

Enterprise Architecture Evaluation Report

Coventry University



JISC Enterprise Architecture and ArchiMate Project

Published date	22.07.2011
Version	Version 0.2
Author	Nathalie Czechowski, Shaban Padam, Ian Anderson and Craig Woodcock

Table of Content

1.1. Background	4
1.2. Document Purpose	5
2. Executive Summary – Lessons Learnt	6
3. Adopting ArchiMate	8
3.1. EA Objectives	8
3.2. Tailoring ArchiMate For Our Needs	8
3.2.1. Creating Standards Document.....	8
3.2.2. Don't Dilute the Value of Models By Overloading with Objects	9
3.2.3. Creation of our ArchiMate Meta Model	9
3.3. EA Business Layer.....	12
3.3.1. Introduction	12
3.3.2. Business Process Modelling Overview	12
3.3.3. Actors and Roles.....	13
3.3.4. Business Processes and The Archi Tool	16
3.3.5. Microsoft Visio Tool.....	17
3.3.6. Level Of Detail.....	17
3.3.7. Process Events	19
3.3.8. Business Process Modelling Standards and Tool Stencil.....	19
3.3.9. Business Process Models vs Diagrams	21
3.3.10. Measurements and Metrics.....	22
3.3.11. Business Process Analysis	25
3.4. Modelling The Business Layer With ArchiMate	26
3.4.1. Business Model Objects	26
3.4.2. Out of Scope ArchiMate Business Objects	28
3.5. EA Application Layer.....	30
3.5.1. Introduction	30
3.5.2. Modelling Application Components and Services.....	30
3.5.3. Modelling Application Interfaces	31
3.5.4. Modelling Data and Extending the ArchiMate Language.....	33
3.5.5. Naming Conventions.....	34
3.5.6. SOA and Removal of Point to Point Interfaces	35
3.5.7. Microsoft BizTalk.....	35
3.6. Modelling The Application Layer With ArchiMate	36
3.6.1. Application Objects	36
3.6.2. Out of Scope ArchiMate Application Objects.....	37
3.7. Relationship Connectors	38
3.7.1. Other Relationship Connectors.....	40
3.8. EA Technology Layer.....	41
3.8.1. Modelling a Virtualised Environment.....	41
3.8.2. Modelling Naming Standards.....	42
3.9. Modelling The Technology Layer With ArchiMate	44
3.9.1. Technology Objects	44
3.9.2. Out of Scope ArchiMate Technology Objects.....	45
3.10. EA Views.....	46
3.10.1. Creating Views to Meet Specific Audience	46
3.10.2. Integrated Model	47
3.11. Promoting ArchiMate within IT Services	48
3.11.1. Introduction Workshop	48
3.11.2. Resolving Issues from Workshop	48
3.11.3. New skills developed – what and how	49
4. The Smartcard Project.....	51
4.1. Initial steps	51
4.1.1. Smart Card Implementation	51
4.2. Project Scope & EA Opportunity Objectives	51
4.2.1. The EA Opportunity.....	52
4.2.2. Smartcard Creation and Issue (Overview).....	53

4.2.3. Managing Access Control (Building and Room Access across the university)	54
4.2.4. Sports Centre Membership and Access	55
4.2.5. Print Management.....	56
4.2.6. Borrowing Books and Media from the Library.....	57
5. Governance	58
5.1. EA Governance Principles Adopted.....	58
5.2. Principles Adopted	58
5.2.1. Reduce Costs of Non-Value-Adding Processes and Resources.....	58
5.2.2. Business Continuity.....	58
5.2.3. Interoperability (SOA), Portability, Scalability and Capacity (Cloud)	59
5.2.4. Reduce Complexity in IT Infrastructure and Reducing Carbon Footprint.....	59
5.2.5. Service Ownership, Data Ownership, Security and Asset.....	59
5.2.6. Technology Alignment with Strategic Standards	60
6. EA Delivering the Benefits	61
6.1. EA Assisting With Project Development Cohesion.....	61
6.2. Assisting with Speed of Information within Analysis and Design.....	61
6.3. Analysis (Impact analysis and change assessment)	61
6.4. Estimation	62
6.4.1. Exploring Service Orientated Architecture Through EA.....	62
7. Using EA Beyond the Smartcard Project	64
7.1. Student Footprint Project	64
7.2. Working with other HE institutions	64
7.2.1. ArchiMate Modelling Bash	64
8. Tools We Used with Enterprise Architecture.....	65
8.1. Evaluation of Archi EA Modelling Tool.....	65
8.2. Evaluation of JISC Impact Calculator	67
8.2.1. Coventry University Process Improvement Cost Calculator.....	67
9. Appendix.....	68
9.1. Coventry University ArchiMate Meta Model.....	68
9.2. Appendix 2 – Re-engineering CU Smart Card project EA and processes	69
9.2.1. Appendix 2.1 – Sports Centre Membership and Access EA and processes.....	69
<u>As-Is EA Model</u>	77
9.2.2. Appendix 3.2 – ID Card Issuing and Managing Access Control EA and processes	79
9.2.3. Appendix 5 – Print Management EA and processes	79
9.2.4. Appendix 6 – Library EA and Processes (Search, Reserve, Loan and Return).....	80
10. Introduction	80
11. Processes	81
12. The following is true for all processes:	89
13. Metrics & Measurements.....	91
13.1. Timings.....	93
13.2. Process Savings Made	97
13.3. Enterprise Architecture	98
As-Is EA Model	99
To-Be EA Model.....	101
13.4. Appendix 3 - As-Is Integrated EA Model.....	102

1.1. Background

The current economical challenges faced by the HE sector demands that Higher Education Institutions (HEI) have to re-appraise their vision and strategy in order to prosper and respond rapidly to external change.

The reduction in funding by HEFCE and the high focus on environment sustainability forces HEI's to:

- Innovate to generate income from other sources, increase globalisation, increase business partnership, etc.
- Reduce cost by conducting organisational reviews in order to lean processes and standardise systems;
- Invest in new technology or exploit current one to provide sound returns on investment;
- Reduce carbon footprint.

To be able to prosper during these external changes and to quickly adopt new strategies and visions there is a need for HEI's to be both flexible and agile.

In January 2010 Coventry University Project Amundsen was launched with a directive to perform a whole organisational review. Project Amundsen was to assess if the organisation is fit for purpose and ready to take on the challenge in order to meet our 2015 vision. One of the work package objectives was to identify areas for improvement which would generate cost savings immediately or in the future.

This work package identified the following areas for improvement:

- Standardisation of processes.
- Integration of systems (especially the security access system).
- Better use of technology to improve process efficiency.

A stream of projects have emerged to put in place recommendations from this review. One area identified for immediate attention is the replacement of our current card technology and access control system with the introduction of a new Radio Frequency Identification (RFID)-based "Smartcard" system across the University. This would replace the existing INDALA card technology currently used and would be directly linked with the adoption of the new Access control system (Salto).

The current card technology is limited (read only) and prohibits the use of extra functionality in other systems which would result in greater and speedier return on investment. The introduction a new smartcard technology brought the university an organisational wide transformation.

Careful management of organisational change is required for a wide reaching system change to be successful and realise its full range of benefits.

Coventry University invested in Smartcard combined with a new access control system. This large scale project triggered organisational wide changes which required careful change management. Being part of the Flexible Service Delivery (FSD) programme, Coventry University understood from other HE partners, such as Liverpool John Moores (LJM), how they have benefited from adopting an Enterprise Architecture framework.

This project aimed to build upon the experience of others in order to demonstrate how an Enterprise Architecture approach can help to overcome cultural barriers associated with a change initiative such as governance, staff roles and responsibilities, as well as ensuring that all opportunities are exploited and that new business processes contribute in reducing environmental impact and efficiency savings. This project is built upon the successful experience of other Universities and shows how we can exploit the benefits of Smartcards and implement organisational wide change through the adoption of TOGAF.

1.2. Document Purpose

The document intends to share Coventry University's experience of using enterprise architecture (EA) with other HE institutions that are investigating or perhaps considering the adoption of EA. The project summarises the adoption of EA from investigation and understanding to the practitioner level that we have now reached.

The document intends to be used as a reference document that can be used by other institutions to understand our learning experience and hopefully to provide some guidance within their enterprise architecture journey.

2. Executive Summary – Lessons Learnt

Intro: This section summarises our conclusions of using EA (Enterprise Architecture) within Coventry University.

ArchiMate Language

The ability to create EA diagrams using the ArchiMate language isn't something easily picked up, it takes many iterations of feasibility modelling and discussions with peers and reviewing the ArchiMate specification before you can create your EA models. With every new domain that we looked at modelling, fresh new challenges would appear that we had not needed to previously model. Only after a number of these iterations did we become good ArchiMate modellers.

ArchiMate has been very successful in communicating messages within the IT services team. Due to it being very visual and a rich language (i.e. many different objects with a distinct meaning), we have found the concept of a visual language a much easier way of describing the business, application and technology domain, certainly much more effective than large documents and specifications that we previously created; these were difficult to understand, time consuming to produce, review and maintain. Within IT services, we are practitioner enterprise architects, using our EA models for impact and change assessment, project scoping, estimation and many other benefits described in section 6 of this document. ArchiMate's strength of being a rich language is great for IT professionals, however we have found that it does not lend itself well to communicate a message to business stakeholders in our experience. We have been able to create some very simplified views to business stakeholders that do convey the message very well due to the visual method, but any views that are more than a very simple business service/process/actor view is not easily understood, even when we have walked the stakeholder through the diagram. Our belief here is that IT professionals can see the benefits that EA can bring and also benefits of using the ArchiMate language over previous specification documents. Most members of the IT services team that were involved with the early adoption of ArchiMate could see how the language would benefit their role in some way, hence we believe that there is a motivation for them to learn the language, invest the time in achieving this. Business stakeholders do not see the benefits of ArchiMate and therefore do not have the motivation to learn the language, there is also the culture that some of the concepts in ArchiMate are more easily understood by IT professionals than business stakeholders.

We have seen great value in business process modelling with the business stakeholders, these diagrams are much more intuitive to the business and use a very simple language. The business have seen the benefits of using business process modelling for collaborative analysis of an as-is and a to-be process either with IT business analysts or within a larger workshop environment.

TOGAF

TOGAF is a framework that contains methods and techniques for achieving your to-be vision, i.e. your target to-be EA model. One of the issues that we have found with TOGAF is that it is not at all prescriptive in providing a method of how to go about achieving your to-be vision.

What we have realised through the many months of using EA, now that we are practitioners, is that the best methods for realising your EA vision are good IT development methods, such as a project management methodology such as Prince 2, an effective approach to analysis and an agreed set of deliverables before, during and as a final output from a project realising a to-be EA model.

The project management methodology was something that we already had in place, however our business process analysis approach required further improvements. We have really identified the techniques on how to analyse an EA or business process model. When creating our to-be

EA models that we wish to adopt we apply a number of principles (see section 5.2) that ensure that we are delivering a to-be model that enables the IT strategy to be fulfilled. We have found that in order for the business strategy to be implemented successfully, the IT strategy needs to be aligned in delivering it, projects that are carried out support the business and IT strategy with the end deliverable, the project objectives should therefore be aligned with the business and IT strategy otherwise we are not strictly following our strategy. The creation of an EA model and the analysis needed to finalise the model shall apply our EA principles that fulfil the IT strategy whilst we carryout analysis to ensure the to-be model fulfils the project objectives (which in-turn fulfils the business strategy).

As an example of this CU's business strategy is to streamline its business processes, become leaner and more efficient along with reducing overhead costs. Projects carried out shall therefore have objectives supporting this such as reducing the resource required to facilitate a process by an amount of people or reducing the cost of consumables required for the process by 25%. Our EA principles that fulfill the IT strategy may be to adopt a single technology platform or to provide scalable solutions for the next 5 years with every development. The EA model that we create therefore needs to fulfil the project objectives along with EA principles; the document describes how we have achieved this with our implemented to-be EA models.

3. Adopting ArchiMate

3.1. EA Objectives

Before we started looking at the ArchiMate language and creating some feasibility models, we had several discussions on what we wanted to achieve from our enterprise architecture, section 3.1 expands on the aspirations and how we looked to achieve them, however it is worth starting this section by reviewing our EA objectives, this we hope shall help you understand some of the decisions that we have made and some of the areas that we have focussed on a little more than other.

The objectives that we set out to achieve are listed below:

- Introduce business process improvements through the analysis of the business process models and remove any duplicate or non-value adding processes or process activities where possible.

Explicitly the business process improvement (in financial terms) was to reduce the staffing costs of facilitating each of the processes, i.e., a head count reduction.

- Improve the student experience by reducing the time taken by students to carryout the processes and making the experience a more convenient one.
- Identify and exploit service orientated architecture opportunities within internal and external systems by analysing the as-is EA model, thus reducing the Its overhead of managing point to point interfaces of data between the many systems that were required to support the processes.
- Reduce the technology costs required to provide the ITS applications that would support the business processes.

3.2. Tailoring ArchiMate For Our Needs

3.2.1. Creating Standards Document

It should be noted that whilst using the ArchiMate EA modelling language to describe the enterprise architecture of Coventry University we decided that the language was very rich, initially too rich for our needs. The tailoring of the ArchiMate modelling language that we have carried out is to exclude modelling objects and techniques that are superfluous for our EA objectives, along with minor additions and amendments to support our EA objectives that ArchiMate does not fulfil in its current version.

3.2.2. Don't Dilute the Value of Models By Overloading with Objects

The ArchiMate language is a comprehensive one that uses objects to represent concepts at the business, application and technology layers. One of our first exercises was to assess each of the ArchiMate objects and determine if each object would represent something of value within our EA model. EA models are large and complex for an organisation such as Coventry University, therefore by removing objects that we believed did not add value would help ensure that our model wasn't over engineered and over complicated to review and analyse, to put it another way our rationale was to not dilute the value of a diagram by overloading it with superfluous or non-value adding objects.

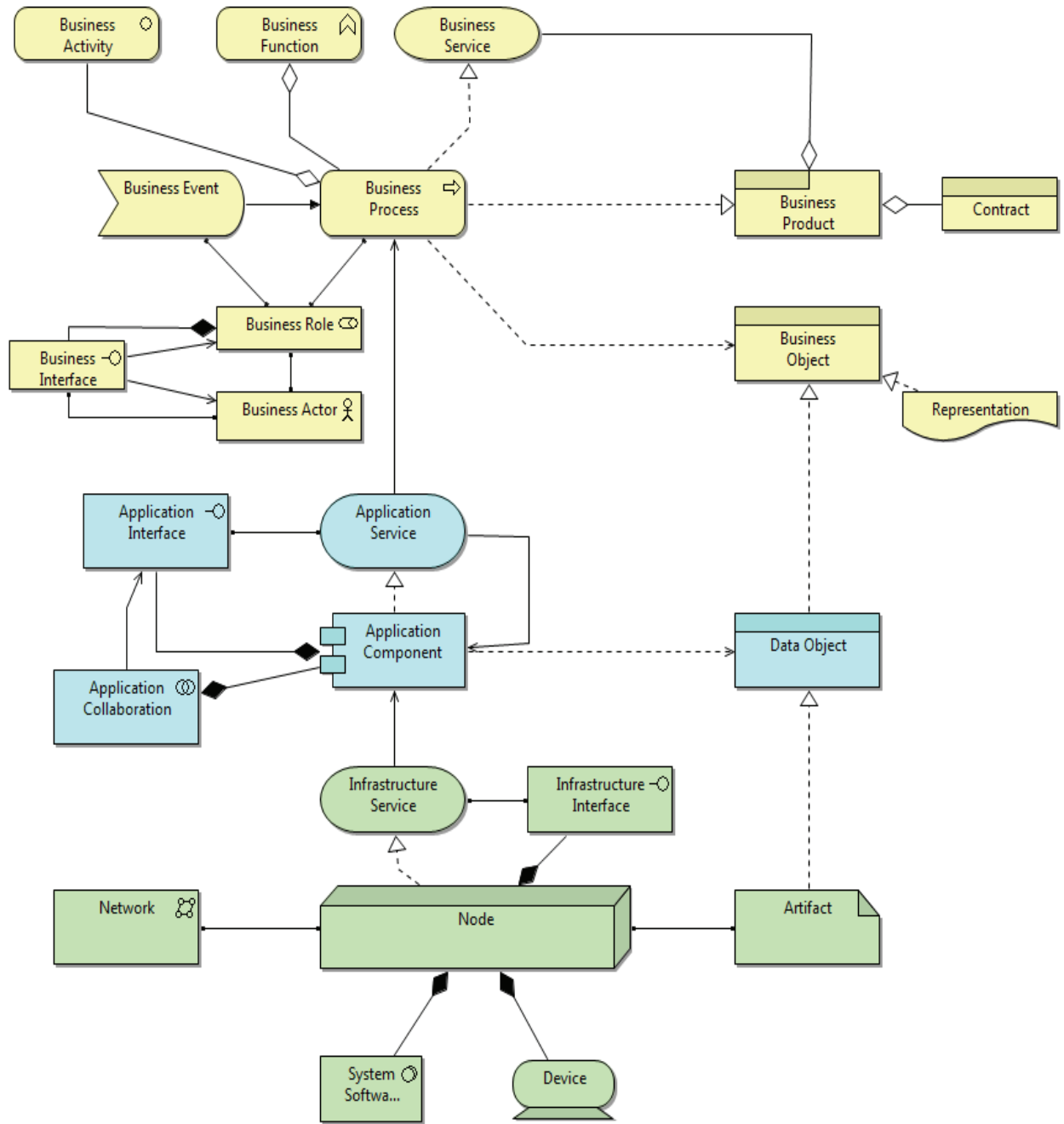
We found through our feasibility models and communicating these with other IT Services members that many objects did not provide valuable information and therefore some of the objects just became noise that distorted the message and made it more difficult and time consuming to read and understand the message being conveyed. A diagram should convey a message clearly and succinctly and we knew that we must address this issue.

From this realisation we then questioned the objects within ArchiMate and tried to determine the level of value and where we may use each object within the scope of our EA modelling. We found several objects that we believed did not add value to our model such as the *meaning object* and *value object*. We believed that the *value* of say a business service or the *meaning* of a relationship to a particular actor should be implicit from the naming and naming conventions used within our model. These and other ArchiMate objects have been deemed superfluous to our model requirements and have not been used in the models created so far. A full list of the objects that we have decided to not use within our EA modelling so far can be found in sections 3.3 to 3.6 of this document.

3.2.3. Creation of our ArchiMate Meta Model

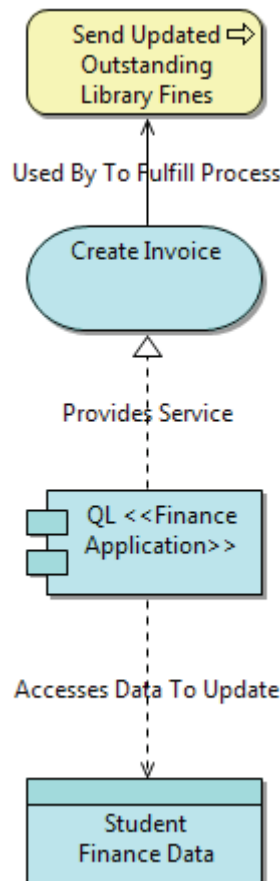
Once we had identified the ArchiMate objects that we were to include within each of the EA layers, we felt that we should create a meta model describing the objects and their relationship with one another. It was agreed that a meta model would be very useful to all members of IT services that would be either creating or reviewing the EA models.

The meta model went through several iterations before we were happy to publish it. During the ArchiMate modelling bash that we held for other HE institutions at Coventry University, it was interesting that Twente University in The Netherlands had also created a meta model of the ArchiMate objects that they had decided to use within their EA modelling. The meta models were very similar and many of the objects that both universities omitted from using were omitted for the same reasons of not adding value or not being an explicit enough object for us to clearly describe our message using an EA model. A copy of the Coventry University meta model can be found below.



Coventry University ArchiMate Meta Model

As an extension to our meta model, with the EA models that we initially created we added the relationship descriptions, this helped the understanding of our EA models within the organisation early on in adopting the ArchiMate language. E.g. an actor plays a role, a system fulfils an application component, an application component access data etc. An example of how this was created can be found in the diagram below.



Example of Describing Relationships Early On In Our Modelling

Describing the relationships between the objects within our EA models was only carried out whilst launching EA into CU, once an understanding of the ArchiMate language was established, the explicit descriptions of the relationships were dropped as they were then implicitly known, i.e. drop the descriptions off the connectors so that the meaning is implicit for a reviewer’s understanding of the ArchiMate language.

3.3. EA Business Layer

3.3.1. Introduction

The TOGAF¹ Enterprise Architecture framework and ArchiMate modelling language both define enterprise modelling should differentiate three specific layers i.e. three different domains of an organisation, a business domain (people and processes), application domain (software) and technology domain (infrastructure or specialist software such as Oracle or an operating system).

Coventry University have been carrying out As-Is and To-Be Enterprise Architecture modelling of its organisation at each of these layers, i.e. Business Layer, Application Layer and Technology Layer. The following section shares our experience and how we believe modelling should be carried out to maximise the business value.

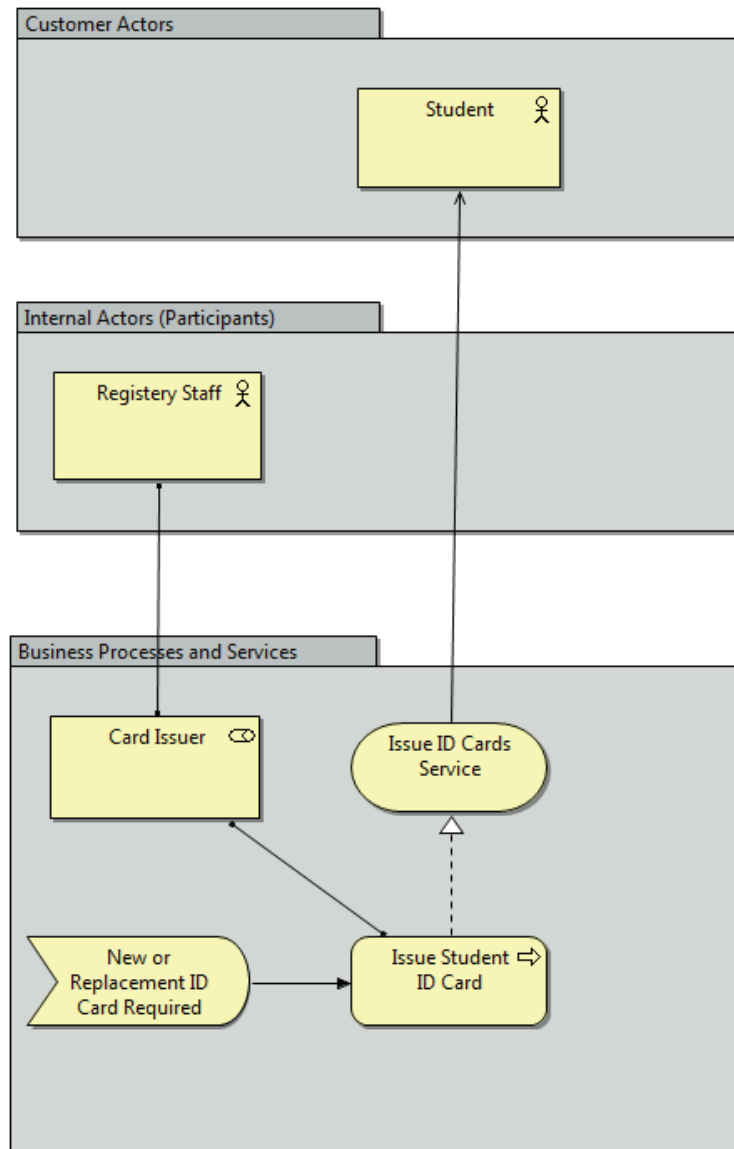
3.3.2. Business Process Modelling Overview

Once we had read the ArchiMate specification and various books that we have found, we decided that it would make sense to start our modelling (initial modelling trials) with the business processes. It made sense to look at some processes within the scope of the SmartCard project (see section 4) and once we were happy with our business modelling we would move on to the application layer supporting the business layer.

We modelled our first set of processes and started to determine what information would be useful to us to help improve our business processes, it is certainly not as simple as looking at your as-is business process model and rely on a sudden eureka moment that enables you to create your to-be model..

We are using the ArchiMate EA diagrams to view the business services, processes and sub-processes that are in our scope or view (see section 3.10) along with the events, actors, roles and a couple of other artifacts that add value and enable us to realise the benefits of EA, which include communication, change/impact assessment, estimation and project resourcing. See the example diagram for an overview of business domain modelling within ArchiMate.

¹ TOGAF is an acronym for The Open Group Architecture Framework, this is a framework for modelling enterprise architecture within an organisation.



ArchiMate Diagram Representing Business Domain Modelling

3.3.3. Actors and Roles

Many of our business stakeholders that we speak with to create and review the EA and business modelling diagrams (see later section) are initially confused between the actor and role objects, it therefore makes sense to specify our definition of the two objects and how we are using them.

Within ArchiMate an Actor is a person who is the recipient of a business service or a participant in a business process. We have chosen to differentiate actors that are recipients of one of our business services (for example a student) from actors that participate in a business process (for example a finance administrator). It is important to note that within ArchiMate we believe that systems that are also recognised as actors within UML 2.0 on a use case diagram are not modelled as actors on an EA diagram; the system components itself are modelled (see application and technology layer sections later).

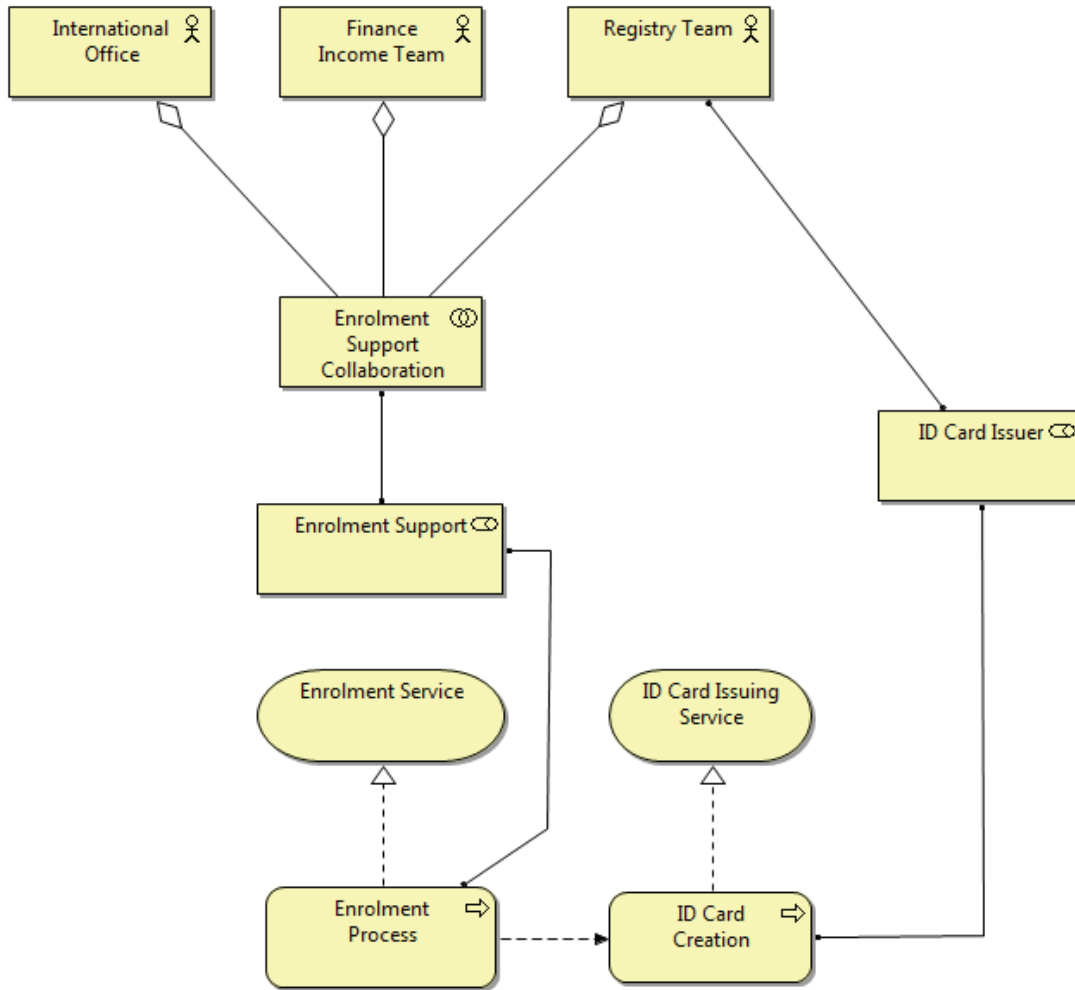
A role specifies the type of job that is carried out by an actor within a particular process. Within the EA models that we have produced we have found that certain actors play several different roles within the model, their role differs between business processes. It is important though to highlight the need to differentiate an participant actor (which is really who performs in a business process) and their role which is really (what they perform within the business process). An example of this would be that a registrar will play the role of card issuer within the process that takes a photograph of the student, creates the card and hands it to the student.

Generalisation vs Specialisation of an Actor

Creating an EA model or certain a view of an EA model is all about creating the correct message for your target audience and the domain that you are describing. In many of our models we will refer to the Student as an actor, the student is an actor, however a student is a generalisation, as we know we have many types of students.

Where all students receive the same service, or interact with the EA model the same, i.e. there is no differentiation between differing types of students then it makes sense to use the generalised actor of student, this is all that needs to be communicated. There will be models that we have created where different types of students need to be specified on our diagram, or the generalised term for student is not applicable, for instance a process that verifies visa duration and overseas qualifications during enrolment is pertinent to overseas students only and not UK students, we would therefore need to specify the actor as an Overseas Student.

Differentiating a actor is known as a specialisation, students are a good example of an actor that we would specialise, it may be that certain services are only received by overseas students, disabled students, post graduate students, part time students. Where there is a clear differentiation then making the actor a specialised actor is very important to put the message that you are conveying with your EA diagram into content.



Example of Actor Playing Differing Roles, Including One with Collaboration

Collaborations

Another way that we have modelled actors and roles is where a number of actors collaborate together to perform a role within a business process, we have found this within the enrolment processes which are carried out on an infrequent basis where special business processes are carried out just a few times per year on a mass basis. A collaboration of different actors perform a role within the processes.

3.3.4. Business Processes and The Archi Tool

To meet one of our EA modelling objectives, which is to simplify and streamline business processes, we attempted to model our diagrams using our EA modelling tool Archi. Unfortunately, we believe that detailed process analysis is required to realise the full benefits of business process improvement. For this we need to understand and model our processes at a business activity level (business processes are fulfilled by many business activities being carried out). We've found that trying to model business processes at a detailed level cannot be achieved within an EA model without over complicating the model and compromising its value. A much more effective approach is to create separate business process activity diagrams and map them back to the processes contained on our EA model.

Ideally we wished to link our detailed business process diagrams to the EA model, however Archi does not provide the functionality to decompose business processes contained on the EA model into a more detailed diagram, there is no mechanism to link diagrams within the tool. As a workaround to this issue we are storing our business process diagrams (created using MS Visio) in a single directory and adding the path of the file to the corresponding process contained on the EA model using the documentation attribute in Archi. We did consider using the aggregation ArchiMate concept to specify the activities that would be carried out within a process, i.e. what activities a process composed of.

An example of how this looked can be seen in the diagram below, after consideration of the number of business processes within our SmartCard project scope and therefore the number of activities that we would need to be model it was felt that the EA model would be overloaded and not convey a clear message. So like the ArchiMate concept of separate views to tailor the presentation of information to specific stakeholders we have decided to create separate business process models and link them back to our EA diagram.

We have chosen to map the detail, i.e. events, activities, hand-offs, decisions, scenario paths and results of each process or sub process that is contained within our EA model.

As an example, the 2 business processes (Borrow Library Book Process and Pay Library Fine/Invoice Process) and Borrow Library Book 3 sub processes that are contained within the ArchiMate diagram below will each have their own business process model created and managed using the MS Visio tool.

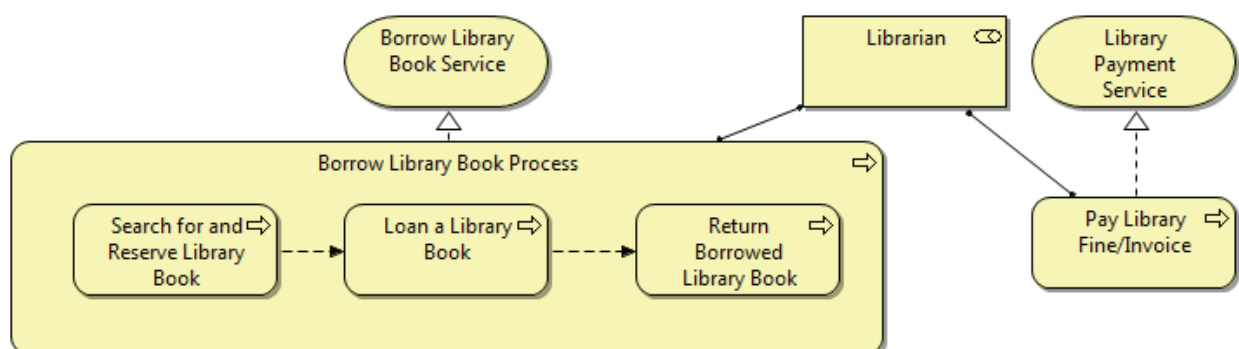


Diagram Illustrating The Level Of Business Process Detail Contained On Our EA Diagram

3.3.5. Microsoft Visio Tool

To aid the analysis of the role our applications play in supporting our business processes we have extended the ArchiMate business process object with our business process models, to illustrate if a process or activity is carried out manually or by the user and application collaborating together by adding different coloured process objects. In addition to this we have added the name of the application that supports individual process activities, this is an extension of the realisation concept in ArchiMate that illustrates which applications are used to fulfil a business process.

3.3.6. Level Of Detail

A problem that can be encountered where modelling the business domain in an EA diagram using ArchiMate (or any other notation) is that you need to agree the level of detail that shall be contained on the diagrams so that the diagram does not try to convey too many messages to the readers or try to convey too much detail in just one diagram (we find that using multiple diagrams to convey differing message or a lot of detail is far more effective with the stakeholders using our EA diagrams).

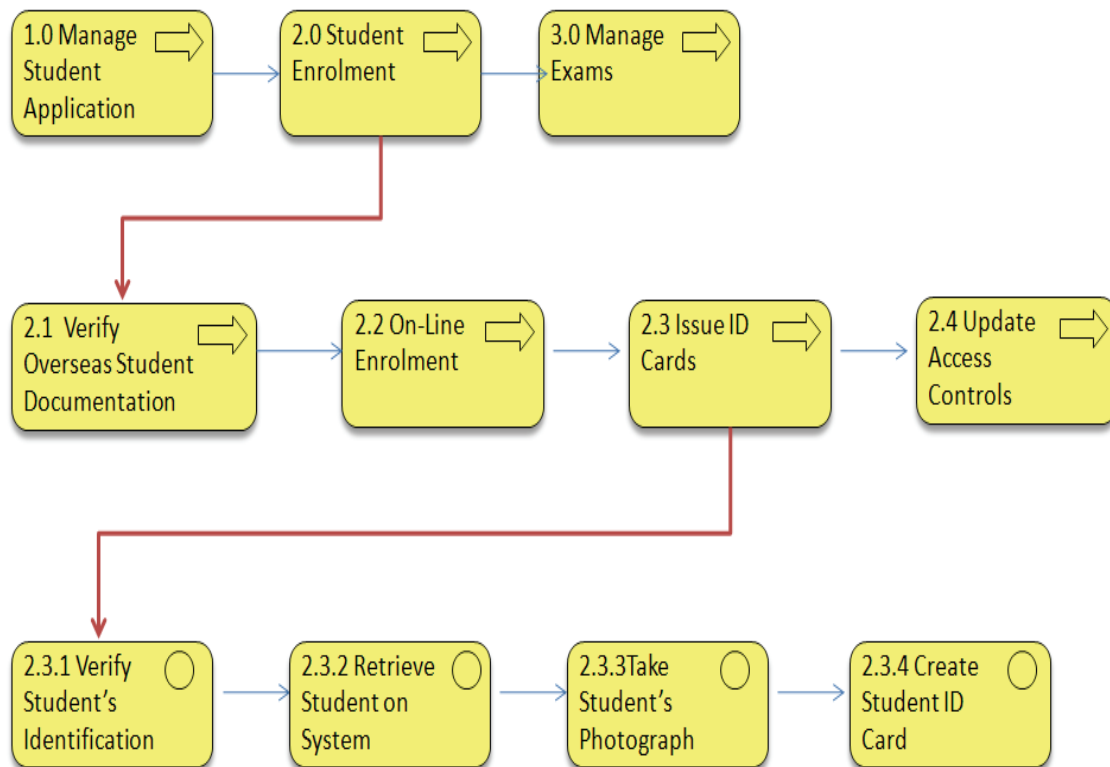
We believe that business processes should be modelled down to three levels, the main process (e.g. enrolling a student or borrowing a library book/media), the sub processes e.g. reserving a library book, loaning a library book or returning a library book and the activity level, i.e. the activities that are carried out within each sub process, e.g. for returning a library book activities such as updating book inventory, checking for future reservations, apply a fine that may be applied to a late returned book, would all be an example of activities. Further examples of the 3 levels that we have agreed upon for our business process modelling can be found in the diagram on the subsequent page.

We have chosen to use Microsoft Visio for our business process modelling as it allows us to create our own modelling stencil, is an application that we have licensing for at CU and is a tool that we are already familiar with using. There are two primary reasons for this. Firstly we believe the ArchiMate language is better used to describe business services, process and their relationship with actors, functions, application services and other business and application domain objects as opposed to modelling the process activities and scenarios. We have concluded that the detailed business process models should not be created using the ArchiMate language and therefore not the Archi modelling tool. We have created a stencil that we have used to create our business process models, the details of how we are creating our models and our recommendations are documented with the remainder of section 3.3.

Indexing

The Archi modelling tool does not currently support the ability to link different diagrams together, allowing a model to be viewed at an overview level before drilling down levels on various areas to view the detail.

For business process modelling using Microsoft Visio the business processes and business activity objects can be assigned an index number that corresponds with its level within the model (see the diagram below), this shall enable a reader to navigate to diagrams in greater or less details quickly and easily.



Indexing Processes, Sub Process and Process Activities

Further Detail

We did consider a further level of detail, i.e. work instruction level where each activity would be broken down into the steps that are carried out e.g. calculate the fine based on the number of days overdue, add additional penalties for certain book types, update the student's outstanding fine amount with calculated fine, etc. However we deemed that this fourth level was too detailed and did not provide analysis value in improving the process, however this level of detail would be effective for designing software or publishing training instructions to staff. We felt that this would result in our process diagrams becoming far too cluttered, making them very difficult to read and assess.

Having settled on the 3 levels of a process being the correct level for us to model our business processes, it became clear very quickly that an EA diagram would not be the best diagram to model that level of detail along with the rest of our business domain and application & technology domain. We believe that process models should be created and documented in separate diagrams that link back to the overall or a particular EA diagram, thus the business process models become an extension of EA.

3.3.7. Process Events

We looked at the definition of an event in ArchiMate. An event is a something that happens (or you expect to, but does not happen) that means we need to respond in some way, events will trigger a Coventry University process or activity. The following types of events shall be captured and included within our EA modelling:

External Event: An external event can originate from an external party (e.g. Student).

Internal Event: An internal event can originate from an internal person (Lecturer) or from an internal process within Coventry University that generates an event (entering exam results, is an event that may require a process to inform students or publish results).

Timed-based Event: An event can occur at a set/scheduled time, i.e. a weekly, monthly or even annual event, such as student enrolment.

Non-Event: A non-event is where an expected event does not occur, i.e. nothing happens. An example of a non-event would be if a student is expected to return or respond to a letter regarding issues with course fee payment but does not, with this scenario we would still need to address the fact that no response has been received by issuing a further letter or preventing the student from enrolment.

3.3.8. Business Process Modelling Standards and Tool Stencil

By choosing to utilise a separate diagram for our business processes we debated around which modelling tool should be used create and manage the business process models. Archi was the tool of choice for creating and managing our EA models however there were a number of key value adding elements that we wanted to include within our business process that Archi did not support. It should be pointed out that Archi did not support the elements we wished to utilise as it was not designed for business process modelling, we have found Archi an excellent tool for modelling our EA, a summary of our experience can be found in section 8.1.

Business Process Modelling Elements

Within the business process modelling carried out at Coventry University, three types of activity boxes are used within the models produced differentiating the types of process activity used and adding value to our models for analysis:



A Yellow activity box represents an activity carried out by a user and a system collaborating together to fulfil the activity (e.g. the user searches for a student on the system to retrieve their details and verify certain student information).

A Blue activity box represents activities that are carried out solely by an IT system, these activities are not carried out by a user.

A Green activity box represents activities that are carried out solely by a user/s without the aid of an IT system.

For activities carried out by the user and system or activities that are automated by a system, the name of the system being used shall be specified above the activity description (illustrated in the diagram above).

Differentiating between differing types of processes and sub processes, i.e. ones that are system automated and ones that are completely off-line (i.e. not using any IS provision). Where a system is used to fulfil a process activity we have added the name of the system to the process activity on the process diagram.

We trialled drawing our business process diagrams using swim lanes, this illustrated the team (actors) that were responsible in carrying out the process activity.

3.3.9. Business Process Models vs Diagrams

Business process models are not just diagrams of activities of what is carried out, we believe that they should contain a lot more information, this differentiates a diagram from a model, the following is a list of information that we are gathering with our business process models to ensure that they are models that provide valuable information that can be used for analysis and not just diagrams to communicate a simple message:

Who performs the process activity - this is specified by placing the process activity within a swim lane that describes the actor carrying out the activity. Where the activity is carried out by more than one actor, the activity is placed on the dividing line of the two actors (an example of this is shown in the diagram below). With our business process models, we have included swim lanes, specifying the actors who participate in each activity carried out for a process. The ArchiMate language (although not a business process modelling language) assigns actors to processes via the role they are playing within the process. We started out with this concept and extended it to our detailed business process modelling. However assigning several actors and roles to each activity box created a complicated looking diagram that added too much noise and also made it difficult for the business and IT to understand. By using swim lanes the diagrams are much cleaner looking and simpler to understand.

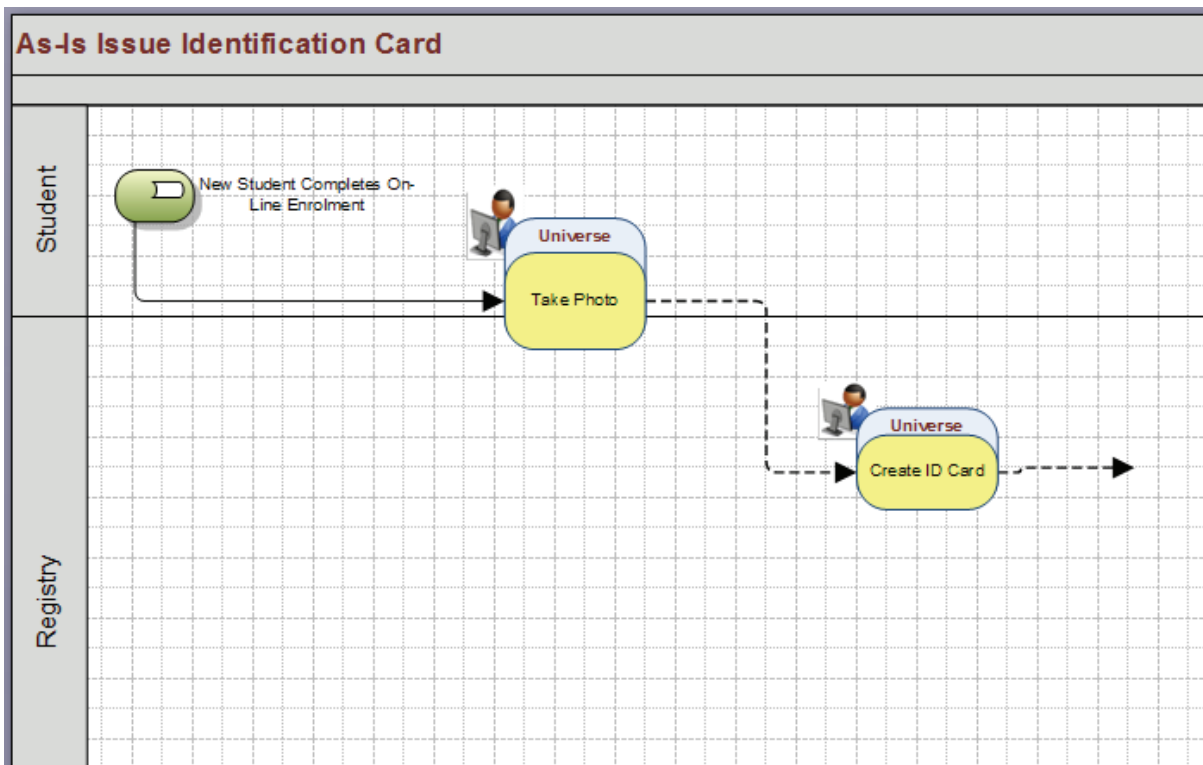


Diagram illustrating process activities and which actor carries out the activity. The diagram also illustrates how we model an activity that is carried by two actors collaborating together.

Process Event Frequency – In order to understand the extent of the time/resource required to fulfil a process you need to determine how often each event occurs. Process activities are triggered by an event (see section 3.3.7) we need to understand how often the event occurs, is it an event that occurs once a month, or annually. Is it an event that occurs twice per week per student (therefore 30,000+ occurrences), only with this information can you successfully analyse your business processes; this information should be recorded on the business process model.

Process Activity Timings – To identify the true cost of a process, one of the key factors is to understand how long it takes the resource facilitating the process, i.e. carrying out the activities. We collect and document the median average time (i.e. the typical time excluding the extreme scenarios that can occur that would distort the typical view) and document on the as-is diagram. We then, using the event frequencies, can determine how often the activities are carried out and the time scales involved for both university staff and the end customer, e.g. students.

This information is useful to prioritise business process improvement and the following EA changes that are likely to be required. It is also useful to include the timings with your to-be models, to illustrate the improvements such as staff resourcing or speedier service for customers. We have often produced several different to-be models each with differing application and technology support required to fulfil the process models, including model data such as timings is crucial in helping decide which to-be model is to be adopted.

3.3.10. Measurements and Metrics

Following on from collecting process activity information to include with your process models (i.e. information that differentiates a process diagram from a process model) there are lots of measurements and metrics that we identify and analyse with our business process modelling.

Analysis Can Only Performed with Process Information:

To analyse the problems with an existing business process as part of your EA you need to collect information that can be used to aid the creation of to-be models that could be adopted fulfilling the EA, Business or Project objectives that are to be realised (e.g. reduce the head count required to facilitate the process, improve the student experience and satisfaction or reduce the technology costs involved in supporting the process).

We recommend measurements and metrics are gathered, defined and agreed for both As-Is and To-Be processes.

As-Is: The purpose of collecting measurements and metrics for the as-is model is to help determine how successful or effective it is, using as evidence in supporting subjective views of the process and to benchmark your processes against your expectations, between departments or potentially between universities.

To-Be: The purpose of defining measurements and metrics for the to-be model is to ensure that the to-be model that is agreed to adopt fulfils the objectives to be achieved, or at least satisfies the stakeholders who shall approve the change.

The following measurements and metrics shall provide us with the following:

As-Is Models

- A benchmark set of measurements to compare current process performance with potential process performance improvements.
- A set of measurements that can be used to identify areas that should be improved, i.e. analysis of delays, bottlenecks or where peaks occur that need to be addressed.

To-Be Models

- A set of measurements that can be used to assess project benefits realisation, i.e. measure the metrics of the process and compare with the measurements that were defined within the To-Be process model prior to improvement.
- A set of measurements that can be used by the business to monitor and compare how the business is working and comparing with how the business should be working.

Measurements and Metrics to be used within Coventry University's EA Modelling

The following section specifies the measurements and metrics that we look to collect for our business process modelling within Coventry University.

Business Process / Business Activity

1. **Time.** The time taken to complete a sub process or an individual activity is recorded and defined within the model's supporting information. In addition to capturing the time taken to complete a sub process or activity, the whole end-to-end time taken to complete the process shall be recorded along with any waiting/delays where interacting with an external party e.g. waiting for a student to respond to a letter may take several days.

As an example of individual vs end to end process timings, it takes approximately 2 minutes to complete a membership application form to join the university sports centre (a single activity), however all of the activities required for the *join the sports centre* process, such as adding details to the Scuba system, writing the access control code to an identification card etc would result in the end to end process taking approximately 8 minutes.

2. **Throughput / Capacity.** We record the number of transactions per hour/day/week for each business process/sub process or activity. In addition to defining capacity and throughput for processes and activities, the number of occurrences of certain events (that trigger a process or activity) may be recorded.

As an example Coventry University issue 13,670 identification cards per year, 1500 for staff members and the remaining split between new students and returning students that require a replacement identification card.

3. **Maximum Throughput / Capacity.** It is useful for certain processes to understand the maximum number of transactions that could be carried out for a certain process or activity with the current people, process and system support. This shall aid the focus of the overall business process improvement, i.e. a small number of transactions may be due to the poor performance of a preceding activity carried out by a separate team.
4. **Number of People.** The number of people that are involved in completing a particular process, sub process or activity are recorded. This measure shall highlight any productivity improvements made with a To-Be process. As an example during enrolment 6 people are required to issue identification cards, whilst 4 people are required to verify overseas student documentation and 4 student ambassadors, 2 ITS members and 1 finance member support the on-line enrolment process carried out at the student centre.
5. **Number of Actors.** The number of actors involved in the process are defined within the models produced. By identifying the number of actors involved within a process the hand-off of work between different actors can be reduced, thus simplifying and potentially speeding up the overall process.
6. **Errors.** The number of incorrectly carried out transactions or incorrectly produced end artifacts are recorded along with the ratio of the errors (e.g. 1 in 100 student ID cards are produced incorrectly). A target reduction can be specified for the To-Be process and used post implementation to measure the success of a new process. Measuring errors can be performed by speaking with the people who carry out the process, conducting a survey with the end recipients of the process, by understanding the number of complaints received, or perhaps running a report on a system to identify errors/inconsistencies.
7. **Environmental.** The following environmental measures are used to monitor environmental improvements that can be made to processes and systems within Coventry University.
 - a. Materials such as paper generated from printing and photocopying
 - b. Energy such as the number of desktop PC's or other devices used to support a process.
 - c. Maintenance and support costs involved with the systems/devices or technology.

3.3.11. Business Process Analysis

Naming Conventions

Processes: We would recommend that a verb, noun, naming convention is adopted. Processes are actions that are carried out, this improves the communication of the process to reviewers. It therefore makes sense to describe the process firstly with the action being carried out (the verb) and what the action is being carried out on (the noun) as seen in the example in the diagram below, with Send being the Verb and Withdrawal Letter being the Verb.

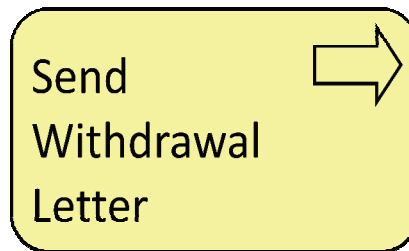


Diagram of the Verb, Noun Business Process Naming Convention

A few examples from our modelling include Create (verb) Assignment (noun) and Issue (verb) Identification Card (noun).

By adopting this naming convention it is clearer to readers what action is being carried out and to what entity and therefore the diagram becomes clearer and more explicit.

Business Process Documentation

As we stated earlier in the document we are linking our detailed business process models to our EA models so that the full details of what is carried out within each process included on the EA diagram can be viewed. However our business process documentation is not limited to a collection of business process models, we are creating documents that contain the objectives of the process, an overview of the current process, the actors involved and their role along with the costs incurred, for both the as-is and to-be models.

3.4. Modelling The Business Layer With ArchiMate

Intro: The following section specifies the ArchiMate modelling standards that were discussed within this report, the following section specifies our tailoring of the ArchiMate EA language and what was finally agreed within the project team for creating EA models.

The business layer specifies the organisational behaviour being carried out within Coventry University to fulfil the goals of its customers and students (these goals are known as business services within the ArchiMate modelling language). The business layer modelling that we shall carry out comprises of the following objects: Events, Processes, Activities, Actors, Roles, Functions, and Business Services, all of which are defined further in a later section).

3.4.1. Business Model Objects

The following section contains a definition of each of the business objects used within the business layer modelling at Coventry University. In addition to the definition of each business object used the section specifies the purpose of modelling the object and specifies the tailoring of the ArchiMate modelling language.

1. Events

An event is a something that happens (or you expect to, but does not happen) that means we need to respond in some way, events will trigger a Coventry University process or activity. The following types of events shall be captured and included within our EA modelling:

External Event: An external event can originate from an external party (e.g. Student)

Internal Event: An internal event can originate from an internal person (Lecturer) or from an internal process within Coventry University that generates an event (entering exam results, is an event that may require a process to inform students or publish results).

Timed-based Event: An event can occur at a set/scheduled time, i.e. a weekly, monthly or even annual event, such as student enrolment.

Non-Event: A non-event is where an expected event does not occur, i.e. nothing happens. An example of a non-event would be if a student is expected to return or respond to a letter regarding issues with course fee payment but does not, with this scenario we would still need to address the fact that no response has been received by issuing a further letter or preventing the student from enrolment.

2. Business Service

A business service is offered by Coventry University to its customers and students; a business service is an offering that the customer or student wants or needs to make use of, i.e. a business service is often, but not always, something of value.

An example of a business service would be document printing service, this is a service that Coventry University offers to staff or students, fulfilled by internal processes and systems. Printing a document is something that a student wants and needs to make use of during their course.

A business service is realised (fulfilled by) by a business process or function.

3. Processes  

A process describes a set of activities carried out within Coventry University to fulfil a business service/s used by its customers or students, or produces an output that is used by a proceeding process/sub-process. A process is triggered by an event or the completion of another process, a process can directly fulfil a key business service that is used by an internal or external actor, such as a lecturer or student.

By identifying the processes that are used to fulfil a business service, it may be possible to identify business process improvements or system application changes that could reduce the cost of a process or increase the service levels offered to students.

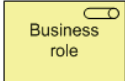

4. Functions  

Business functions carryout processes and activities through one or more roles, a business function is often a department of people with differing roles (e.g. finance is a department with specialist roles such as Credit Control, Financial Reporting and Management Accounting etc). The processes and activities carried out can be grouped within the functions that carry them out.

5. Actors  

An actor is usually a person, team or organisation that interacts directly with the business as a recipient of or participant in a Coventry University process. They may trigger an event that the business needs to respond to with a business process, they may utilise a business service that is offered or they may participate in a business process/activity carried out within Coventry University.

By identifying the Actors that interact with our business processes, activities and services, it may be possible to identify organisational structure, business process and business process collaboration improvements that can be made within Coventry University.

6. Roles  

An actor shall play a role within the organisation as a participant in the process; the role describes their participation in the process, e.g. for issuing student identification cards, the role that the registry team play is of card issuer. NB an Actor can have many roles within Coventry University; the actual role played by the actor in a particular scenario is what is being described.

7. Representation 

The *representation* of a business object specifies the form that information exists in, i.e. information that can live in a document, PDF, ASCii file, as an example an invoice sent to a student is represented in the form of a paper invoice bill.

8. Business Interface  

A business interface is used for a business role or actor to access a service, for example a student accessing library services via a website, via email enquiries, phone enquires or in person. A business interface could be a website, fax, phone call, letter etc, are we concerned within the interface channel.

9. Product 

A product business object is the aggregation (collection) of business services which is offered as a whole. Products that we've identified so far within our modelling include the sports centre membership.

3.4.2. Out of Scope ArchiMate Business Objects

It is suggested that the following ArchiMate business objects shall not **currently** be used within the EA modelling undertaken by Coventry University. The inclusion of the following objects adds little/no value to Coventry University's EA models, i.e. inclusion of the object does not directly meet the objectives of our modelling. The inclusion of the objects would also add unnecessary complexity to the models produced.

The purpose of tailoring, especially removing objects from the ArchiMate language is to simplify the models produced without compromising the value we gain from modelling. Tailoring ArchiMate for use within Coventry University should make it easier to visualise, analyse and communicate using the EA model.

1. Meaning 

Illustrating the *meaning* business object is intended to reveal the value that an object has from a particular actor's point of view or in a particular context. *Meaning* adds value to a diagram where external actors/internal actors have a different understanding or value of a business function or service.

2. Value 

The value business object illustrates the worth or usefulness that a business service holds for a particular actor (usually an external actor such as a student). The value is often implicit from the description of a service what value is held by associated actors, for this reason it is recommended that this business object is omitted from Coventry University's EA modelling.

3. Activities

An activity (included within early version of ArchiMate but not version 1.0 onwards) is a collection of individual tasks that are carried out by one person and/or system at one-point in time. Activities shall only be contained within the business process modelling carried out at Coventry University. Activities are deemed too low a level for Enterprise Architecture modelling (even though they exist within the Archi tool).

4. Contract

A contract business object is used within organisations where formal contracts are agreed with clients (finance, insurance, legal etc) and also with informal contracts, such as service level agreements with suppliers.

5. Business Object

Business object typically illustrates types of information that is accessed by a business process, function or actor. An example of a business object maybe a service level agreement with a supplier, or a set of information regarding a student.

6. Business Interaction

Business interaction is a business process or function that is carried out by more than one role in collaboration; an interaction can be assigned to collaboration

3.5. EA Application Layer

3.5.1. Introduction

The following sections describe how we chose to model the application layer our enterprise architecture.

Modelling the application domain was an area that we felt more confident with within the CU EA team, mainly because IT services provided the bulk of the application components that are used in the business domain and we were very aware of each of them.

3.5.2. Modelling Application Components and Services

We started our modelling top down, i.e. we modelled the business layer and then moved onto the application layer supporting the business domain. When modelling the as-is EA we found it more logical to identify and create the application components that were used to support the business processes, before adding the services that the application provided to each corresponding business process and then the groups of data that were used by each application component to provide the application service.

When creating the to-be models we have found that the best approach is to identify the application services that are needed to support business processes, this then provides you with the 'what' is required from your application layer before you address the 'how' they shall be fulfilled, i.e. the application components, data stores and interfaces that are required to provide each service.

From analysing the application services that are required along with viewing your full as-is EA model it can be easy to identify applications that offer similar services and therefore this can be the first step in investigating the feasibility of reusing an application component to provide the required service.

This analysis can also lead you to a leaner enterprise architecture with systems providing specific functionality to all business process that require them, removing the duplication of services that are being provided by multiple applications.

We have found within the scope of our EA modelling several application components and indeed several full systems (i.e. application components, interfaces and data stores provided by a dedicated technology layer) providing similar application services. From being able to easily see this on our EA models we shall be able to create a much leaner EA model with single applications providing single application services that can be shared across our business processes. This shall further ensure that information provided by the service is consistent and up-to-date as opposed to several applications providing several versions of the service in an inconsistent manner.

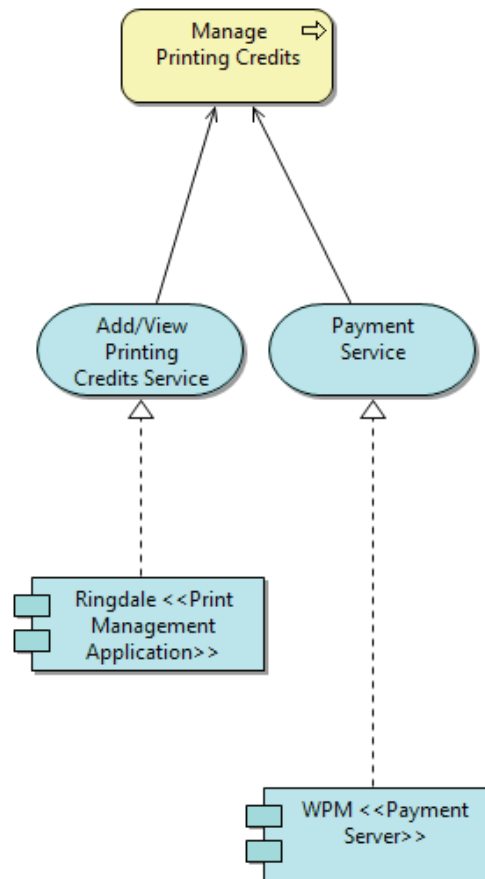


Diagram Of Application Services Provided By Application Components

3.5.3. Modelling Application Interfaces

There are various ways of illustrating the many point to point interfaces that exist between some of our systems sharing common data across the enterprise. We initially mapped these as services that the application provides to other applications (just like an application provides functional services to business processes). The problem with this approach is that the model implies that we have a *service orientated architecture*, which is not the case (although through analysis of our EA models this is something that we shall be moving towards section 6.4.1)

The next option was to use a flow connector between the applications and describe the type of data that the interface provides. This illustrates the direction of the interface (i.e. which application is sending the information to which application) and describes the data being transacted, however it is not clear that the data is being transferred by a piece of functionality, i.e. functionality that extracts data, creates an interface file and transfers to the recipient system. What we finally agreed upon was using the flow connector (illustrating the direction of data transfer) from source application to recipient application but also using the interface object between the two applications to describe that the transfer is via an application interface and also describing the data that the interface transacts.

In addition to this we can also specify which application component provides the interface, using the aggregation connector. So in the example contained within the diagram below we can see that the Staff and Student Details Changes interface is part of the Universe application component. Viewing the example below you can also see that we have included the technology services that are used to enable the interface such as an FTP file transfer service as shown in this example below.

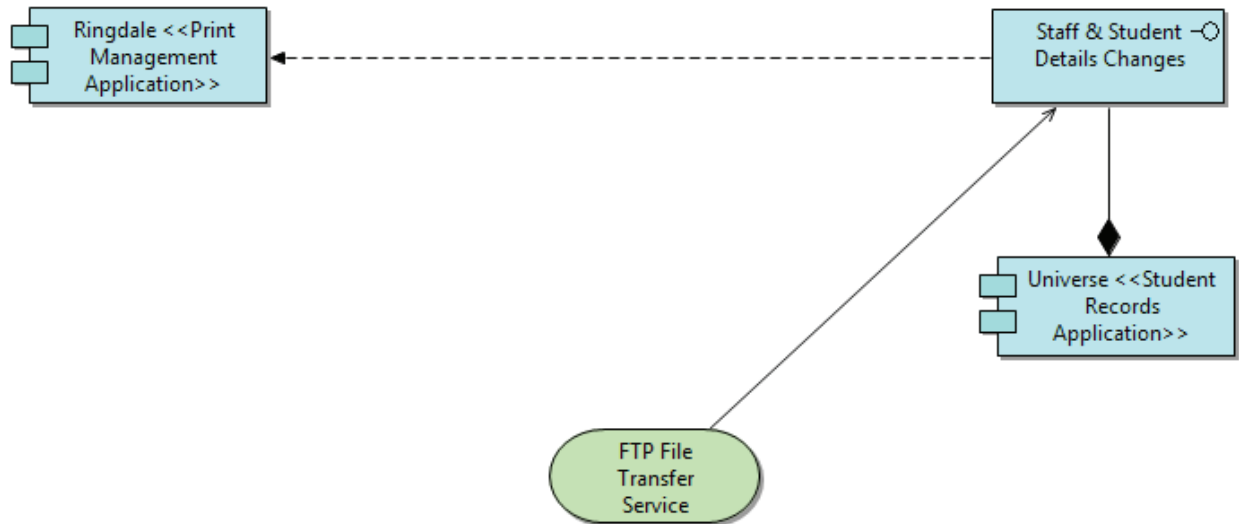


Diagram Illustrating How We Have Chosen To Model Interfaces

3.5.4. Modelling Data and Extending the ArchiMate Language

What we like about the ArchiMate language is that it is flexible and extensible so that we can specify information that adds value to our analysis for system and application improvements. An extension that we have included with our EA modelling is to specify exactly what each application is doing where it accesses a data store.

The ArchiMate language, out of the box, states that you should use the access connector to specify that an application accesses a particular data store in some way. We wanted to take this a little further so hand ave added some text to each connector that states whether an application creates a record within a particular set of data, just reads the data and uses it in some way or updates/deletes records within the data store (i.e. CRUD analysis), see example in the diagram below. This extension to the ArchiMate language has allowed our analysis to determine which applications should be the master source of a particular set and therefore effectively manage our data architecture.

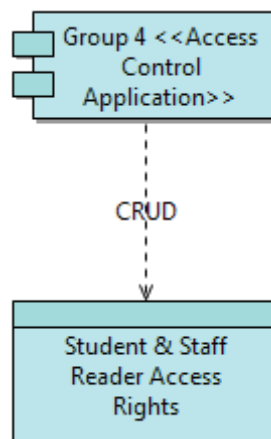


Diagram: Illustration of extending the access relationship to specify what actions an application component carries out on a set of data

Adding relationship descriptions to the relationship connectors helped the understanding within the Coventry University IS team early on with adopting the ArchiMate language, e.g. an actor plays a role, a system fulfils an application component, an application component access data etc. As there was no culture of ArchiMate modelling or UML (which ArchiMate borrows heavily from) within Coventry University, therefore the subtleties in the ArchiMate language, i.e. the relationship connectors used to describe the model were not understood.

To combat this, we described the type of relationship connector by adding the ArchiMate connector name for each relationship on our diagram. Once we have established a cultural understanding of the ArchiMate language within Coventry University IS, we reverted to using ArchiMate out of the box.

3.5.5. Naming Conventions

Not strictly an extension of the ArchiMate language, but an important addition that is not detailed within the ArchiMate specification is the naming conventions that should be applied to the elements of an EA diagram.

We have listed the more important naming conventions that should be considered, and we recommended adopted, below:

Application Components: In addition to naming the application component, we have felt that it is useful to describe the type of application that has been modelled, just by stating the name of the application can be of little value to someone who is unfamiliar with the application. For instance, at Coventry University our student records system is called Universe, this is an application component that appears on many of our EA diagrams, to readers of the diagrams outside of our university the application component Universe is meaningless. We have therefore decided to include the type of application within the naming convention, to represent this we have used the stereotype notation that is used within UML 2.0. The example in the diagram below states the name of the application (Universe) and the type of application that it is (Student Records System).

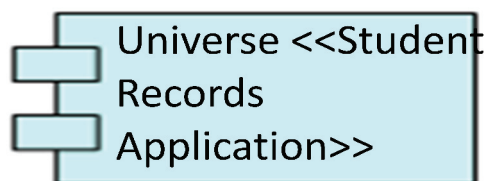


Diagram of an Application Component with our Stereotype Naming Convention

We have tried to use generic terms for the stereo type of the application on our EA diagrams, examples of these stereotypes would include: CRM Application, Payroll Application, Content Management System, Collaboration System etc.

3.5.6. SOA and Removal of Point to Point Interfaces

Another of our objectives to achieve through EA modelling is to exploit the use of service orientated architecture within our applications. This shall enable us to reduce the time and cost of improving in our systems going forward to meet the future needs of Coventry University. One of the key analysis areas that we shall carryout on our completed EA model is how we can make use of services to share data across applications reducing the point to point interfaces that we currently have.

ArchiMate and the Archi tool allow us to model data access application services on the many data objects that we have on our model, from this we shall be able to design these data access services that can easily be reused across future developments without the programming costs and testing overhead of changing point to point interfaces.

3.5.7. Microsoft BizTalk

Due to the commercial off the shelf systems that are used to facilitate the processes in the scope of our enterprise architecture modelling not having a service orientated architecture, we have been unable to add a service to our student records system that provides the student information upon request from each of the commercial systems. Due to this issue we have been unable to implement Microsoft Biztalk that would have been used to integrate our applications and facilitate the service messages between Universe (our student records system) and each of the commercial systems supporting the business process areas, i.e. Library System, Sports Centre System and Access Control System.

3.6. Modelling The Application Layer With ArchiMate

Intro: The following section specifies the ArchiMate modelling standards that were discussed within this report, the following section specifies our tailoring of the ArchiMate EA language and what was finally agreed within the project team for creating EA models.

3.6.1. Application Objects

The modelling to be carried out at the application layer of Coventry University’s EA model shall include the following objects:

- 1. Application Component 

The application component shall be used to illustrate information systems and component applications that are used within Coventry University. These components offer application services through their interfaces and user interfaces (see later).

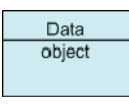
An application component can fulfil application services, access data stores and used by business processes, functions or other application components.

- 2. Application Collaboration 

This object should be used where two or more application components collaborate together to perform some form of functionality and used by a business service or process.

- 3. Application Interface 

The application interface object illustrates how the functionality of a component can be used by other components or application services (i.e. either system interface or user interface). An application interface can be assigned to application services or business services.

- 4. Data Object 

The data object shall be used to illustrate what data is stored this is illustrated as data groups, not individual attributes. Data objects can be used (for example) to represent databases, data records and certain database tables.

- 5. Application Services 

External services (i.e. services of systems functionality) that fulfil a business process either by enabling the users to call upon application functions (i.e. screens, data, processing) or by fulfilling a business process directly (i.e. an automated application service).

NB the naming convention to be used should be a verb ending in ‘ing’. Example application services within Coventry University would be services offered by various components of the Universe system for instance the student record data accessing service or identification card producing service.

3.6.2. Out of Scope ArchiMate Application Objects

The following ArchiMate application objects shall not be used within the EA modelling currently undertaken by Coventry University.

1. Application Function



The application function object represents a group of application components and represents internal functionality that is used to realise a application service. It is to be agreed whether this business object shall be used within Coventry University's EA model.

2. Application Interaction

An application interaction is external behaviour from the perspective of each of the participating components, but the behaviour is internal to the collaboration as a whole. It is yet to be agreed whether this object shall be used within Coventry University's EA modelling.

3. Application Interaction



The object is defined as behaviour performed by the collaboration of two or more components. This object seems quite an advanced notation that may be better to review at a later date, not recommended for initial EA modelling.

3.7. Relationship Connectors

The following section specifies the relationship connectors that shall be used within the Coventry University EA modelling. It should be noted that a description of the relationship shall be added to some of the connectors to aid the team to understand the type of relationship. This explicit naming of the relationship shall remove the need for a full understanding of the ArchiMate language and therefore help the team adopt ArchiMate language quicker.

Dynamic Relationship Connectors

1. Flow 

The flow connector shall be used to illustrate information being transferred from one object to another, i.e. flow of information from a process to an actor. An example of where the flow relationship connector could be used would be during the application process, the offer made to the student (e.g. conditional/unconditional) is information that is transferred to the student.

2. Trigger 

The trigger connector shall be used to illustrate that an object (i.e. a process, activity or service) has been initiated by another object (event, process, activity, service). As an example, the event *Student Accepts Conditional Offer* will initiate the process *Admissions*, therefore the event has triggered some behaviour within the admissions process.

Structural Relationship Connectors

3. Access 

The access connector shall be used to illustrate that an object has a relationship to retrieve or update another object for information, i.e. an object is accessed by another for information. As an example the application service *ID Cards* on the Universe system accesses the *Student Records Database* to retrieve and update student information.

4. Used By 

The used by connector shall be used to illustrate that an object has a relationship to use another object in some way, i.e. the information or behaviour of an object is used by another. As an example the application service *ID Cards* on the Universe system is used by *the issue student ID card process* to retrieve and view student information and also to communicate with the printer to print the card.

5. Realisation 

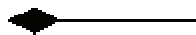
The realisation connector shall be used to illustrate that an object fulfils another object, i.e. a the behaviour of an object is only possible because of the use/interaction of another object. As an example the application service that generates a student's email address is fulfilled by the Universe system.



6. Aggregation

The aggregation connector shall be used to illustrate that an object is in some way made-up of one or more other objects, i.e. it exists as a collection/group of objects, the connector illustrates the objects associated within the collection. As an example a the enrolment process aggregates several sub-processes such as Enrol On-Line, Pay Fees, Issue Student ID Cards etc.

It should be noted that aggregation can also be illustrated by grouping the collection of objects together, it is to be agreed which is the method to be adopted.



7. Composition

The composition connects shall be used to illustrate that an object is in some way consists of several other objects, i.e. it consists of several other objects and only exists due to these other objects. This relationship is very similar to the Aggregation relationship, however an object that composes of other objects can only belong to one group with a composition relationship, e.g. a student's personal details can only belong to the student records database.



8. Assignment

The assignment connector shall be used to illustrate associations between active objects and objects of behaviour that they have been performed by them, for example a business role *Exam Marker*, performs the processes *Grade Papers* and *Submit Student Grades*, the assignment connector would be used in this exam to highlight the link between the role and processes.

9. Association

The association connector is a generic one that illustrates relationships that exist between objects that cannot be described using any of the other relationship connectors. Associations are an extensible technique of the ArchiMate modelling language and may be used within Coventry University's EA modelling.

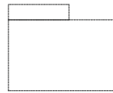
3.7.1. Other Relationship Connectors

10. Specialisation



The specialisation relationship connector shall be used to illustrate generalised relationships, i.e. where a generalisation is being made or for objects that are fundamentally the same but have subtle differences. An example of a specialisation relationship would be to illustrate that a business service *Student Services* is a generalisation for *Library Services* and *Sports Centre Services*.

11. Groups



The groups object shall be used to contain objects that are being described at the same layer/viewpoint (i.e. business layer, application layer, technology layer or even sub groups such as internal/externally hosted systems, data objects etc). The use of groups helps diagrams become cleaner and more intuitive to read.

12. Junctions



Junctions shall be used to illustrate alternative paths that could be followed for processes or activities. As an example an enrolling student may be released from admissions before enrolling on-line and collecting their student ID Card, for an overseas student an alternative path could exist where they must have their documentation and visa verified before enrolling on-line.

NB junctions shall only be used within the business process modelling that is to be carried out and shall not be contained with any EA models.

3.8. EA Technology Layer

3.8.1. Modelling a Virtualised Environment

One of the decisions that we made early on with our modelling was how we would model the technology layer of our EA model. At Coventry University we have several applications that run on physical technology for instance a server box that runs some operating software, database software and perhaps some specialist software e.g. Microsoft clustering services or FTP software. In addition to the applications that run on physical server boxes, we have many applications that use virtual servers, the operating software and other required technology software is provided by a server farm and the data stored on a SAN (Storage Array Network).

Our discussions therefore were based around whether we should model the physical or the logical (virtual) technology environments, or perhaps both. We looked at the objectives that we wanted to fulfil from our EA model, which included using the model as a tool for change analysis and to evaluate the scope of work required when amending the model to a new proposed to-be model. For this reason we felt that we would need to represent both the physical and the virtual technology that was used by the application layer, otherwise we could not fully understand the impact of changes on the technology layer where the changes were initiated at the application layer.

Using the Archi tool (and therefore ArchiMate EA language) we are modelling all of the physical technology used to support our application layer and specifying all of the virtual technology services that are realised from our server farm and SAN, we can then add the dependencies that our application layer has on either physical technology or a particular virtual service (such as an Active Directory service or Oracle Data Service).

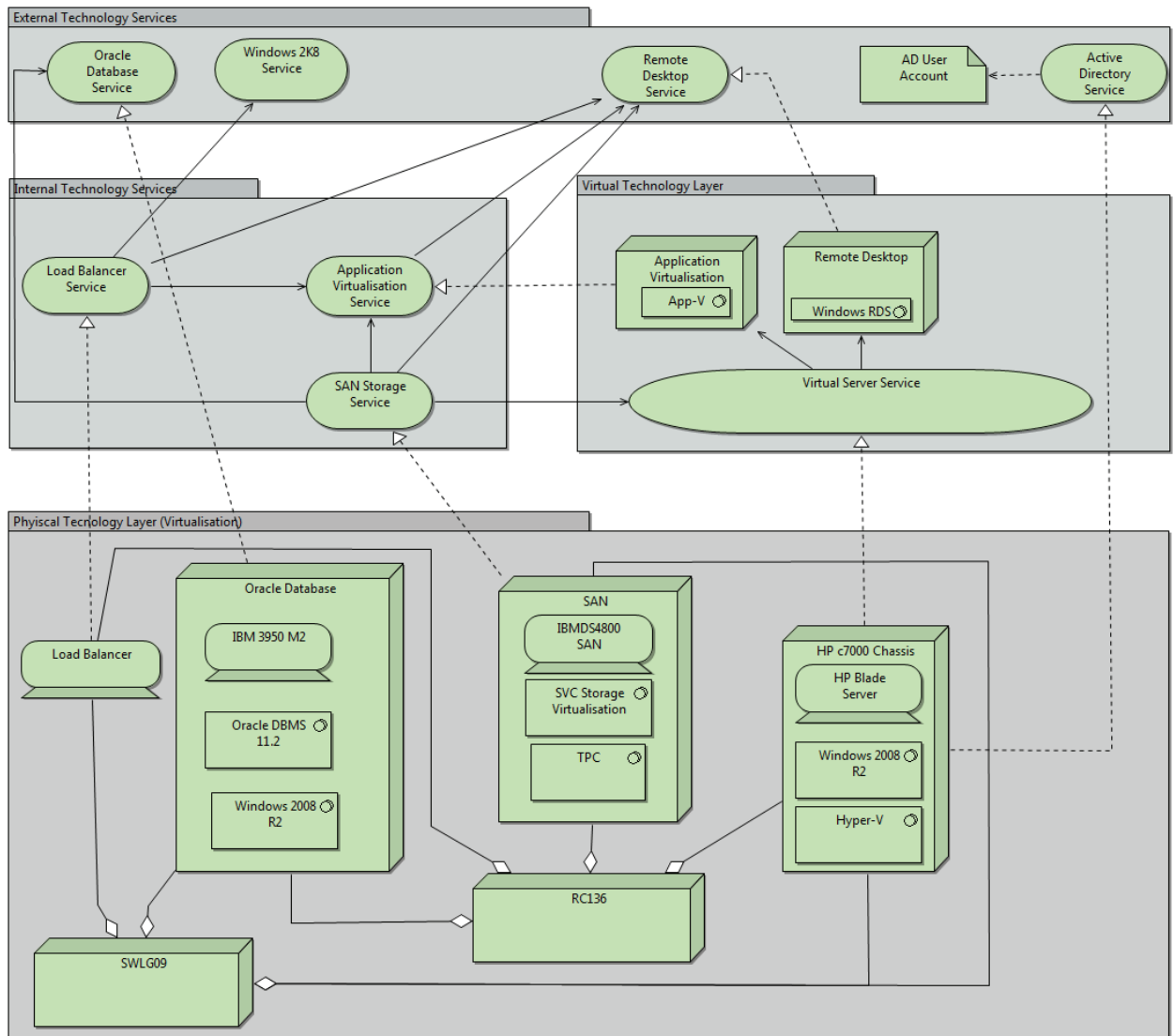


Diagram Illustrating How Virtualised Environment Was Modelled With Services

3.8.2. Modelling Naming Standards

We looked at the naming standards that should be applied within the technology layer, in the previous layers we adopted a simple verb and noun convention for business processes and application name and application stereotype for application components. Within the technology layer much greater value can be benefited from ensuring the correct naming standards are applied. We have tried several naming standards within the technology layer but have agreed upon and would recommend the following:

System Software: Specifying the name of a system software technology object, we discussed and agreed the notation to use. We have chosen to specify each system software object by firstly stating the vendor of the software (e.g. Microsoft or Oracle), followed by the product name (e.g. SharePoint), followed by the version (e.g. 2007). This naming convention helps with the configuration management of the technology and helps us identify where multiple version of the same software product are being used to provide services to differing application components. This has helped us identify cost savings by moving certain applications onto newer version of a software product that exists within CU, reducing maintenance overhead.



Diagram of System Software Naming Convention

Software: Vendor Name, Product Name and Version, e.g. Microsoft, SharePoint 2007.

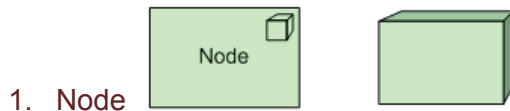
The benefits of using this standard is that you can see your reliance on certain vendors far easier, if you have a consultation meeting with the vendor it is useful to pull up a view of the EA model and use as a basis for discussing future requirements from the vendor, or to assess changes where a vendor informs you a product or even product version shall no longer be supported.

3.9. Modelling The Technology Layer With ArchiMate

Intro: The following section specifies the ArchiMate modelling standards that were discussed within this report, the following section specifies our tailoring of the ArchiMate EA language and what was finally agreed within the project team for creating EA models.

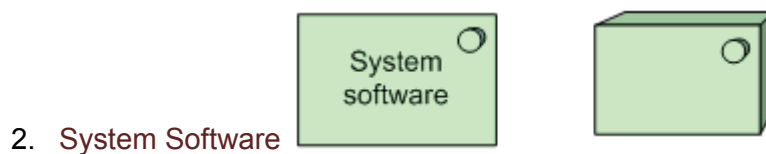
3.9.1. Technology Objects

The modelling to be carried out at the application layer of Coventry University’s EA model shall include the following objects:



Two types of Node objects can be used within ArchiMate, the first type of node shall be used to represent physical technology used within Coventry University’s systems. Physical technology such as database servers, application servers (e.g. IBM Blade Servers) shall be represented. The second type represented by nodes is the physical software that runs on the technology for example UNIX operating system, Oracle 11 database software or Microsoft Exchange Mail Server software.

NB This second type of node shall be modelled using the System Software object with Coventry University EA modelling.



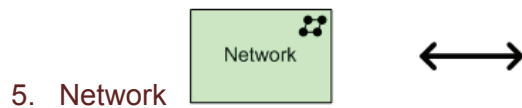
The system software object is very similar to a node (i.e. a specialisation), however it shall be used within the Coventry University EA modelling to represent the various types of system software and operating systems that existing within our organisation. An example of system software would be an Oracle Database.



A device is a special type of node (specialisation), it is a physical device that can be used to communicate with other objects in the technology or application layers of our EA model or it can be used to run specialist software. An example of a device would be a printer, card reader or PC workstation.



The object shall be used to represent a point of access, e.g. enabling a system to use data from another system via a point to point interface or enabling the functionality of a node to be accessed by other nodes or by applications, e.g. the universe system accessing the SQL database (which would be the physical server and SQL software allowing access to the data).



This Network object shall represent connections between two or more devices or nodes; it is an enabler of a communication path between technology devices. A network can be wireless or local or wide area, no differentiation is made with the object. It is best practice to specify the bandwidth of the connection between devices, this can help with improvement analysis, however this has currently not been agreed.



An infrastructure service maybe used by application components in the application layer or nodes within the technology layer to fulfil an need or request. Examples would be storage and retrieval services, data transfer/messaging, back-up services, file archiving etc.

3.9.2. Out of Scope ArchiMate Technology Objects

It is suggested that the following ArchiMate technology objects shall not be used within the EA modelling undertaken by Coventry University.



Communication paths are a collection of one or more networks that enable nodes to exchange data between themselves.



An artifact is a physical piece of information that is used at the technology layer, examples include documents, files, data messages, database tables etc.

3.10. EA Views

3.10.1. Creating Views to Meet Specific Audience

We like the different viewpoints that can be created from a single EA model with the ArchiMate language. EA diagrams cross the business, application and technology boundaries and because of this many different stakeholders are concerned with them and are consulted when creating potential To-Be models. Rather than show a whole EA diagram we like the ability to create tailored views specifying only the information that a particular stakeholder or group of stakeholders are concerned with. This makes it much easier for the stakeholders to understand the diagram and we spend far less time explaining the whole diagram to stakeholders regardless of the specific areas that we wish to discuss.

We have found when speaking to the various stakeholders that are involved with the Smartcard project (and other projects) that spending a few minutes to create a tailored view of the enterprise architecture that is of relevance.

An overall EA model has been created (see next section), however from this model certain viewpoints have been created. A viewpoint provides the reader with a view of the EA from a particular perspective, providing them with only the information they are concerned with. For example a business process improvement analyst may only be concerned with a view of the processes, actors, roles and functions along with their relationships. An SOA architect may only be concerned with the data and data access services/interfaces used by the university's systems.

3.10.2. Integrated Model

Integrated EA Model and Analysis Carried Out

We initially stated creating Enterprise Architecture diagrams for specific domains, such as the business processes, supporting applications and technology that provides the applications for the university's library, sports centre and building access control. We have recently integrated each of our EA models together to create a single view. Now that we have a single view the analysis that we can carry out at each layer allows us to introduce efficiencies across our business.

From the single view we have been able to see duplicate and similar data sets that are used by separate processes and applications, business domains that are carrying out similar processes. We have seen the power of a single view EA model (although still focussing on key areas of the university and not all the processes, applications and technology across the university) to become more efficient with our processes, the use of applications and specific functions within applications that can be standardised to provide us with greater efficiencies. We have identified many potential improvements that can be made and shall explore many of these further.

A copy of our integrated EA model can be viewed in the appendix of this document.

3.11. Promoting ArchiMate within IT Services

3.11.1. Introduction Workshop

Towards the end of 2010 we ran a workshop to various members of the ITS team. The purpose of the workshop was to inform the ITS members of what EA modelling is (and what it is not), the benefits that we perceived we may get from using such a model and an overview of the ArchiMate language and the models that we have produced so far.

Many of the members had limited knowledge of Enterprise Architecture prior to the workshop, however it was good to hear that all members became interested in EA and felt that the concept of EA modelling would deliver benefits to Coventry University and their IT Services role. The attendees could see the benefits of using EA modelling early into the walkthrough of our initial diagrams; they liked the clarity of how the information was presented through a visual diagram, as opposed to a large document that would take longer to review. IT Services could see the benefits for evaluating work required in their areas as well as a tool to help them with change analysis. Some concerns were raised during the workshop that we are resolving prior to rolling out EA across all IT projects, these concerns centred around keeping the model up-to-date and the control mechanism of updating the model. This is a process and policy that we're looking to agree shortly.

3.11.2. Resolving Issues from Workshop

Intro: There were several issues raised during the workshop that presented a problem in how we roll-out EA, a solution was put in place for each issue, summarised below.

Who is responsible for updating the model

We had decided to create a master EA model that would be updated with any additions or changes to the business processes, applications or technology at CU. An issue that was identified was the who would be responsible for updating the EA model.

There were a few solutions that we could have put in place. Should this be one person who would have to know about all the changes being made across each of the three layers. Should this be 3 people, perhaps one person per layer who would understand the changes within their specialist domain, e.g. a principle analyst developer would be responsible for the application layer and the server manager would be responsible for the technology layer. The other solution was that several people were responsible for updating the model, to spread the workload across multiple resource so as not to require a full time or part time enterprise architect.

Our agreed solution was that a the project manager/business analyst responsible for the project or piece of work that has been carried out shall be responsible for updating the overall EA model with any changes to the business, application or technology layers. Using a range of people across each project to update the model would potentially lead to inconsistencies and gaps between the hand-off points of each person. To use three people looking at their own domain would require collaboration between the three roles, we do not believe that the modelling of EA can be carried out in isolation within each layer. For this solution to work would require many collaboration meetings that would add additional time to the process.

How will we ensure that our Model is Up-To-Date

An issue was raised on how we would ensure that the master EA model would be up-to-date, i.e. that it was an accurate representation of our enterprise architecture? With so many changes being carried out from various projects (some IT services ran, others not), as soon as our model was out-of-date, the value it would provide us and the accuracy of information that we would use for our various analysis would be compromised.

Our agreed solution for this was to include the sign-off of updating our EA model with the release management process for updating any business processes, applications or technology. Whilst all application and technology changes would be known by IT Services, there may be some business process and process structure changes (e.g. actors, roles and collaborations) that IT Services would not be aware of. For these changes we are launching the EA model into the business, using business analysts to regularly speak with key stakeholders and highlight the importance of our EA model to us and also how being up-to-date is essential to realise the full benefits.

3.11.3. New skills developed – what and how

We have come along way in the past 12 months with our EA journey. Initially our experience was very limited, we had not created any business, software engineering or system modelling let alone EA models using the ArchiMate language. We are now using EA on many projects and imminently rolling our EA to all projects, ensuring that the creation of an as-is model, the analysis and creation of a to-be model is carried out for all projects early-on.

We would now consider ourselves leading the way with EA within higher education institutions, having fully understood how we can leverage the benefits of EA (see section 6), agreed a framework and methodology to realise our to-be EA vision (see section 5) and also having tailored the ArchiMate language (see section 3) to maximise its value in describing our EA. Along this journey many of us have developed many new skills, a summary of them is detailed below:

Modelling skills: There is an art to creating and amending huge EA models like the one included in section 13.4, creating complex models that contain many objects in a manner that is clear and easy to read was a new skill that we developed over time. Our initial simple EA models were easy to create and manage (i.e. make necessary amendments), however there becomes a point which we believe that everyone shall reach where the model becomes a complex one and the organisation, grouping, positioning and joining of objects (with connectors) becomes a puzzle in its own right.

We are also skilled with business process modelling, understanding the different levels with processes, sub-processes, activities and further the naming conventions and swim lanes to use and ensuring that the process model covers all significant scenarios, i.e. the conditions of where a process scenario may follow a different path.

Benefit realisation focus: We are now collecting measure and metrics of existing processes and IT provision to enable us produce more accurate cost benefit cases within project proposals. We are focussed on applying measures and metrics within our to-be process and EA models and reviewing these measures and metrics post the implementation of the project ensuing that we have achieved what we set out to achieve. Having this focus up-front in the project is useful shaping what is to be delivered.

Enhanced the role of BA from system analysis to business analysis: We are now much more focussed on carrying out business analysis to understand what the business stakeholders really need and not just taking their requests and looking at solutions and how to deliver the project. We are not carrying out more business analysis working with the stakeholders to shape the project and carryout requirements analysis before we even start identifying solutions to the problems to be resolved.

4. The Smartcard Project

Intro: The following section details the Smartcard project and why it was chosen to initially use enterprise architecture to help achieve our future vision.

4.1. Initial steps

The SmartCard project at Coventry University has introduced a new staff and student identification card to the university replacing the previous card. The smart card utilises a microchip within the card that holds staff and student data and can be updated with information using the Salto door reader points².

4.1.1. Smart Card Implementation

The introduction of smart cards impacts many business process areas, proprietary applications and in-house developed applications. The smart card technology provides Coventry University with an improved identification card platform, no longer do we use proximity identification cards that have a radio frequency aerial specifying the unique identification number of the card and therefore staff member or student. The smart card technology utilises a chip that stores a limited set of data about the staff member or student, this therefore provides us with a platform to improve our business processes and the applications and technology that support them to improve student satisfaction and reduce the staff costs in facilitating the processes.

The introduction of smart cards will provide opportunities that shall enable us to improve our processes utilising the improved technology, hence the reason for choosing the scope for our EA analysis. It should be noted that our to-be vision was not limited to just improvements that were possible due to the introduction of the technology, any improvements to the processes, applications or technology that could be made were included in our to-be models.

4.2. Project Scope & EA Opportunity Objectives

For our EA trial and investigation we identified 5 key business areas that could be improved through the introduction of smart cards, each of the areas were impacted by the change to our staff and student identification cards. We didn't exactly know how they could be improved but felt an opportunity existed and that EA analysis would provide the knowledge and solutions.

The five areas that we identified as investigation areas were as follows:

- Creating the staff and student identification cards
- Managing the university access control of buildings and rooms accessed by staff and students using their identification cards.
- Joining Sports Centre and Accessing its facilities
- Utilising the print management system to submit and retrieve document printing
- Borrowing books and media from the university library

² The Salto system provides much of the university's access control to buildings and rooms along with a set of 30 reader swipe points across the campus where students can register their attendance of being on-site.

4.2.1. The EA Opportunity

Whilst each of the business processes specified in the scope section would be impacted with the introduction of smart cards, we wanted to utilise our enterprise architecture analysis to do more than just create the existing EA model (as-is) and create a target model (to-be), we wanted to maximise the opportunity to deliver many benefits. Our objectives for improving the business areas included:

Coventry University used Enterprise Architecture modelling and Business Process modelling with the aim of identifying improvements that can be made to business processes and both internal and external systems. The improvements improved fulfil process efficiency, improve the university's service offering to students and customers along with reducing process and system costs within the organisation.

When identifying how we should look to investigate and trial the use of enterprise architecture within Coventry University we agreed that the analysis should ideally produce improved business processes and services (student satisfaction and reduced staffing costs of facilitating the processes) along with reducing the ITS (Information Technology Services) costs or other procurement resource costs.

We agreed that the ITS cost reduction should include the ITS resource costs, physical technology costs of providing the applications, i.e. the hardware, hosting and specialist software required to support the applications such as operating software and middleware.

The objectives that we set out to achieve are listed below:

- Introduce business process improvements through the analysis of the business process models and remove any duplicate or non-value adding processes or process activities where possible.

Explicitly the business process improvement (in financial terms) was to reduce the staffing costs of facilitating each of the processes, i.e., a head count reduction.

- Improve the student experience by reducing the time taken by students to carryout the processes and making the experience a more convenient one.
- Identify and exploit service orientated architecture opportunities within internal and external systems by analysing the as-is EA model, thus reducing the Its overhead of managing point to point interfaces of data between the many systems that were required to support the processes.
- Reduce the technology costs required to provide the ITS applications that would support the business processes.
- Establish the benefit of EA to support an organisational transformation and especially help reduce resistance to change

4.2.2. Smartcard Creation and Issue (Overview)

The analysis of improving our business processes and services, applications and technology to fulfil our EA objectives is fully documented in appendix 3 (section 9.2).

Creating and issuing identification cards to students is carried out in bulk during the enrolment periods that we have at CU, particularly end of September / early October. This process is part of the enrolment process (and is actually therefore a sub process) that is carried out by the central registry team with support from temporary staff.

The process requires validation of that the student is who they claim to be, before taking a picture of the student if it is their first enrolment (or a new picture is required due to perhaps change of appearance). Once this has been performed the card is created using an application service provided by the Universe application component using a thermal printing device.

Our aim here was to reduce the costs of the cards and reduce the time experienced by students in obtaining their card and also the staff time in carrying out the process.

The to-be model that we have adopted has reduced the card costs. With the introduction of the new Salto access control system and door readers (i.e. the technology), more suppliers exist offering a compatible smart card, as opposed to the previous system where only one card supplier could be identified with high purchase costs. We have also produced an application service that enables students to load up an image of themselves from an existing photograph, which validates the image is of an appropriate quality and automatically crops the image so that it can be used for printing the new smart cards.

Total Savings - **TBD**

University Staff Time/Cost Savings:

Student Time Saving:

Consumables:

Hardware:

See appendix 3 (section 9.2) for full details of the EA analysis carried out and the improvements that were introduced to this business process as a result.. The appendix contains the as-is and to-be business processes, measurements, EA models and costs savings achieved.

4.2.3. Managing Access Control (Building and Room Access across the university)

Once a university identification card has been issued to a new or existing member of staff or student we need to ensure that they have access to the buildings and rooms that they require; the current process is a very manual one.

It is worth noting that a manual process exists where new staff members and students are downloaded from the student records system (Universe) onto a USB drive and manually added to the access control system on a daily basis, this is how the access control system is kept up-to-date with new and amended data.

For staff that require access to buildings and rooms the corresponding department notifies the access control team via email, the access controller shall print off the email and then retrieve the member of staff and either assign an existing access right or create a new one and assign, depending upon the buildings and rooms required and also the timings that the access is required for (e.g. a cleaner would need access between 6am and 12pm, however a lecture may require access between 8.30 and 6pm for the same rooms).

For many students, they are automatically assigned the standard building, room and time access, however for many students that require access to certain rooms such as laboratories or computer rooms, an email is sent from the faculty to the access control team for the required access which is manually assigned (as per staff access). It is also worth noting that disabled students requiring specialist access are notified to the access control team via email for manual access configuration.

The to-be EA model that we have adopted removes the need for manually updating the access control system by providing an improvement to our application layer for the process. The biggest staff cost savings come from the introduction of further application layer services (provided by improvement to application components) by automatically assigned the access rights (buildings, rooms and times) using a set of rules to assign the access rights based on the student's faculty, course and disability type and for staff based upon their department, job title and disability type.

Total Savings - TBD
University Staff Time/Cost Savings
Student Time Saving:
Consumables:
Hardware:

See appendix 3, section 9.3 for full details of the EA analysis carried out and the improvements that were introduced to this business process as a result.. The appendix contains the as-is and to-be business processes, measurements, EA models and costs savings achieved.

4.2.4. Sports Centre Membership and Access

The sports centre offers both staff and students the opportunity to join its membership and access all of the facilities that the sports centre has to offer (gym, indoor and outdoor sports facilities such as badminton courts and football pitches). Joining the gym for the first time, or renewing your existing membership (an annual event) is a time consuming process that requires documents to be manually completed and re-keyed into the sports centre's membership and booking application (Scuba).

Upon joining the sports centre a member shall receive an identification card to access the buildings and facilities, there are costs of purchasing the cards and also printing on each card.

The to-be and implemented system utilised application interface of information of students from the master student records system reducing the amount of information to be entered on paper forms by each member, therefore reducing the internal cost of facilitating the process, i.e. reduction in head count. The improvement also ensured that any changes to membership details were updated on a daily basis from the student records system, again reducing staff overheads to manage the changes.

The implemented solution introduced an improved staff and student experience when applying for membership and gaining access to the sports centre facilities. Minimal information is now provided by members and the existing and single identification card can be reused to access the sports centre facilities.

Our redesigned process and the EA model of the applications and technology that supports the to-be vision looked to reduce the amount of time it took members to join or re-join the sports centre and also reduce the staff required to key information into the sports centre application (Scuba). This was fulfilled by using the existing student records system to provide data to Scuba significantly reducing the membership application time and almost eradicating the activity of re-keying the data by university staff.

Another observation that we found through analysis of our business process models was that a separate identification card was used to access the sports centre facilities. We analysed and changed the application and technology to read the new CU smart cards, therefore reducing the costs of purchasing and printing the cards, reducing the process of issuing the separate cards along with improving the student experience of having an identification card that could be used to access as many university facilities as possible.

Total Savings - TBD

University Staff Time/Cost Savings:

Student Time Saving:

Consumables:

Hardware:

See appendix 4 for full details of the EA analysis carried out and the improvements that were introduced to this business process as a result. The appendix contains the as-is and to-be business processes, measurements, EA models and costs savings achieved.

4.2.5. Print Management

Printing documentation at the university using our network of printers offered students a limited number of printing options, this didn't offer the service that students required to optimise their assignment submission in terms of presentation. Retrieving a document that had been submitted to the print management system for printing required students to login to a networked PC to access the print management server controlling the print queue for each printer. Adding printing credits to a student's account required a convoluted and manual process of purchasing money onto a payment card (known as the flexicard) and then the library team debiting the account and manually adding credits to a student's account on the print management system.

This process is an inflexible one that is resource intensive, it is what we call a non-value adding process, i.e. a number of activities are carried out that do not directly fulfil the objective of what is to be achieved by the process, which is to allow students to print documentation (the need to add printing credits is a business policy decision and the method of paying for and adding the credits the non-value adding set of activities).

Our redesigned enterprise architecture was to not only look at the impact and opportunities that using the smart card within the process could offer but to also make improvements that improved the service offering and fulfilled several of our EA principles (see section 5.2) such as removing the non-value adding process and reducing the head count, improving the service and speed of service for students and reducing our technology maintenance expenditure whilst improving our energy efficiency.

The to-be model that we have adopted fulfils these EA principles, it reduces the technology costs, improves the speed of accessing documentation (through logging into a print management print via using the CU identification smart card) and provides a convenient a significantly reduced head count process to add and make a payment for additional printing credits (using a website based facility to add printing credits and make payment). It should be noted that our preferred to-be model to adopt during the analysis carried out utilised a payment facility using the smart card, i.e. using the smart card for cashless trading. Due to budget and timescale constraints the model was not adopted, however this is included in the future to-be model that we hope to adopt within the next 3 years.

4.2.6. Borrowing Books and Media from the Library

Students at Coventry University have access to the library and its facilities. The main and probably the most important use is the ability to be able to access books for their studies.

A student will need to use their ID card in order to loan, renew, return books and pay fines if any incurred.

There are small changes between the As-Is and the To-Be EA models in terms of software and hardware as the fundamental process remains the same. The supplier for the handheld device to take card payments with has changed, and there have been upgrades of servers in the technology layer.

The main improvements have been the actual processes becoming more automated, thus saving on staff time and costs. The kiosks will allow the user to loan, renew books and there is a book hopper where all books are returned, and the books are also sorted into categories, again saving on staff resource.

Fines can be paid by cards also alleviates the problem of dealing with cash, although cash payments can still be made.

There is a cultural change in terms of students using the on-line catalogue to find and/or reserve books and this can be done from any location as long there is access to the internet.

This can be seen more clearly in the As-Is and the To-Be process flow diagrams.

Overall the library processes have become more automated and quicker and as a result, less reliance for a need on staff.

Total Savings - **TBD**

University Staff Time/Cost Savings

Student Time Saving:

Consumables:

Hardware:

See appendix 3, section 9.3 for full details of the EA analysis carried out and the improvements that were introduced to this business process as a result. The appendix contains the as-is and to-be business processes, measurements, EA models and costs savings achieved.

5. Governance

5.1. EA Governance Principles Adopted

5.2. Principles Adopted

The following section describes some of the EA principles that have been agreed and now been applied within all of the future project work that we undertake within IT Services to help ensure that our future EA to-be models are aligned with our EA vision that has been derived from our IT strategy.

5.2.1. Reduce Costs of Non-Value-Adding Processes and Resources

There are many processes within our university that are carried out that do not directly add value to the student experience, i.e. the output of the process is not something that a student particularly values.

As an example of some of these processes, producing a student identification card is something that students need to access buildings and facilities. The facilities and buildings directly affect the student experience, however providing a card to enable access is just something that has to happen. Another good example that was within the processes that we looked at was the adding and purchasing of printing credits. The printing of documentation, the facilities, quality of prints, flexibility of options will directly impact the student experience, however purchasing print credits to enable a student to make use of the printing facilities is just a process that has to happen.

With non-value adding processes, we should look to reduce the cost of carrying out the process as well as taking the opportunity to improve the process.

5.2.2. Business Continuity

We are ensuring that we have business continuity within our IT provision at Coventry University, that we have the necessary ability to provide IT services even where issues arise. This requires us to ensure that we have mirrored technology facilities (hardware, operating software and specialist software), load balancing and clustering services for many of our key applications. Enterprise Architecture models provide us with a great visual aid to analyse the key applications and understand what specialist software is required, where the hardware is located and if a mirror is or can be provided. Continual management of this within our EA diagram shall aid our business continuity planning and provision.

5.2.3. Interoperability (SOA), Portability, Scalability and Capacity (Cloud)

We are ensuring that where we design new processes and new EA models that we understand what the model shall need to support within the next 5-7 years, examples of this is the capacity, i.e. from a process perspective, the number of students or the number of transactions that the process shall need to be carried out for. To achieve this we are looking at the process events and the number of times the event is likely to occur in the future.

On our EA models we are looking at the sizes of data that needs to be provided by the technology or the bandwidth, number of connections etc. By adding this information to our to-be EA models we can ensure that project estimations and costs are more accurate and further that the correct to-be model is implemented successfully for the future. We have also speculated that by understanding the capacity information upfront it may be that we can conclude much earlier that a particular to-be model is too costly to implement, saving time on the development project.

Portability is an important principle for developing new technology platforms and especially for purchasing commercial off-the-shelf packages. We shall ensure that packages that we purchase do not tie the process/business service into a particular application or technology. It is acknowledged that there would always be some work required in migrating to another application, however we shall assess the ability to do this and the commercial constraints to ensure that we are not able to move a business service from a particular application or technology.

5.2.4. Reduce Complexity in IT Infrastructure and Reducing Carbon Footprint

We have in the past been guilty of proving over-engineered and inflexible IT provision certainly at an application layer. We are to adopt a principle with all future to-be EA models that we assess and approve that the architecture needs to be as simple as possible in providing the services and providing future flexibility, i.e. changes can be applied without a huge re-write of an application component. Service Orientated Architecture principles that we have discussed within this document that we hope to adopt one day shall certainly help us fulfill this principle.

Reducing carbon footprint is a principle that we are also taking seriously and ensuring that we apply to our IT provision, whether it is more efficient technology (desktops, servers or peripherals), use of less consumables or just the reduction in the amount of technology required (i.e. less desktop pc's or devices through improved capacity).

5.2.5. Service Ownership, Data Ownership, Security and Asset

The enterprise architecture models provide visibility of the business, application and technology services that are made available along with the groups of data that are utilised by applications to provide services to business processes. Having this visibility has made it much easier to have conversations with the corresponding business and IT services stakeholders regarding ownership. When we model a service, for instance a technology service then we identify who owns this service, they instantly become a stakeholder if any changes are to be made to the service. If we are creating a new service then we shall seek an owner for this during the development and on an on-going basis (nb this we have found is often different people).

Taking this opportunity to promote ownership has not been limited to services, we have been promoting ownership with groups of data logical groups of data not physical database tables) and various other assets contained within our EA models.

5.2.6. Technology Alignment with Strategic Standards

One of our technology principles is to ensure that the applications we build and commercial applications that we purchase utilise the strategic technologies that we have chosen. We have recently made a strategic technology choice to develop our applications within the Microsoft .Net framework. Selecting a single technology platform means that we can invest in training and skills within the technology improving our capability in providing complex applications along with ensuring that applications are built on a technology that we believe is scalable for our non-functional (performance, capacity, security etc) and functional (complexity, usability) needs.

6. EA Delivering the Benefits

6.1. EA Assisting With Project Development Cohesion

There are several projects underway at Coventry University many originating from different business departments or faculties. There have been many meetings between each of the project teams, facilitated by the programmes office, to ensure that there is a cohesive design to our development and to ensure that design changes are not agreed solely to fulfil one particular project.

To facilitate the discussions and encourage a cohesive application and technology design for all of our projects we are using enterprise architecture modelling to help with the analysis and design of changes to our current application along with the technology set-up.

We have been able to discuss and identify the correct sources for data that shall be used by each component to fulfil the new application services; this has led to agreeing the architecture for master data sources for each of the data groups.

Through analysing the various to-be EA models we have also found commonality within services that are required across the projects and therefore identified single services that need to be created and not project specific duplications. One of the common pieces of functionality identified from analysing the various to-be EA models is the ability to send SMS messages to students alerting them of unacceptable attendance or non-coursework submission. By analysing the to-be models we were able to ensure that a cohesive design for providing the SMS functionality. By bringing all of the project specific designs together we shall be able to ensure that our enterprise architecture is reusable, can be produced with minimal effort, is scalable and does not introduce any complexities that would stifle future developments.

6.2. Assisting with Speed of Information within Analysis and Design

An issue with so many projects running at the same time is that there can be a resource dependency on certain ITS members for information, this can become a bottleneck. The result is that projects are delayed in obtaining information or resolving technical issues and risks due to the bottleneck on ITS resource for information. With a fully documented EA model this information is readily available to analysts and developers for requirements, analysis and system design quickly, thus reducing the risk of delays for each project.

In addition to making the information readily available the model is providing us with confidence in the accuracy of information we're using to assist with analysis and design and therefore reducing the time required to confirm that information we think is correct is actually correct.

6.3. Analysis (Impact analysis and change assessment)

EA models deliver the best benefits by comparing an as-is EA model with the to-be EA model/s. From analysis of the as-is to to-be models you can very quickly determine the changes to people, structure, business services and processes, suppliers, applications, interfaces, user interfaces, services, data stores, hardware and software, identifying the changes required to implement your to-be model so quickly makes EA models a great impact and change assessment tool.

6.4. Estimation

To-be EA models that are created as part of a project are being used for project estimation and helping us providing more precise estimates, this is very useful and adds value to the selection of a to-be EA model or indeed the whole project or development (many of our projects and developments have several EA models that could be adopted to fulfill the project objectives).

Through analysing an EA model we can identify the stakeholders that need to be brought into the estimation process, we can start to break our estimations down into the differences between the as-is and to-be EA models. This has been particularly rewarding within the technology provision for a project. Often when estimating time and costs of a development, we focus our effort on the application changes required and not necessarily on the technology changes. Using EA firstly forces us to consider this and also enables us to instantly see the impact at a technology level any changes that are made at an application level. Secondly the EA model has forced us to identify supporting systems and suppliers of those systems earlier, hence they can be brought into the estimation process and therefore provide a more precise estimate.

6.4.1. Exploring Service Orientated Architecture Through EA

One area that we have been keen to explore and introduce to Coventry University is a more service orientated architecture to our systems. We have recognised the power of EA modelling to visualise, analyse and identify areas that would provide the greatest efficiency gains within our system.

We have analysed our As-Is EA model and identified several systems that require student information, that is details of new students and updates of amendments to existing student details, such as course changes or whether they have withdrawn. These systems are currently fed the necessary information from our student records system on a daily basis, using system specific interface file. We have identified 4 systems that require the information, we are therefore maintaining 4 separate interface files and further more if change student information on our SRS or the recipient systems required additional information due to a university wide change or a legislation driven change then we have 4 interface file programs to change.

We have explored how we could benefit from a service orientated architecture (SOA) to reduce the maintenance overhead of our IS and increase the speed in which we can adapt to business or legislative driven changes. We have looked at creating service on our student records system that could provide multiple systems with new and updates to student information.

The conclusion of our discussions is that for SOA to have the greatest impact, then the service orientated architecture would need to be developed for both the source and recipient systems. The 4 systems that we have identified requiring student information, currently, do not have an SOA, therefore there is much less value in changing our student records system to an SOA as the benefits cannot be fulfilled at the recipient system end.

The systems currently receive a batch file of student information that is processed overnight ready for system operations during the working day. If we were to change the architecture of these systems to request the student information from our student records system as and when an operation is executed (in real time) then the benefits could be fully realised.

Due to the recipient systems being commercial packages, further discussions would be needed with the vendors to understand their architecture road map and when we could introduce a true service orientated architecture for managing student data for each system. In the mean time we shall explore how we could develop a student data service on our student records system that

could offer operations to retrieve both single student details data (e.g. by a recipient system passing a student ID number or similar unique key attribute) and bulk student details data, e.g. student details for all active students on a certain programme, course, location etc..

The benefits of a service that can provide data for a single student or range of students (based on the recipient system's requirements) would enable us to introduce a service orientated architecture within our student records system and also support future developments that would require single and multiple student details. The drawback here is supporting the 4 commercial packages and the interim. To achieve this we would need to develop 4 additional services that utilise the student data service to obtain the data and also transform the data into the required output format and layout for the recipient system.

We have started some analysis on the work required to achieve this and have identified the documentation artifacts required to support the development. These artifacts consist of a to-be EA model, a service orientated architecture model and a human readable specification for each service in the form of a *service contract* along with a system service contract, such as a *WSDL schema*.

7. Using EA Beyond the Smartcard Project

7.1. Student Footprint Project

A new project has recently started to monitor students various footprint activities to determine if they are engaging with their course. The project is in its early stages but we are using Enterprise Architecture modelling and business process modelling to analyse, define and communicate the scope of the development to be undertaken.

We are scoping and determining high level requirements and key features of the project and using EA to define the processes, application service functions that shall support the new process along with the data sets that shall be required. These models have been a good tool to communicate our initial thoughts to different members of the project, i.e. confirming the actors, roles and processes to the business stakeholders, the application service functions and data to the development team. With subsequent analysis of the application services and data we have identified what can be reused from existing applications functionality, what existing applications and data sets can be built upon to fulfil the high level requirements and from this, communicate the technology requirements we require, such as database requirements, operating systems and other specialist software.

7.2. Working with other HE institutions

7.2.1. ArchiMate Modelling Bash

Earlier this year we held a *ArchiMate modelling bash*, i.e. an ArchiMate conference/workshop with the emphasis on workshop. We had several key speakers sharing their experience of modelling with ArchiMate with all of the attendees; however the bulk of the time during the two day event was a practical hand-on modelling session.

The session was effective at enabling HEI's who were interested in the benefits of EA and perhaps had a little experience of modelling EA, some with ArchiMate, to start creating some models with the support of other HEI's and other commercial organisations that had much more experience at ArchiMate modelling.

The session was also effective at forming a HEI working group sharing further experiences and advise on using ArchiMate. We had worked with Falmouth University in the past helping them, adopt ArchiMate and business process modelling, during the session we had expanded our working party to include Liverpool John Moores, Southampton University, Kings College, Leeds Met and others. On the back of this modelling bash several universities have agreed to make the modelling bash a regular event where we can all get together, share our experience and move forward within our use of EA within our higher education institutions.

8. Tools We Used with Enterprise Architecture

8.1. Evaluation of Archi EA Modelling Tool

Intro: We have been using the Archi tool for many months now to create our Enterprise Architecture model using the ArchiMate EA language, this section summarises our experience.

Using a tool such as Archi to create and manage your enterprise architecture model requires the ability to do many things:

- Draw the diagram
- Publish/communicate the diagram
- Add valuable information to the diagram (thus creating a model)
- Analyse your models

This section is our evaluation Archi from these four key requirements.

Drawing the diagram

To draw the EA diagram we have been using the Archi tool

What we like about the tool:

Object alignment: When arranging objects onto a diagram, the tool provides a *blue cross hair* allowing the user to align objects precisely with other objects. When demonstrating EA models it is important (especially with complex models) that the models are very presentable, the *blue cross hair* within Archi allows for quick and precise arrangement of objects that results in a very presentable EA model.

EA Modelling in Archi is made easier with the use of the group object. This object allows you to create a partial model and then move the partial model around the diagram without having to manually move individual objects. This is particularly useful when EA modelling as these large diagrams evolve over a period of time as and when individual business areas and applications and systems are analysed.

Additional room can be created on the diagram above or to the left of the diagram, this makes it easy to add objects to your diagram by eliminating the need to reorganise all of the diagram's objects which is necessary with other modelling tools.

Many members of the CU EA team have found the magic connector in version 1.5 onwards of the Archi tool very useful, this has helped the selection of the correct connectors and is ideal for other members of our IS team who will be picking up EA modelling in the future.

Archi Improvement Recommendations

- Ability to embed hyperlinks to objects, allowing supporting documentation to be stored with the object and a reader of the diagram can launch the file (e.g. MS Word doc or MS Visio file) to access further supporting information.
- Ability to sort objects that have been used in a model by object type (i.e. all services grouped together) as opposed to a flat alphabetically sorted list.
- Ability to add additional information to an object, such as a further descriptions, locations or add attributes that are stored in a data store.
- Ability to add metrics to an object such as bandwidth, number of people in a team of actors, or process metrics such as the number of transactions carried out per day/week/month etc.
- Ability to move the connection point of a connector arrow head, where an object has many connections the arrow heads can all be connected to the same point, it is therefore difficult to see which type of connectors are connected to the object.

Publishing the diagram

For many stakeholders that we need to publish our EA diagrams to do not have the Archi modelling tool installed, this coupled with the sheer size of some of our EA models prevents us from simply adding the image to MS Word and distributing as part of a document. Publishing the diagram with the latest version of Archi is best exporting the diagram as an image and distributing the image or loading to a collaboration web page.

In the future it would be great to be able to publish the model as a web page where users could navigate the diagram a little easier and view the properties of each object that have been specified.

Adding valuable information to the diagram (thus creating a model)

Using the properties section of each object within Archi you can add all sorts of information a few examples include: hyperlinks to other diagrams (ERD's, Business Process Diagrams) or documents, frequency of events, bandwidth of networks, capacity of databases etc.

8.2. Evaluation of JISC Impact Calculator

Using the JISC InfoNet Impact Calculator

One of our first decisions was to complete the JISC impact assessment calculator for each of the processes that we are changing. By completing the tool for each process rather than at overall project level the true benefits and impacts would be exposed for each process, as opposed to masking the individual impacts/benefits and just viewing an overall analysis, an overall view wouldn't tell us exactly where we had been successful or unsuccessful.

We're currently using the tool to aid the gap analysis of the as-is and to-be processes. The tool has enabled us to focus our efforts on where the greatest benefits can be realised, as each measure and metric is individually very visible once documented in the tool.

In addition to recording measures and metrics we have been using the tool to record the project costs throughout the project, this has been useful to add costs as and when they are paid so no expenditure or resource time is omitted. The tool has also been a good prompt to consider all costs that have been encountered such as office overheads, expenses, travel and not just the expenditure on hardware and software and time taken in improving our processes and applications.

To meet one of our EA modelling objectives, which is to simplify and streamline business processes within Coventry University, we believe that detailed process analysis is required. A constraint of the tool has been that measures and metrics for the as-is and to-be models can only be entered at an overall process level and not at a more granular level, i.e. process activity level. Whilst viewing benefits at an end-to-end process level provides us with benefits across the organisation for the project, it doesn't help with analysis of the as-is model and where improvements can be made.

To achieve this we have analysed all of the individual activities for each process where time could be reduced. So rather than just looking at the end to end time reduction for a process we are focussing our analysis on individual activities, activities such as the manual completion of a form, the entering of this information into a system, validating that the information is correct etc. It has encouraged us to think where time can be saved for each and every activity along with where on the process model our people and time-based measurements should be.

8.2.1. Coventry University Process Improvement Cost Calculator

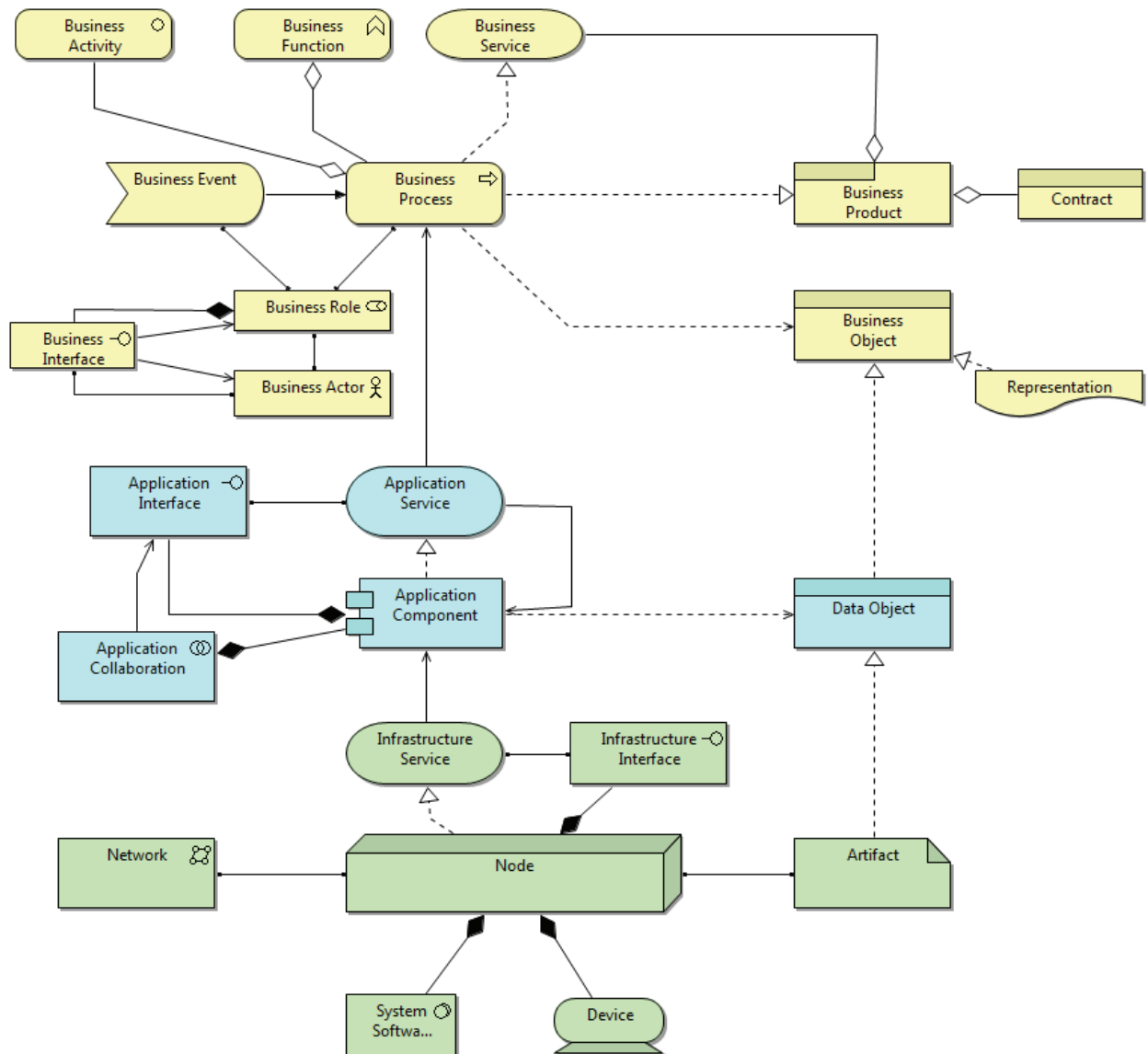
Two of our EA objectives were to reduce the staffing costs involved in facilitating the business processes and also to improve the student satisfaction in receiving the services of the processes. Part of the student satisfaction in receiving the services is the amount of time taken to realise or enable the services, this we found should be measured by the time scales that are incurred with process activities that they must carryout. The staff cost reduction could directly be attributed to the time that was taken by Coventry University staff in facilitating the process activities, we therefore wanted to measure the time taken by both staff and students within the as-is process and create a to-be process that reduced both staff and student involvement, thus realising the EA objectives.

We developed an MS Excel calculator that at an activity level enable us to assess the existing as-is costs and compare the actual time savings of the to-be model for each actor involved. This tool provided us with the ability to model changes between processes, structure, capacity, frequency, bottlenecks at a detailed level. The calculator allowed us to carryout what if scenarios, almost simulations of the impact of peoples time between different to-be models, thus optimising the productivity of a process with our finalised to-be model.

9. Appendix

9.1. Coventry University ArchiMate Meta Model

Intro: The following diagram specifies the ArchiMate meta model that we created and used to determine what objects were to be model and the inter-relationships between them.



9.2. Appendix 2 – Re-engineering CU Smart Card project EA and processes

9.2.1. Appendix 2.1 – Sports Centre Membership and Access EA and processes

Business Process Model & Enterprise Architecture Documentation

Joining the Sports Centre

Introduction

Document Version 1.0, first published version.

This document defines the detailed business processes (at an activity level) for the business processes contained within Coventry University's Enterprise Architecture Model. The document defines the activities carried out for each process along with the following information:

Process

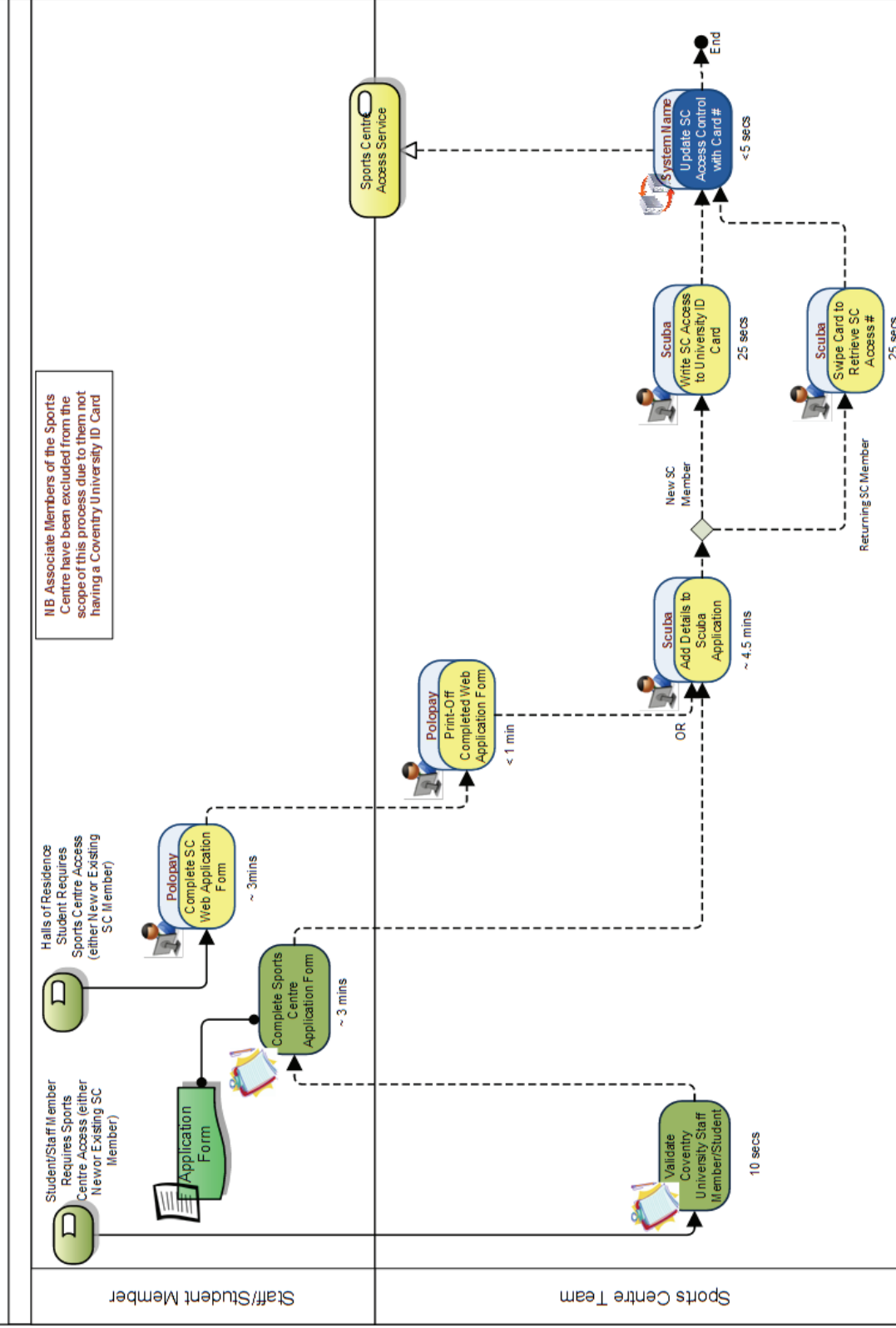
- Objective of the process
- As-Is and To-Be process models
- Description of the process and actors that participate in the process

Measures and Metrics (As-Is model versus the To-Be model)

- Total number of transactions and frequency of transactions
- Peak periods
- Number of actors involved
- Staff and customer timings that are saved along with staff costs
- Environmental metrics (such as paper usage, PC usage and other consumables)

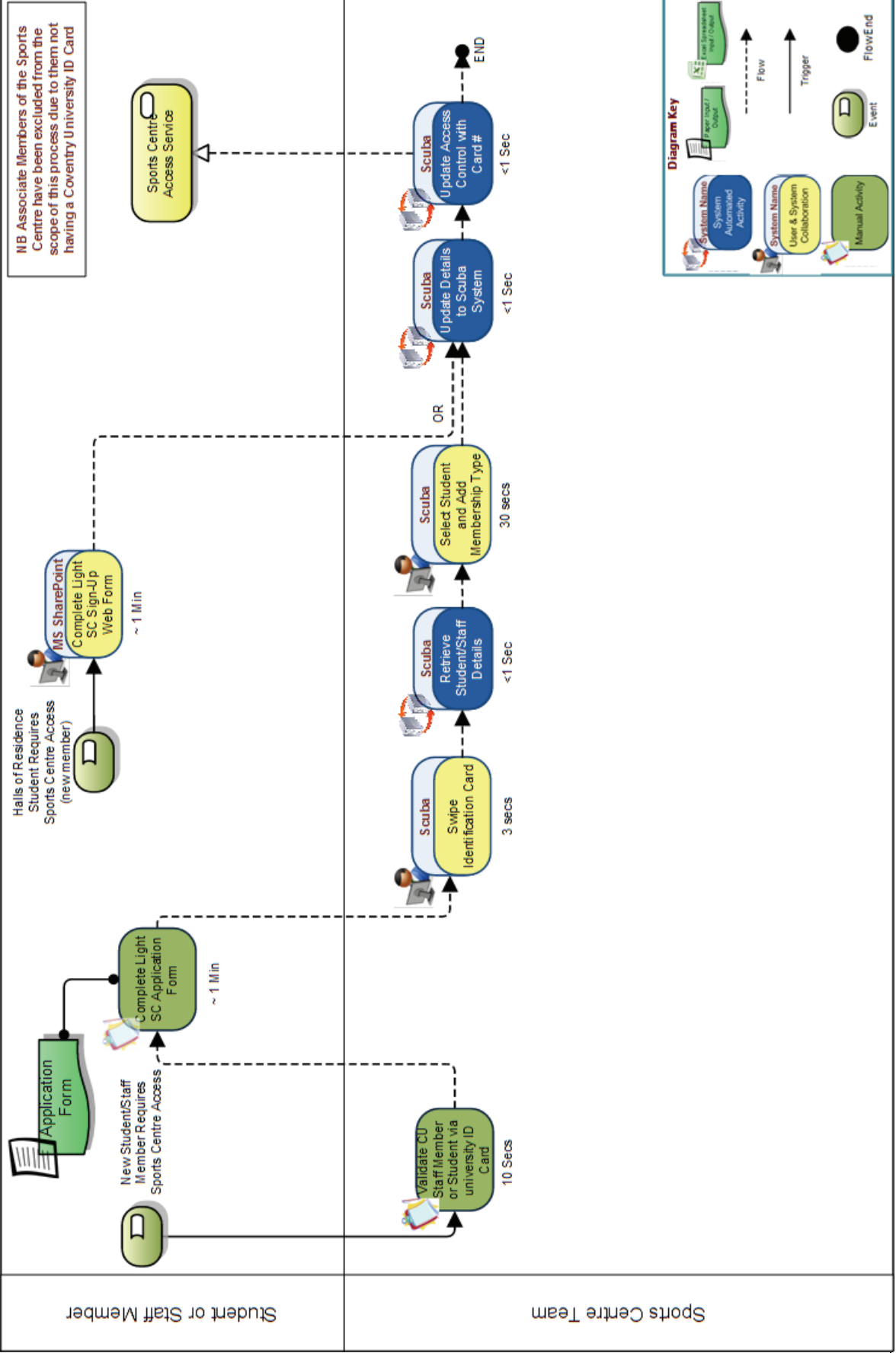
Processes

As-Is Join Sports Centre Diagram



To-Be Process Diagram: Join The Sports Centre

Pre-requisite: Universe has provided a feed of staff and student data to Scuba (nightly activity)



NB Associate Members of the Sports Centre have been excluded from the scope of this process due to them not having a Coventry University ID Card

Objective of the process: The process exists to enable Coventry University students and staff to join or rejoin the Sports Centre and access the Sports Centre university buildings and facilities with an identification card. For staff, their university identification card shall be reused (pending the number of magnetic stripe tracks available) to access the Sports Centre buildings. For students or staff without available magnetic space on their identification card, a separate Sports Centre identification card shall be issued (costs are involved here).

The process is carried out for all new and returning students and members of staff joining/rejoining the Sports Centre (annual event) along with being carried out to issue replacement identification cards where a student or member of staff has lost or damaged their card. The process is carried out for all existing members of the Sports Centre every year.

It should also be noted that the sports centre has two locations, the Sports Centre building within the Coventry University campus and the Westwood Way out door facilities on the outskirts of Coventry.

Actors and Roles:

Student: The *student* (actor) is the *recipient* of the identification card and is granted access to the sports centre as a result of this process.

Member of Staff: The *Member of Staff* (actor) in this process is similar to the student as they are the *recipient* of the identification card and are granted access to the sports centre as a result of the process.

Sport Centre Team: The *sports centre team* (actor) play the role of a *card issuer* for a student within the process and carryout all of the activities illustrated on the process diagram.

Process Prerequisites:

- Staff or Students must have a Coventry University identification card for verification that they are a student or member of staff at Coventry University.

Inputs: Student or Staff Coventry University Identification Card

Outputs: Updated Staff Coventry University Identification Card (containing sports centre access) or a Sports Centre Identification Card.

Scope: The scope of this process is limited to joining the sports centre and updating the sports centre's access control system to allow members to access the various sports centre facilities. The process does not cover the booking of certain facilities (e.g. badminton courts) or payment for products (e.g. bar service).

Process Improvement Objective: The primary objectives for improving the process are to speed up the time to join or rejoin the sports centre for members, therefore improving the experience and customer satisfaction. The improvement shall also look to reduce staff time and resource that is required to facilitate the joining or rejoining process.

Metrics & Measurements

The measures and metrics are based upon **4,099** sports centre members that are either staff members or students. It should be noted that associate members of the sports centre (former students and staff members that are still sports centre members) are not included within the measures and metrics.

Timings

The following section specifies the timings for each of the *Issue Identification Card* process activities. NB it may be useful for the reader to refer to the As-Is and To-Be process diagrams on pages 2 and 3 of this document.

The following calculations are based upon **4099** current sports centre members of which **2200** are new members (i.e. joined in the last 12 months) and **1899** are existing members that have rejoined within the last 12 months. It is also important to note for this process that **440** sports centre members are students that are at CU accommodation and no payments are required for membership; these students are able to apply for membership via the Polopolay website which is an alternate flow within the process.

As-Is

The following table specifies the name of each activity carried out within the process (refer to the process diagram), the actor that is carrying out the activity, the percentage of transactions where this activity is carried out and finally the typical time taken (in seconds) to carry out the activity per transaction. The table also specifies the total time in hours and days spent carrying out each activity based upon the number of transactions that are carried out (i.e. 100% is **4099** transactions). NB the activity numbers correspond with the basic flow of the process (activity 1, 2,3 etc) and the Alternate Flows within the process (activity AF1, AF2 etc).

Activity #	Activity	Actor	As-Is Transaction %	Time (secs)	Total Hours	Total Days ³
1	Validate Coventry University Student or Staff Member	SC Team	89%	10	10.16	1.36
2	Complete SC Application Form	Staff/Student	89%	180	182.94	24.39
3	Add details to SCUBA Application	SC Team	100%	270	307.43	40.99
4a	Write Sports Centre Access to Coventry University Identification Card	SC Team	54%	25	15.31	2.04
4b	Swipe Card to Retrieve SC Access #	SC Team	46%	25	13.19	1.76
5	Update Access Control	System	n/a	5	n/a	n/a
AF1	Complete SC Application Web Form	Staff/Student	11%	180	22.01	2.93
AF2	Print-off Completed Web Application Form	SC Team	11%	60	7.34	0.98
Total					564.06	75.21

Total time taken by the SC team per annum: **353** Hours / **47.1** Days

Total time taken by staff members and students: **205** Hours / **27.3** Days

³ NB This is based upon a 7.5 hour working day.

To-Be

Activity #	Activity	Actor	As-Is Transaction %	Time (secs)	Total Hours	Total Days
1	Validate Student/Member of Staff CU	SC Team	89%	10	10.16	1.36
2	Complete Light Application Form SC	Staff/Student	89%	60	60.98	8.13
3	Select Student and Add Membership Type	SC Team	89%	120	121.96	16.26
4	Import Details to Scuba System	System	N/A	5	N/A	N/A
5	Update Access Control with Card #	System	N/A	5	N/A	N/A
AF1	Complete Light Application Form SC	Staff/Student	11%	60	7.34	0.98

Total	200.44	26.73
--------------	---------------	--------------

Total time taken by the SC team per annum: **132 Hours / 17.6 Days**

Total time taken by staff members and students: **68 Hours / 9.1 Days**

Process Savings Made

The adoption of the To-Be model shall save the sports centre team 221 hours per annum, (30 days), which equates to staffing costs of £1,768 per annum.

Additional cost savings can be made by removing the need for PC terminals required by the sports centre team to read and write access control numbers to the identification cards and manually add membership details to the Scuba application; this reduction in work equates to 3 PC terminals no longer required.

Sports Centre Identification Card Cost Savings: £13,485

PC Terminal Cost Savings: £1,486

Non-Tangible Savings:

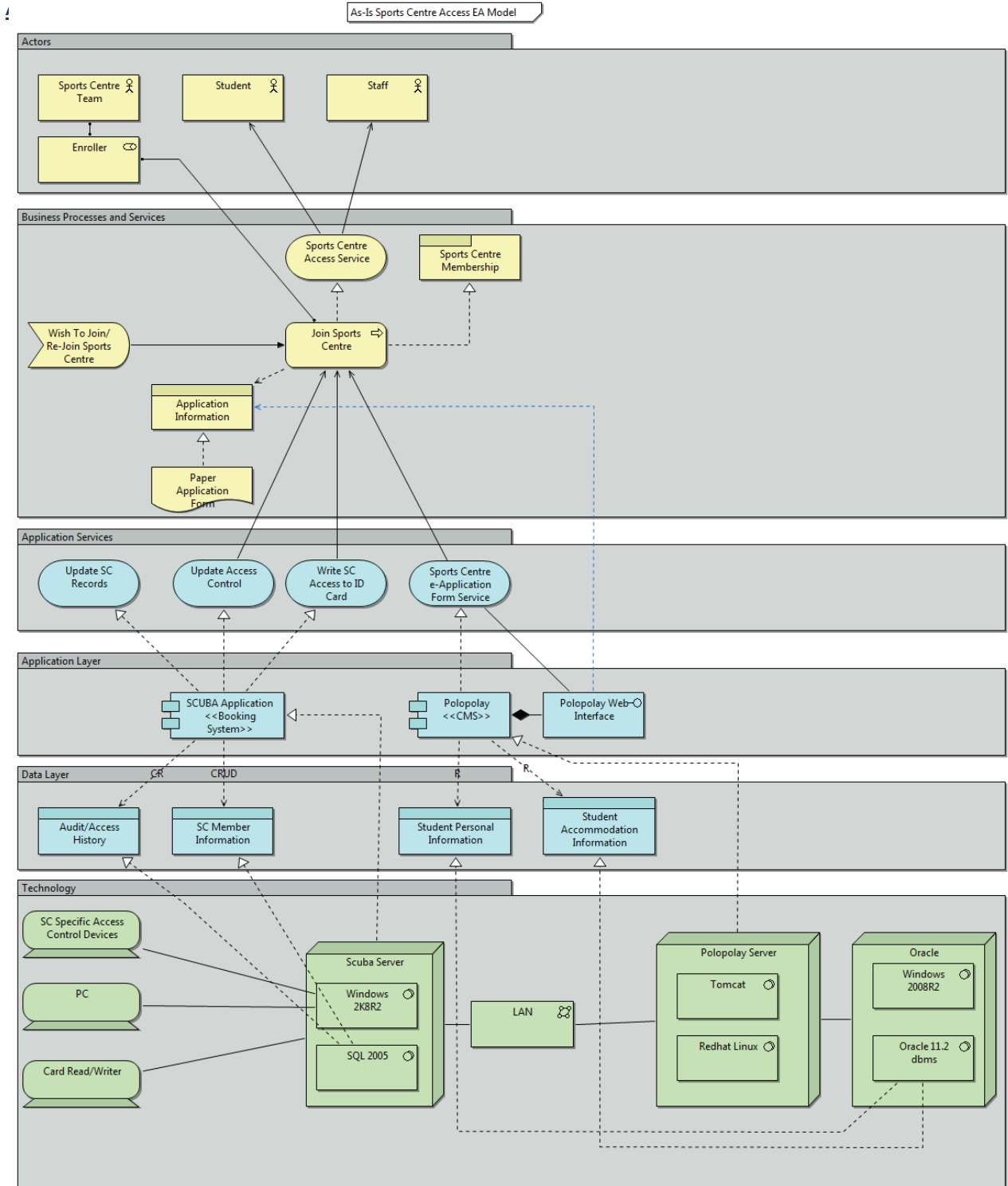
The membership application process shall be a simpler and less time consuming task for staff and students. The policy changed that has been made as part of the process improvement to remove the activity of completing an application form for existing members shall also be an improved service offering by the Sports Centre.

The adoption of the To-Be model shall save the customers (i.e. staff and students a combined 137 hours, on average 2 minutes per transaction).

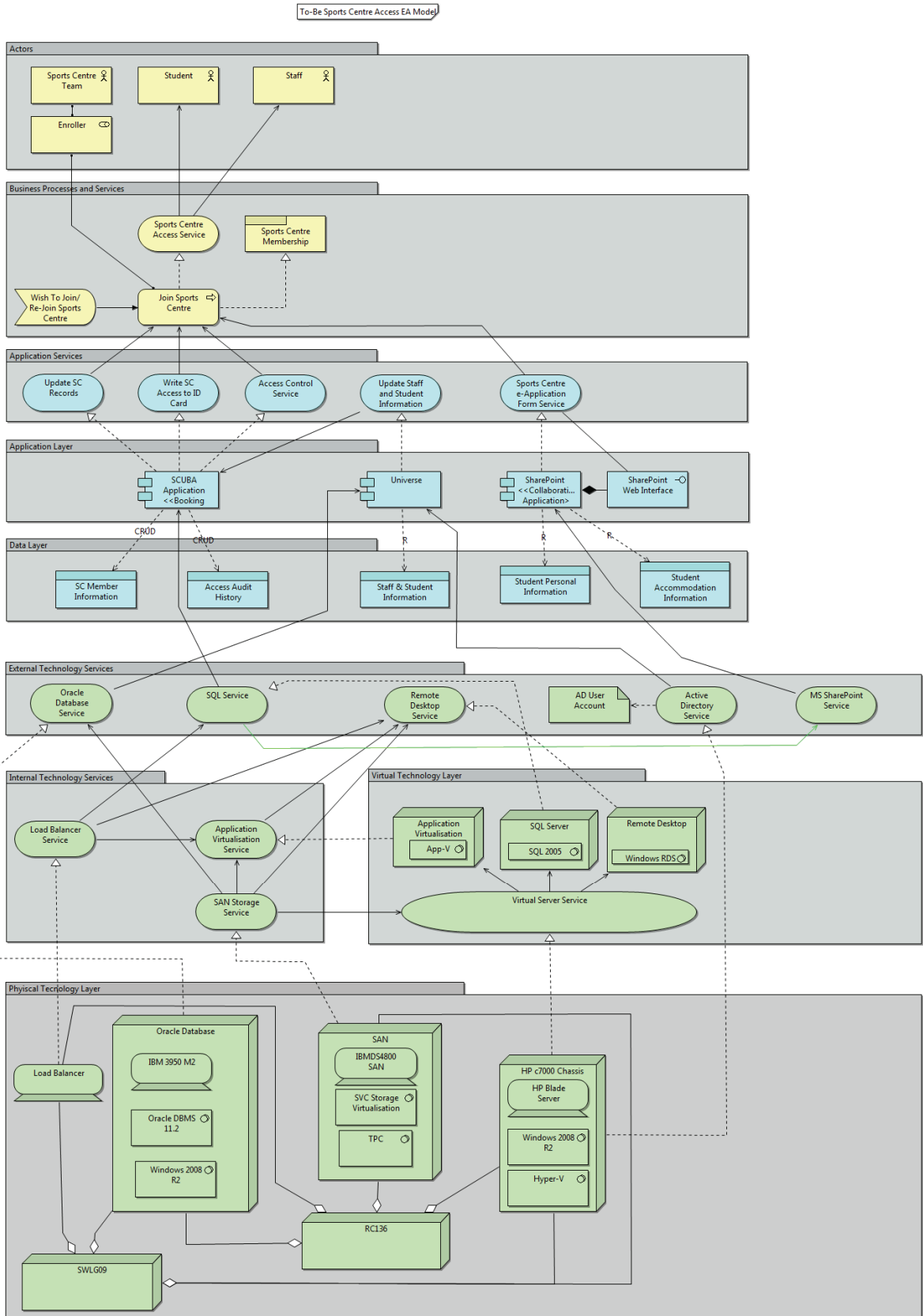
Enterprise Architecture

Application Changes (evident when viewing the as-is and to-be EA models on the following pages): The e-application form to join the sports centre shall be provided by MS SharePoint and not Polopolay. This decision has been made as part of a wider IT strategy to move document collaboration from Polopolay to the MS SharePoint platform. The Universe application has been used to provide student data that is used by Scuba, this shall remove the need for members to enter their details and also for the sports centre staff to key the information into Scuba.

Technology Changes (evident when viewing the as-is and to-be EA models on the following pages): The changes to the technology layer from the as-is to to-be model include removal of hosting of polopolay and the inclusion of hosting Microsoft SharePoint (hosted on a virtualised environment) that us used to provide the e-application form. The Universe application is used within the to-be model and provided by the virtualised environment.



To-Be EA Model



9.2.2. Appendix 3.2 – ID Card Issuing and Managing Access Control EA and processes

9.2.3. Appendix 5 – Print Management EA and processes

9.2.4. Appendix 6 – Library EA and Processes (Search, Reserve, Loan and Return)

Business Process Model & Enterprise Architecture Documentation

Coventry University Loan a Library Book Process

10. Introduction

Document Version 1.0, first published version.

This document defines the detailed business processes (at an activity level) for the business processes contained within Coventry University's Enterprise Architecture Model. The document defines the activities carried out for each process along with the following information:

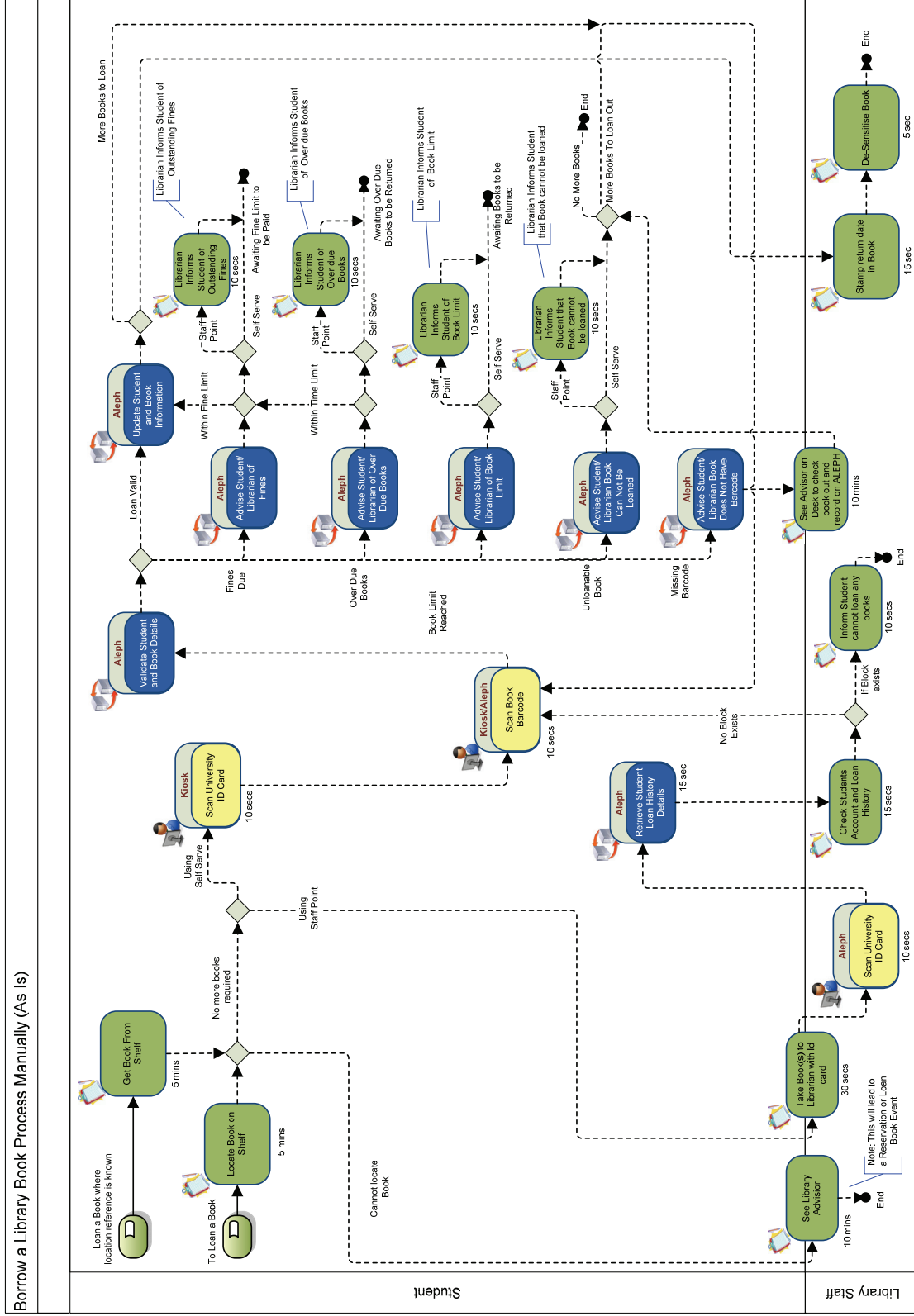
Process

- Objective of the process
- As-Is and To-Be process models
- Description of the process and actors that participate in the process

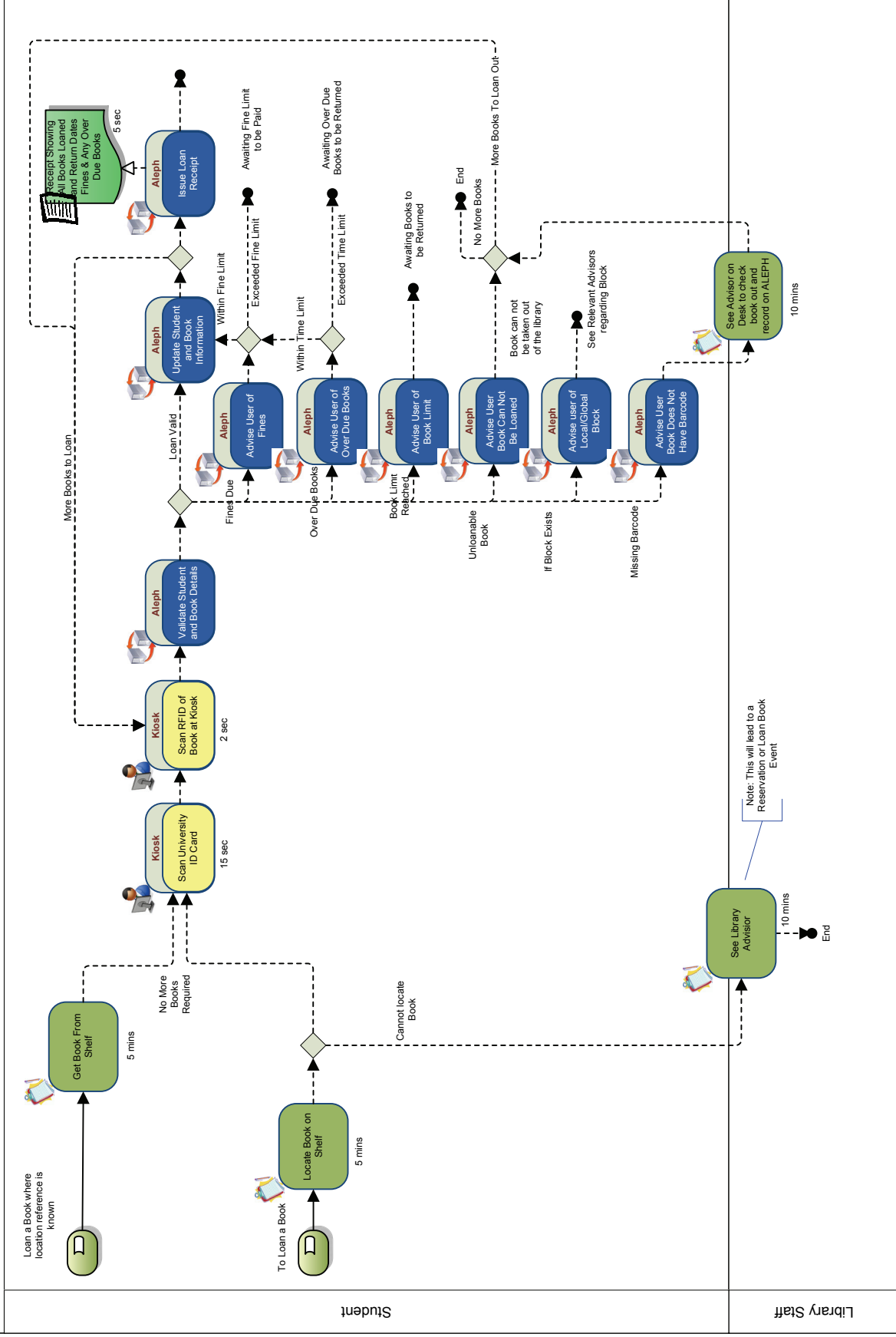
Measures and Metrics (As-Is model versus the To-Be model)

- Total number of transactions and frequency of transactions
- Peak periods
- Number of actors involved
- Staff and customer timings that are saved along with staff costs
- Environmental metrics (such as paper usage, PC usage and other consumables)

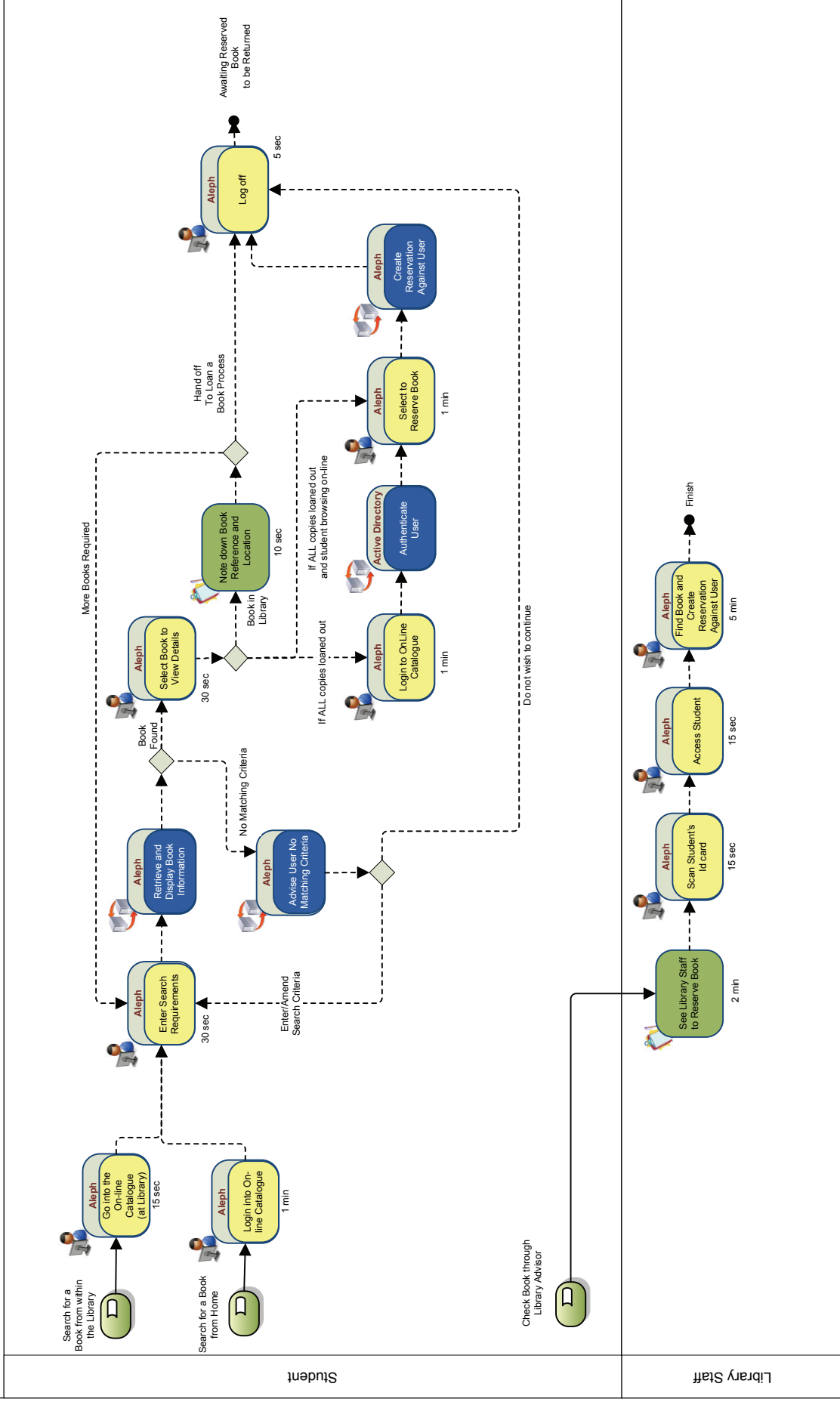
11. Processes



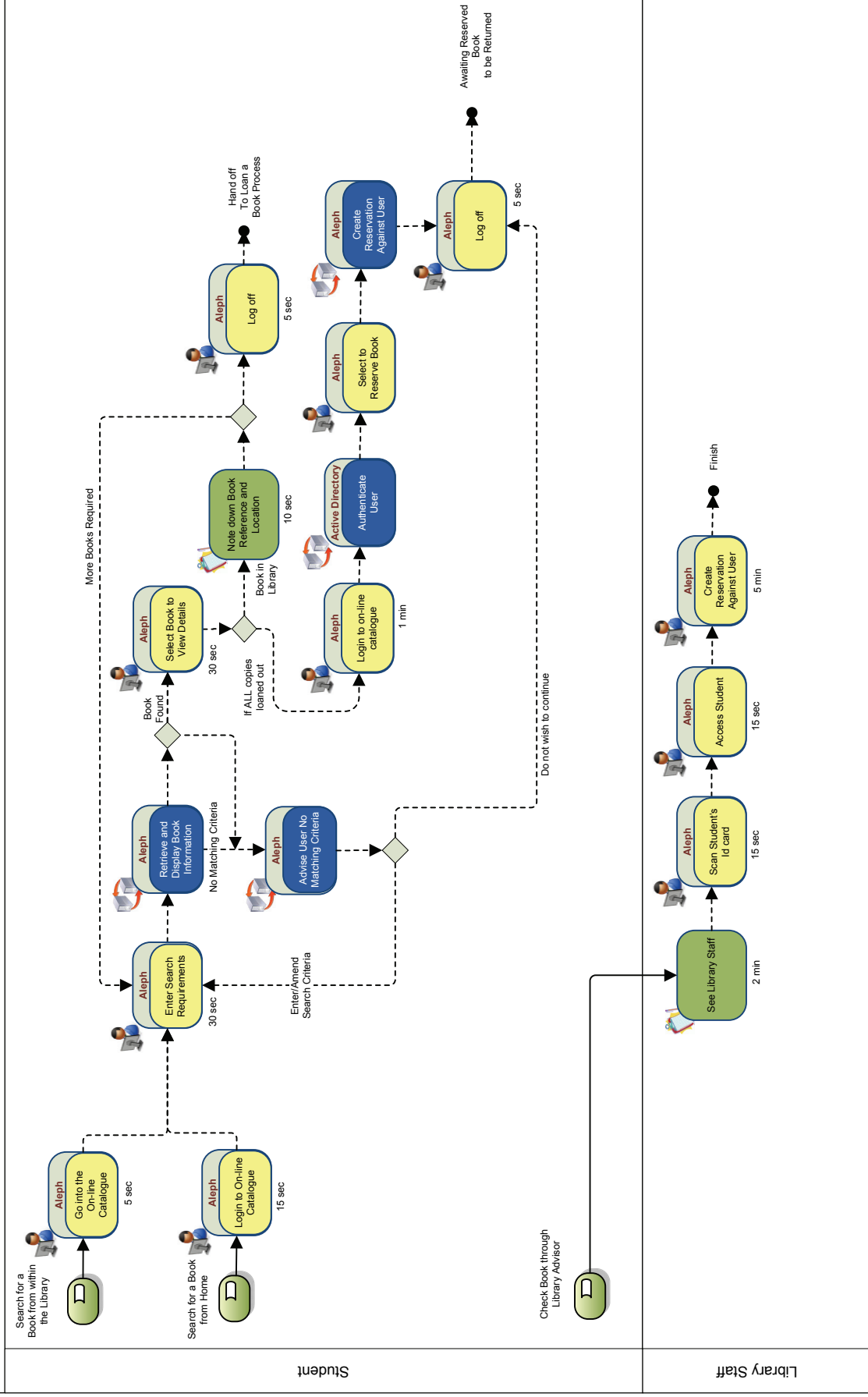
Borrow a Library Book Process Manually (To Be)



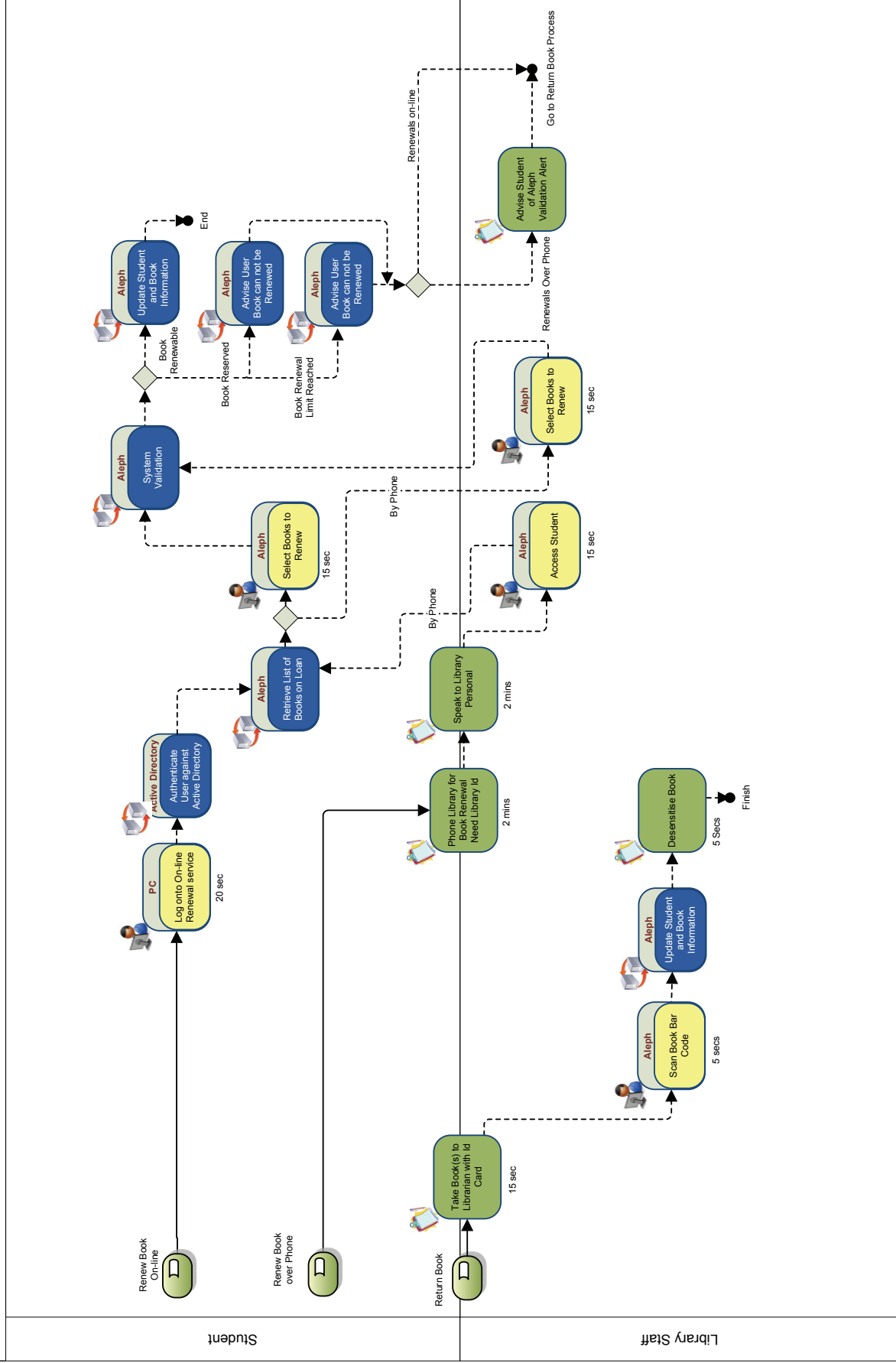
Search and Reserve Process (As Is)



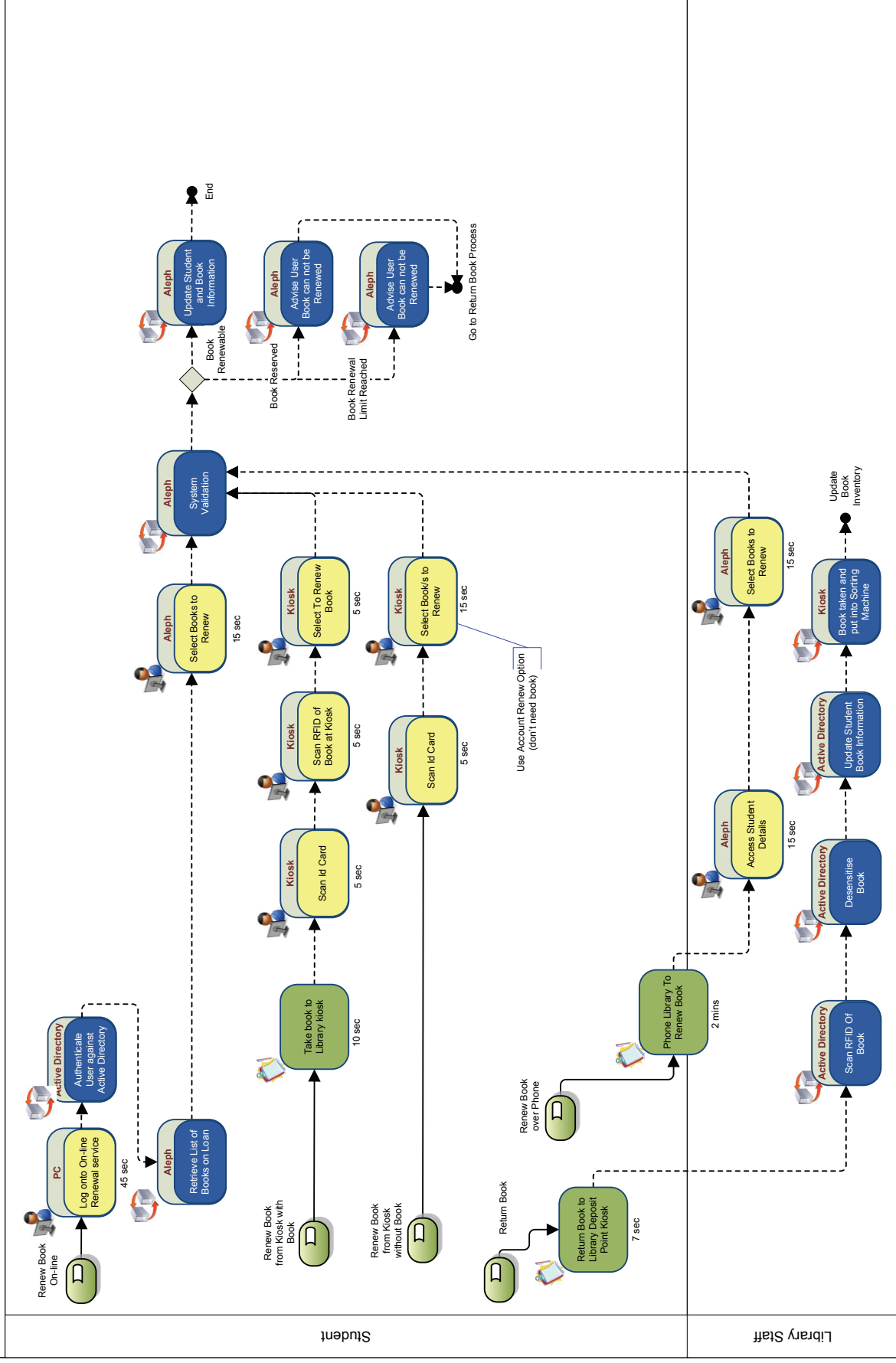
Search and Reserve Process (To Be)



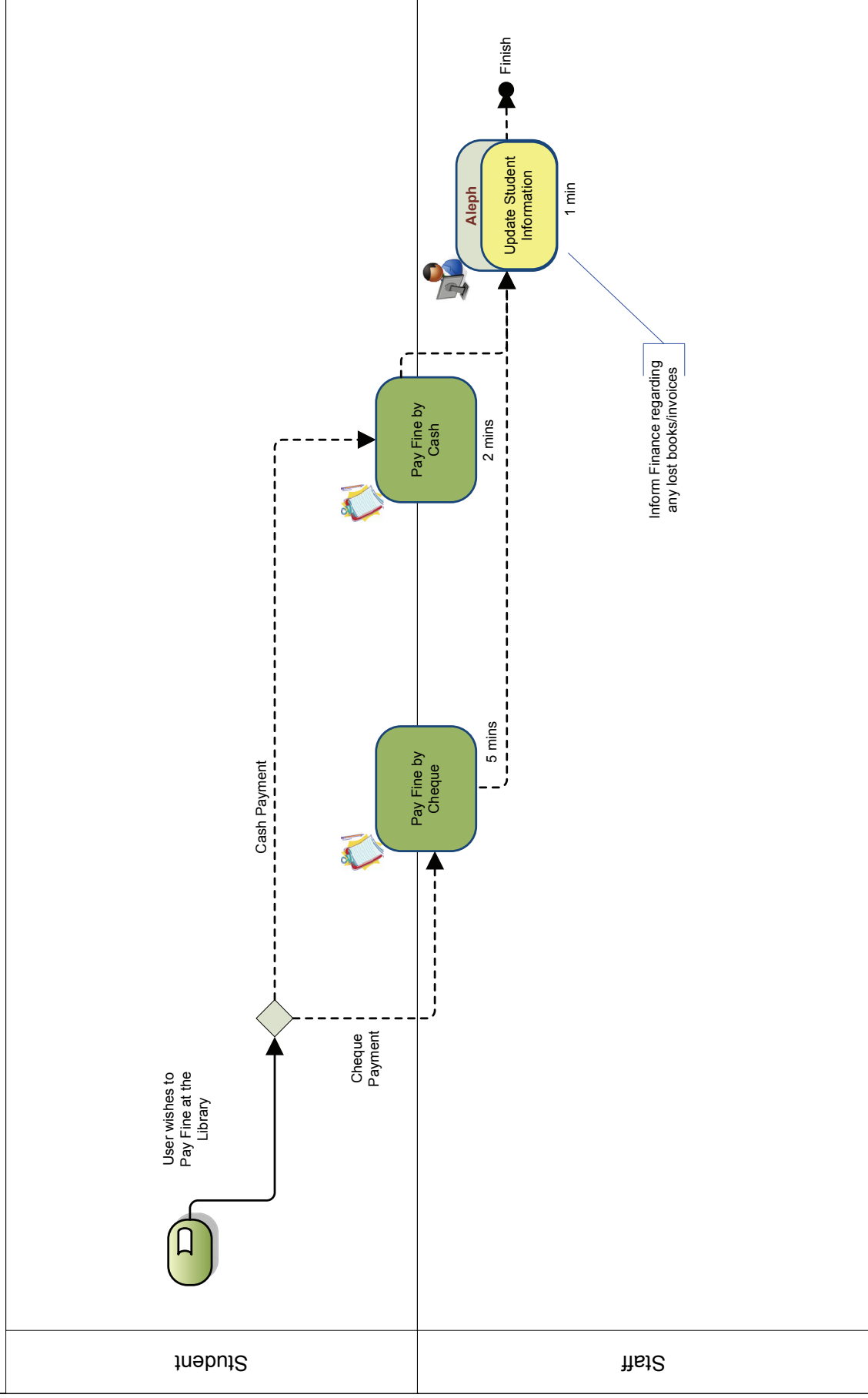
Return/Renew Book Process (As Is)



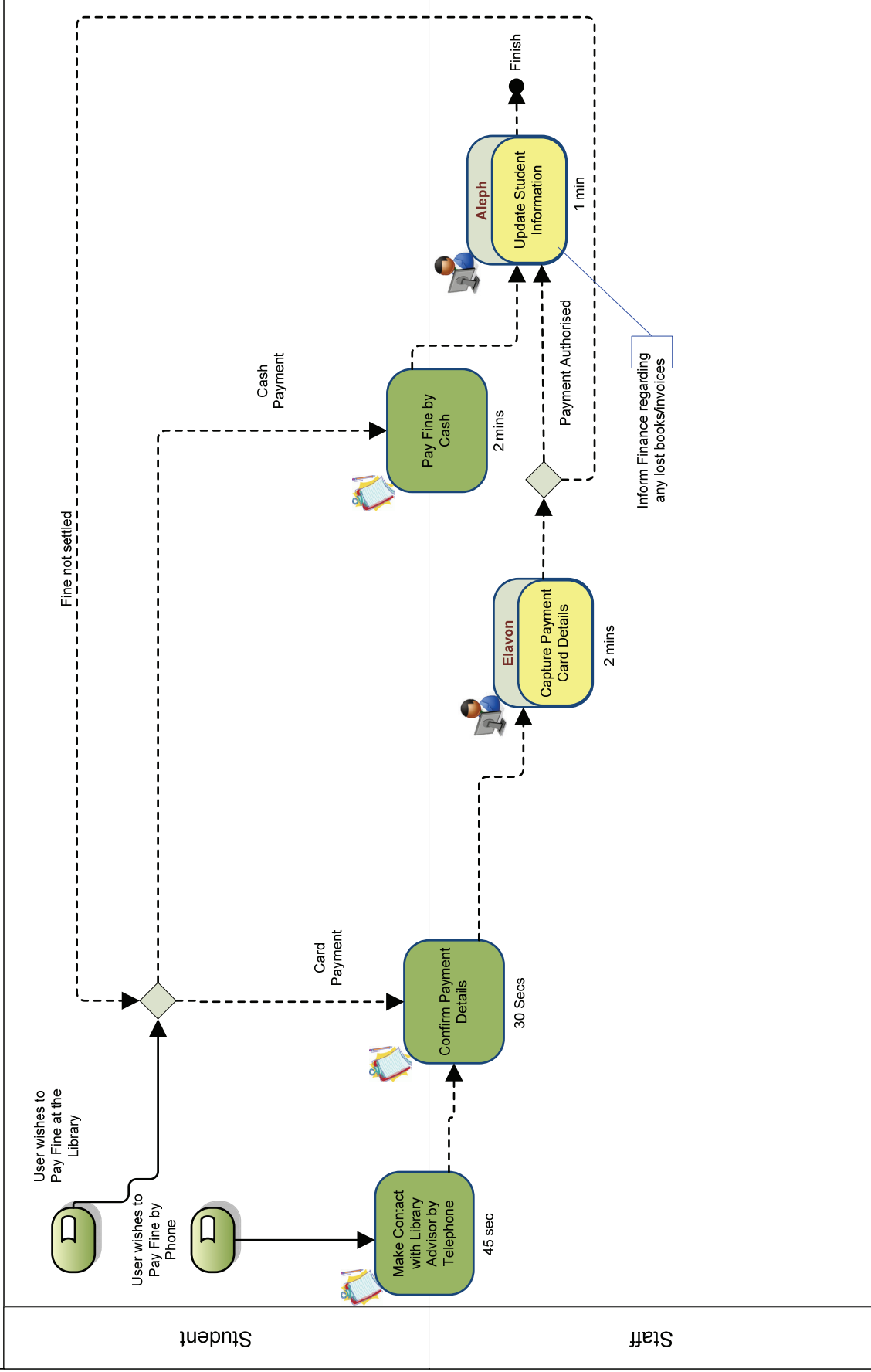
Return/Renew Book Process (To Be)



Pay Library Fine (As Is)



Pay Library Fine (To Be)



Objective of the process: This process identifies the use of the student ID card within the library.

The processes identified are

- Borrow a book from within the Library
- Search and Reserve a Book using the Online Catalogue
- Return/Renew Book
- Pay a Library Fine
- Daily Run of tasks e.g. sending out reminders etc

12. The following is true for all processes:

Actors and Roles:

- Student:** The *student* (actor) is able to loan, renew, reserve or return books from the library
- Library Staff:** The *Member of Library Staff* (actor) in this process will assist the student in order to loan, renew, reserve or return books in any problems have been encountered.

Process Prerequisites:

- The student has to be a current student enrolled at this University and have a student ID card to be able to loan any books.

Inputs: Student or Staff Identification Card

Outputs: Books and any other loan able material, receipts

Scope: The scope of this process is limited to library and its terms and conditions on loaning any material.

Process Improvement Objective: The primary objective of the process is to improve the service to the students in terms of speed, loaning, renewing and returning books. The improvement shall also look to reduce staff time and resource that is required to facilitate the process.

Borrow a Library Book Process

Objective of the process: Allow a student to borrow book(s) from the library.

Total number of transactions: The total number of loans for the year is 303,172.

Peak periods: The library is open throughout the whole year, but it does reduce its hours during the summer when there not many students on campus and increases its hours to 24 hour opening during the main exams period.

As Is Process

Number of actors who facilitate the process: There is a reception point, two service desks and 3 enquiry desks which are manned. The hours are increased during term time and are reduced outside of term time.

The student should only need to go to these points when having trouble locating a book, experiencing a problem when trying loan a book or pay a fine.

The desks are manned on a rota basis and equate to 41 person hours a week.

Environmental metrics (such as paper usage, PC usage and other consumables):

There are 2 kiosks where students can loan, renew or return books.

The service desks have a PC workstation each on which the member of staff can check student accounts and deal with any related issues.

To Be Process

Number of actors who facilitate the process: There is a reception point, two service desks and 3 enquiry desks which are manned. The hours are increased during term time and are reduced outside of term time.

The student should only need to go to these points when having trouble locating a book, experiencing a problem when trying loan a book or pay a fine.

The desks are manned on a rota basis and equate to 35 person hours a week.

Environmental metrics (such as paper usage, PC usage and other consumables):

There are 4 kiosks where students can loan, renew or return books. A receipt is printed for any transactions that have been performed.

There are 2 points where borrowed items can be returned to the book hopper.

The service desks have a PC workstation each on which the member of staff can check student accounts and deal with any related issues.

Search and Reserve a Book Process

For Both the As Is and the To Be Processes

Objective of the process: Allow a student to search and/or reserve books using the library catalogue. This can be done from within the library or from another location logging via a computer.

Total number of transactions: It is not possible to record how many have been performed, as this activity is not possible to record.

Number of actors who facilitate the process: The only actor involved at this stage is the student performing the search and/or reservation.

Environmental metrics (such as paper usage, PC usage and other consumables):

Access to a PC is required if searching away from the University. Alternatively from within the Library there are several workstations available when a student can use the online search facility.

Return/Renew Book Process

Objective of the process: Allow the student either return or renew a book.

Process Overview: A book can be either renewed online, via the phone, renewed at the kiosk with the book, or renewed at the kiosk without the book.

As Is Process

Environmental metrics (such as paper usage, PC usage and other consumables):

If the student is renewing online, then access to a computer is needed. A phone is needed if renewing over the phone. There are 2 kiosks where the books can be either renewed or returned.

To Be Process

Total number of transactions: The total number of renewals for this year is 379,237, but it is not possible to break it down any further.

Environmental metrics (such as paper usage, PC usage and other consumables):

If the student is renewing online, then access to a computer is needed. A phone is needed if renewing over the phone. There are 4 kiosks where the books can be either renewed and 2 points where items can be returned. A receipt is given from the kiosk, so receipt paper is required.

The facility to renew books at the kiosks will reduce the workload for the desk points.

The books can be returned at the book hopper without having to scan it in.

Pay a Library Fine Process

Objective of the process: For the student to pay their library fine, to clear their debt.

Total number of transactions: The total number of fines in one year is £93,684.89. This can be broken further

Cash Payment £16,772.78
Card Payment £76,912.11

The student has the ability to pay their debt by card, thus increasing the card transactions and reducing the cash transactions.

13. Metrics & Measurements

The measures and metrics are based upon the number of books loaned, renewed and returned during a 12 months period in the academic year 2009 – 2010. It also looks at the equipment required to perform the processes identified.

Equipments Costs

The following costs are based on the both the As – Is and To-Be models per annum.

	As-Is	To-Be	Unit Saving	Total Annual Saving
Kiosks	£1000.00 x 2	£1000.00 x 4	0.00	£-2000.00
Workstation	£500.00 x 3	£500.00 x 2	0.00	
Paper for receipts	£29.95 (20 rolls)	£29.95 (20 rolls)	0.00	£-179.52
Paper for Auto sorter	-	£31.98 (5 rolls)	0.00	£-767.52

The equipment costs have gone up, as the library has moved from 2 kiosks to 4 kiosks. The workstation costs will remain the same. The paper order will increase as 4 kiosks will now need to produce receipts and the paper for the auto sorter now needs paper as well.

Staff Costs

During term time the service points are manned for longer periods of time and reduced outside of term time.

There is 7 staff employed on a rota basis on the To Be process, whereas there was 8 staff on the As Is process, so the number of persons hours needed has been reduced.

Staff Costs	As-Is	To-Be	Unit Saving	Total Saving
Permanent Staff Mon – Fri	177.5 Hours Grade 3	147.5 Hours Grade 3		30 Hours at Grade 3

	6.00 ph			
Permanent Staff Sat - Sun	9 Hours Grade 2	9 Hours Grade 2		

Grade 2 5.10 – 6.25 per hour

Grade 3 5.76 – 6.80 per hour

13.1. Timings

The following section specifies the timings for each of the processes. It may be useful for the reader to refer to the As-Is and To-Be process diagrams for more detailed information.

The following section specifies the timings for each of the activities.

As-Is vs. To-Be – Borrow a Library Book

As-Is and To-Be Events/Inputs:

Total Transactions:	Total Loans Per Annum	303172	100%
Events:	To loan where the book reference is known	246176	81.2
Events:	To loan a book without a book reference	56996	18.8
Events:	Book Loans Per Visit Ratio (2.5)	121268.8	40

The following table specifies the name of each activity carried out within the process (refer to the process diagram), the actor that carrying out the activity, the percentage of transactions where this activity is carried out and finally the typical time taken (in seconds) to carry out the activity per transaction. The table also specifies the total time in hours and days spent carrying out each activity based upon the number of transactions that are carried out. NB the activity numbers correspond with the basic flow of the process (activity 1, 2,,3 etc) and the Alternate Flows within the process (activity AF1, AF2 etc).

The following assumptions have been made:

- 25% of students would have fines, 40% of loans were done at staff points. The average number of books loaned at one time is 2.5.
- 22% of students will be informed that they have overdue books.
- 9% of students will be informed of reaching the book limit.
- 5% of students will be told that the book not loan able.

Activity #	Activity	Actor		As-Is Transaction %	Activity Time (secs)	Total Hours	Total Days
1	Locate book on shelf	student		81.20%	300	20514.64	2735.29
AF1	Get book from shelf	student		18.80%	300	4749.69	633.29
1a	See Library advisor	student		0.50%	600	252.64	33.69
2	Scan Id card	student		60.00%	10	505.29	67.37
3	Scan book barcode	student		60.00%	10	505.29	67.37
4	See advisor on desk to loan book	student		0.50%	600	252.64	33.69
5a	Stamp return date in book	Library staff		38.40%	5	161.69	21.56
5b	Librarian informs of fines	Library staff		4.40%	10	37.05	4.94
5c	Librarian informs of overdue books	Library staff		4.00%	10	33.69	4.49
5d	Librarian informs of book limit	Library staff		2.00%	10	16.84	2.25
5e	Librarian informs book cannot be loaned	Library staff		1.00%	10		
6	De-sensitise book	Library staff		100.00%	5	421.07	56.14
AF1a	Take book to Librarian	student		40.00%	30	1010.57	134.74
AF1b	Scan Id card	Library staff		40.00%	10	336.86	44.91
AF1c	Check students Account and history	Library staff		40.00%	15	505.29	67.37
AF1d	Scan book barcode	Library staff		40.00%	10	336.86	44.91
AF1e	Inform student cannot loan book	Library staff		1.00%	10	8.42	1.12
Total						9125.48	1216.73

Total time taken by Library Staff: **382** Days

Total time taken by the Students per annum: **3570** Days, this works out, on average to be less than 2 hours per student per year.

To-Be

Activity #	Activity	Actor	Actor2	As-Is Transaction %	Time (secs)	Total Hours	Total Days
1	Get book on shelf	student		81.20%	300	20514.64	2735.29
AF1	Locate book from shelf	student		18.80%	300	4749.69	633.29
1a	See Library advisor	student	Library staff	0.05%	600	25.26	3.37
1a	See Library advisor	Library staff	Library staff	0.05%	600	25.26	3.37
2	Scan Id card	student		40.00%	15	505.29	67.37
3	Scan RFID of book	student		99.95%	2	168.34	22.45
4	See advisor on desk to loan book	student	Library staff	0.50%	600	252.64	33.69
4	See advisor on desk to loan book	Library staff	Library staff	0.50%	600	252.64	33.69
Total						26493.78	3532.50

Total time taken by the Students per annum: **3495** Days (averages at @~ 2hours per student)

Total time taken by Library Staff: **37** Days

The total savings made are

Staff 345 days

Student days 75 days

This amounts to a substantial saving in staff time, and there is even a small saving for students as well.

Taking an average salary of £6.00 ph, this equates to a saving of £2,070 per annum.

As-Is vs. To-Be – Search and Reserve a Book

As-Is Events/Inputs:

		Totals	%
Events:	Total Number of Searches	606344	100%
Events:	Logins	121269	100%
Events:	Search and Reserve through library staff	606.345	1%

Total time taken by students per annum: 1919 days Total time taken by staff per annum: 23.5 days

To-Be Events/Inputs:

		Totals	%
Events:	Total Number of Searches	606344	100%
Events:	Logins	121269	100%
Events:	Search and Reserve through library staff	121269	100%

To-Be

The following assumptions have been made:

- It is believed that on average 2.5 books are borrowed per visit, therefore the total number of system logins to search shall equate to books borrowed / 2.5.
- A ration of 2:1 searches to book borrowed has been used within the calculations, a figure of 606344 searches per annum has been used within the calculation for the as-is and to-be models.
- An assumption has been made that more people now search from home more in the as-is model.

Total time taken by students per annum: 1895 days Total time taken by staff per annum: 23.5 days

There is a saving of 24 days for students, but the staff time has remained the same.

As-Is vs. To-Be – Renew and Return (Inc Fines)

As-Is and To-Be Events/Inputs:

		Totals	%
Events:	Total Number Renewals	45475	100%
Events:	Total Number of Returns	303172	100%
Events:	Total Number of Fines	5250	100%
Events:	Total Number Of Deposit Point Collections	698	

As-Is

The following assumptions have been made:

- It is assumed that 15% of borrowed books are renewed and all borrowed books are returned.
- It is assumed that there are 5250 fine transactions per annum.
- It is believed that on average 2.5 books are borrowed per visit, therefore the total number of system logins to search shall equate to books borrowed / 2.5.
- A ration of 2:1 searches to book borrowed has been used within the calculations, a figure of 606344 searches per annum has been used within the calculation for the as-is and to-be models.
- 75% of renewals are carried out on-line.
- 4% renewals carried out at the kiosk with the book.
- 10% renewals carried out at the kiosk without the book.

Total time taken by students per annum: 301 days Total time taken by library staff per annum: 238 days

To-Be

It is assumed that 15% of borrowed books are renewed

It is assumed that all borrowed books are returned

It is assumed that there are 5250 fine transactions per annum

It is believed that on average 2.5 books are borrowed per visit, therefore the total number of system logins to search shall equate to books borrowed / 2.5

A ration of 2:1 searches to book borrowed has been used within the calculations, a figure of 606344 searches per annum has been used within the calculation for the as-is and to-be models.

Total time taken by students per annum: 505 days Total time taken by Library staff per annum: 32 days
--

The total saving for staff is 206 days. The time for students has one up by 20 days, but this is probably due to the fact the fines can now be paid by debit card and this process does take longer although being more convenient.

13.2. Process Savings Made

The adoption of the To-Be model would save the library approximately £2000 per annum for staff on an average salary of £6.00 ph.

Non-Tangible Savings:

The processes for borrowing and returning books are more automated consuming less staff and student time, as well providing a modern approach for the students.

The adoption of the To-Be model would save the staff 551 days per annum. For the students the actual time has increased by 105 days more per annum, but in reality the actual time for each student is insignificant.

There is also a cultural change whereby the students are actually carrying out more of the processes themselves, rather than the staff. Also the introduction of the book hopper helps the automated processes.

13.3. Enterprise Architecture

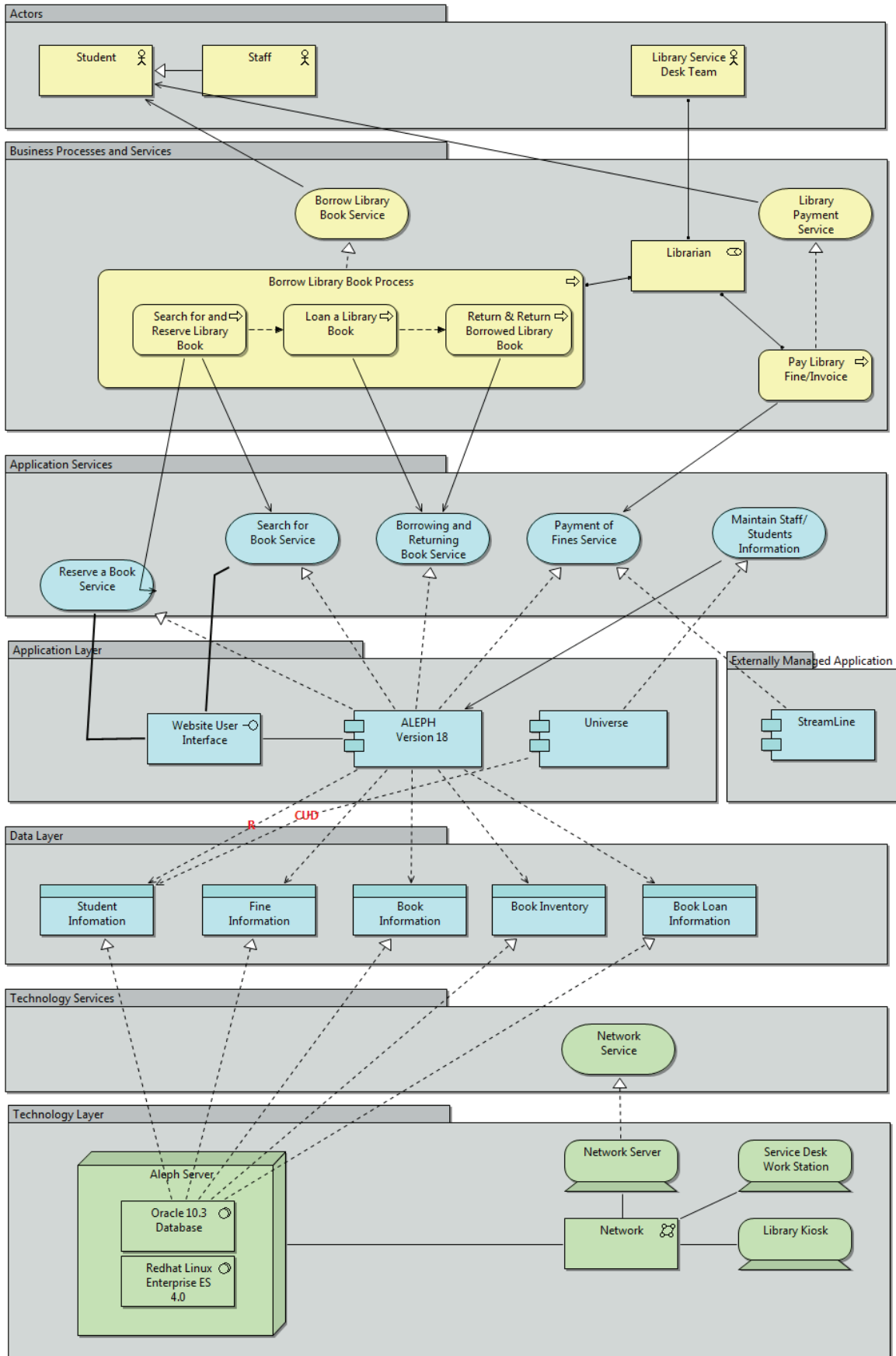
Application Changes:

The application changes from the As-Is model to the To-Be model are minor as the basic processes have remained the same. The On-line catalogue is more extensively used as students have more access to computers, on and off site.

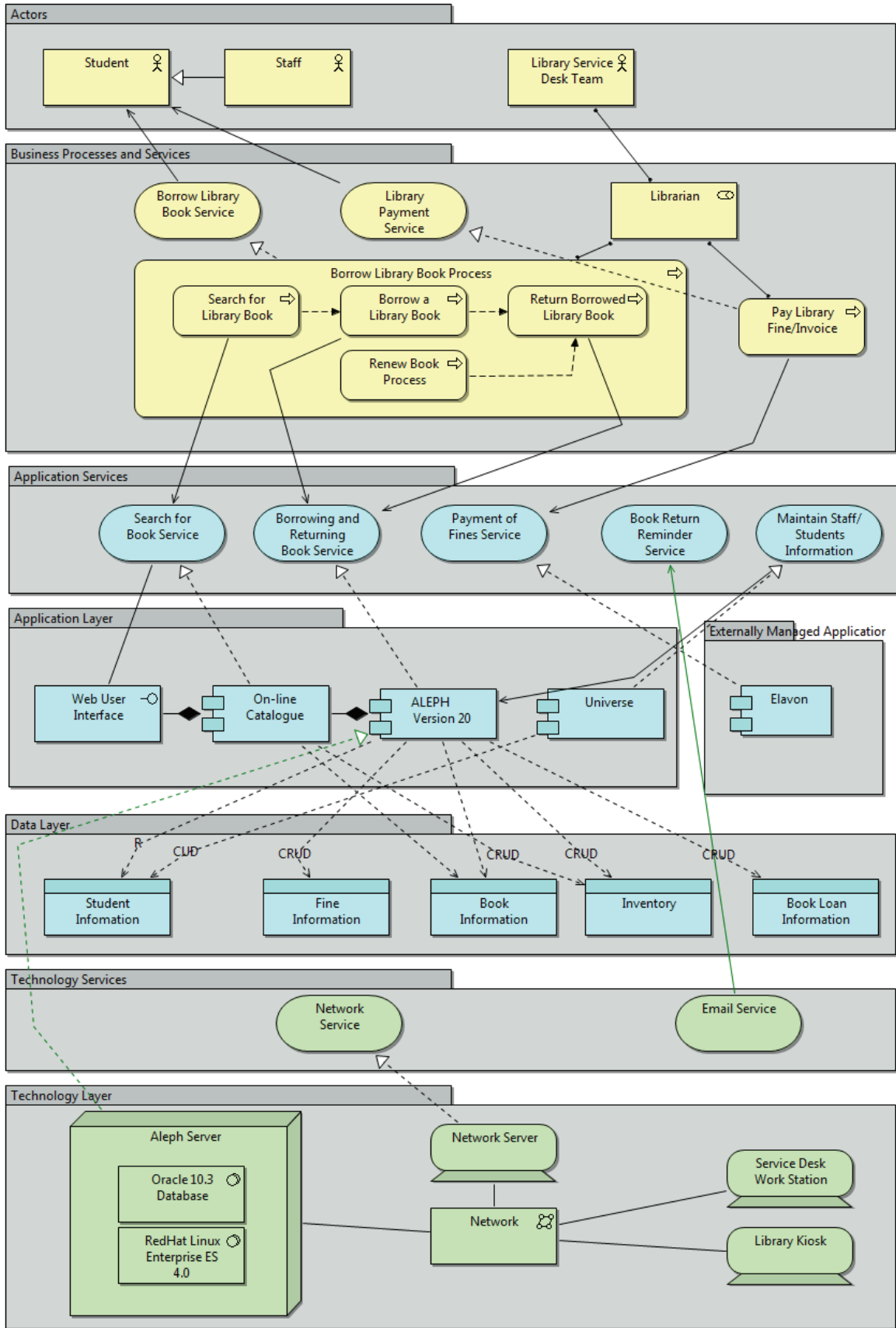
Technology Changes:

The changes to the technology layer from the As-Is to the To-Be are minimal. Two more kiosks have been purchased and the current kiosks have been replaced by newer models. The card payment hand held device has also been changed due to a change of supplier.

As-Is EA Model



To-Be EA Model



13.4. Appendix 3 - As-Is Integrated EA Model

Enterprise Architecture Evaluation Report

