for service integration, is an integration architecture that is based on two fundamental architectural guidelines [Hohpe, 2003; Kalakota, 2003; Sleeper, 2002]:

Minimize impact on both existing systems and on the business. This is important as it makes the integration architecture acceptable for involved service providers. And it is critical for a collaborative effort that requires long-term support.

Decouple wherever possible to minimize dependencies. This will make changes possible in the business processes, in technology and in resource systems, without breaking the integration architecture. This will allow the integration architecture to grow incrementally and gradually.

Additionally, for the sake of separation of concerns, flexibility, and scalability integration architecture should adhere to other elements like: a layered structure, service-oriented, an appropriate integration topology, and a loose binding to technology

Layered Structure: service-oriented integration architecture needs a layered model that should result in integration solutions. These solutions should not only be limited to information- (data) and portal-oriented integration. Therefore, a traditional model of two or three layers is not sufficient. A four-layered model is required for service-oriented integration (also called a service platform [Bloomberg, 2004; Kalakota, 2003]). These layers are logical layers and do not need to be co-located on the same machine. These layers are presentation, business process, integration, and resource (See Figure 2.8).

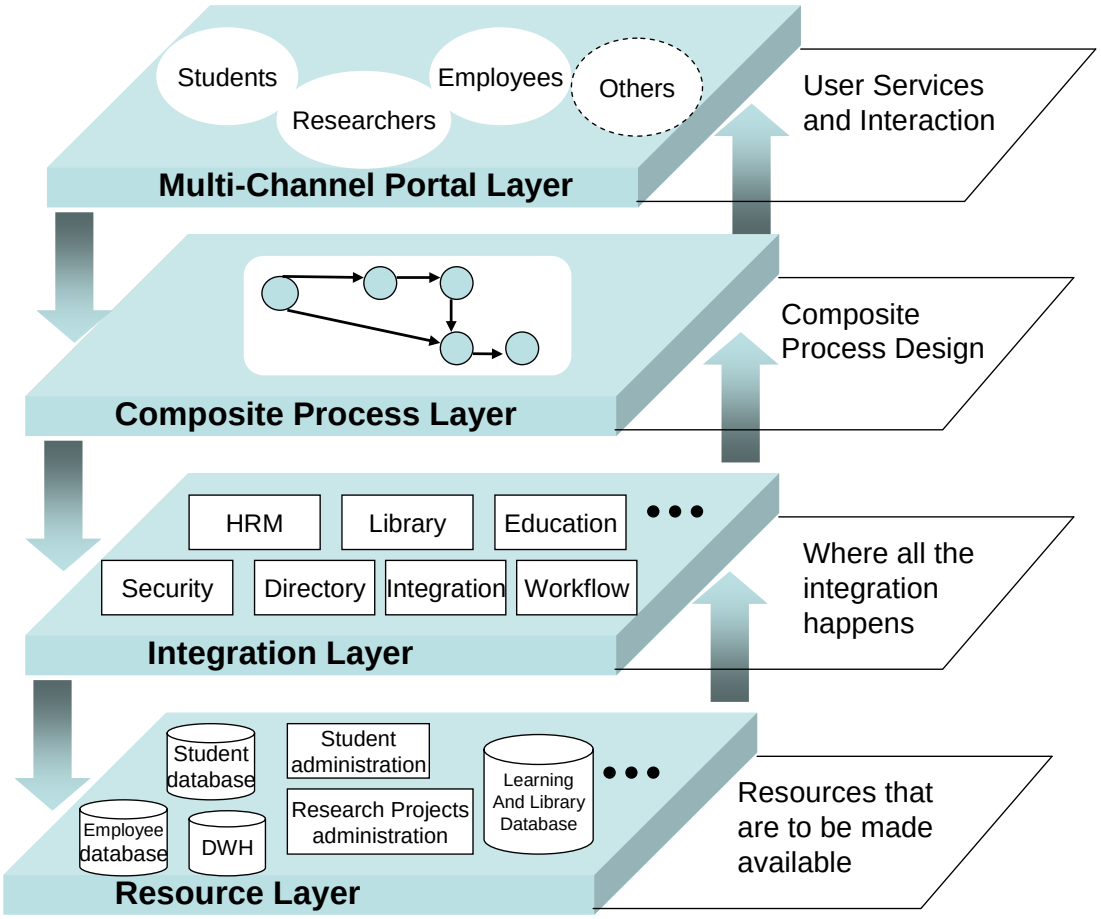

Figure 2.8: four-layer service-oriented integration architecture (adapted from source: [kalakota, 2003])

- **Presentation Layer:** This is the portal layer, which is the layer that provides multi-channeling (e.g. web and mobile handhelds) and interaction. It is the window through which the customer (business client, student, manager, lecturer, etc.) interacts with services.

- **Business Process Layer:** This is the composite process layer where services are assembled, coordinated and deliver their functionality to the customer via the presentation layer.

- **Integration Layer:** Is responsible for integration across resource systems, across organizational units and departments. It enables the various front-office and back-office applications. The integration layer is not a wrapper for a resource system, but rather a mediator that externalize (integrate) a business function, a service.

- **Resource Layer:** This layer includes all the systems, databases, and interfaces that are subject to integration.

These layers represent the pillars of service-oriented integration architecture. They should be well understood and described by the organization undertaking the service integration effort.

Service-oriented: It is not enough to have web services scattered across the organization or inter-organizations without a framework that pull them together. Such a framework is the Service-Oriented Architecture framework (SOA) [Hohpe, 2003; Kalakota, 2003]. SOA consists of a set of services that defines its groundwork architecture. Figure 2.9 illustrates the dependencies between different types of services. These services are as follows:

- **Infrastructure services:** Also called integration service, are those services that are responsible for management and control like event management, transaction management, data logging, exception handling, etc.

- **Generic-services:** Also called business-neutral services. They are used across service domains, and they are shared by multiple applications. Examples of these services are: notification service, authentication service, address reformatting service, etc.

- **Domain services:** or business services, they provide domain functionality, and they vary based on the service domain. When (re)building these services, the granularity (e.g. fine grained vs. coarse-grained) should be determined based on low coupling and high functional cohesion patterns [Larman, 1997]. These two patterns when applied correctly result in high reusability of services. Examples of these services are: credit card validation, library book renewal, etc.

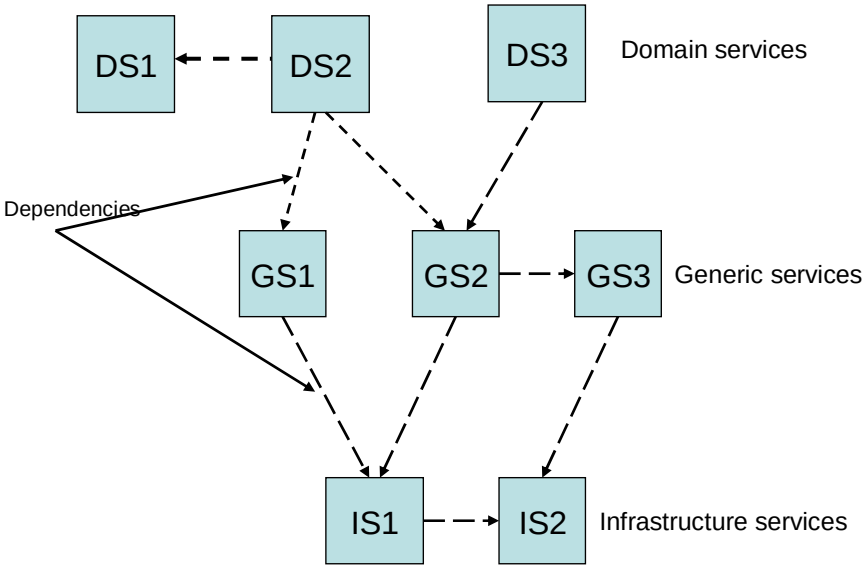

Figure 2.9: Service suites determined by service dependencies

Furthermore, SOA is characterized by 4 elements that constitute the pillars of the framework [Sleeper, 2002] (See figure 2.10); these elements are at the origin of its flexibility and the interoperability it may offer.

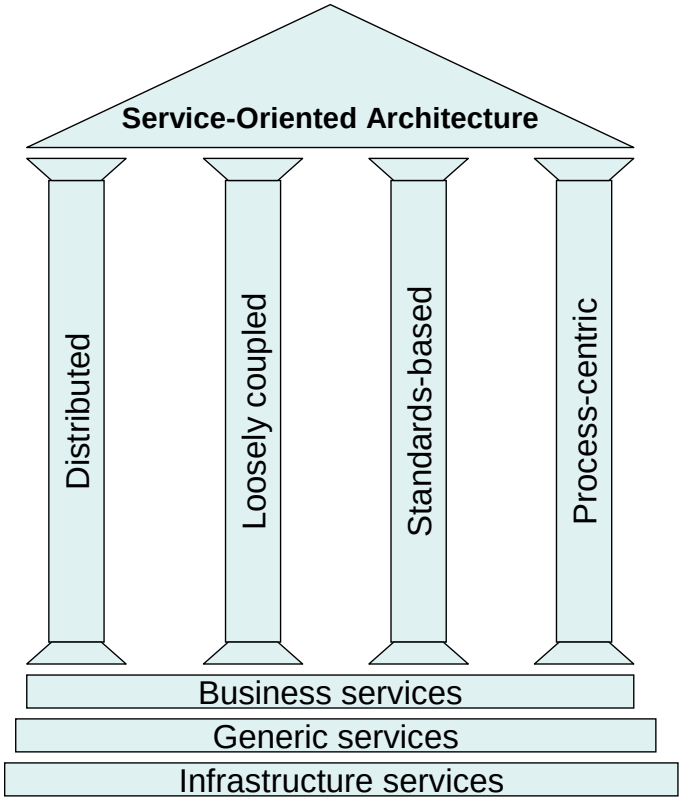

Figure 2.10: The four pillars of service-oriented architecture (adapted from source: [Sleeper, 2002])

- SOA's are **distributed**; integrated business functions (services) that are, eventually, part of existing applications are deployed on multiple systems and execute across local or remote networks
- **Loosely coupled** interfaces; involved services are invoked and assembled to form composite services without being co-located and tightly coupled
- Connections are based upon vendor-independent **standards** to ensure interoperability
- **Process-centric**; services are business functions that form steps in a workflow or business process

Finally, the SOA's business value is to provide solutions by leveraging existing systems (e.g. HRM, CRM, financials, etc.) and not replacing them. The following table 2.3 illustrates the existing SOA frameworks plus related vendors and technology.

Vendor	SOA	Technology
IBM	E-Business on Demand	Websphere
Sun Microsystems	Services on Demand	Sun ONE
SAP AG	Enterprise Services Architecture (ESA)	NetWeaver
PeopleSoft	Real-Time Enterprise	AppConnect
Microsoft	.NET	.NET Enterprise Servers
Oracle	Dynamic Web Services	Oracle 9i Application Server
BEA Systems	WebLogic Workshop	WebLogic Platform

Table 2.3: SOA Vendors, Frameworks, and Technologies (source: [kalakota, 2003])

Topologies: Two topologies exist; hub-and-spoke and Enterprise Service Bus (ESB). Hub-and-spoke is a product of EAI and offers a central integration point. The proponents of hub-and-spoke architecture argue that its single point of control makes it inherently easier to set up and manage than a bus. The bus proponents, on the other hand, counter this by stating that hub-and-spoke can be a single point of failure [Longworth, 2003]. Additionally, hub-and-spoke are expensive, complex and require additional skills [Craggs, 2003]. ESB, on the other hand, is a pre-packaged SOA implementation as it already has the functional components to achieve the SOA aims. Figure 2.11 illustrates a basic structure of ESB.

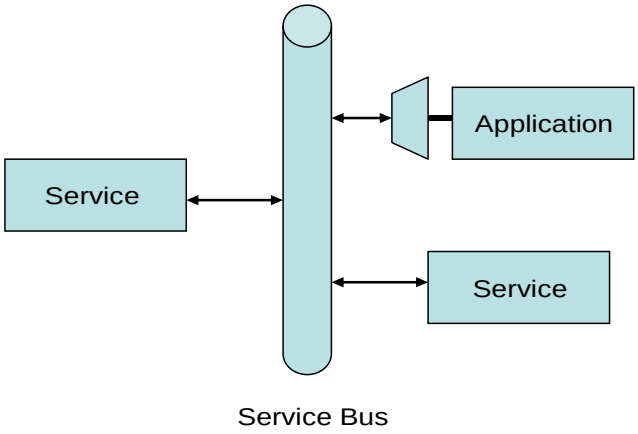

Figure 2.11: Basic structure of a service bus

Conclusion: This part of the research, like other research and articles on this topic, has revealed that service integration, when considered at enterprise-level, needs more than tools and quick fixes. On the other hand, although portals form a central integration point, they do not create value by themselves. They are merely windows into various processes [Kalakota, 2003]. Enterprise service integration needs an architecture that should offer future flexibility and avoid disruptive integration effects for existing systems. Such architecture consists of a service-oriented architecture and appropriate integration technology standards.

2.4 Value roadmapping to service integration roadmap

This section aims to provide answers to the research question: ***Which roadmapping approaches apply to determine the possible paths for service integration in a portal?***

2.4.1 Introduction

Service integration is a complex undertaking, and like anything with similar complexity, it needs a perfect plan of approach in order to deliver the expected business impact. I choose to call this plan a roadmap instead of a methodology because a methodology undermines the level of complexity that is involved with such undertaking like service integration. In the following I will provide a definition of a roadmap, discuss the different approaches involved with roadmapping (the process), benefits of roadmapping, and how roadmapping can help achieve service integration.

2.4.2 Definition

The term “Roadmap” is used liberally through the published literature. It has different meanings in different contexts. According to *Kostoff* there are not any definitions mentioned in commonly used dictionaries. Webster’s dictionary defined a “map” as “*a plane surface representation of a region of the earth or sky”*. *Kostoff* states further that generically, a roadmap is a layout of paths or routes that exist (or could exist) in some geographical space.

Roadmaps are used by travellers to decide among alternatives routes toward a destination. It is a tool used by travellers to achieve understanding, direction, and some degree of certainty in travel planning [Kostoff, 2001; Kostoff]. The term roadmap has gained popularity and is used in the literature as a metaphor for planning. On the other hand, the variant "Roadmapping" is the process of roadmap development. *Kappel* has provided taxonomy of roadmapping in order to eliminate definition ambiguity. *Kappel* distinguishes the following types of roadmapping [Kappel, 2001]:

- **Science/Technology roadmaps** are aimed to set industry targets. The main purpose is to better understand the future by identifying specific trends and generating accurate forecasts

- **Industry roadmaps** are aimed to set industry expectations by combining forecast of technology performance, adoption, cost, and so on

- **Product-Technology roadmaps,** also called corporate roadmaps, are aimed to align decisions with trends by highlighting the links between product generations and successive technology generations

- **Product / Portfolio management roadmaps** are aimed to schedule product introductions through communication with customers and internal audiences

Furthermore, roadmapping might be confused with scenario planning; however, roadmapping differs from scenario planning in one important respect. Unlike scenario planning where the end-point is forecast, roadmapping starts with the end-point or vision clearly in mind and then traces the alternative paths to achieve it [GUIDE-TRM, 2001].

2.4.3 Fundamentals of Roadmapping

Roadmapping helps organizations to make better investment decisions based on better information, which becomes available through 1) identification of stakeholders needs and drivers, 2) determining the alternatives solutions that satisfy these needs and drivers, and 3) generating a plan to develop appropriate alternatives. Additionally, a roadmap is driven by a need not by a solution as there may be more appropriate solutions for a need [Garcia, 1998].

Roadmapping Framework

The essence of a roadmap is that it sets an objective (an end-point) and answers a set of "Why, What, and How" questions to develop an action plan for achieving a defined objective. The roadmap process is based on the "Fast-start Technology Roadmapping" [Albright, 2001; Albright; Phaal, 2001]. Figure 2.12 illustrates the building blocks of the framework.

Business level (the "Why"), defines the objectives, the needs and the drivers of the target audiences. This part also includes market and competitive assessment as well.

Service level (the "What"), defines the services that should satisfy the needs and drivers of target audiences

Technology level (the “How”), defines the integration technologies that will implement the different services

The fourth part defines the action plan, the “To-do’s” of the roadmap. The action plan defines key developments actions, resources, skills, risks, and technology investments. All parts of the roadmap are laid out over time, the “When” of the roadmap.

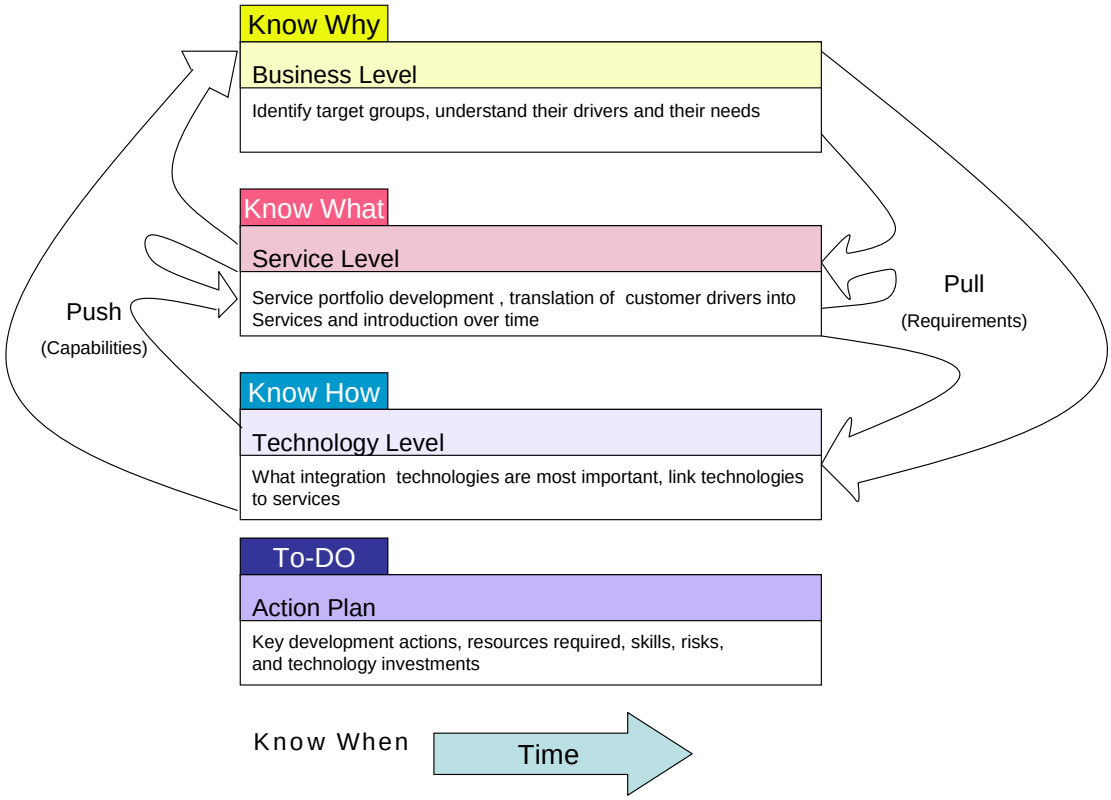

Figure 2.12: Fast-start Technology Roadmapping framework (adapted from source: [Albright])

2.4.4 Roadmapping Approaches

Based on literature [Kostoff, 2001; Kostoff; GUIDE-TRM, 2001], two fundamental roadmapping approaches are identified: expert-based and workshop-based.

Expert-based

A team of expert (e.g. technical and business people) comes together to develop strategy, identify target groups, services, technologies, resources, risks, etc. and relationships that link them together.

Workshop-based

This approach is aimed to achieve the same results as expert-based approach. Additionally, this technique is used to engage a group of stakeholders and surrogate users to achieve better understanding, and build consensus

Both approaches make use of retrospective and prospective analysis (See section 1.4.3 for more details). The outcome of both approaches is an action plan that further should translate into projects.

Further, there is a third approach, the so-called computer-based approach. This approach has not been included as it does not fit within the goals and the scope of this project.

2.4.5 Benefits of Roadmapping

Roadmapping provides several benefits that have broad usage. *Schaller, Garcia* and *Kappel* identify the following major benefits [Garcia, 1998; Schaller, 1999; Kappel, 2001].

Coordination and planning

From a managerial point of view, when the organization is complex or distributed, the need for roadmaps is high. *Kappel* argues that coordination and planning is difficult in these situations as a result of the fact that organization units do not share the same set of priorities. Hence, the need of roadmapping for better coordination and planning.

Consensus

Roadmaps help develop consensus among stakeholders with regard to their contribution, the integration needs, and the solutions required to achieve those needs. Consensus building is achieved through the inherent collaborative aspect of roadmapping.

Better insights

Challer states that roadmapping is a communication tool and a learning experience. These two benefits lead to better insights and better decision-making. *Kappel* argues further that roadmapping brings with it better alignment of organizational decision making. In case of service integration this means better alignment between business, process, and technology and better alignment between the inside-out and outside-in perspectives. Alignment is the result of gap analysis; what is possible and what is not.

And finally the most important benefit is the effect of uncovering common needs through cross-roadmap reviews. An additional benefit of across-roadmap reviews is mapping where duplication of efforts occurs and as a result the opportunity to consolidate

Conclusion: Although a “service integration roadmap” category does not appear in the above taxonomy, the roadmapping framework, fundamentals, and benefits can be broadly

extended to other domains, including the service integration topic. The value of roadmapping to service integration topic lies in its inherent collaborative aspect that helps build consensus and pulls together the different views and knowledge of involved stakeholders to carry out the roadmap process and plans. Hence, both approaches (expert-based, approach-based) apply. And the choice to use one or the other should be driven by the necessity to build consensus and achieve better understanding.

2.5 Service integration reference framework: putting it all together

This section aims to provide answers to the research question: ***What is involved in building the service integration reference framework?***

Service integration reference framework is the result of my literature research on the topic service integration. The framework puts together the elements and aspects that constitute the buildings blocks of service integration, and brings to the fore the interaction between involved entities and actors. The framework is illustrated in Figure 2.13. The framework consists of three main parts:

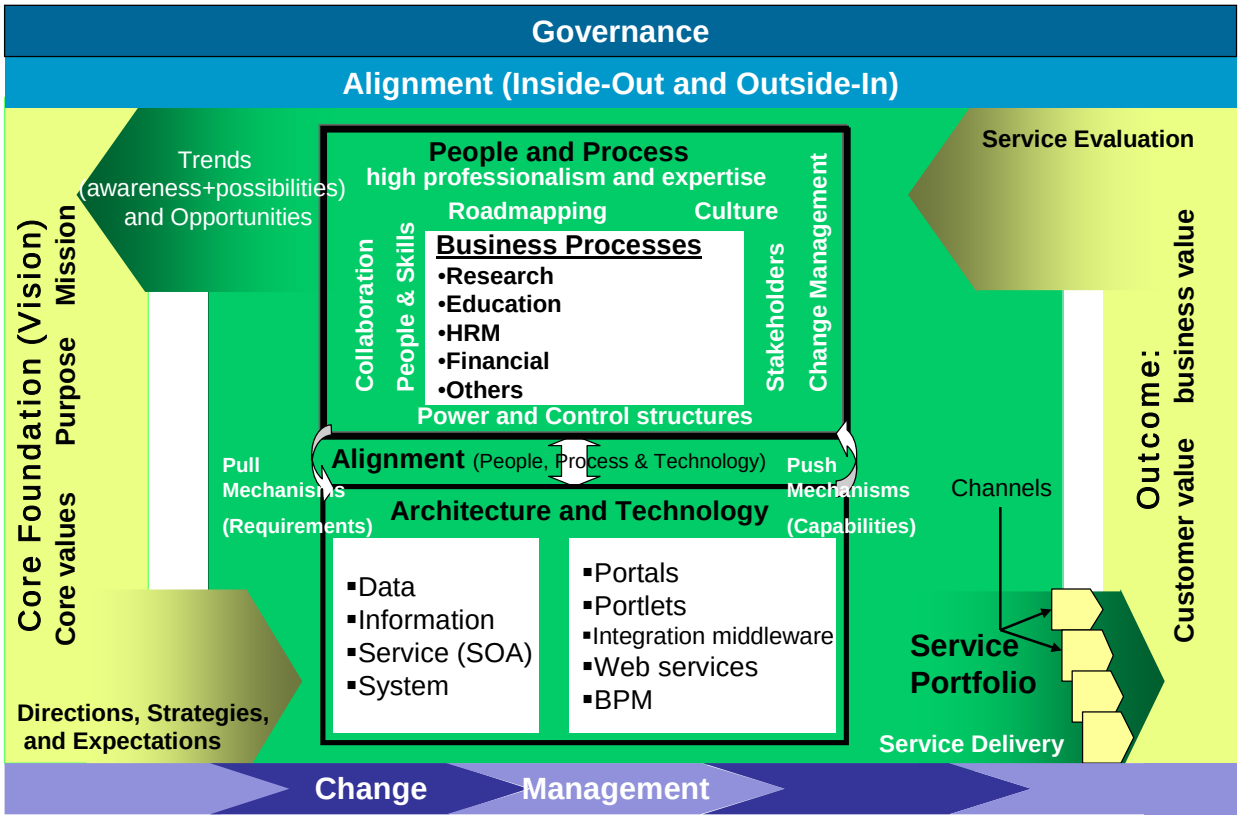

Figure 2.13: Service Integration Reference Framework

2.5.1 Core foundations

Service integration is an enterprise initiative that touches the whole organization. Such important and critical initiative needs a vision, which consists of a set of core values that

differentiate an organization, a purpose, and a mission. An articulated vision translates into a set of prioritized strategic issues that are subject to execution. On the other hand, vision is subject to change and adjustment as a result of feedback and trends from its environment.

2.5.2 People, process and technology

This part consists of three components and it is the heart of service integration. A sound alignment between the three is determinant for success and the value of the outcome. Alignment is also the ability to find the balance between the push and pull mechanisms between technology and process. Besides alignment each component has its own characteristics that influence other components when interaction takes place.

The people component

Service integration involves many factors related to people's behaviour, culture, power structures, and skills (See section 2.2 for more details). These aspects determine the level of commitment to the innovative initiative of service integration as well as the quality of its execution and implementation. Commitment, on its turn, is determined by a change management process (see section 2.2.9) that respectively consists of awareness, understanding, acceptance, and buy-in. Furthermore, the extent of collaboration between involved people (stakeholders) is determined by the behaviour and culture aspects. And more importantly, understanding these aspects will help applying appropriate mechanisms such as a well suited governance structure (see section 2.2.10) and roadmapping approaches (see section 2.4) that foster collaboration (see section 2.2.6) and make service integration effort successful.

The process component

The process component is the set of business processes (education, research, HRM, etc.) and service integration processes (collaboration, change management, project management, development and integration of services, etc.) that should be understood in order to eliminate redundancy through streamlining of business processes, building enterprise data, and integrating and coordinating the developed services.

The architecture and technology Component

Architecture and technology represents the third component of the second part of the framework. This component reflects the integration needs in architecture and technology to build a solid and flexible integration environment. Such an environment is a critical and powerful enabler for organizations trying to adapt to the changing needs of the digital customer. The needed integration architecture is not an architecture that is about:

- Integrating system A from department A with system B from department B
- Enterprise application integration (EAI) consisting of interconnecting a large set of applications

- Integration within a department or an organization unit. This is a much simpler type of integration as it does not involve disparate systems and people with conflicting interests

The needed integration architecture (see section 2.3) is one that integrates business functions (services) across the scope of the organization. This integration will obviously require close collaboration of the service domain owners. Additionally, the envisioned integration aims at eliminating redundancies, sharing services, reusing services, and working together, between organization units where that is possible for the greater good of the organization.

Many integration technologies (see section 2.3) and standards are available varying from data integration to business process integration technologies. Integration technologies or the so-called middleware include distributed objects, application servers, integration servers, web services, message-oriented middleware, and database-oriented middleware. Service-oriented standards, on the other hand, include XML, XSLT, SOAP, WSDL, UDDI, portlets, ebXML, BPEL4WS and so on. This short list is limited to standards that provide service integration capabilities and which currently have momentum.

The second part of the framework results in a services portfolio that is delivered to target audiences using multichanneling capabilities of the portal. This service delivery brings us to the last part of the framework, the outcome.

2.5.3 Outcome

Outcome consists of the generated customer value and business value. These values reflect the outcome of the service integration effort. These values are measured in terms of tangible and intangible benefits. Finally, the outcome is subject to evaluations through customer feedback and business results. Service evaluation may bring with it adjustments in execution and strategy.

Conclusion: The service integration reference framework puts the different components together. These components have been subject of thorough discussions in earlier sections. Additionally, the framework provides a total view of the involved components and aspects, as well as it shows the interactions between the different elements in terms of information flow and alignment.

3. Analysis: Wageningen UR Case

3.1 Introduction

In this chapter, the context in which this case study has been performed will be analyzed. This analysis is the result of acquired insights from the literature research, inside documentation, and face to face interviews with key people from the organization. This chapter presents the current and envisioned situation, discusses the analysis results based on the research questions that are used as guidelines through this thesis.

3.2 Current Situation

In Wageningen UR's current environment resources are scattered, information and services are made available through a multitude of vertical web sites/portals. Customers need to visits multiple web sites to locate the information and services they seek. Wageningen UR has decided to make the available information and services accessible through a campus-wide portal in order to remedy the existing fragmented user experience.

3.2.1 Corporate Policy

Wageningen UR as illustrated in chapter one (The organization) is an organization that has a decentralised structure. This structure is based on the principle of "everything decentralized unless otherwise…." This organization set up has resulted in organizations units and departments with a great autonomy, and standalone ICT systems that reduce the integration flexibility of both people and systems. Each organization unit has leadership that traditionally does its own thing. There is currently an increased awareness about the need to share services, information, and knowledge. This awareness has resulted in a new mindset in some parts of the organization that become aware of the benefits of creating the networked organization or the so-called e-culture. In such an e-culture organization, information is intended to shield the organization structure and becomes the glue that holds the organization together.

3.2.2 ICT Policy

ICT policy within Wageningen UR is geared toward providing ICT support services for the Wageningen UR community. These services aim at providing a functioning ICT infrastructure that enables users to do their daily jobs. Recently, there have been ongoing efforts to centrally integrate ICT services, which range from network services to software services (e.g. one network system –WURnet, one mail service, etc.). This course is a result of the recent merge between the two organizations (the university and DLO foundation). There are also ongoing efforts in software standardisation, integration of ICT support (hardware, and software when necessary), and the portal integration is just one of those initiatives that fits within the course of the adopted policy. This said; the current situation around ICT is as follow:

Corporate ICT

- Support of systems organization-wide
- Innovation: Investigation of the application of new tools and technologies
- Determine standardising policy
- Application development for student administration and office application

Local ICT

- Local application development and system management
- Autonomy in defining own needs
- Independent from other organizational units

Data/information exchange/integration and knowledge sharing

- Point to point data integration through batch procedures
- Information sharing using Microsoft office applications, including email
- Local intranets with news, reports, etc.
- Corporate intranet with corporate news, presentations, reports, phone number list, and who is who
- Increasing number of different local systems and databases

In general, there is lack of a strong vision about the corporate ICT. Most of the information systems supporting the organization are structured along organization unit lines, with no ability to provide a consolidated view at an enterprise level of employees, students, and clients within the organization.

3.2.3 Architecture

The current decentralised ICT policy and the fragmented offer of information and services do obviously not raise high expectations about enterprise architecture. Enterprise architecture with emphasis on the word enterprise does not exist, and if it does, it hardly consists of a so-called “spaghetti-architecture”, Figure 3.1, illustrates what this architecture looks like.

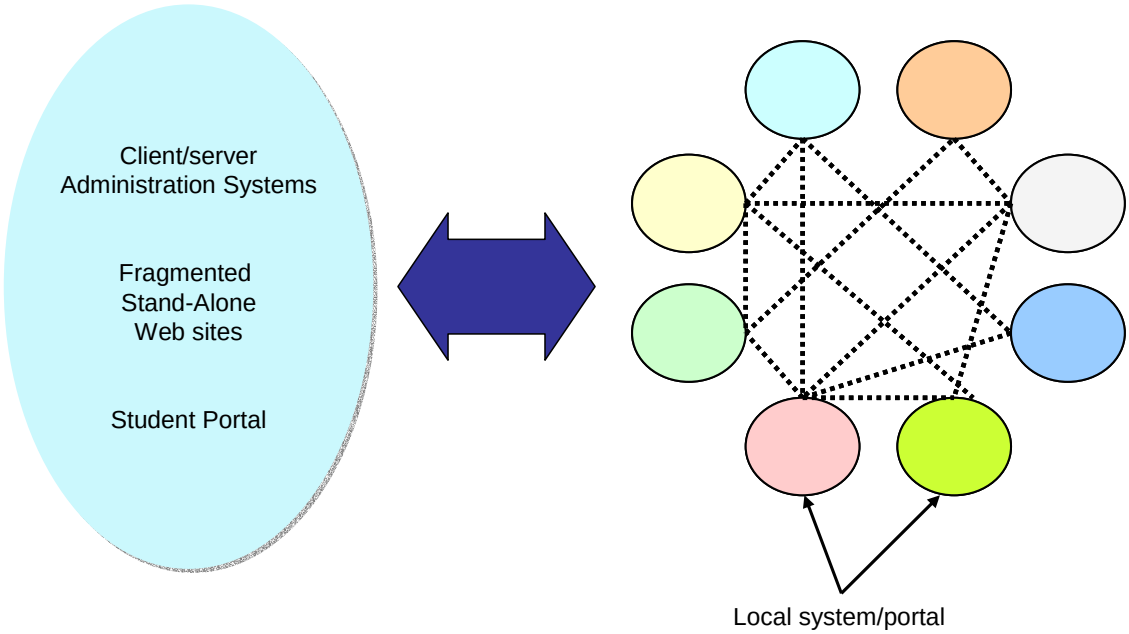

Figure 3.1: View of current situation and architecture at Wageningen UR

3.3 Envisioned Situation

In response to changing customers (student, researcher, lecturers, and staff) expectations and the ongoing digital innovations, tight budgets, and competition in education and research environment, Wageningen UR feels the pressure to meet the demands of the next-generation digital customer.

The challenge lies in shielding the complexity and fragmentation from the customer. Achieving simplicity involves integration of existing services from disparate systems, consolidation and presentation of these services through a uniform look-and-feel, and streamlining of back-office processes. The Wageningen UR customer, in general, wants to complete her task without going from web site to web site. She wants one web site offering a broad array of services, she wants a real portal. The portal aims at simplifying the current environment by providing single sign-on when accessing different information sources and services, enabling customer self-service, quickly find the needed information and peers, and sharing knowledge. This shielded complexity needs an enterprise integration architecture that should govern the integration complexity. Figure 3.2 illustrates this envisioned situation.

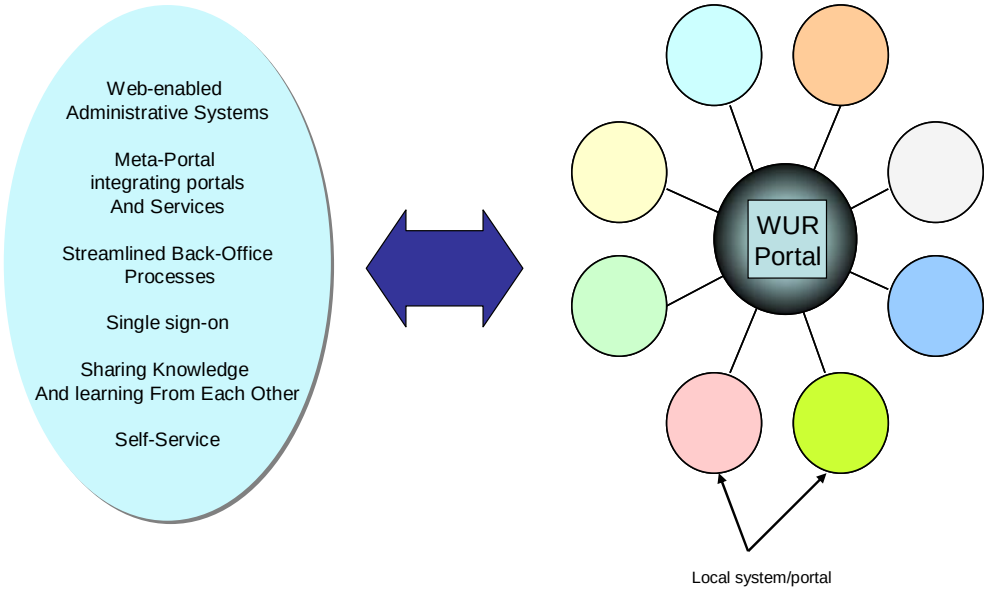

Figure 3.2: Envisioned situation and high-level architecture at Wageningen UR

From the envisioned situation sketched above the following scenarios can be envisioned for a future environment of students and knowledge workers. These scenario descriptions also answers question of *"How can service integration/Portal contribute in increasing satisfaction and effectiveness of knowledge workers?"*

The Wageningen UR student

It is Monday morning 2005. Sarah is an undergraduate MSc student; she rolls out of her bed walks over to her Wi-Fi-enabled laptop, and logs on to the student's portal to check her schedule for the day. She first submits her assignment to her lecturer, then according to the plans with her friend for the end of the day, she makes a reservation for a squash room at the campus sport complex, notifies her friend of the reservation, shuts the laptop, and makes herself ready to join the campus.

The Wageningen UR Knowledge Worker

September 2006: Sarah has recently finished her PhD and started her first job at Wageningen UR. She has joined the knowledge unit of Plant Sciences. During the first weeks, she took the time to get acquainted with the organization's culture, core business, and learn about the issues and knowledge that represent the intellectual assets of the organization. All this information has been made available to her through her role-based access to the portal. Today, after she has completed her knowledge and interest profile using the portal, her profile is submitted to a back-end service that links her profile to the organization's

knowledge tree[2]. As a result relevant documents have been retrieved, summarised, and presented to her. Besides the map of documents referring only to information that is relevant to Sarah's function and interest, the following has been suggested to her: a contact map of expert people she may want to interact with, and also suggestions about joining communities of practice that might be useful for her knowledge development and sharing.

3.4 Results Analysis

3.4.1 Service Integration Requirements

This section aims to provide answers to the research question: ***What are the Wageningen UR portal requirements for service integration?***

Portals, though, variously defined are now achieving importance as a central integration point for the diverse information sources and services available in a networked enterprise environment. From the interviews I have conducted to elicit the portal requirements for service integration, I have distinguished the following requirements that relate to the integration topic: environmental requirements, organizational requirements, functional requirements, managerial requirements, and finally the technical requirements where architecture and technology will be discussed.

Environmental Requirements

Culture: Wageningen UR is a merge between two extremely different organizations and subsequently two different cultures; an academic culture that is used to a great level of freedom, which is, to a certain degree, necessary to foster creativity and quality of scientific research. And on the other hand, the profit-oriented research institutes of the DLO foundation, which need clear policy and goals that are aligned with market demand. Both cultures are futurists because of the innovative nature of the core business. Furthermore, both organization parts are characterised by high professionalism and expertise because of high educated people that make up the organization. This creates the tendency within the units and departments to do things their own way. As a result, this turns out to create units which are internally focused, emphasizing the concept of ownership that impedes collaboration and that yields many drawbacks for the organization in its entirety such as efforts duplication, lack of knowledge sharing, and missing business opportunities.

On the other hand, this culture-mixture of the business-oriented and academic culture is, despite the differences, perceived by the middle management as strengthening and complementing each other when these differences are engaged to serve the common vision and goals of the whole organization.

2 A knowledge tree is the sum of the knowledge of the individual members of a community [Meij, 2002]

Based on the corporate culture theory of Baltzer (see section 2.2.4), Wageningen UR's culture does not only fit in just one category. Its corporate culture is rather a mixture of various cultures (futurist, profit centre, and consensus) where top management decision is necessary in initiatives that touch the whole organization. As a result, initiatives that demand collaboration, service integration included, should take these differences into account to develop an approach that suits each group.

Finally, as a result of the recent merge, Wageningen UR is still suffering from the effects of the silos culture, which has resulted in lack of collaboration and increased service fragmentation. One of my respondents described the culture as follow *"We are a fleet with a face of a ship".* This statement illustrates the current fragmented situation and the desired situation.

Extreme organization heterogeneity, high professionalism and expertise in combination with internal focus and ownership are elements that are at the origin of silos and different cultures. A customized approach should be adopted for each organization unit in order to make the service integration successful.

Collaboration: As stated previously the current culture within the organization does not foster collaboration. Despite the fact that the portal idea of integrating common services has been received positively, potential problems have been identified during the interview sessions. These problems could impede the collaboration effort:

- lack of communication about the goals and the benefits for the stakeholders and the customers
- Lack of a coordination structure that should drive such effort. Currently, there are some permanent coordination structures in place that coordinate the implementation of innovative ideas (e.g. Coordination ICT in Education group, Research Strategy group). However, horizontal collaboration between these groups is currently missing
- Because of cultural issues, people fail to recognize the need to collaborate as a result of internal focus. Additionally, people simply assume that they should solve their own problems. Consequently, they miss opportunities to collaborate with peers and finally find themselves reinventing old wheels
- Competition within Knowledge units is also perceived as a roadblock for collaboration as there is lack of openness, transparency and trust

Wageningen UR: The WURnet example

In general, there is good will to collaborate when the benefits and opportunities are well communicated and well understood. An organization-wide initiative like WURnet is a typical example that has been successful in the past. Among the success factors of such collaboration were an architecture blueprint, a master plan that outlines what will be achieved, membership that consisted of making stakeholders part of the project, a good

coordination through a governance structure and so on. WURnet example should be used as a best practice for current and future organization-wide initiatives like service integration.

Many problems that impede collaboration, and that have been identified in my literature research have been recognized during my interview sessions. These problems deal mostly with issues of communication, coordination, trust, openness, and project membership. To make the service integration successful, these issues should be taken into account and develop an approach that helps diminish or eliminate these problems.

Lack of communication, lack of coordination, internal focus, and internal competition are issues that frustrate good collaboration. These elements should be taken into account to make service integration successful.

Power and Control Issues: Wageningen UR is an organization with many organization units that enjoy relatively great autonomy in managing their daily business and have control over their budget spending. Wageningen UR is therefore no exception as to the issues of power and control (See section 2.2.7 for more details). Digitization levels within the organization units differ from one another. Most of them, if not all of them, have an internet presence with their own service offering to their own perceived target groups (customers). Issues related to control or ownership topics have been recognized by my respondents but perceived as not problematic with the assumption that control stays in the hands of the owners. However, because of the internal competition between knowledge units, achieving agreement about sharing information (e.g. project information) might be problematic as some of this information has the proprietary or confidential status within the knowledge unit that own that information. This issue is recognized among the causes of missing business opportunities and reinvention of old wheels.

Power related issues mainly involve funding and power of influence, which are related to each other. Therefore, approaching the right people in the organization units, persuading them of the benefits of the service integration is a step in the right direction, which can ensure funding of integration projects. Organization units as well as the executive board are ready to pay when benefits and ROI can be made visible.

Finally, shared vision, common goals and an endorsed justification of the overall benefits should be the drive to make the power and control issues less problematic for the service integration. It may even, to the contrary, turn these issues in favour of the service integration initiative.

Ignoring issues that are related to control or ownership, and underestimating the power of influencers are among factors that contribute to failure of service integration

People and Skills: Currently, the realization of the integration efforts has been conducted by the section Innovation and R&D. The section consists of the head of the section, two project leaders, and an application technologist. There is lack of integration resources (people), which make the integration results take too long. Further, service providers are lacking integration skills, which demand training or subcontracting integration consultants.

Further, from the service domain perspective, service integration will require additional skills and training of departmental ICT people in order to provide the required integration interfaces. Additionally, more resources will be needed in order to cope with the overhead incurred by additional activities.

Additionally, Wageningen UR does not possess a position of a CIO. Parts of this position are assumed by different people in the organization. Among these people are the head of the ICT department, the head of the section Innovation and R&D and people from other different groups like information-, and research strategy. Lack of a horizontal collaboration between people from these groups does not provide the expected insights about the why (vision and opportunities), the what (services, products), and the how (technology, skills and resources).

Business and technical skills, training, appropriate development tools, and training are necessary requirements to achieve successful service integration

Alignment:

There is lack of enterprise alignment between people, process, and technology as these three components are scattered across the organization. As a result “the right hand does not always know what the left hand is doing”. There is also lack of alignment between the inside-out view and the outside-in view. This is because services are assembled and offered at the department level and not at the enterprise level.

Conclusion: Shared vision, common goals, business and technology alignment, inside-out and outside-in alignment, skilled people, stakeholders commitment, and executive board commitment are all factors that determine success of service integration

Organizational Requirements

Organizational Structure-based Drivers: There is an increasing awareness among my respondents that the only sustainable source of the competitive advantage to attract and retain students as well as providing quality research is maximizing collaboration between involved actors, stakeholders on the one hand and the employees on the other hand, through access to information/knowledge, sharing experiences and best practices, and learning from existing knowledge, successes and failures. This necessity is the effect of drivers such as functional convergence, and project-centric approach.

- **Functional Convergence:** as discussed previously, the decentralised structure of Wageningen UR brings with it barriers between the university and the DLO foundation on the one hand and mutually between the university departments and knowledge units on the other hand. These barriers constrain a common shared understanding to develop and improve products (high quality research) and high quality services. But, to stay competitive my respondents recognize the necessity of functional dependencies, which should be strongly related than ever before. Traditional barriers, which are related to the organization structure must be removed and give way to intensive collaboration between different departments and knowledge units. Therefore, buy-in and appropriate portal

integration of services should bridge the existing gaps and differences and help generating benefits from these functional dependencies. The portal should offer a functional integration layer that transform Wageningen UR from the organizational structure of bricks-and-mortar into a functional structure enabled by clicks-and-mortar, the e-Wageningen UR.

- **Project Centric:** research relies on project-centred teams to innovate and develop quality research. This is also valid for students, lecturers, and other employees that might want to work together on a project. Therefore, there is a need for a collaborative environment offering easy and just-in-time access to the needed information. A collaborative environment will increase efficiency and throughput of a project. Additionally, skills developed during the collaboration process and lessons learned might be lost if there is not any mechanism to help retaining the gained knowledge. The portal should provide a project-centric environment supported by appropriate service components (groupware, CMS, etc.) that help achieve this.

Personnel-focused Drivers: The personnel-focussed drivers include the need of being involved in learning, sharing and creating knowledge, as well as the need for mobility and efficiency in doing the daily job.

- **Collaboration:** The collaborative nature of the tasks performed by researchers (research projects), students (study groups), and staff (projects) involve sometimes many functional dependencies that make good collaboration critical and mandatory to achieve success. The other benefit of collaboration is that it encourages conversations and discussions, which is an effective way to share knowledge and to stay informed and tuned.

- **Mobility:** With Internet connectivity, the physical presence of employees in the office is no more a constraint for being able to do the daily work. Exploring this open connectivity through a well organised and functionality rich corporate portal will provide employees the freedom to work from any place any time.

- **Efficiency:** This issue regards the need to get access to the just-in-time and just the right information and services. This facility will provide more satisfaction in doing the daily job and will help researchers, students, and staff to answer their objectives within the defined timeframes.

Process drivers: Process drivers are focused on improving work processes through access to better and just-in-time information. For example researchers need answers to questions like how much budget left I have for my research project. What facilities (facility sharing – lab machines and tools) and knowledge exist within the organization, who is doing what and where? All these questions arise when working on a process. Additionally, streamlining back-office processes that aim at achieving effectiveness through self-service and cost reduction is another driver for service integration. Examples of such processes are travel requests and travel reimbursements, student registration, projects administration, HRM systems (e.g. administration of absence through illness, holiday and days off administration, etc.). The portal, when equipped with the right integration (business process integration), becomes an asset that contributes to improving work processes.

The portal should provide a functional integration that shields the traditional organizational structure and transform it into a functional organization structure resulting in e-Wageningen UR.

Functional Requirements

The expressed functional requirements are similar to functionalities (or portal services) offered by enterprise portals. These requirements have been discussed earlier in section 2.1.5.

Managerial requirements

These requirements mainly deal with providing good leadership and put in place a governance structure. The latter should drive, communicate, coordinate, and tie the different results together of the service integration effort.

Technical Requirements

Technical requirements for a service integration solution within Wageningen UR need a thorough analysis. Additionally, a detailed analysis of these requirements does not contribute directly to the resolution of the research problem. Nevertheless, the results of my interviews underline the need for an integration architecture that clearly illustrates how domain services will be integrated. These requirements have been raised by ICT managers from service domains.

Conclusion: The portal requirements for service integration, though, divers have been categorized according to the following taxonomy: environmental, organizational, functional, managerial, and technical. The results of these requirements will form the basis for the design of the roadmap.

3.4.2 Current Approach and Best Practices

This section aims to provide answers to the research questions:

***Question:* Which approach, if any, has been applied so far to rolling-out the existing portal services?**

The existing portal services that make up the EDUweb portal are student services. EDUweb is the first portal that has been rolled-out. The services that make up the student portal were centrally managed and the integration of these services (Marks, schedules, mail, e-Learning, etc.) has encountered little resistance. In addition to these two factors, there has been commitment from the executive board, which made it possible to achieve the progress booked so far.

From my interviews with project members of the student's portal (EDUweb), the rollout of existing student's services and the integration initiative in general is lacking a master plan. However, this does not mean that there were no plans in the head of people being in charge

of this integration initiative, but what is missing is rather a documented master plan that should be communicated to the involved service providers.

Conclusion: The current situation is lacking a strategic approach for service integration resulting in a master plan.

***Question:* What are the Wageningen UR best practices on service integration in a portal?**

The student portal (EDUweb), though not yet complete, has become a success under students and lecturers. Although, its success is inherent to hard work, which has finally paid off, there were other elements that contributed to that success. These elements are:

- A permanent project team that along the way has coordinated the integration of different services that make up the portal. It is important to mention that those services have had one origin (e.g. students' administration) where no resistance has been encountered.
- Aggressive marketing campaigns that took advantage of every opportunity for exposure: brochures, campus news paper, workshops, test teams of students, etc.
- Organization of feedback sessions that resulted in continuous improvement of the portal
- The portal has been launched with a number of killer services that attracted students and ensured their retention (e.g. marks and schedules)
- Secure sponsorship at the highest level through commitment of the executive board
- Incremental roll-out, which has kept failure risks low
- High reliability and high availability supported by a production environment using mechanisms like load balancing and fail-over

Conclusion: The above best practices are useful and will be reused in the development of the roadmap

3.4.3 Miscellaneous

This section aims to provide answers to the research question: ***What are the opportunities, constraints, impact, roadblocks, and risks - with respect to Wageningen UR policies, culture, and strategy – involved in this service integration undertaking?***

From the conducted interview sessions, the following findings have been identified as answers to the above research question. A summary of these findings is as follows:

Opportunities and Benefits

The respondents have been asked to determine which opportunities they identify for themselves and the organization as a whole. The following opportunities have been identified:

Opportunities and benefits for service providers:

- Increased visibility of own services for Wageningen UR customers
- Better visibility of their throughput and the quality of their services within the organization
- Better insight into the existing service offer from other units and the possibility to react on that offer and learn form the units making that offer
- The possibility for reuse of existing services. These services can be business-neutral services (Authorisation, notification, etc) or business services (e.g. project administration, time registration, etc.)

Opportunities and Benefits for Corporate Organization:

- One face to the customer through uniformity and unified access to the service portfolio
- Improve the Wageningen UR image as a progressive higher education and research organization. As a result attraction of more prospective students, enthusiastic parents, retention of existing students, and better quality research
- Customers satisfaction through one pint of access to a complete and consolidated service offer
- Cost reduction through self-service and streamlining of administration processes
- Satisfaction and effectiveness of employees through easy access to just-in-time information and services
- Better communication between different groups, knowledge sharing , and easy access to experts; a student may need access to a lecturer, a staff member may need assistance from a colleague or need an expert for his/her project, and a researcher wants to have access to peers
- Happy business clients through better quality research
- Enhance software standardisation within the organization
- Foster reuse of common services and elimination of duplicate efforts
- Opportunity to make common resources (students databases, business client databases, etc.) enterprise resources

- Ability to develop enterprise services that can be shared and used organization-wide, and cost reduction through shared cost

- A key opportunity of this integration is CRM capability through integration of fragmented customer databases into one database (data warehouse)

Identified Challenges

The main challenges that have been identified by the respondents are dealing with finding ways to work better together and align efforts and sharing existing capabilities. These challenges include:

- The integration of people part, as integration success still depends on the willingness of service providers to collaborate and work in an enterprise way. This will depend on promoting the we-feeling under middle management

- Convincing stakeholders of the benefits of service integration because of the internal focus mindset and the legacy culture

- Administration nightmare as there are not any clear ideas about how to administer, manage and keep in live the integrated services. Besides this, there is not any body that is responsible for this

- Incompatible technologies and platforms; what integration techniques should be used to minimise coupling and maintenance?

- Information and services overload; which services are worth to integrate (killer services) and which are not?

- Multiple logon procedures; which appropriate single sign on should be put in place to reduce logon procedures?

Barriers and Success Factors

Based on literature research and the interview sessions, a number of roadblocks and success factors have been identified. Subsequently, the respondents have been asked to provide a score for the identified roadblocks and success factors. The scores indicate the most important roadblocks and critical success factors for failure and success of service integration as perceived within Wageningen UR. It is important to **notice** that scores for "Barriers to success" reflect the perceived actual barriers in Wageningen UR, and "Success Factors" reflect the perceived needs and requirements. Table 3.1 illustrates the obtained scores.

Score	Barriers to Success	Success Factors	Score
++	Lack of clear vision and articulated	Clear vision and articulated goals	+++

	goals about service integration	about service integration	
++	Lack of stakeholders awareness about the benefits of service integration	Appropriate communication about the benefits of service integration	++
++	Lack of stakeholders involvement	Early stakeholders involvement	+++
0	Misalignment of integration projects and business needs	Prioritization of integration projects according to pressing business needs	++
+	Implementation-oriented solutions (…our technology solution will do a much better job than yours)	Integration-oriented solutions (leveraging existing systems)	++
++	High professionalism and expertise (…we want to do things our own way)	Shared vision and common goals	+++
++	Internal competition	Readiness for sharing information and knowledge	+++
++(-)	Organization culture & politics impedes participation / progress	Organization culture & politics support for participation / progress	++
++	difficulties in building relationships, developing trust, conflicts in values	Openness, transparency, trust, and common values	++
0	silos culture and Internal Focus	Focus on customers (students, researchers, employees, etc)	+++(-)
+	Lack of commitment from Board of Directors	Commitment from Board of Directors	++
+	Lack of commitment from stakeholders (service providers)	Commitment from stakeholders (service providers)	+++(-)
0	Lack of an integration team	An integration team that should lead and monitor the service integration	++
0	Dictating integration solutions	Integration team must include members from involved service providers (membership)	++
+++(-)	Required leadership and appropriate skills are missing	Strong leadership and appropriate skills	++

++	Timing of service integration initiative is inappropriate		Timing of service integration initiative is appropriate		++
++	Departmentalized service integration (Stovepiped integration)		Approved organization level architecture for service integration (Enterprise architecture)		++
-	Lack of effective tools, techniques, methods, and technologies		Effective tools, techniques, methods, and technologies		+++(-)
+++	Lack of effective communication, facilitation, and training		Effective communication, facilitation, and training		+++(-)
+	Initiative overload / distraction from short-term tasks		Appropriate expectation management		+
Legend	Totally Agree	Agree	Probably Yes	May be	Do not Know
Score	+++	+++(-)	++	+	0

Table 3.1 Barriers and Success Factors for Service Integration (Wageningen UR)

Additionally, Stakeholders who have high level of digitisation are reluctant to participate if they are not persuaded of the added-value of service integration in a common portal.

The above table does not reflect precisely everyone's meaning within Wageningen UR. As a result, its significance is limited, but it brings clearly to the fore the roadblocks that are experienced as most risky, and success factors that are perceived as most important. A lack of a timely risk management will constrain the integration effort.

An additional risk lies in the fact that the portal may represent a single point of failure if appropriate fail-over procedures are not well conceived or implemented.

Furthermore, the service integration effort will inevitably bring with it additional resources demand from involved departments and organization units. This will distract people from their daily activities and short-term goals. This is perceived as an impact of the integration effort.

Conclusion: This part of the research reveals important elements that are useful for the design of the roadmap as well as for roadmap documents (e.g. change management plan, communication plan). The design of the roadmap should take these findings into consideration.

4. Design

4.1 Results Evaluation

This section aims to provide answers to the research question: ***What is the best method to make a fit between the service integration reference framework and the Wageningen UR specifics?***

The service integration reference framework has been the basis for conducting further work. The insights that have been put together by the service integration reference framework are the results of my literature research. Further, the framework has been used to conduct the interviews and to elicit the requirements for the service integration in the context of Wageningen UR as well as gathering information about existing approaches and best practices on this topic.

The analysis results provide similarities but also differences between the service integration reference framework and the Wageningen UR specifics. Similarities in the sense that findings from literature research have been recognized in Wageningen UR specifics (e.g. cultures issues, collaboration issues, etc.). And differences in the sense that some findings from literature research have not been recognized in the Wageningen UR context (e.g. integration skills, integration competence centre, etc.). On the other hand, there are also some new findings that have emerged during the interview sessions (e.g. need for governance, need for enterprise data, etc.). Figure 4.1 illustrates the fitness between the service integration reference framework and the Wageningen UR specifics. Although, the service integration reference framework has intentionally been used to understand and elicit service integration requirements, it turned out to form together with the Wageningen UR specifics two puzzle pieces that complement each other to provide the design of the roadmap. Hence, the best method to make the fit between the service integration reference framework and the Wageningen UR specifics consists of using the different pieces (similarities, unmatched findings, and new findings) in such a way they contribute to the design of the roadmap. This usage consists of:

- Similarities are the sum of best practices, lessons learned, and issues that are identified as common to both. These similarities are a combined result of the literature research, and the prospective and retrospective analysis of Wageningen UR. These similarities do not necessitate any further research and can be used as is, where appropriate, in the roadmap.

- Unmatched findings are the sum of findings from the literature research that do not have a match with the Wageningen UR specifics (e.g. the role of an integration competence centre, the role of a CIO, etc.). These findings will be used to make the roadmap all-encompassing

- New findings are the result of the prospective and retrospective analysis of Wageningen UR. These findings have not been identified, in first instance, during the literature research. Examples of these findings are: the unique structure of the organization, the

need for a roadmapping process, and the need for governance. These findings are further investigated through additional literature research or become subject to further research

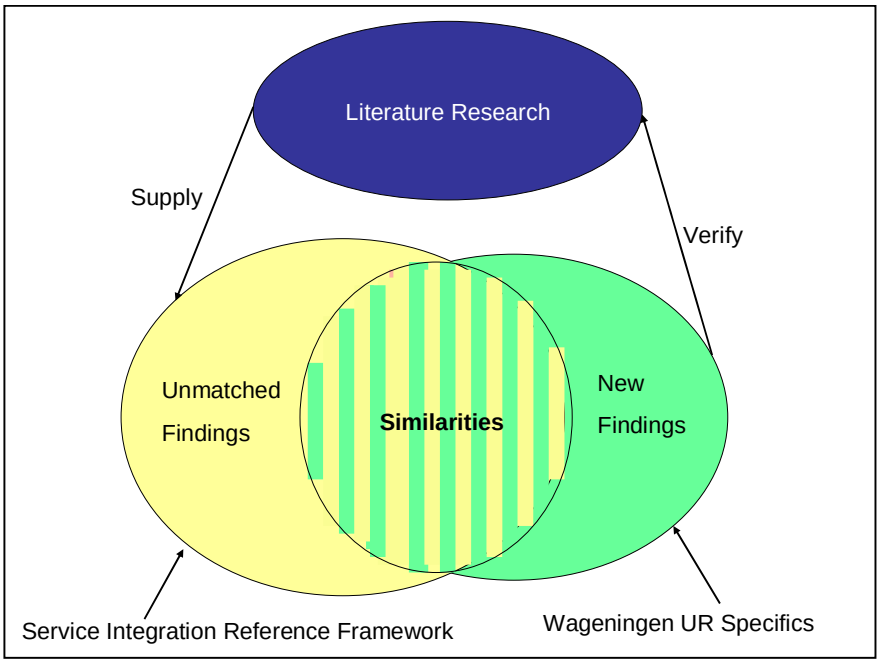

Figure 4.1: Method for evaluation of analysis results

Conclusion: The best method to make a fit between the service integration reference framework and the Wageningen UR specifics is as follows: similarities and answers to new findings should be used as is to design the roadmap. On the other hand, unmatched findings should be used, where appropriate, to increase usefulness and flexibility of the roadmap

4.2 The Roadmap

This section aims to provide answers to the research question: ***What are the roadmap steps that best fit the service integration in Wageningen UR portal?***

The following roadmap is a systematic execution leading Wageningen UR to achieve the envisioned service integration. This roadmap is the outcome of my literature research and the interview sessions I have conducted with key people across the organization. Additionally, the roadmap is an abstracted strategy that is geared toward the Wageningen UR specifics. However, these specifics are so diverse that a “cookie-cutter” methodology is doomed to fail because of the organization complexity.

The proposed design of the roadmap is consistent with the parts of the service integration framework I have proposed in chapter (research). Therefore I find it useful to think of this roadmap in four phases; strategy development phase, execution phase, pilot implementation

phase, and delivery (rollout) phase. Each phase includes a number of steps that can be started according the proposed sequence or sometimes in parallel.

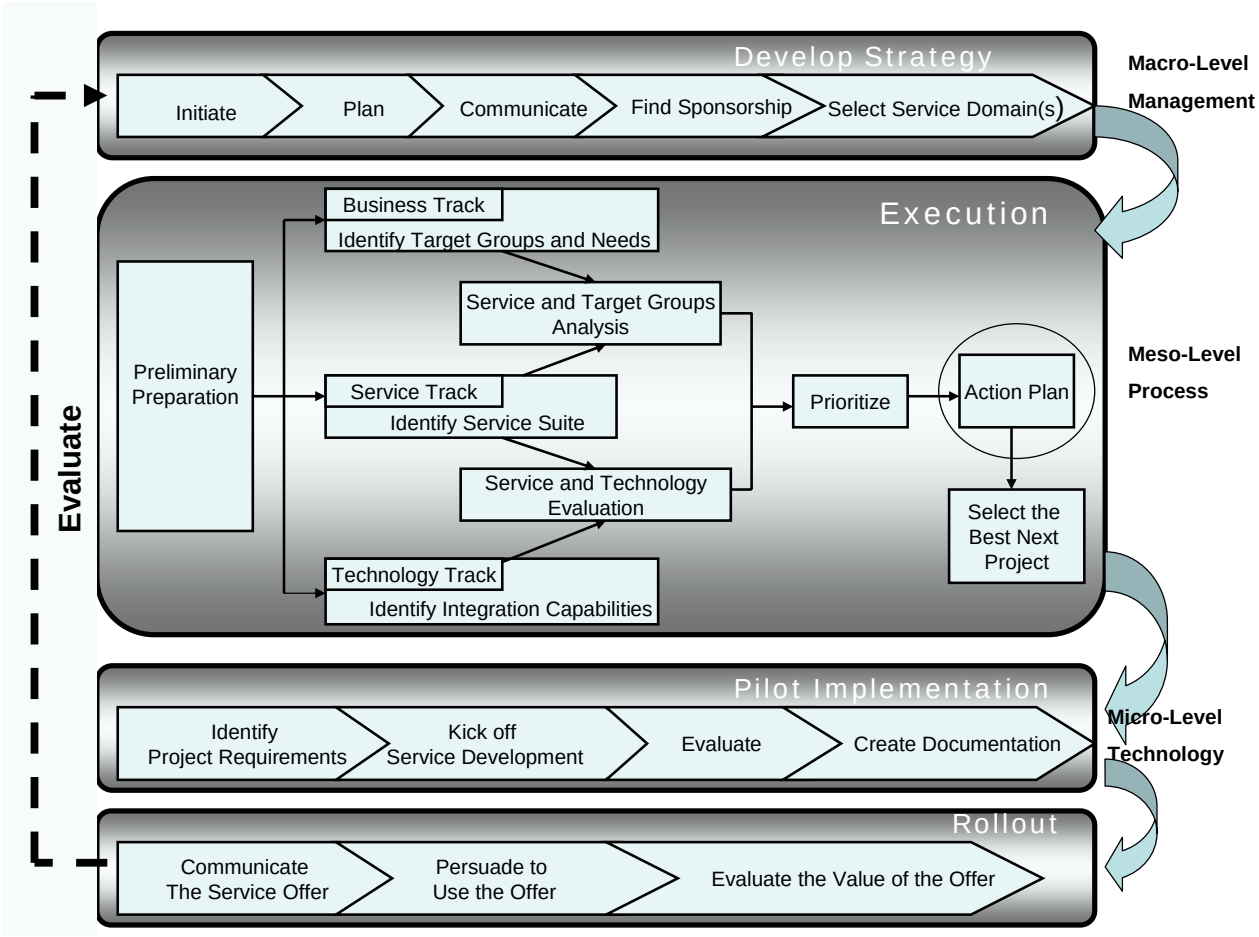

Figure 4.2: Service Integration Roadmap

4.2.1 Phase I: Develop Strategy

At this level, the main goal is to understand why service integration is needed. This question introduces a set of actions that need to be performed. Starting with an assessment of where the organization is today and where it wants to be. As a result, an understanding of present capabilities will be achieved, which will provide adjustment and prioritization of the service integration goals, the so-called focal points [Kalakota, 2003].

Step 1: Initiation

Understand yourself: As described earlier we are dealing with an organization with complex organization structure that needs a sound understanding of its environmental factors (See sections 2.2 and 3.4 for more details). Success of this initiative is depending on a significant collaboration (See sections 2.2 and 3.4 for more details) across different business functions. The present work contributes to achieve in great part the understanding of not only the organization factors that may influence the success of this initiative but also the

understanding of what this service integration entails. These insights should, down the road, help assess every encountered situation and act accordingly.

Change management: starts here and ends where the program ends (See section 2.2.9 for more details).

Set a governance structure: The service integration program is everyone's project. This introduces the assumption that everyone is responsible, and experience reveals that when everyone is responsible, no one is responsible. In order to avoid the pitfall to have no one in charge, I propose to put a tried governance structure (See section 2.2.10 for more details) in place that should conduct the integration initiative. This governance structure has been applied in the past (e.g. WURnet program) and consists of a three levels structure: steering committee (e.g. executive board – the sponsor), a program team (project managers headed by the program manager), and project teams (business professionals and IT professionals from service domains).

- **Steering committee:** The executive sponsor is the executive board. The executive sponsor is responsible for the whole program, provides strategic directions, influence, and (partially) funding. The executive sponsor's understanding of the overall benefits of the program and commitment are critical to diminish resistance and keep the program in live.

- **The program manager**: Should be the CIO. This position is missing within Wageningen UR. The alternative, depending upon availability, could the head of corporate ICT or the head of section innovation and R&D. However, besides a good business perspective, the profile of the program manager has to comply with the profile sketched above (see section 2.2.8). The program manager role should be played by an insider. Only an insider knows the politics and the power structures in the organization.

- **Project manager**: The project manager(s) are representatives from the service domains. They lead the ongoing integration projects and report to the program manager

When projects are finished they give way to new projects until the service integration program is complete. The program manager and project manager bring continuity and leadership. The information flow between the involved actors is illustrated in (figure 4.3)

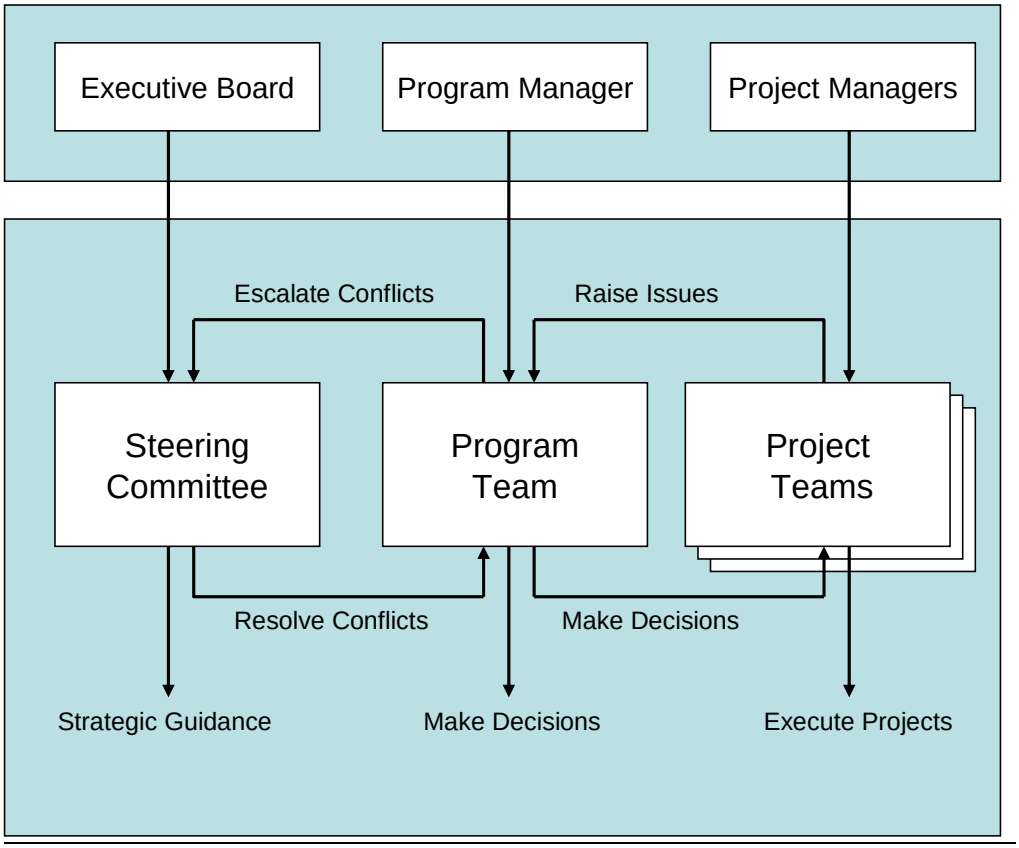

Figure 4.3: Governance structure: Interaction between actors (adapted from source: [Kincaid, 2002])

Define the integration architecture blueprint and technology standards: Architecture represents the backbone for the service integration. To achieve truly integrated services in a complex environment like Wageningen UR, there is a need for integration architecture. Such architecture should be service-oriented and able to tie together disparate business functions. SOA (see section 2.3.5) is a candidate integration architecture that supports incremental integration without causing disruptive effects for service providers. SOA also has the benefit to incorporate new services without compromising future flexibility. Additionally, technology standards should also be determined at this stage.

Wageningen UR: This is a major first step as it lays the foundations for further work. Make use of the WURnet best practice for governance, establish a change management plan, and define the architecture blueprint and integration standards before you start.

Step 2: Plan

Define objectives and strategic issues: This is a critical step, which at the end will determine the success of the delivered integration solution. Providing a final solution to the current fragmented offer of services within Wageningen UR introduces doing many unrelated different things. This is due to the heterogeneity of the organization environment; different types of business processes (research projects administration, student enrolment administration, business travel reimbursement, finance administration, etc.), different needs,

and different local business priorities, and so on. So, here the focal points must be clearly articulated. By doing so, success is defined and the risk to leave room open to others to define or influence that definition of success is eliminated. Additionally, at this point the integration focus should be determined based on what the organization (people, process, technologies, and budget) is capable to deliver as well as the time horizons to deliver.

Prioritize: After defining focal points, success, and the organization capabilities then priorities of execution of focal points should be defined. These priorities should translate into short term, mid-term and long term objectives.

Identify service domains: Consists of identifying the service domains that are impacted by the focal point with the following highest priority, the selected focal point. The identified service domains, together, form the candidates' domains for providing the needed services to achieve the objectives of the focal point at hand.

Identify stakeholders: Success of the integration will depend to a large extent on the collaboration of the involved stakeholders as integration involves people issues and politics. Per service domain, an inventory of the important stakeholders should be made as well as their relevance for the service integration must be understood. Next, a strategy must be defined with respect to each stakeholder. There are a number of stakeholders to consider: local ICT departments, managers of departments and knowledge units, staff groups like knowledge strategy group, coordination ICT & education group, communication & marketing, and works council (e.g. privacy issues). Identify influencers.

Assess readiness: Once service domains and stakeholders are identified, the next step consists of identifying the role they could play in the integration effort, identify their potential resistance and concerns, identify their potential expectations, and finally what it will take to win them over.

Identify key risks: service integration as it is the case within Wageningen UR is a meta-project. Therefore, a list of potential risks and challenges should be established so that their impact can be reduced or even eliminated. This risk summary will also provide sensitivity to the early signs of problems, which may derail the integration program.

Funding: It is not realistic to think getting the necessary funding for the entire integration program from the outset. What seems realistic is getting funding for the strategy development phase. In general, there is willingness from departments and organization units to participate in funding the integration projects they are involved in. This willingness should provide the necessary funding for the phases execution, pilot implementation, and rollout. However, vigilance is required when funding is related to business solutions that do not fit within the integration architecture and the integration schedule.

Creating realistic expectations: This initiative is the first in its genre that involves a great visibility (the portal) organization-wide. Therefore, if appropriate expectation management is lacking, people may expect miracles. The expectation should be well communicated and understood. If the outcome and delivery pace do not correspond to people's expectations, they will consider the program a failure and will return back to their old habits and systems. A

sound expectation management together with good communication should eliminate the risk of expectations.

Wageningen UR: Articulate clearly your focal points and then define related problem(s). Evaluate what has been achieved with integration of student services. Prioritize your focal points. Identify stakeholders and service domains, assess readiness using environmental and technical factors, and engage.

Step 3: Communicate

This step represents the transition of the strategy phase to the execution phase. Communication is one of the most important aspects for the service integration initiative, since it will touch all organization parts, including the people, in the organization and since the concept is new within the organization.

Prepare your sales campaign: Stakeholders are not waiting for general and vague PowerPoint presentations, but one that should focus on the benefits that are closest to that stakeholders concern. Therefore, there should be different presentations for different stakeholders. This could be done with the help of demonstrators that come from software providers or peers that already have been through similar initiatives. The presentation should also provide the high level integration architecture, the architecture blueprint, to the audience so that they have a high-level understanding of how their services will integrate in the total architecture. The marketing campaign should focus on those service domains that contribute to the focal point at hand.

Create a master plan: the master plan represents the core reference document that puts it all together. Although, the master plan will later include schedules for rollout of services, at this stage it should include the elements of the big picture and the benefits that need to be communicated. It should communicate a clear message that tells the organization “We know where we are, we know where we are going, and we know how to get there”. The plan should include the following elements:

- **Vision:** Describes the envisioned end state. It should include how the organization will be able to operate differently with the service integration in place. It should also include information about the elements that will support the execution of the vision. This includes the architecture blueprint, technologies that will support the architecture, and resources. The vision should also reflects the achievements for the organization at enterprise level as well as departments and organization units level

- **Motivations:** Include the strategic issues or focal points and priorities. Include also the benefits of the integration architecture like reuse of enterprise services, reliable information, enterprise information management (student database, employee database, projects database, etc.), elimination of duplication efforts, etc.

- **Approach:** This covers in general terms how to proceed, which comes down to how to get from the current state to the envisioned state and how to make the integration happen (e.g. architecture, process, resources, etc.). The approach should be clear and

understandable with the emphasis on the big picture as it should leave room for feedback and negotiation and not be threatening for the stakeholders

- **Process:** Includes information about how the program will be governed. This will include description of roles and responsibilities, the interaction between the roles, and the interactions between the projects. The latter requires interaction between the integration architect and the services development team for coordination reasons.

- **Schedule:** This part of the program is the "living document" of the roadmap that communicates what services and capabilities are to be delivered and when. Subsequently, this part is subject to frequent change as it must remain up-to-date.

Responsibility**:** The program manager is responsible for the master plan

Wageningen UR: Communication is perceived as one of the important success factors. Therefore, keep the master plan up-to-date, and communicate early and often.

Step 4: Find Sponsorship

Once the plan is communicated, the next step is to find funding for starting the program. This includes funding for developing the architecture, creation of the service integration organization, creation of the infrastructure services, proof of concepts, and planning. All these activities are preparation and planning activities. Furthermore, stakeholders who are ready to fund parts of the program should understand the priorities and the integration architecture so that they not form expectations that can not be met. For example, short term deliverables that may detract from the final goal and which may result in the so-called spaghetti-architecture should be negotiated. There are two group categories that are candidate to sponsor the early projects. These groups are the innovators and early adaptors. They have mostly pressing business needs or they become aware of the opportunities and subsequently they are ready to take risks.

Step 5: Select service domain(s)

From the candidate service domains whose stakeholders show interest in the project, the program manager should base the selection of service domains on the following two criteria:

- The contribution of the candidate service domain to realise the goals of the focal point at hand, and

- The contribution to build enterprise services, which will be reused for next integration projects

These selection criteria help laying the architectural foundation and provide the architectural building blocks. Once the service domains have been identified, prioritized, and selected, the execution phase can begin.

Wageningen UR: For early projects, focus on those sponsors and service domains that contribute to realisation of the focal point at hand, and in building common enterprise

services.

4.2.2 Phase II: Execution (Meso-Level)

The Meso-Level represents the execution of the individual focal points for service integration. This execution takes place on the selected service domains that are impacted by the focal point at hand. The outcome of the execution phase is an action plan that will be translated into integration projects. The action plan is the result of a roadmapping process (See figure 4.4) that aims at finding appropriate solutions for the needs of the target groups. These solutions consist of service suites and related integration technologies. The building blocks of this execution phase are based on the fast-start technology roadmapping framework (See section 2.4.3 for more details).

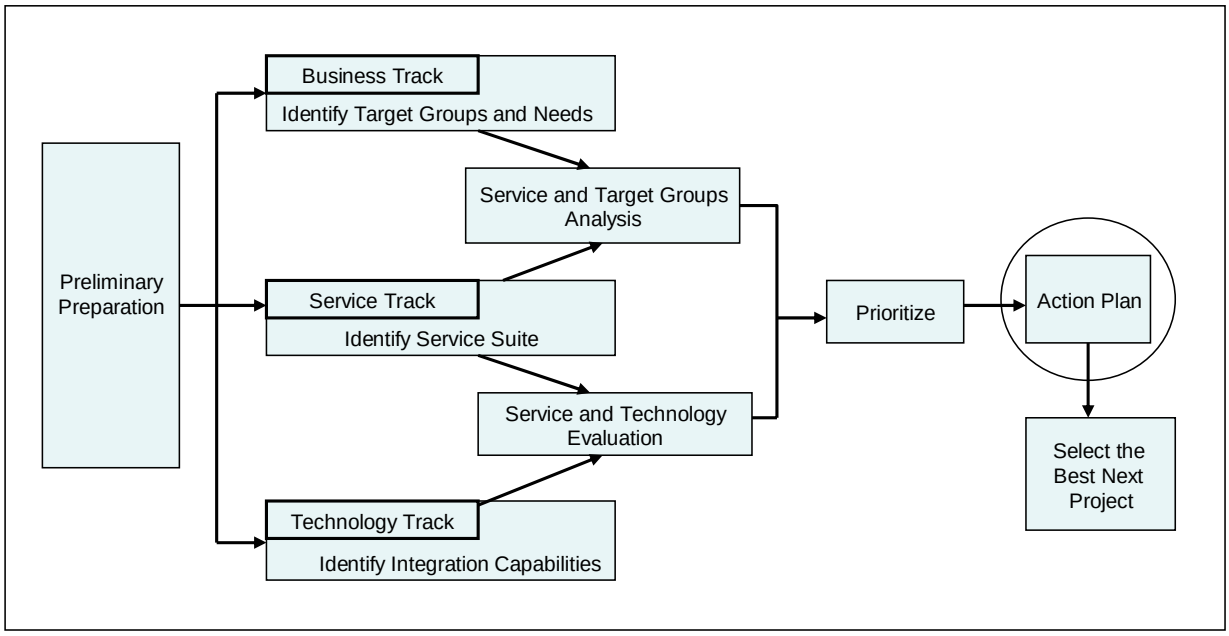

Figure 4.4: Meso-level: The roadmapping process

Step 1: preliminary preparation

Identify and validate the need of the roadmapping process:

The execution phase is a collaborative process aimed at determining the needs for the service integration. Therefore, there must be a perceived need for a collaborative process. The roadmapping process needs participation from the involved stakeholders (e.g., marketing, Service domains, R&D, etc.) as well as from key customers or surrogate users.

The roadmapping process should be needs-driven rather than solution-driven. There must be a clear specification of the boundaries of the effort, what is and is not within the scope of the roadmap and how will the roadmap be used.

Depending on the amount of people involved and the toughness of the subject, the appropriate approach should be used. One can choose between the expert-based approach and the workshop-based approach (See section 2.4.4) when consensus building is at stake. A facilitator can be engaged to facilitate the roadmapping process.

Define the scope and deliverables of the roadmap process:

This step ensures that the context of the roadmap has been specified, and the objectives have been clearly articulated. It ensures that a vision exists and the roadmap can support that vision. It further identifies why the roadmap is needed and how it will be used. Finally, it clearly specifies the scope and boundaries of the roadmap as this will drive the planning horizon and the level of detail.

Set up the integration team:

Define the skills and knowledge the integration team will need and put the team together. (See sections 2.2.8 and 2.3 for more details).

Wageningen UR: Use the workshop-based approach when achieving understanding is required and when consensus is at stake. Define scope and deliverables clearly. Make sure you have the right people and the right skills in the groups. It is also preferable to hold separate sessions for service-level and technology-level.

Step 2: Identify target groups and needs (The "Why"):

This step consists of defining the target audiences that impact the focal point at hand as well as understanding their drivers and needs.

Target groups: Are the target audiences that will benefit from the identified services. There might be more than one target group. Scoping and prioritizing should help define the target groups that will be focused on.

Needs: Identify and understand the drivers and needs of the target groups (e.g. Why should students use the portal?). Answering these kinds of questions will provide answers to what attract the target audiences to the portal. This brings us to define the "What".

Step 3: Identify service suite (The "What")

Services are defined as a combination of domain services, generic services and infrastructure services. As a set I call them a "service suite" as they depend on one another and because the development and release within the suite should be coordinated (See section 2.3.5 for more details). In this case, what matters the most are domain and generic services, and in particular the domain services as they answer the "What". The infrastructure services or integration services, on the other hand, are part of the adopted integration framework solution (e.g., .NET Enterprise Server)

Domain services: They provide domain functionality. Although there may be no functional overlap, and thus no redundancy, between identified services, they may still depend on one

another (the so-called horizontal dependency). For example, a book reservation service is depending on a catalogue search service. In this case the catalogue search service should first be in place before the reservation service becomes operational

Generic services: They provide cross-domain functionality and offer great reuse capabilities (e.g. notification service, authentication service, etc.)

Once these services are determined a list of business services can be compiled, which will be part of the architecture in its end state.

Step 4: Services and target groups analysis

This step consists of linking the identified services, which are needs driven to the identified target groups. The analysis should show which services are common for different target groups and which are not. Second, the analysis should also show which group consumes the most services. These two findings should contribute to establish priorities for target groups and services.

Step 5: Identify integration capabilities (The "How")

Now, the "What" has been defined, which consists of the service suite, we need to define the "how" of the roadmap. This involves integration technologies, resources, and skills that are necessary to make the integration of the identified services happen.

Technologies: Consist of the integration technologies that will enable the integration of the identified services (see section 2.3 for more details). The identified services from candidate service domains use different technologies. This fact brings with it limitations about how the candidate service will be integrated. The identification of integration technologies provide a set of alternative technologies to choose from when the ideal technology solution can not apply directly. For example, in case there is a service-oriented architecture in place, when a library catalogue search can not be made available as a web service to the portal in the immediate time, a temporary alternative technology solution can be adopted till the appropriate implementation becomes feasible and available.

Resources: Consist of identifying the set of hardware, software (e.g. development tools) and people (e.g. Architect, Developers, etc.) that will be involved in the integration of the identified services.

Skills: Consist of identifying and assessing the skills of the people that will be involved in the integration process. When appropriate skills are missing, training should be provided to bring the skills at the desired level. Another alternative is calling in expertise from outside the organization.

Step 6: Service and technology options evaluation

In this evaluation the identified integration technologies are linked to the identified services. For each service, the candidate technologies are assessed against feasibility and availability. As a result, an integration technology is attributed to rollout the service at hand.

Step 7: Prioritizing

The goal of establishing priorities is to differentiate between short-term, mid-term, and long-term rollout of services for the different target groups. Prioritizing will also help identifying the so-called 'crown jewels', the services that are critical to attract and retain users to the portal. The rollout priorities of candidate services will be determinant for the success of service integration effort and subsequently to business success. Therefore, the early integration efforts should be focused on these services.

The identification of these critical services is based on identifying their critical attributes. A general rule of thumb is finding the balance between business value and customer value. Among the critical attributes that should be taken into consideration are implementation cost, contribution to customers satisfaction by answering their direct needs, immediate contribution to achieving the goals of the focal point at hand (e.g. cost reduction, more students, or happy employees, etc.) feasibility, reliability, performance and so on.

Furthermore, because the rollout of each service brings with it ongoing enhancement and support, it is critical to determine the pace with which new services will be made available. The factors that should be considered for prioritizing the rollout of services are:

- **Funding:** There is a need to know how long is funding available and for which services
- **Resources:** How many people are available and what is the readiness of those people. The plans include time and budget for training these people in the master plan
- **Tooling:** are the necessary tools (e.g. development tools, test environments, etc.) available?

Once the priorities have been established, the rollout of identified services and their timelines can be set. This forms the basis for putting together the action plan.

Wageningen UR: Focus in first instance on corporate information services, in particular those services that form the common denominator for internal consumption. These services fall in the category must-have services that everyone needs. These services should be considered as a way to entice users to use the portal.

Step 8: Establish action plan

This part defines the action plan, the "to-do's" of the meso-level roadmap. The action plan defines the key development actions, resources required, risks, tools, skills, and timelines. The action plan should result in the project roadmap. The first project should be one that is most important, given the criteria above, the scope of the projects should be limited to about six month or less. The period of six months provides the ability to deliver a proof of concept. Unlike a prototype, a proof of concept delivers real results based on real data. Additionally, a proof of concept delivers real functionality, which can be put into use immediately, making a foundation for adding features and developing the appropriate technology when the used technology solution is temporary. A project of this length eliminates the risk of never getting done or that the requirements or sponsorship has changed before the finish. Figure 4.5

illustrates the effect of small projects vs. Lengthy projects. Furthermore, when there are already projects underway (e.g. Student portal services), focus should be put on these projects first; they should be scoped down so that they deliver results in less than six month.

The roadmap shows people when future services are planned and the scope of six month (or less) allows to deliver quick wins and to maintain sponsors commitment. This is critical to setting realistic expectations throughout the organization. Finally the focal points and the service integration life cycle ensure that each project leads toward the final goal.

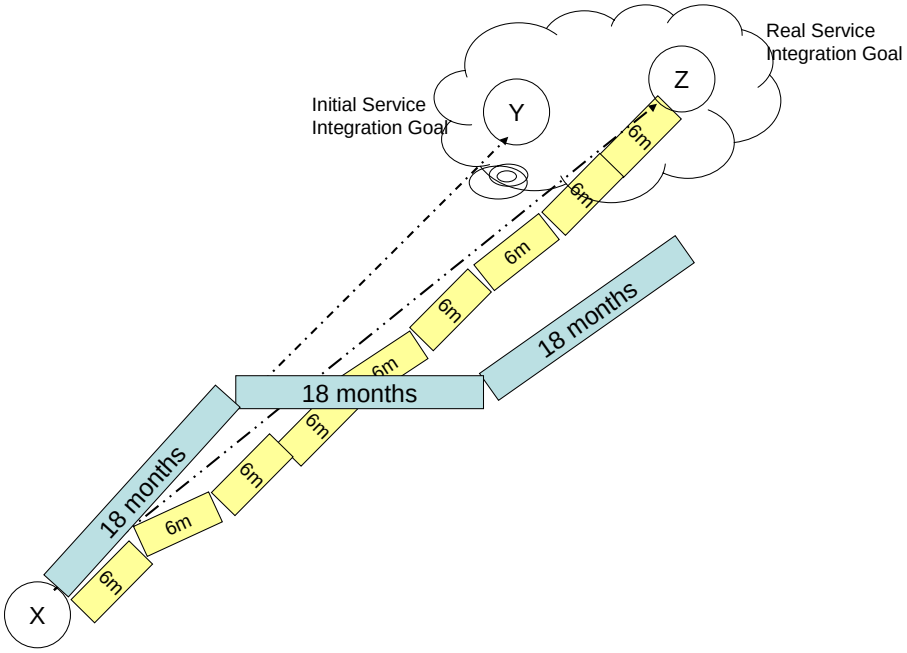

Figure 4.5: Effect of small projects vs. lengthy projects (adapted from source: [Kincaid, 2002])

Step 11: Select the best next project

This step is the transition step to the implementation phase. At this stage the service integration program has a single project (may also be a couple of projects that take place in parallel). The identified projects that should be started with are projects that yield quick success and build on each other to deliver the overall goal. These projects should:

- Be completed in less than six months
- Contribute to the realisation of the focal point at hand
- Yield a visible and measurable result
- Build on previous success

Wageningen UR: Focus on those projects that deliver quick wins, have little risk and big impact. A project should be limited to one or few service(s) that can be delivered within a period of six month or less.

4.2.3 Phase III: Pilot Implementation (Micro level)

Up until now, the service integration roadmap consisted of plans and preparation. The phase two has resulted in a set of projects that are ready for the start. Once again, the projects priorities should be based on their contribution to the enterprise infrastructure and must avoid being drawn into stakeholder-specific implementations, which will impede reusability at enterprise level.

Furthermore, the complexity at this point will depend on the chosen type of integration, shallow integration vs. deep integration (see section 2.3.4).

Step 1: Identify project requirements

In this step, assessment of the project requirements for service integration takes place. This assessment will map out the development work that the integration teams will have to perform. This assessment includes the following:

Understanding the service context: This is a basic requirement-gathering. It involves interfacing with documentation, people, and systems in order to understand the different problems and challenges and determine the information that is needed for realising the integration of the services at hand. Services involve integration at different levels.

Make sense of the data: It is important to understand the data involved in the integration effort as it forms the basis for each integration type, whether this integration works at the service, application interface, or user interface levels. Understanding data becomes more important when integration aims at integrating data at enterprise level (e.g. student database, projects database, etc.). This data exists in databases scattered throughout the organization. At this level there are three basic steps that must be followed to implement data integration [Linthicum, 2003]. It is beyond the scope of this research project to elaborate on the different steps:

- Identify the data
- Catalogue the data; this is the process of gathering metadata. The resulting catalogue becomes the basis for the enterprise metadata model, which is the foundation of data integration (IOI) (See section 2.3.3 for more details)
- Build the enterprise data model that will govern the integration of the database scattered throughout the organization

Make sense of the processes: Once the data is understood and the baseline information (e.g. enterprise metadata model) has been created, the view of the organization at the service-oriented level requires understanding of the business processes and how they relate to each other. It is important to document existing business processes to understand what they do. This makes it easy to understand how to integrate them at the service-oriented level, for example through a composite application.

Resource systems: Identify the interfaces of the resource systems and what form they take.

Interface contracts: The interface contracts of the generic services (e.g. authorization, notification, etc.) need to be clearly defined for the service domain projects. On the other hand, interface contracts for the domain services should also be defined.

Step 2: Kick off service development

At this stage with the first projects, the development of generic services will start. These services will form the architectural groundwork for the integration. It is difficult and risky to create generic services when there is a requirements vacuum (e.g. when no projects have been engaged yet). An incremental rollout approach for generating generic services, on which domain services from current and future projects will build on, should be adopted. An incremental rollout guarantees early visibility of domain services and at the same time contributes to building the architectural groundwork services.

Organise training: Before starting with the development of services, the necessary training should be offered on architecture and technologies that are new to the project teams. Make sure that training takes place before the start of the project.

Define a configuration management: This is important to ensure that the correct versions of generic services are used to make sure the services work well together with domain services.

Create test plan: Testing is expensive and time consuming. Still, if an integration solution is not tested properly, the business value will be affected and customers will lose confidence. For example notifying wrong customers with wrong publications or facing a student with wrong marks, or even worse data can be overwritten and thus lost. Therefore, a test plan is needed to insure proper testing.

Consider performance: This aspect is important, especially for a portal as a high visibility asset. Services that do not perform well are destined to fail. As a rule of thumb, the response times should be under a second even when user and processing load has increased. In short, the integration solution should be scalable.

Step 3: Evaluate

At this stage, the service integration program should be assessed on how it has handled the pilot implementation. This evaluation should include organization, communication, process, architecture, and technology.

If the pilot implementation has been a success, then the next step is delivery of the services that have been integrated. Even in case of (partial) failure, there is a need to understand what went wrong and what went well, and what should be adjusted for the next projects. It is important to establish a list of issues and identify the causes that have created these issues.

Step 4: Create documentation:

This consists of updating the master plan with the changes that has occurred; updating the architectural guidelines with what is considered best practices, and writing down the lessons learned that can serve avoiding future mistakes.

Step 5: Tell the success story

A pilot implementation, when it is a success, is the most powerful selling tool to achieve buy-in in the remainder of the organization.

Step 6: Create maintenance procedures

It is necessary to consider how the integrated services will be maintained and who is going to maintain what over time? Who will administer portal users? Who will monitor system performance? Who will solve problems? These needs should be addressed and people and responsibilities should be assigned before rollout. The portal represents now the hart of the organization. It is also a single point of failure that will damage the organization image and damage the confidence of the different stakeholders in case of malfunctioning. With these issues in mind, necessary measures should be taken to reduce the risk of any disaster

4.2.4 Phase 4: Delivery (Rollout)

It is now time to deliver the service offer to the target groups. Delivering the offer consists of communicating the offer, persuading the target groups to make use of the offer, and evaluating the value of the offer.

Step 1: Communicate the offer

The message should be customized for each target group (students, researchers, lecturers, and other customers) and should communicate a positive experience. At this stage all available communication means should be used to achieve maximum reach (e.g. campus news paper, email, web, workshops, etc.).

Step 2: Persuade to use the offer

The value statement should be customized for each target group. This said, customized does not necessarily mean personalized. However, the characteristics of each target groups should be well understood and should be used to attract them to use the offered services.

Step 3: Evaluate the value of the offer

Based on what has been defined as a success in the first phase, now, there is an opportunity to measure that success. It is often a good idea to evaluate the offer based on small samples from various target groups as well as feedback sessions.

The other side of evaluation consists of determining the business value of the service integration. This comes down to evaluating the amount of Euros that will be saved by a

successful integration. This is mostly the combination of soft- and hard-euros. Hard Euros value is related to self-service and the ability to eliminate costly processes and duplication of efforts such as different databases and different systems for the same student, employees, and other customers, different project administrations, and different many redundant things. Soft Euros, on the other hand are difficult to quantify. They are mostly related to students, and customers' retention, high quality research, knowledge sharing, and happy and productive employees.

Conclusion: The above roadmap is the result of combining both worlds; the service integration reference framework and the Wageningen UR specifics. The phases and steps are designed according to three-level roadmap plus a delivery phase: the three levels are as follows:

- Macro-level: the main charge at this level is to understand why service integration is needed. Assess where the organization is today and where it wants to be. Define the focal point of service integration. Establish plans for governance, change management, and communication. And then the take-off.
- Meso-level: at this stage, the focal points are translated into action plans, which on their turn translate into projects. All this takes place when necessary funding is secured and roadmapping is succeeded.
- Micro-level: at this stage the development of services gets started. Here design and technology come into picture. The result is a pilot implementation
- Delivery: rollout of the developed services. The rollout is subject to evaluation and may result in adjustment of strategy and planning

5. Validation

5.1 Roadmap Refinement

This section aims to provide answers to the research question: ***What possible refinements could be made to the roadmap to make it more appropriate?***

5.1.1 Introduction

The Library has the role of the content manager of scientific information within Wageninegn UR. It provides support for the primary processes in education and research. These processes consist of 1) leveraging scientific knowledge and extending it for the sake of scientific research, and 2) selling the scientific research and education.

Further, the management of the Library believes, rightly, that you only can sell good research and education when you do research and being current with the last scientific developments. This requires a sound information and knowledge infrastructure to support lecturers, researcher, students, and other staff. Besides the function of the Library within Wageningen UR, it also has a public function as some facilities are made available for the public. Hence, the primary target groups are student, researchers, and lecturers plus employees and citizens.

The Library is aware of the portal's opportunities and believes that it should play a prominent role within the portal. However, the Library insists that the service offering from the library should take place in a way that also satisfies the Library. The process of delivering Library services to the portal has started in the past but was suffering from lack of consensus about what services should be delivered and how.

Further, a **notice** should be made of the fact that the proof of concept roadmap only covers the execution phase of the total roadmap. Remaining phases from the total roadmap (e.g. strategy development, pilot implementation, and delivery) do not apply because of the following reasons: the strategy development phase is intended to cover the entire organization and is not limited to a particular service domain. The phases of pilot implementation and delivery are implementation-related. Therefore, they fall outside the scope of this proof of concept.

5.1.2 Results and findings of the proof of concept roadmap

For validation purposes of the designed roadmap, a proof of concept roadmap for the Library has been performed. The roadmap is performed using the workshop-based approach. The choice of the workshop-based approach is made based on the following criteria: achieving consensus about and better understanding of needs in services, and creating room for an innovative process that is aimed to result in useful services. The workshop plan and results are covered in Appendix 4 and Appendix 5, respectively.

The proof of concept roadmap reflects the following findings:

Execution plan: The proposed plan for execution is a good fit and it is feasible and simple enough to deal with. As a result, there is no need for including additional steps or excluding existing ones.

Roadmap approach: The library has already been involved in the process of service integration (e.g. student portal). Therefore, for some participant the plan has been perceived as “deja vue”. Further, besides the criteria of consensus and understanding that justify the workshop-based approach, the workshop form is better suited for situation where there is vagueness about the why, the what, the how, and the when of the roadmap (See section 2.4.4 for more details).

Scope and deliverables: These should be well defined to avoid irrelevant discussions en keep the focus on expected deliverables.

Key representatives: For personal reasons some key representatives did not show up during the roadmap process. This influenced the perception of other members with regard to the importance of the process and decision-making. Key representatives from involved parties must be involved in the roadmapping process, especially, when consensus is at stake.

Value of communication: Sometimes irrelevant discussions arose about how to integrate and what technology should be used to integrate. This is still the result of lack of communication and in particular the lack of a master plan (See section 4.2.1 for more details) that includes a blueprint of the integration architecture. Hence, the necessity of a master plan from the first phase is made clear at this stage.

Conclusion: Although the proof of concept roadmap has been limited to the execution phase of the total roadmap, the following conclusions can be drawn with regard to refinement.

- The proof of concept has shown that the execution phase of the roadmap is a good fit; the building steps follow a logical order and build upon each other’s results. Hence, no change is needed here.
- Scope and deliverables should be well defined to ensure effectiveness before starting the roadmapping process to a service domain
- Communication (e.g. master plan) should take place prior to start the execution phase

5.2 Assessment of Roadmap Effectiveness

This section aims to provide answers to the research question: ***What are the criteria to determine the effectiveness of the service integration roadmap?***

Accurate criteria that determine the effectiveness of a roadmap are, in general, hard to establish. Suppose that the assessment showed that the execution of the roadmap plan was followed rigorously by the involved participants, and the goals were achieved exactly as predicted by the roadmap. Does that mean the roadmap was effective?

According to the literature on technology roadmaps [Schaller, 1999, Kappel, 2001], this is not necessarily the case. Schaller further states the following reasons:

- The roadmap developers may have been conservative in their targets. In the case of service integration this means that the right people and functions (or at least the composition of the group of the roadmap developers) were not involved in the roadmap process. As a result, innovative ideas about what services are needed for which target groups, and with which technology may remain forthcoming.

- The participants may have been narrow in their outlook. In the case of service integration this translates in the fact that the participants may not have drawn from similar projects or initiatives that have been undertaken by peers or related fields. This results in lack of information and knowledge about what already exist.

The above findings are true and show that it is indeed difficult to establish criteria that determine the effectiveness of a roadmap. However, when only taking into consideration the situation of this case study, the above findings become partially true. The criteria for effectiveness of the roadmap should be seen in the light of the contribution of the roadmap to solve the original identified problems of the service integration effort. Hence, the following criteria:

- **Better understanding:** The current situation shows that there is lack of understanding of what the service integration exactly entails from both perspectives; people and process, and technology. This roadmap contributes to achieve better understanding of this topic. This criterion has also been underlined during the evaluation session of the organised workshop. Better understanding is the result of the discussions during the Library roadmap process

- **Articulated strategy:** In the current situation, a tactical approach has been adopted for service integration (on a project by project basis). This approach is lacking the **how** to get from “where we are to where we want to be”. This roadmap contributes to draw the needed strategy that will drive the service integration initiative from where it is to where its is expected to be

- **Buy-in and commitment:** The current situation is characterised by confusion and misconceptions about the impact and the opportunities of a common portal and in particular the service integration. This is because a communication plan is lacking. One of the outcomes of this roadmap is a communication plan that should promote and sell the service integration initiative within the organization. As a result, buy-in and commitment are among the criteria that determine the effectiveness of the roadmap.

- **Consensus building:** The current situation suffers from lack of consensus between stakeholders about what services should be integrated, with which technology, and so on. The roadmap brings the different stakeholders together to discuss the “cons and pros” of the different alternatives.

- **Prioritized services:** The current situation is lacking an approach that guide the prioritization process of which services should come first (short-term) and which ones

should come later (mid-term and long-term). This roadmap provides an approach that leads to a justified prioritization. The approach consists of mixing and matching the different elements (e.g. target groups, services, technology, time, skills resources, etc.)

- **Flexibility:** This is a very important criterion. The environment of Wageningen UR is heterogeneous. This means that a cookie-cutter roadmap will not be appropriate, let alone effective. Therefore, the roadmap should be flexible enough to be deployed in different situations (service domains) and repetitively.

In addition to the above intangible criteria, there are also tangible criteria that consist of key performance indicators such as the number of involved departments/organization units, the number of integrated services, and in particular the growth of these numbers over the years.

Conclusion: The point to be made here is that the criteria of roadmap quality and effectiveness, are indeed difficult and divers, yet very important as the roadmap is supposed to become an operational tool to roadmap the service integration.

6. Conclusions

6.1 Introduction

The central research question **"How to create a roadmap for integrating disparate services in an educational and research portal?"** is intriguing. I have tried, in this thesis, to provide an answer by uncovering what the vaguely defined notions of service integration and roadmap are. I have done this by conducting a literature research, which has resulted in two frameworks; a high-level service integration framework and a roadmap framework.

Further, recognizing that the problem at hand has multiple aspects is of major importance for this research. In order to deal with the complexity introduced by this multiplicity of aspects, three perspectives have been introduced; the people and process perspective, the technical perspective, and the roadmapping perspective. Further, the central research question has been broken down into sub-questions that provide answers to these different perspectives. In the following, I will discuss and conclude the answers obtained for each question, and finalize with a conclusion about the value of this research for Wageningen UR.

6.2 Discussions

This research has been devoted to address the problem of reluctance of stakeholders (service providers) to effectively collaborate in the service integration initiative. This reluctance and resistance on their turn were caused by a set of factors (See section 1.2.1). Based on the perspectives introduced in the introduction, the first perspective that has been the subject of this research is the people and process perspective.

The first question[3] about the people and process perspective has resulted in a set of factors (See section 2.5.2) that are determinant for the progress and success of the integration effort. Nevertheless, notice should be made of the fact that while technology of enterprise integration and service integration in particular is broadly and thoroughly covered by literature, the perspective of people and process is hardly covered. As a result, my research relied on the findings from research in other related areas, in particular the area of integration of human services. These areas show two important similarities with the current case; these similarities consist of decentralized organization structures and fragmented services. The findings from this literature research have been verified once again in the current case (see section 3.4.1). This part of the research leads to the following conclusions: Results have revealed that success or failure of service integration starts with the level of understanding of the environmental factors (see sections 2.2), which mainly are behavioural factors (e.g. culture, power and control structure, and high professionalism and expertise, etc.). These factors are difficult to assess, and assessment thereof should result in developing customized approaches and processes (e.g. collaboration, change management,

3 What service integration entails, with respect to culture, power structure, shared values and strategy in an educational and research environment?

governance, etc.) that should help with integrating the people component before the system components.

Contrary to the first question, there is a wealth of information and a huge amount of literature available about the technical aspects of integration and service integration in particular. So, answering the second question[4] was rather a matter of not getting overwhelmed and disoriented by all available information. Service integration entails a lot (see section 2.3). The most important findings are as follows: 1) portals, although they form a central point of integration, do not create value by themselves. They are merely windows into various processes. 2) Enterprise service integration needs a service-oriented architecture (SOA), which has its origins in component-based architecture. Services can be local components and remote components (e.g. web services). 3) Enterprise service integration also involves data and process integration. These two types of integration are necessary to share enterprise data and streamlining processes across the organization. 4) There are different integration technologies available varying from distributed objects and web services to different middleware technologies (see section 2.3.4). Finally, the main conclusion is that service integration ultimately needs a service-oriented architecture based on web services technology. But while the SOA benefits are tempting, the paradigm shift of using true services will remain unmet in the near future as this will require dissolving monolithic applications into self-contained and well-defined business services, which is from a business point of view “mission impossible” in the short-term. The trade-off is a co-existence between wrapped legacy applications and web services resulting in an incremental transition to SOA.

The above conclusions bring us to the third question[5] whose answer consists of putting together the elements that make up the reference framework for service integration. The main purpose of the framework is bringing to the fore the linking pins between the different constituents (See section 2.5). These linking pins are alignment between business, process, and technology, and between the inside-out and outside-in views. The linking pins are also the interactions that link vision to people, process and technology, and outcome of service integration. A final conclusion here is that the reference framework represents the roadmap for gathering and assessing requirements, best practices and lessons learned within the context of this case study.

Now, there is a reference framework that will serve as a roadmap for further work. The next question[6] that should be answered consists of finding a roadmapping approach that provides possible paths for integrating identified services. Literature research has resulted in a roadmapping framework (See section 2.4.3), which aims at bringing stakeholders together. And in a joint effort, the process of roadmapping takes place resulting in solution paths for a

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4 What service integration entails, with respect to architecture, integration techniques and technologies?

5 *What is involved in building the service integration reference framework?*

6 *Which roadmapping approaches apply to determine the possible paths for service integration in a portal?*

determined problem. This roadmap framework, which has its roots in the field of science and technology roadmapping, could easily be extended to other domains where the need for collaboration is high and building consensus is at stake. Because of these characteristics and other additional benefits (see section 2.4.5) this roadmapping framework has shown its potential and benefits for the service integration problem where people and technology are involved. Notice should be made of the fact that despite the potential benefits of this roadmapping framework, the decision to adopt the framework has only been made after analysis of the case at hand. The case of this research is a complex environment where environmental factors are strongly visible and where consensus is stake. The conclusion that can be drawn here is that a cookie-cutter methodology in such an environment is doomed to fail. Hence, the need for a flexible and dynamic approach, which leads to the roadmapping approach discussed above.

Gathering of requirements and analysis took place based on insights that were provided by the reference framework. The requirements question[7] delivered various requirements that have been categorized by type, which resulted in the following taxonomy: environmental requirements, organizational requirements, functional requirements, managerial requirements, and technical requirements (See section 3.4.1). The results of these requirements together with answers to existing best practices, lesson learned, existing opportunities, and experienced roadblocks formed the basis for the creation of the roadmap solution. My conclusions regarding requirements are as follows:

Environmental requirements: there is a need for a shared vision and common goals, a collaboration approach that brings stakeholders together, and a change management plan and a communication plan that help achieve commitment within the organization.

Organizational requirements: service integration should provide solutions to cope with the demands and trends of functional convergence, project-centric, process-centric, and individual-centric. The latter consists of mobility, collaboration, and efficiency

Functional and non-functional requirements: service integration should provide solutions that are own to the nature of the organization (e.g. education and research). These functionalities consist of e-learning, an expert directory, a collaboration environment, a federated search, security, etc. to just name a few (See section 2.1.5).

Managerial requirements: service integration requires a competent leadership that understands business and technology. It also requires a governance structure that should drive, communicate, and coordinate the integration effort.

Technical requirements: This requires additional research that should tackle what integration architecture and technology are needed to respond to current and future demands. The analysis I have conducted so far is not thorough enough to conclude about what exactly is needed. Nevertheless, there is a need for an integration architecture blueprint that should be communicated to the different stakeholders.

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[7] *What are the Wageningen UR portal requirements for service integration?*

A final conclusion is that the organization requires an integration of services that should result in a functional structure. Such a functional structure should shield the traditional organizational silos.

This case study has not only delivered requirements but also best practices[8] with current ongoing effort on service integration, approaches[9] that have been used to rollout existing services, as well as miscellaneous[10] information about opportunities, roadblocks, impact, and so on. This additional information is valuable and useful for the design of the roadmap and the resolution of the research problem. Research on the above topics (See section 3.4.2) has resulted in the following conclusions:

Approach: The only approach that is adopted so far consists of a tactical approach and that is a project by project basis. This tactical approach delivers short-term benefits that may compromise the benefits of service integration on the long-term and thereby missing the various integration opportunities like reuse, elimination of duplicate efforts, and so on.

Best practices: The current ongoing effort has delivered a set of best practices that should be leveraged to improve future work. These best practices are rather related to implementation and rollout of services. The following best practices have been identified: aggressive marketing campaign leveraging available channels for attracting target audiences (e.g. students) to the portal, organization of feedback sessions that resulted in continuous improvement of the portal, high reliability and high availability using mechanisms of load balancing and fail-over, and so on (See section 3.4.2). However, best practices with true service integration according to service-oriented integration architecture have yet to come.

Challenges, impact and opportunities: Service integration brings with it opportunities, but also challenges (See section 3.4.3). The most important challenges facing strongly decentralized organizations are the integration of the people component, and the strong disparity of systems in underlying departments and organization units. There are of course additional challenges (See section 3.4.3), but these are rather common to the service integration problem. On the other hand, service integration does not only bring with it challenges but also opportunities. The identified opportunities are twofold: opportunities for service providers, and opportunities for the corporate organization. The most important opportunities for service providers are greater visibility for their services and their throughput, but also reuse of common services and cost sharing. At the corporate level the most important opportunities are reuse, elimination of duplicate efforts, cost reduction through streamlining of processes and customer self-service, reduced time to market, ability to adapt and change in case of merger, outsourcing and customer relationship, and most importantly bridging the organizational silos through creation of the e-Enterprise (See section 2.1.4 and

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8 *What are the Wageningen UR best practices on service integration in a portal?*

9 Which approach, if any, has been applied so far to rolling-out the existing portal services?

10 *What are the opportunities, constraints, impact, roadblocks, and risks - with respect to Wageningen UR policies, culture, and strategy – involved in this service integration undertaking?*

3.4.3). The most important perceived impact of service integration is the incurred overhead that it will bring with it for involved departments and organization units (service providers). Most service providers argued that they may be lacking time and resources to cope with the incurred overhead.

Risks, roadblocks and success factors: These three elements are related to each other one way or the other (See section 3.4.3, table 3.1). To just name a few, lack of clear vision versus clear vision and articulated goals, lack of effective communication versus effective communication, lack of commitment versus commitment from the executive board. These few examples that were identified in this case study show the kind of barriers that could impede the integration effort when appropriate risk management is lacking. When the latter is done correctly roadblocks are transformed in success factors.

My conclusion on the above part is that success of a service integration effort requires genuine commitment and participation from service providers and commitment from the executive board. Nevertheless, these commitments are inherent to the degree of effective communication, including clear vision and articulated goals and expectations, as well as resources (e.g. financial, people, time, and tools) availability.

The above discussions and conclusions raise a legitimate question[11] whose answer should provide a method that makes a fit between the service integration framework and the case study specifics. It is important to notice that my primary intention behind the service integration reference framework was to elicit and verify requirements and other specifics from the case study. This exercise (See section 4.1) turned out to provide two puzzle pieces that together with the roadmapping framework (See section 2.4.3) forms the building blocks of the roadmap. These building blocks are: 1) similarities between findings from the reference framework and the case study specifics. These findings will be used “as is” in the design of the roadmap. 2) New findings from the case study. These findings are verified against available literature whereupon they are used for the design of the roadmap. 3) And finally the unmatched findings from literature to the specifics of the case study. These findings were used where appropriate to extend the usefulness of the roadmap. Hence, the fit between the service integration reference framework and the case study specifics lies in the mix and match of the different findings in order to produce an all-encompassing roadmap.

The above findings, which are the result of combining three worlds: the service integration reference framework, the case study specifics, and the roadmapping framework. They all have resulted in the design[12] of the roadmap. The roadmap consists of four phases that are consistent with the reference framework. These phases build on each other, hence the three levels structure of macro-level, meso-level, and micro-level. Each phase consists of a set of

11 *What is the best method to make a fit between the service integration reference framework and the Wageningen UR specifics?*

12 *What are the roadmap steps that best fit the service integration in Wageningen UR portal?*

steps that can be performed subsequently or in parallel. Phases and steps are designed according to three levels roadmap plus a delivery phase: the three levels are as follows:

Macro-level: This is the strategy development phase. The main charge at this level is to understand why service integration is needed. Assess where the organization is today and where it wants to be. Define the focal points of service integration. Establish plans for governance, change management, and communication.

Meso-level: This is the execution phase. At this stage the focal points are translated into action plans, which on their turn translate into projects. All this takes place when necessary funding is secured and roadmapping is succeeded.

Micro-level: This is the pilot implementation phase. At this stage the development of services gets started. Here design and technology come into picture. The result is a pilot implementation

Delivery: This the rollout phase. At this stage the developed services are delivered. The rollout is subject to evaluation and may result in adjustment of strategy and planning

As a conclusion, the above design is the result of achieved insights from literature and analysis results of the case study. The roadmap, though, designed based on a to a top-down approach, its internals provide a high degree of agility as to the execution of the roadmap. This agility is mainly provided by integrating the principles of roadmapping techniques.

Further, a workshop has been organized to verify the fitness of the roadmap and to find out what possible refinements[13] could be made to the roadmap to make it more appropriate (See section 5.1.2). However, it is important to notice that this verification has been limited to the meso-level of the roadmap (e.g. execution phase). This is because of two reasons; it is not possible and not feasible to validate the total roadmap within the time constraint of this research. Second, the service domain (e.g. Library) that has been appointed to be the subject of the roadmap validation only provides an environment for validation for the last three phases of the roadmap (e.g. execution, pilot implementation, and delivery). Finally, only the execution phase has been validated because of its value for this research (e.g. roadmapping) and obviously because of the time constraint. After this short discussion about what has been roadmapped and why, the following conclusion can be drawn: the building steps of the execution phase have been experienced as simple to follow and feasible, which make the proposed steps of the execution phase a good fit for the roadmapping process. On the other hand, it is suggested to better define the scope and deliverable before starting the roadmapping process. Further, lack of prior communication (e.g. master plan) about purpose of service integration, integration architecture, etc. has sometimes generated irrelevant discussion and disorientations as to which integration technology should be used and which not. The latter could be avoided if prior communication has taken place. Hence, the need of a master plan that should be communicated before execution.

13 *What possible refinements could be made to the roadmap to make it more appropriate?*

Finally, according to literature, determining criteria for the effectiveness[14] of roadmaps proves to be difficult (See section 5.2). The difficulty lies in the assessment of the quality of the roadmap as their execution, regardless of how rigorous it might be, does not provide measurable criteria about their effectiveness. Nevertheless, for the sake of this research, the criteria for effectiveness should be seen in the light of the contribution of the roadmap to solve the original identified problems of the service integration effort. Hence, two types of criteria have been identified. These criteria are tangible and intangible; the tangible criteria consist of key performance indicators such as the number of involved departments/organization units, the number of integrated services, and in particular the growth of these numbers over the years. On the other hand, intangible criteria are better understanding, the ease of building consensus, the ease of prioritizing services, and the degree of flexibility for applying the roadmap to different service domains. The latter is very important as the roadmap should be agile enough to be deployed in different service domains and repetitively.

The final conclusion on this part is that despite the difficulty to determine effectiveness criteria, it is very important to define them as the roadmap is supposed to become an operational tool to roadmap service integration efforts. And more importantly, defining criteria means defining success of the roadmap. If success has not been defined through the definition of criteria for success, somebody else will define that success, which may constrain the value of the roadmap.

6.3 Final conclusion

In today's information age and ongoing changes, service integration is a key approach to an integrated enterprise. It has the potential to reduce the effect of environmental factors (e.g. power and control issues) through consolidation and bringing people together. Its power and strength lie in its incremental integration approach, its flexibility through assembling services, its disruption effect that is reduced to a minimum, and last but not least its significant rewards for both the business and the customer, which are thoroughly described and discussed in previous chapters. This research has explored the links between the different perspectives of service integration as well as the value of roadmapping techniques to the service integration domain.

The results of this exploration show that creating a roadmap for service integration needs more than technology alone; it needs a good understanding of the people component and developing approaches that bring people and technology together.

14 *What are the criteria to determine the effectiveness of the service integration roadmap?*

7. Recommendations

For Wageningen the content of this thesis should not be merely considered as a work that has been conducted to obtain the Master degree. But, it definitely reflects requirements and findings that have their origin in the context of Wageningen UR. Further, these requirements and findings are the result of collaboration with different key people from the organization. The proposed roadmap provides insights in the topic of service integration. Both aspect of service integration have been uncovered. This offers better understanding of the different factors that need to be taken into consideration, as well as the technical aspects that are involved in this topic. The achieved insights and application of the roadmap should help in the realization of service integration in Wageningen UR. In addition to the provided insights and the proposed roadmap, I have the following recommendations:

Strategic

- Focus on understanding yourself as the first step. This should provide insights about what you can and what you can not achieve in the immediate time, based on the existing situation and possibilities. The findings from this thesis should help in achieving this goal
- Develop an enterprise-level vision and strategy for service integration that is endorsed by the executive board
- Develop a strategic approach for service integration instead of the current tactical approach that is based on a project by project basis. The danger of the tactical approach is that it compromises the long term benefits of service integration (e.g. reuse, elimination of duplicate efforts, and business flexibility)

Organizational

- Address cultural issues to avoid long term problems
- Communicate vision and plans early and often
- Evaluate results frequently and adjust the course accordingly
- Document best practices and lessons learned down the road of the integration to be more effective and achieve results quickly in the future
- Involve stakeholders as early as possible
- Set up a governance structure that should drive, communicate, and coordinate the program parts of service integration

Business

- Tackle outstanding integration issues first (e.g. student services and single sign-on service)

- Focus in the outset on those projects that deliver quick wins, have little risk and big impact. These services are information services and form the common denominator for the whole organization. Make an inventory of these services and start with their integration.

- Select and prioritize integration projects according to business needs and the contribution of the projects to build the integration architecture

Technical

- Build a scalable integration architecture that is geared toward service integration and use the portal for presenting aggregated services and multi-channelling

- Leverage existing systems through wrapping and adopt a gradual transition toward a true service integration

- Leverage existing infrastructure and embrace open standards where possible

Further work

Additional research is needed to determine the right architecture that should support the service integration in the distributed environment of Wageningen UR.

Finally, service integration is a long way, but equipped with the proposed roadmap the road will be exciting and the rewards are enormous for Wageningen UR.

8. Reflection

8.1 Introduction

My original intention was to answer the question of general usefulness[15] of the proposed roadmap based on feedback from professionals from similar organizations. This ambitious intention has not been concretised because of the time constraint. As a result, the answers to this question are based on achieved theoretical insights and feedback from Wageningen UR professionals who are knowledgeable in the field of education and research.

8.2 General usefulness assessment

My respondents have been asked to provide answers to the question: "what does make Wageningen UR different from peer organizations?" Answers to this question have provided differences and similarities between Wageningen UR and peer organizations. The purpose behind these differences and similarities is to assess whether any extensions or adaptations are needed to the roadmap in order to increase its general usefulness. The provided answers are summarised below:

The organizational structure of Wageningen UR differs from regular education and research organizations. These differences are as follows:

- Wageningen UR is a **hybrid organization** consisting of a merge between a university and a profit-oriented organization (See chapter 1 for more details). Whereas, other similar organizations are merely **universities**.

- Wageningen UR consists of **one faculty** (e.g. Life sciences). Whereas other universities are a conglomerate of **various faculties**

- The need within Wageningen UR for **intensive collaboration** between **knowledge units** is much bigger than it might be the case between **disparate faculties** (e.g. Mathematics vs. Law)

On the other hand, Wageningen UR has also similarities with education and research organizations. These similarities are as follows:

- Both organization have the **same core business**, which is **education and research**

15 *What adaptations and/or extensions to the Wageningen UR roadmap for service integration are needed to broaden its general usage and usefulness for rolling-out an educational and research portal?*

- Wageningen UR is organised in knowledge units. This structure is similar to the notion of faculties in regular education and research organizations. They both have the **same decentralised organization structure**

- Wageningen UR and peer organizations have the **same business processes** in common

8.3 Final conclusion

Based on the differences and similarities discussed above the preliminary conclusion that can be drawn is that peer organizations, at most, are better off with a light version of the proposed roadmap. This is because of the following: The differences in peer organizations are recognisable in slightly different forms within the context of this case study (e.g. faculties vs. knowledge units). And secondly, the proposed roadmap is designed based on the great need for intensive collaboration and consensus building in a strongly decentralised organization, ICT included. These findings raise the following questions:

- What is the level of decentralisation (e.g. People + ICT) in peer organization?

- How great is the need for consensus building and collaboration in peer organization?

Answers to the above questions are determinant to find out which adaptations the roadmap should undergo. Therefore, more research is required to adapt the proposed roadmap and make it useful in situations where centralized and decentralized organizations need different roadmapping approaches. Nevertheless, as stated previously, the proposed roadmap and in particular the messo-level thereof presents enough agility to become a candidate for broader usage.

8.4 Further Work

This thesis opens new possibilities for further research. These possibilities are related to the introduction of the roadmapping element in this research. The notion of roadmap is widely used and its meaning is often linked to understanding and planning. Another form of roadmapping is science and technology roadmapping. This form is getting increased acceptance in industry and technology development. It is used to foster processes of innovation, collaboration, consensus building, and more. Further research should bring to the fore the role that roadmapping can play in bridging the gap between people and process on the one hand, and technology on the other hand in enterprise integration efforts.

Additionally, further work should be devoted to the inter-organization aspects of service integration as this aspect has not been covered in this research. This is primary because the issue has not been raised during the problem definition and secondly because of the time constraint.

Appendix 1. Portal Requirements

A1.1 Functional requirements

Functional Requirements

Embedded Search service: A powerful search capability is defined as a prerequisite. The wealth of information that is available within the organization needs a smart search engine to help locate and retrieve the requested information and services. Furthermore, this information and services are mostly fetched from different sources ranging from legacy databases to documents of different formats. These sources reside on distributed systems and therefore a so-called federated search is needed to search the different sources in parallel, aggregate the results and present them according to ranking of relevance.

Notification service: This component consists of informing portal users about events that are of interest to the different groups or individuals and reminds them of the availability of relevant information.

Single Sign On service: This is considered a key component for the portal. It enables users gaining access to all services contained in their profile by firing a signing on once through the portal. However, some critical applications may request additional authorization to ensure that data is not altered accidentally or purposely.

Content Management service: This is one of the core components of the portal. It consists of authoring, contributing, reviewing, approving, publishing, delivering, and maintaining content that include structured and unstructured data as well as electronic documents.

Collaboration service: Collaboration is an enabler of remote teaming and brings members of a team or a community to work together. This service is a prerequisite for the portal to enable building communities. Capabilities such as asynchronous communication include e-mail, discussion forums. Synchronous communication includes online meetings through Net meeting, chat and video conferencing. In synchronous communication, network bandwidth must be high enough to ensure acceptable response times. Additionally, there is much groupware software that provides collaborative capabilities; examples are Lotus Notes, Bazaar (open source), etc.

Expert directories service: Expert directories are semi structured databases that contain information about knowledge worker's experience, projects, training, and formal education. Storing and making available resumes of knowledge workers can be considered as a start point, but expert directories should contain more information about areas of expertise, management competencies, description of projects undertaken, and the availability to answer questions [Sullivan, 2003].

Taxonomy service: Also called classification, consists of organizing content according to a logical structure that enhances retrieval capabilities and eases navigation.

Business Intelligence capabilities: This is the capability to get access to or receive tailored information (marketing, production, financial analysts) in the form of predefined reports. These reports can be, for example, generated on a regular basis in order to instruct and provide analysts with the information that empower them to measure the performance of the business and analyzing competition data in order to take accurate decisions.

Internationalization service: Internationalization aspect within the portal is very important because of the different nationalities of the users within Wageningen UR (students, researchers, business partners, and clients) as well as the portal capability to support global access. The portal interface as well as content must be translated on demand. This capability has a lot in common with customization if it is not even inherent to it.

Knowledge Management (KM): Intellectual assets are the basis of each organization value. These assets consist of explicit and tacit knowledge that is stored in repositories and in the head of knowledge workers, respectively. A portal plays a key role in managing knowledge through a set of services provided by the portal. KM lends its existence to services like content management, collaboration, search service, and expert directories.

E_Learning: This consists of a composite service which mainly rely on collaborative tools (e.g. groupware) and tools for building interactive content (e.g. Blackboard). Additional components are tools for students tracking and tracing, and tutoring systems (e.g. Perception) this service makes physical presence of students not mandatory any more.

In addition to the above services, there is a number of services that should ensure the integrity and a good functioning of the portal. These services fall under the non-functional requirements.

A1.2 Non-functional requirements

Security: This can be a problem as the portal interacts with a wide range of applications. Additionally, the portal is accessed from both inside and outside the firewall. In order to prevent unauthorized access, the necessary security mechanisms have to be put in place. Examples of security mechanisms are secure socket layer (SSL), public private key, etc.

Reliability: The portal is aimed at integrating a large numbers of services and support a significant number of user transactions. Load balancing and fail-over capabilities are necessary to ensure good performance and high availability

Multi-channelling: The basic access to the portal is the web. However, the digital customer in education & research organizations is also a mobile customer. Therefore, the use of devices like PDAs and cell phones becomes evident. These devices should mainly be used for emails, notifications, and news updates.

Appendix 2. Collaboration

A2.1 Collaboration components

Components of collaboration from the process perspective according to Kruizinga:

Communication

Communication is the basis of each collaboration work. It consists of a clear and consistent information exchange between involved parties about tasks and the collaboration process itself as to, for example, who should do what?

Cooperation

It consists of assisting each other with respective activities by providing information, support and resources. This mutual assistance is geared to achieve mutual and collective gains and in turn the goals of the organization

Coordination

As in any effort of joint activities and communication, coordination is the process of gearing the activities to one another with regard to responsibilities about, planning and synchronisation of activities, goals, and objectives

A2.2 Collaboration factors

The following are categories of factors that determine success or failure of collaboration, according to Mattssich:

Environment

Environment includes the **collaborative history** within an organization. If such history is non existent or insufficient, time and effort need to be invested in developing buy-in among involved parties. Another important environment factor is trust regarding the collective reliability, competence and intentions. Lack of **trust** emphasizes individualistic and non-collaborative behaviour through reluctance to share information, to plan collectively, to engage in joint programming, and to share resources [Maxwell, 1990]. Trust is central and fundamental to developing collaborative working relationship between collaborating parties to achieve service integration. The origin of the trust problem must be detected and repaired. In general, trust should deepen as the collaborative effort proceeds and partners prove themselves through their performance [Rinehard, 2001]. Finally, one should think realistically about what can be accomplished within a given environment

Membership

It consists of individuals from involved parties who will influence the success of the collaboration effort or can be affected by it. Involved parties must be ready and willing to devote time and energy in developing mutual respect and to compromise; members can not make any assumption to get the perfect fit for the preferences of each member

Structure and process

There is no magic formula for this. However, it is essential that involved parties understand and “buy into” the process and structure that the group will use. Openness and flexibility are among the keys to adjust the structure to meet the collaboration goals. This said; objectives, roles, and responsibilities need to be clear and not assumed. Furthermore, collaboration should not be limited to the top leadership layer or the front-line layer, but involved parties should involve relevant people from all levels of the organization. Finally, each collaboration effort goes through different stages. The start-up phase should be used to build trust and collective strength. Therefore, only modest and short-term goals should be realised. Later, when collaboration matures, challenging tasks and goals can be started

Communication

Formal and informal approaches should be used in order to keep each other informed and up to date

Purpose

The goal of the collaboration effort might be broad (e.g. service integration). In that case one should start with realistic goals that lead in that direction to book success and strengthen collaboration. This vision should be made clear in the early beginning

Resources

Collaboration needs funding, time and staff. So, every involved party should contribute according to its means. Putting off the resource question for later can be a fatal mistake.

Appendix 3. Integration Techniques and Technologies

A3.1 Integration Categories

Information-oriented integration

Information-oriented integration (also called data integration) (IOI) forms the foundation of service integration. It provides a simple mechanism to exchange information between a source and a target system (See figure A3.1). Information could be data coming from a database or some application. It may become clear that at this stage there is not any process or application service involved. Among the advantages of IOI is:

- There is not any need to change source and target systems as this type of integration deals with data
- There is not any need to deal with complex logic as the notion of behaviour is missing here
- Easy to understand and wide used

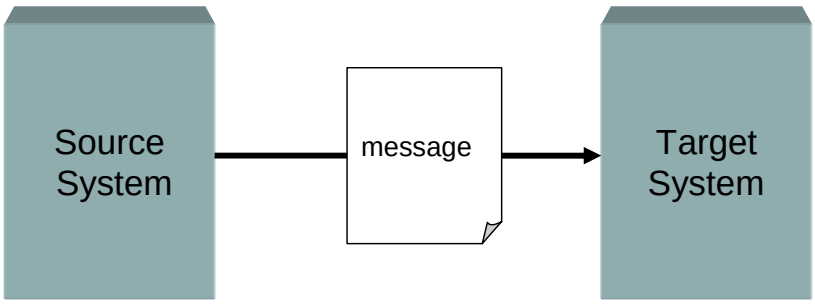

Figure A3.1: Simple information exchange in Information-oriented Integration

Two design patterns are applied to IOI. These patterns are:

- Coupling is the binding of applications together in such a way that they are dependent on each other, sharing the same logic, interfaces, and data
- Cohesion is the act of putting systems together in such a way they are independent from one another

Coupling requires tight binding between involved systems; this implies that any change to either the source or the target requires change to the coupled system as well. This solution may fit a centrally controlled integration but definitely not a solution fit for a decentralised environment because either the source or the target system on the one side may not always be aware of changes that have taken place on the other side.

Contrary to coupling, cohesion pattern means that integrated systems are independent from each other. This implies that change to one system does not affect other systems directly. A

middle-tier, which consists of an integration broker, accounts for the differences (e.g. application semantics, etc.) between the systems (Figure A3.2).

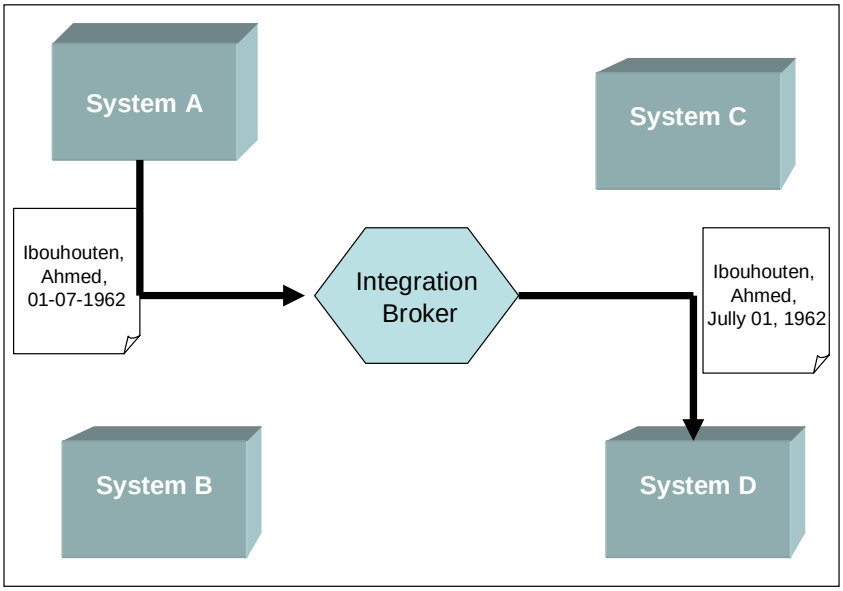

Figure A3.2: Information-oriented integration according to the cohesion pattern (adapted from source: [Linthicum, 2003])

In this type of integration, the focus is information, which can be produced and consumed by participating systems. The participating systems can be involved in one-to-one, one-to-many, and many-to-many relations.

Service-oriented Integration

A service here refers to a shared business function. It is a well-defined function that is universally available and responds to requests from “service consumers" [Hohpe, 2003].

Service-oriented integration (SOI) allows organizations to share common services (functions or methods). As a result reusability and significant reduction of redundant application services is achieved. This concept is known under the notion of web services, which is the ability to access remote services through a well-defined interface (WSDL short for Web Services Description Language), registration and discovery of services through a directory (UDDI short for Universal Description, Discovery and Integration) [UDDI], and a transport protocol (e.g. HTTP) and a mechanism for service invocation (SOAP short for Simple Object Access Protocol) [SOAP].

Linthicum further distinguishes three applications for web services that fit an integration solution. These are:

Event-driven integration is characterised by rather information movement than service aggregation (see figure A3.3). Data moves from system to system in order to complete a business transaction

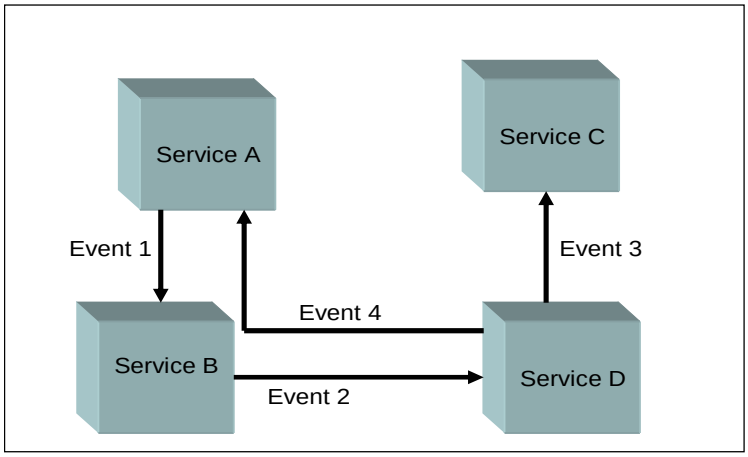

Figure A3.3: Event-driven integration solution (adapted from source: [Linthicum, 2003])

Composite integration is an integration solution that consists of aggregating services into a single composite service. This is similar to the idea of component-based development model [Allen, 2001] where components are assembled to create a single composite component or application. The difference, however, with the component model lies in the fact that web services are remotely accessed as they reside on remote and disparate computers (see Figure A3.4).

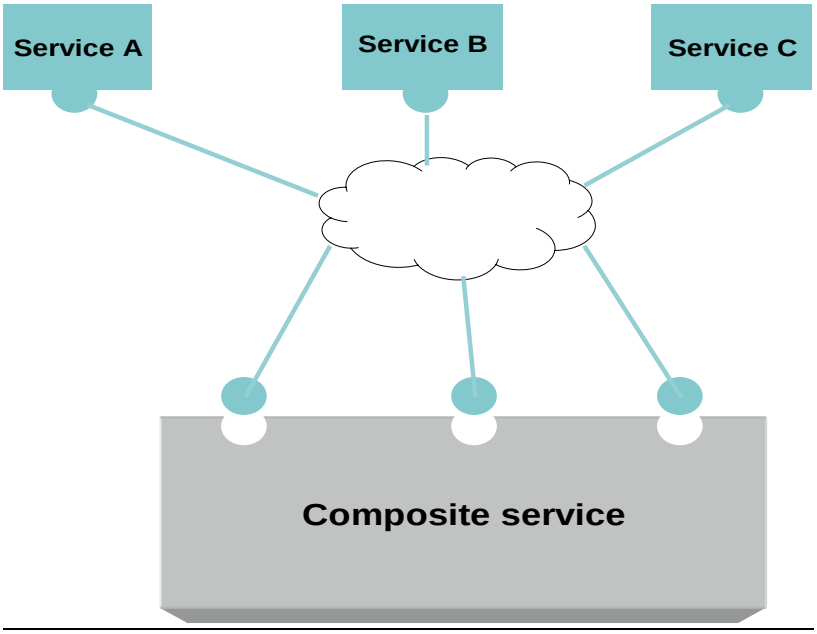

Figure A3.4: Composite integration solution (adapted from source: [Linthicum, 2003])

Finally SOI, true SOI, requires changes to existing systems (legacy systems) and even a rebuilt from scratch thereof in order to provide service-level access to remote services and to take advantage of the new paradigm. This downside makes SOI a difficult sell within organizations because of the costs it incurs. These cots are not only related to the changes/rebuilds themselves but also to the need to test, integrate, and redeploy the

systems within the organization. Despite the costs SOI offers an attractive integration solution through reuse and the great business flexibility to respond to the changing customer demand.

Business-Process-Oriented Integration

While IOI focuses on the exchange of information at the data level between systems in an inter- or intra-organization environment, business process-oriented integration (BPOI) takes into consideration abstract business concepts [Ulrich, 2001]. That is a higher level of abstraction that view the information flow in the context of a business model, or business processes that define business logic, sequence, sub-processes, and hierarchies of processes [Linthicum, -]. BPOI provides a control mechanism that defines and execute the movement of information and the invocation of processes that span many systems. The goal is to abstract encapsulated applications and services into a single controlling business process model (See Figure A3.5). BPOI defines another layer of control over and above traditional application integration (IOI) and SOI (See Figure A3.6). This includes that BPOI spans many instances of IOI and SOI, BPOI is independent of source and target applications/services. Change can be made to the process without changing the underlying source and target applications/services. Finally, BPOI is rather strategic than tactical as it covers processes across an organization instead of being limited to communication between two or more applications.

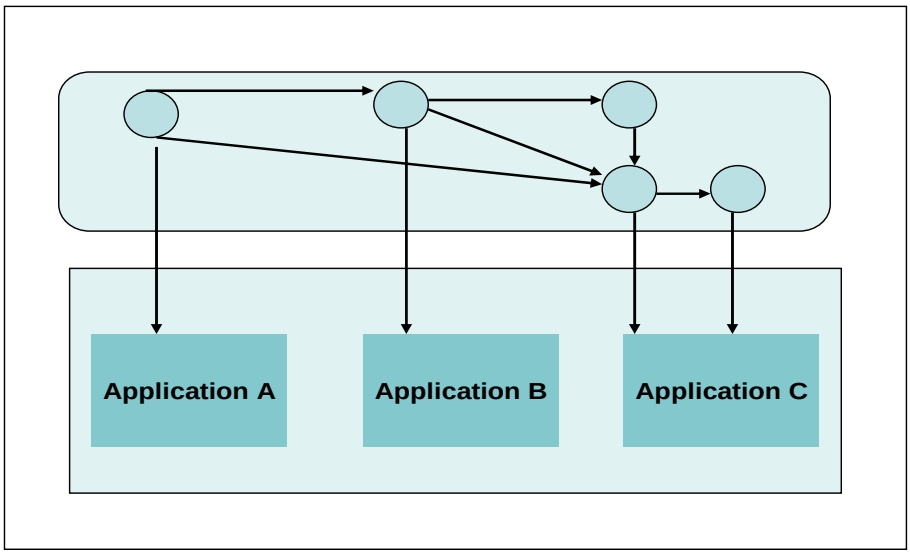

Figure A3.5: Business process-oriented integration solution (source: [Linthicum, 2003])

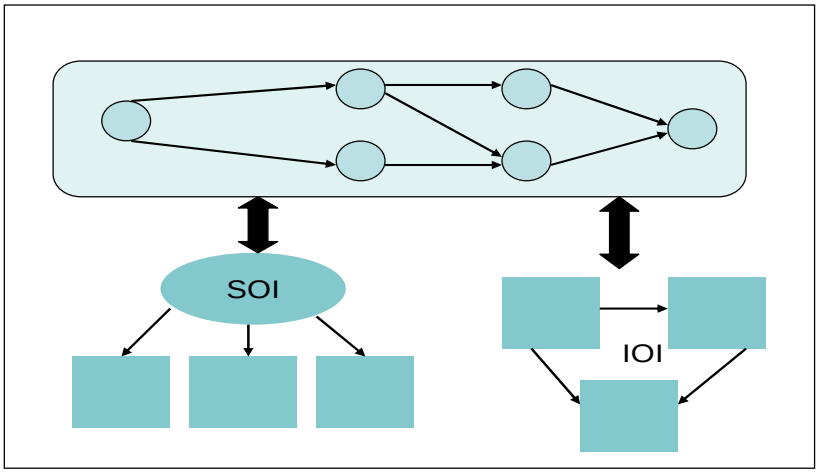

Figure A3.6: Business process-oriented integration solution (source: [Linthicum, 2003])

Portal-Oriented Integration

Portal-oriented integration (POI) consists of externalizing information and services from disparate enterprise systems. Further, services and information are aggregated and presented in a common interface. Contrary to other types of integration, which takes place at the data, application, service or process level, POI takes place at the interface level (see Figure A3.7). POI is a preferred integration solution when there is no need for backend integration to exchange information behind the scenes. However, when real-time exchange of information is a necessity between involved services or systems, then another type of integration is needed, deep integration.

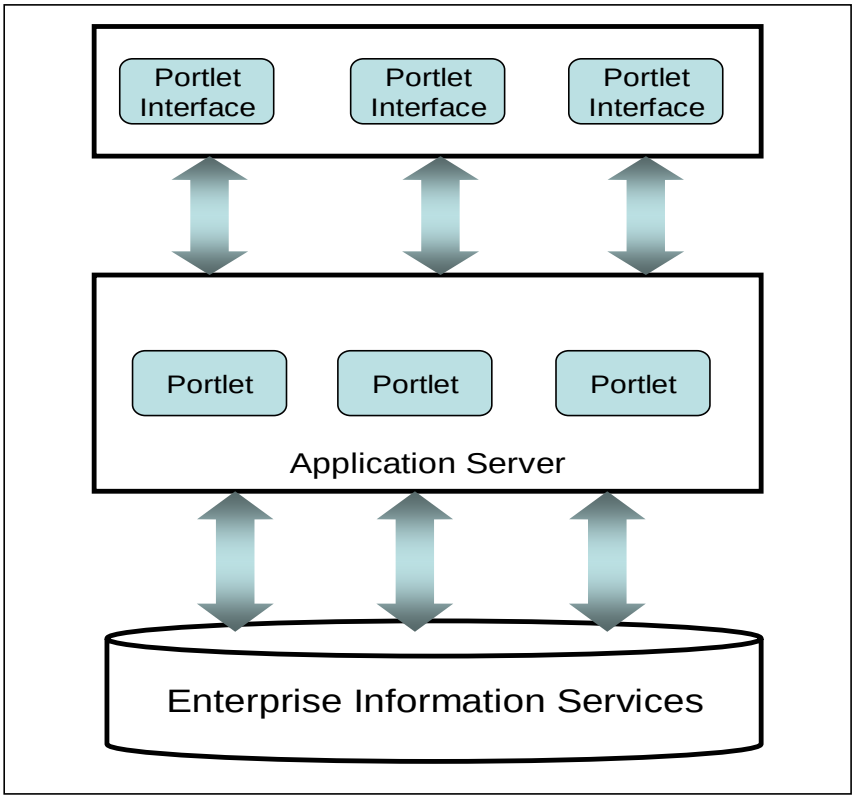

Figure A3.7: Portal-oriented integration

A3.2 Integration Middleware

Message-oriented Middleware

Also called MOM, short for Message-Oriented Middleware. MOM is the result of RPC's shortcoming. RPC's rely on communication between two processes that should be up and running (synchronous communication). As there is no guarantee for this availability, MOM has been created to allow asynchronous messaging. Messages are dispatched to a queue manager, which ensures message delivery when involved processes are up and running.

Database-oriented Middleware

It consists of a middleware that support communication between an application and a database or between databases, mutually. The database-oriented middleware rely on two standards to extract data from databases. These standards are ODBC from Microsoft and JDBC from Javasoft. Besides these standards, other native database-oriented middleware exist. These middleware have the advantage to provide better performance as they are specific to the used database model (relational, object, hierarchical). The downside is lock-in into a particular vendor. The value of this middleware is that it is mature, provides emulation and translation from one database model to another, and well suited for IOI and POI integrations.

Distributed objects

Distributed objects Fall also under the middleware category as they facilitate inter-process communication through object request brokers (ORB's). That is the ORB, which consist of communication services, which provide the middleware of distributed objects. Two standard object models exist; CORBA form OMG and COM from Microsoft. The value of distributed objects to the integration domain lies in developing applications that share common methods as well as creating composite applications that support method-oriented application integration [Hohpe, 2003; Linthicum, 2001; Linthicum 2003]. Finally, distributed objects remain a difficult sell as they lack performance for mission-critical integration; most ORB's rely on synchronous messaging, there are ORB interoperability problems between platforms, and at last but not least the web services alternative that currently have momentum.

Application servers

Application servers do too many things. Therefore, they are broadly used aside from the integration domain. They are a middleware that provide a host for application logic. From the integration point of view, they take existing enterprise systems and expose them through a single user interface (e.g. a web browser). This makes them a good fit for portal-oriented integration. The downside of their integration capabilities is that they lack back-end integration (binding source and target systems together) by themselves [Linthicum, 2001; Linthicum 2003]. This results in coding the necessary integration services (e.g. transformation, extraction, etc.). On the other hand, their broad support by multiple database and application vendors make them invaluable for the integration domain as these vendors provide the necessary integration connectors.

Integration servers

Integration servers are middleware that play the role of information brokers between source and target systems [Linthicum, 2003; Samtani, 2002]. Integration servers provide many services that do different things; they account for differences through transformation services (e.g. semantics formats), they connect systems through intelligent routing, they control the processing and distribution of information through rules processing, and they store information that flows through integration server via message warehousing. Many of integration servers are equipped with other services such as a repository service where information is maintained about systems, a graphical user interface that shields the complexity of designing an integration solution, directory services that include source and target systems, and management services that monitor message movement. They represent a serious solution for mission-critical integration.

A3.2 Integration Standards

Web services standards

SOAP: Short for Simple Object Access Protocol [SOAP] is an XML-based protocol for exchanging messages between computers. The initial focus of SOAP is remote procedure calls (RPC's) via HTTP. It enables client applications to connect to remote services and invoke remote methods. This method invocation is based on request/response message calls. Contrary to other frameworks providing the same functionality such as CORBA and DCOM, SOAP is written entirely in XML. It is therefore language- and platform-independent.

This capability makes of SOAP one the cornerstones of the web services architecture that enables disparate applications to exchange content and invoke services

WSDL: Short for Web Service Description Language [WSDL], WSDL defines an XML grammar (collection of metadata) for describing network services. It specifies the location of the service and the operations (or methods) the service exposes. It is a standard agreement between service providers and service consumers on interfaces.

UDDI: Short for Universal Description, Discovery and Integration [UDDI], is a standard for cataloguing and publishing WSDL descriptions of web services that are available over the internet.

Process level integration

ebXML: Short for Electronic Business Extensible Mark-up Language [ebXML]. This horizontal standard is intended to be used in B2B collaboration, but the standard is also used for intra-organization integration. It is based on process models, and it is also an XML message system to exchange information. ebXML has been updated to leverage XML and web services components. Its maturity provides the infrastructure for information-oriented and process-oriented integration capabilities. ebXML is a complete standard covering many aspects like process, semantics, security, agreements (agree on contact points, contractual terms and a form of communication for the exchange of electronic business documents) [Jenz, 2002], standard information exchange and standard information structure, etc. This is contrary to BPEL4WS that only covers process and semantics [Linthicum, 2003; Linthicum, 2004].

BPEL4WS: Short for Business Process Execution Language for Web Services [BPEL4WS]. It is an initiative from BEA, IBM and Microsoft. BPEL4WS is a standard language for process-oriented integration. The task of BPEL4WS is to provide a service aggregation mechanism, and it bunches these services into a single process. Hence, the result is a new process that is also subject to invocation by other services [Linthicum, 2004]. BPEL4WS is a standard that currently has momentum. This reality makes it an integration solution that has great potential to attract organizations for adoption.

Appendix 4. Workshop Plan

Introduction:

The roadmap for the integration of library services in the Wageningen UR portal is the test case for the proposed solution that consists of providing a roadmap for integrating services in the Wageningen UR portal. The part of the roadmap that is subject of this workshop covers the execution phase of the total roadmap.

Within a knowledge organization like Wageningen UR, library services are an indispensable part of the corporate portal. The integration of these services involves two parties; the section Innovation and R&D (the portal sponsor), and the Library as one of the stakeholders. The development of the library services that should make part of the portal involves collaborative efforts of both parties. Coordination of this joint effort is facilitated by this workshop that aims at defining the portal needs in services from the Library side

Scope:

The workshop brings together the potential integration team for the integration of Library services. The team consists of a mixture between Library professionals, technology professionals, and a surrogate user. The scope of this workshop is about identifying the target groups (users), their needs, library services, related integration technologies, connection between identified target groups and services, connection between identified services and technologies, establishing priorities for rollout of identified services, and finally, addressing solution schedules for short-term, mid-term, and long-term. Because of the time constraint, further scoping will be determined during the workshop.

Workshop Structure

The workshop comprises separate sessions spread over the duration of the workshop. The sessions include plenary sessions, and break-out sessions. In break-out sessions participants will be divided into smaller groups that meet separately to address specific questions. These sessions will take place concurrently and perform the same assignment. Further, during the break-out sessions the participants will be attributed different roles that will help them providing answers from that role's perspective. The following table outlines the topics that will be treated in both sessions.

Session #	Plenary sessions	Session #	Break-out sessions
S1 (10 min.)	Identifying target groups	S2 (15 min.)	Identifying needs of target groups

S4 (20 min.)	Linking Library services to target groups	S3 (15 min.)	Identifying Library services
S5 (15 min.)	Searching for mutual dependencies between library services	S6 (15 min.)	Identifying generic and infrastructure services
S7 (15 min.)	Searching for dependencies of library services on infrastructure services	S8 (20 min.)	Identifying integration technologies
S9 (20 min.)	Linking integration technologies to Library services		
S10 (15 min.)	Assessing impact of library services (cost, performance, customer value, etc.)		
S11 (15 min.)	Establishing rollout priorities for target groups and library services		
S12 (15 min.)	Addressing short-term, mid-term, and long-term schedules		
S13 (30 min.)	Action plan for short-term services		

Table A4.1: Workshop planning

Who is Involved?

Name	Function
Liesbeth Belloni	Student
Peter van Boheemen	Head Application Development and Application Management (Library)
Ahmed Ibouhouten	Facilitator (Library)

Age Jan Kuperus	System Developer (Library)
Ger Spikman	Head Selection and Content Management (Library)
Henk Slijkhuis	Head Marketing and Communication (Library)
Gerrit Seigers	Application Technologist (Innovation and R&D)
Michael Hegeman	Head section Innovation and R&D
Oscar Vonder	Project Leader (Section Innovation and R&D)

Table A4.2: Workshop Partcipants

Agenda

9:30 - 9:40 **Coffee**

9:40 - 9:45 **Opening**

9:45 - 10:00 **Short presentation**

10:00 - 10:10 **S1**

10:10 – 10:25 **S2**

10:25 – 10:40 **S3**

10:40 – 11:00 **S4**

11:00 – 11:10 **Break**

11:10 – 11:25 **S5**

11:25 – 11:40 **S6**

11:40 – 11:55 **S7**

11:55 – 12:30 **S8**

12:30 – 13:00 **Lunch**

13:00 – 13:20 **S9**

13:20 – 13:35 **S10**

13:35 – 13:50 **S11**

13:50 – 14:10 **S12**

14:10 – 14:20 **Break**

14:20 – 15:15 **S13**

15:15 – 15:30 **Evaluation**

15:30 – 15:35 **Adjourn**

Appendix 5. Results of the Workshop

Results of Session #1

The following target groups have been identified:

Target Groups					
Diedenoort students	WUR students	Students from other universities	WUR researchers	WUR Business managers	Staff
Researchers from business partners	Third party users	Everyone	Researchers	AIO's	Lecturers
Student vHall/Larenstein	Library Staff	Communication staff	Commercial Companies	LNV	Unknown

Table A5.1: Library target groups

Further, based on common needs in services the above identified target groups have been grouped into the following target groups: **students, researchers, lecturers, staff, business partners, commercial companies, and third party users**.

Subsequently, because of the time constraint, the following target groups have been selected for further elaboration: **students, researchers/Staff, and lecturers**.

Results of Session #2 and #3

These two sessions have resulted in the following Library services:

Services					
Reservation	Catalogue Search	Current awareness	Document delivery	Online book Abstracts	Keywords list
Search Agent service	ELO Support services	Document discovery	Electronic publishing services	Renewal service	Loan/book request

Table A5.2: Library services

Based on the relevance of the above identified services for previous selected target groups, the following services have been selected for further elaboration: **catalogue search, current awareness, reservation, request, renewal, and electronic publishing**

Results of Session #4

This session consists of linking the identified services to the identified groups from the above tables. Table A5.3 illustrates this linkage. Notice should be made of the fact that the service "catalogue search" has been modified in the service "Mylibrary search" as this service provides access to more databases than the catalogue alone.

Services	Target Groups		
	Students	Researchers/Staff	Lecturers
Current Awareness	X	X	X
Book Renewal	X	X	X
Electronic publishing	X	X	
Mylibrary Search	X	X	X
Book Request	X	X	X

Table A5.3: Relationships between target groups and related services

Results of Session #5, #6 and #7

The result of the session #5 is the identification of domain-neutral services (generic services). The results of session #6 are the identification of the mutual dependencies between Library services. And finally, the results of session #7 are the identification of the dependencies of the Library services on generic services. However, these generic services are currently lacking. Figure A5.1 illustrates these dependencies.

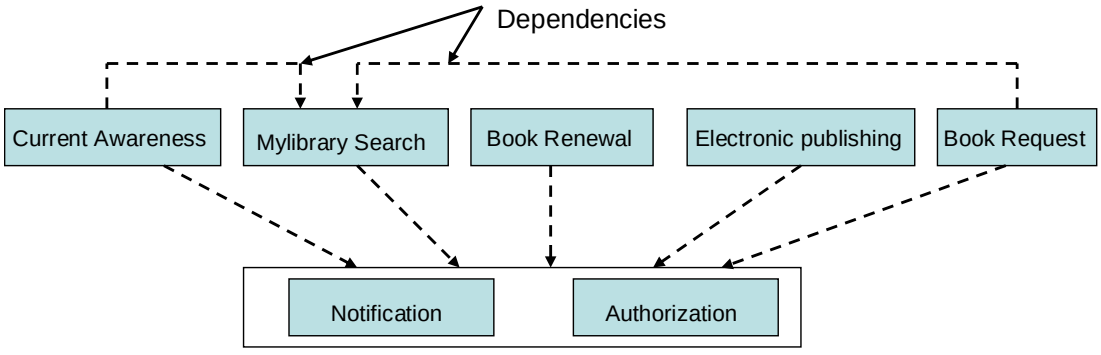

Figure A5.1: Dependencies between Library services and domain-neutral services

Results of Session #8

This session has resulted in the identification of the following integration technologies: HTTP, XML/XSLT, SOAP, WSDL, UDDI, LDAP, and Portlets

Results of Session #9

This session consists of linking the identified services to the identified groups from the above

Technologies	**Library Services**				
	Current Awareness	Book Renewal	Electronic Publishing	Mylibrary Search	Book Request
HTTP	X	X	X	X	X
XML/XSLT	X	X	X		X
Portlets					
SOAP					
WSDL					
UDDI					
LDAP					

Table A5.4: Linking technologies to Library services

Results of Session #10, #11 and #12

In these sessions the impact of services is assessed against criteria such as cost, overhead customer value. The assessment of the impact has resulted in establishing rollout priorities. These rollout priorities, on their turn, provide an indication for short-term, mid-term and long-term scheduling. Table A5.5 illustrates priorities setting and scheduling.

Technologies	Library Services				
	Current Awarenes	Book Renewal	Electronic Publishing	Mylibrary Search	Book Request
HTTP	X MT ●●	X ST ●●●	X LT	X ST ●●●●	X ST ●●●
XML/XSLT	X	X	X		X
Portlets					
SOAP					
WSDL					
UDDI					
LDAP					

●●●● Very high priority
●●● High priority
●● Moderate priority

ST Short term
MT Middle term
LT Long term

Table A5.5: Rollout priorities setting and scheduling of Library services

Results of Session #13

The result of this session is an action plan that defines: Actions, resources, risks, tooling, skills. Figure A5.2 illustrates the action plan.

Action	Time	Who	Skills	Tools	Risks
Mylibrary search	M M+1	Peter/Gerrit	No	No	No
Book request	Available				
Book renewal	Available				
Current awareness	M M+2	Yet to determine	No	No	No

M = Month

Figure A5.2: Action Plan for integrating Library Services

Glossary of Terms

Term	Definition
Architecture	The fundamental organization of a system, embodied in its components, their relationships to each other and the environment, and the principles governing its design and evolution (IEEE 1471-2000)
B2B	Acronym for Business-to-Business; transactional relationship between two organizations not involved in either end consumer/retail or the governmental market
CIO	Chief Information Officer
CORBA	Common Object Request Broker Architecture (OMG)
COM	Component Object Model (Microsoft)
DCOM	Distributed Component Object Model by Microsoft; protocol that enables software components to communicate directly over a network (Internet)
Disparate Services	Heterogeneous services from multiple and various departments and organization units.
Domain services	Business functions that are domain-specific, vary based on the service domain and can include book renewal service, credit card validation, etc.
ebXML	Electronic Business XML; joint development of UN/CEFACT and OASIS to define a world standard on XML/EDI
Enterprise Architecture	An organization in total, including all subordinate entities. It can also be seen as the most comprehensive of systems and views, operating with a set of shared interests, goals, and processes. Enterprise is also a term used to describe the most powerful class of systems and applications - typically having greater functionality and extensibility than other similar or competitive elements
ESB	Enterprise Service Bus
Focal Points	A set of strategic issues that provide the strategic clarity for the execution of business initiative (in this case the service integration initiative)

Generic service	Services that are cross-domain and business-neutral. Example of these services are: notification, authorisation, scheduling, etc.
HTTP	HyperText Transfer Protocol, the underlying protocol used by the World Wide Web. HTTP defines how messages are formatted and transmitted, and what actions Web servers and browsers should take in response to various commands.
Hub-and-spoke	Hub-and-spoke integration is where integration between systems (spokes) occurs with an intermediary, the hub, involved in routing messages to other spoke systems.
Infrastructure services	Include security, management and monitoring, administrative functions, data logging and exception handling, as well as registration and discovery
Integration	Interfacing and connecting different applications, systems and processes so that they work seamlessly together. This often creates both great efficiencies and great value and extends the reach and power of participants in an integrated whole. Metcalfe's Law describes the value of a network as being defined by multiplying connected elements and resources rather than adding them. The same paradigm describes the value of integration
integration services	Are services that allow different applications from different sources to talk to each other without the need for custom programming. Examples of these services are transformation, intelligent routing, message warehousing, etc.
JDBC	Java Database Connectivity
Meta-project	Projects whose ownership is in hands of a third party
Middleware	A layer of software between the network and the applications. A word used to describe in general terms the software that handles common functions for accessing distributing and displaying data between locations that store data and locations that receive data.
ODBC	Open Database Connectivity
PDA	Personal digital assistant: small PC-like devices with limited functionality.
Program	The sum of all the work an organization does to integrate services organization-wide. A program can be as long or short as appropriate to the organization needs

Project	A well-defined effort with specific deliverables, due dates, and cost. To ensure success, a project must produce valuable and measurable results, but it must also be small enough to complete within a business sponsor's attention span
Reference Framework	The set of concepts and building-blocks that will serve as a framework for analysing the Wageningen UR's current practices and service integration requirements for the portal.
ROI	Return On Investment
Service suite	Is the set of related business services, business-neutral services, and infrastructure services
SOA	Service-Oriented Architecture
(Software) Component	Any piece of pre-written code that defines interfaces that can be called to provide the functionality that the component encapsulates

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