Requirements Model of Cardiff University's Coffee Shops

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Abstract

The motivation behind developing a requirements model for the coffee shops is due the realisation that they, in many ways are not meeting the needs of the people they serve. The results of this project can be used to improve the services provided, which will benefit the university as a whole. The potential scope of this project is vast, there are multiple stakeholders with numerous requirements. The focus of this project is to elicit requirements from on set of key stakeholders: the students and staff. To tackle the task of requirements elicitation, a multiple methodologies have been discussed in this document and adopted for use in the project. Issues surrounding requirements management have been addressed in this document and a framework has been developed to manage requirements moving forward with the project into 2013. The results of the first stage of investigation show that students and staff have a lot of issues about the current state of the coffee shops, these will be taken forwarded to inform the later stage of the project. The implications of the findings set out in this spell out what needed for the continuation and success of the project moving forward. An altered project plan has been made based on the findings.

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Introduction

Initially the scope for this project was to model the requirements of the provision of catering in Cardiff university. Catering in the university is a large operation which is vast and complex. Because of this, it was decided that the project should focus on one particular area of catering in the university. The coffee shops that were chosen offer a fascinating landscape for developing requirements.

The university coffee shops differ significantly in comparison to their competitors in the city of Cardiff. This was a driving force behind the decision to focus on them. The university is threaded through the city center this means that students and staff have options when it come to coffee. If the university does not meet the requirements of the customers then they can easily 'vote with their feet'. There is stiff competition in the city with 39 coffee shops in the city center and Cathays (Yell, 2012). The university's coffee shops differ on both the provision of products and the environment they create within them.

A principal aim of this project is to develop a requirements model built from the students and staff. This model can be used to drive and inform change within the Catering and Bars department so that they provide better service in their coffee shops. To do this eliciting requirements from the population of Cardiff university. The information gathered from the students and staff will then feed the development of the requirements. These requirements will be summarised in a specification and will be given the Catering and Bars department. Hopefully this can help them provide coffee shops that are better suited to meet the needs of the staff and students of Cardiff university.

Section 1: Background

'Requirements' are basically statements of need that people seek to satisfy from a system, services, or in this case a coffee shop. The IEEE defines a 'requirement' as follows:

Definition 1: Requirement
1. A condition or capability needed by a user to solve a problem or achieve an objective.
2. A condition or capability that must be met or possessed by a system or system component to satisfy a contract, standard, specification, or other formally imposed document.
3. a documented representation of a condition or capability as in (1) or (2)

(IEEE 610.12, 1990)

Given definition 1, the 1st and 3rd points of the definition is most relevant to this project. The focus being, gathering requirements of the users of the coffee shops. In order to do this a number of elicitation techniques are going to be used. These methods will be discussed further in section 2 of this document. Individual requirements are known as:

Definition 2: Requirement artifact

A requirement artifact is an individual documented requirement
(Pohl 2010, p.16)

1.1 Initial Investigation

As argued by (Christel and Kong, 1992 p.7), having a sound understanding of the requirements elicitation must begin with an analysis of the organization. This process can identify where to source the requirements and who the key stakeholders are in the organisation.

Cardiff university has 14 coffee shops in total (Cardiff university, 2012). These are spread throughout the various buildings in the university from Heath Park Cathays Park campus. The coffee shops are run by the Catering and Bars department. In order to gain a greater understanding of the coffee shops, all 14 were visited. Time was spent observing the behaviour of staff and customers in the shops, taking photographs and making notes on the environment (see Appendix.1 for the notes and photographs). Through the observations it was discovered that the shops differ considerably from each other. No two coffee shops are alike in the university, they all have different furnishings, they offer different products and some offer hot food and some do not.

1.1.1 Key stakeholders

Stakeholders are "anything that is influencing or influenced by the firm" (Sharp et al. 1999). Understanding of the stakeholders of the organisation has helped to focus the investigation and gain a deeper knowledge of the organisations that affect the coffee shops.

Customers of the coffee shops are major stakeholders. They have been categorized in several different forms:
- Students who use the coffee shops on a regular basis.
- Staff of the university that use the coffee shops.
- Unrelated members of the public who use the coffee shops.

Due to the their affiliation with the university it can be argued that all of the students and staff in the university are stakeholders of the coffee shops. These potential customers could be choosing not to go to them for a number of reasons as their requirements are not being satisfied in some way. Identifying these stakeholders and investigating what their requirements are will be an important aspect of the project.

Stakeholders that are internal to the university:
- The estates department
- Campus service department
  - Karen Tanner Campus Services Division ~ Director

Stakeholders External to the university that have an impact on the coffee shops:
- Suppliers, these are changed on a three year cycle.
  - The majority of the suppliers that are used by the Catering and Bars department are nominated and regulated by the TUCO (The University Caterers Organisation) and HEPCW (Higher Education Purchase Consortium Wales) through their membership of these organisations.
- The Fairtrade Foundation, awarding the fair trade status to the university.

Stakeholders internal to the Bars and Catering department:
- The staff
- Clive Newton ~ Manager
- Julia Harris ~ Deputy Catering Manager

The initial investigation highlighted the difficulties of gathering information on the organisational side of the department. This was mostly due the researcher coming from outside the organization. This meant there was limited access to the staff. Having this barrier does not limit the investigation, as the focus will be on the key stakeholders, the customers of the coffee shops. The customers are the most important subjects in this investigation.

1.1.2 Questionnaire

A questionnaire was developed In order to define an initial set of requirements and identify any areas for further research using more exploratory methods of requirements elicitation. There are a total of 31 questions, these pertain to three broad topics that apply to the coffee shops:
- The environment
- The produces
- The price

There are also some questions that deal partially with promotion, the quality of the produces and payment barriers. A list of the questions asked and a document summarizing justification of way these questions were asked can be seen in Appendix.2. The questionnaire was administered by a researcher within the coffee shops. The questionnaire has also been shared to network of people in the university through email and social media for it to completed as and when they chose.

The questionnaire has been developed on the 'Google spreadsheet' platform. The front end of the questionnaire that the subjects see is a simple web page that can be accessed through a URL sent to them. A screen dump of the web page can been seen in Appendix.3, there is also a link to the live web page in the Appendix. The front end is linked to 'Google spreadsheet' where the data is stored.

The decision to use 'Google spreadsheet' to implement the questionnaire was made for a number of reasons. In comparison other widely used platforms such as surveymonkey, 'Google spreadsheet' offer a flexible development platform. It is possible to develop a questionnaire with any number of questions. There is a size limit of a spreadsheet on the platform and that is 400,000 cells, with a maximum of 256 columns per sheet (Google, 2012). This size limitation far exceeds the what is needed for the questionnaire. 'Google' offer this service for free, this is contrary to other platforms that support the development of questionnaires that require a monthly subscription. An example of platform that requires a monthly subscription is surveymonkey, the basic free account is very limited. There is a limit of 100 responders (Surveymonkey, 2012) to the surveys. 'Google spreadsheet' allow data to be exported to a number of different formats with a pantheon of data manipulation operations available. It is for these reasons that 'Google spreadsheet' where used in this project.
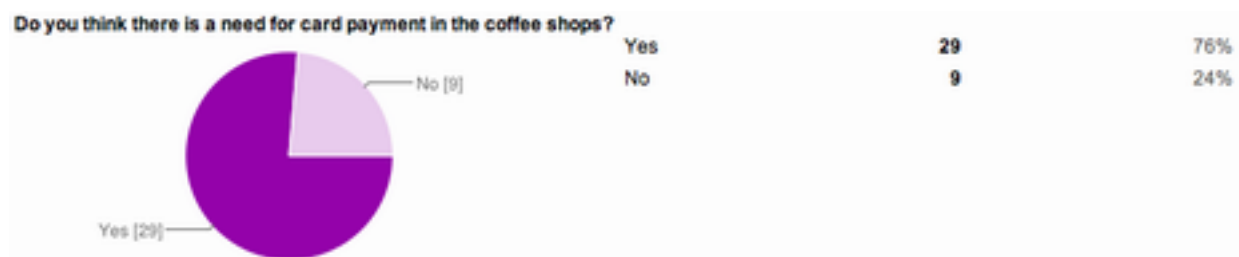
Figure.1

The questionnaire in its current manifestation has already given some great feedback from the customers of the coffee shops. Figure.1 is an example of a question asked to the participants of the questionnaire and the result from their responses. Figure.1 is a 'yes' or 'no' question on the need for card payment in the coffee shops. Having feedback that can specifically state a requirements demonstrates how feedback from directly from the students and staff will develop

the model. Though at this stage there is a small number of participants who have had the questionnaire administered to them, the set provides an excellent base from developing requirements and highlighting areas for further investigation. Figure.2 is an outer extract from the results from the questionnaire, it addresses the issues of maniche vs coffee bar. Through discussing the coffee shops with colleagues this topic came up a number of times, this lead to its involved in the questionnaire.
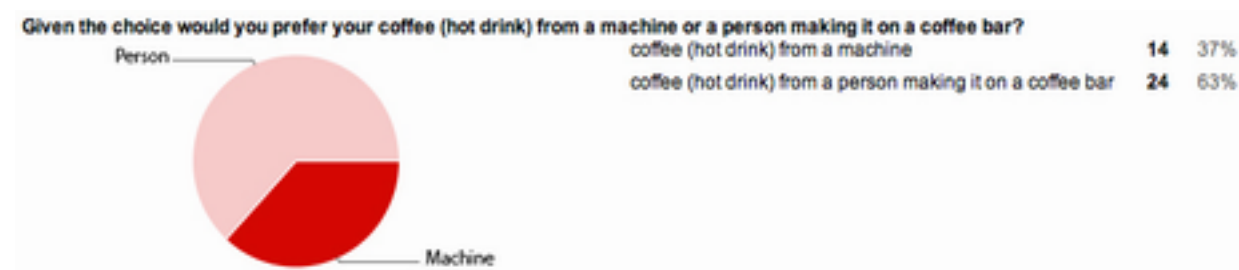

Figure.2

This feed back from the students and staff has informed a number of requirement artifacts. A complete set of results form the questionnaire can be viewed in Appendix.4.

Section 2: Approach, Elicitation techniques

The word 'elicit' is defined in the Oxford English Dictionary as:

Definition 3: elicit

to draw forth (something that is latent or potential) into existence
(Oxford English Dictionary, 2012)

In the context of this project, elicitation is the process of collecting the requirements of the customers of the coffee shops, in this case the students and other key stakeholders. Techniques of elicitation are those that help the researcher *draw forth* requirements for the student subjects. These inform of a set of requirements that have come from the students and staff themselves. With any activity that is probing into an organisation there needs to be considerations of the culture in which they are being carried out, so that there is as little disruption as possible. Therefore the techniques that are implemented need to be as sensitive as possible to the Catering and Bars departments culture so that the investigation does not upset any of their staff.

As the student and staff body of Cardiff university is large, elicitation techniques that are to be implemented would need be wide reaching. Seeking large numbers

of participants to gather quantitative and smaller subsets for qualitative data. With this large population, it will be impossible to elicit requirements from everyone. In this case, it is also necessary techniques to be implemented that seek the views of a smaller more specific subset of individuals, this has many benefits for discussion and development of innovative requirements. This results in an approach that implements multiple elicitation techniques. There is no 'silver bullet' methodology that has been develop to elicit requirements, it is an inevitable fact that multiple approaches have to be adopted. However, it is possible to choose methods that complement each other well.

2.1 Interviews

Interviews can be used to effectively elicit requirements from a subject in a rich way, there are three basic types as distinguished by Pohl (2010, p.409) states that there are three kinds of interviews that can be conducted: standardised interviews, exploratory interviews and unstructured interviews.

Standardised interview: an interviewee is asked a set of prepared questions that are of interest to the investigation. In this standardised form of interviewing there is no diversion from the set of questions asked by the conductor of the interview, regardless of the response from the interviewee. This form of standardisation is useful when it comes to the comparison of the results across the set of subjects.

Exploratory interview: this method of interviewing is more elastic, there is a set of predefined questions to ask the subject but the conductor is not bound to use only theses. They can have a conversation with the interviewee to explore their responses to the questions being asked and dig deeper. Due to the non-standardised form of this method the results of these interviews are qualitative and it can be difficult to conduct comparisons.

Unstructured interview: this method does not have a any form of predefined questions that are to be asked to the interviewee. The conductor is free to ask any questions in a broad manner and can lead the conversation in any direction in regard to the investigation. This method can produce rich responses but it is almost impossible to compare the results due to the differing means of execution.

Interviews will be used in this project as a method for requirements elicitation. The interviews will be conducted using an exploratory method in an informal setting, this being in the coffee shops themselves. There are a number of reasons why these have been chosen for this project, the foremost being their ability to generate rich responses from the students who use the coffee shops.

2.2 Questionnaires

Questionnaires are used to gather existing requirements from large groups of customers. It has been proven that through the process of recording one's ideas in a structured way, facilitates reflection. This would help form the development of innovative requirements and questionnaires can facilitate this reflection. Pohl (2010, p.440) states that questionnaires are a fast and effective way to elicit an initial set of requirements from a large number of stakeholders. There are thousands of students and staff that study and work in Cardiff university.   This group of people are either present consumers or potential customers of the coffee shops. Because of these numbers, questionnaires are applicable in this case due to their ability reach a large audience. Moreover, questionnaires are able to provide a starting block for an initial set of requirement. This has been discussed in the 'background' section of this document.

2.3 Ethnography

Ethnography is defined in the Oxford English Dictionary as:

Definition 4: Ethnography

"the scientific description of peoples and cultures with their customs, habits, and mutual differences."
(Oxford English Dictionary, 2012)

With regard to requirements elicitation, this is essentially the observation of users of a system. In this case the subjects are the students and staff who use the coffee shops. It has been suggested by Hickey and Davis (2003, p.5) in their research into the methods used by industry experts in the field of requirements elicitation, that the use of ethnography is extremely effective. More so when users are too busy to be interviewed. In the context of the coffee shops it will be possible to observe more subjects in the time scale in comparison with interviewing the subjects. Observation techniques are well suited for eliciting existing requirements of the users, however, Pohl (2010, p.439) argues that observation is not suitable for eliciting new and innovative requirements. However, the observer can gain a deep understanding of the activities of the users and this understanding can help inform the development of new and innovative requirements.

Having already carried out some observations in the coffee shops as part of my initial investigation, the effectiveness of this technique has been seen first hand. Observing the customers in the coffee shops has helped focus areas of interest to discuss with users. For example, when observing customers in the humanities coffee shop, it was noticed that a large proportion of people in the environment

were using laptops (see Appendix.1. Section "Humanity's coffee shop"). This informed some of the questions that were administered through the questionnaire that was developed.

2.4 Focus Groups

Focus groups are a loose form of group interview that puts emphasis on communication between participants in order to discuss topics and generate data (Kitzinger, 1995). Focus groups have a theme which is used to drive discussion. This theme is an area or topic; for example, the provision of soft seating in the coffee shops. Focus groups are led by a moderator who is there to steer discussion on a given topic, record the proceedings, encourage agreement and conclusion on requirements that are identified. This is to limit ambiguity in results. The participants are encouraged by the moderator to discuss around the theme to identify requirements and further discuss these requirements so there is some consensus among the group. The discussions are carried out in an informal manner in a controlled environment set up by the moderator. A major advantage of using focus groups as argued by Powell and Single (1996) is their ability to elicit a full range of perspectives from the participants in a short period of time. Moreover focus groups allow for clarification and expansion of requirements through the discussion process where points can be raised by any participant for discussion. Focus groups can be used to clarify ambiguous requirements identified using other techniques (such as questionnaires) and bring consensus. There are some drawbacks to the method:
- It can be very difficult to get a representative set of participants
- Focus groups have between 6-10 participants. It can be difficult to organise a time to suit everyone.
- There is the issue of participant dominance where there is a strong will person in the group that suppress the views of others.

Conducting a focus group will be a very useful method of requirement elicitation and clarification. Focus groups provide rich feedback that can be used to develop innovative requirements for the coffee shops. Importantly focus groups can be used to clarify ambiguous requirements. Ambiguity can be an issue for requirements quality. Using a method that can help to clarify ambiguity will be of great benefit.

There has been some research carried out by Farinha and Silva (2011) on the use of web based forums as a method for requirements elicitation. Similar applications have been proposed by Lai et al. (2012) regarding the use of a web based platform enable forum like discusiones, for the purpose of requirements elicitation. Farinha and Silva implemented an online focus group using a simple online forum as

a platform. They encouraged the participation of all the stakeholders of the system they were investigating. Two methods were implemented in their study. One method consisted of a system where the participants were identified. They were encouraged to discuss topics and give feedback.   In the other method the participants remained anonymous and the focus was to vote on topics discussed in the forum. Their study showed promising results, overcoming the issues surrounding the organisation of people and the temporal nature of focus group. Also, an online focus group mitigates the issues that surround social suppression of an individual or idea, providing a 'level playing field'. An online forum will be used in this project as part of a follow-up technique in order to give the participants time to think after the session has ended and allow them to provide further feedback on the topics.
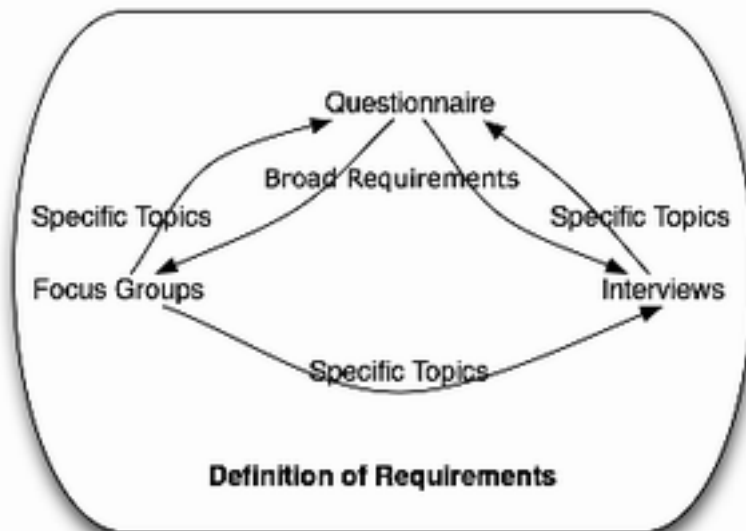
2.5 How They all Relate

Figure.3

The elicitation techniques defined in this section are all interrelated. The use of a questionnaire at begin the requirements elicitation process has a number benefits: It can be used to identify a broad set of initial requirements, the questionnaire has identify broad areas of interest. Having this focusing mechanism will help structure the development of the focus groups, inform topics the both the focus group and interviews. Intern the results from these methods will inform the focus another questionnaire. This is demonstrated in figure.3.

Section 3: Requirement management

Requirements management pertains to the procedures of storing, managing change and monitoring the quality of stored requirements. This section will define some of the criteria that requirement artifacts have to meet in order for them to be recorded also to define how requirements are going to be stored,the quality attributes of the requirements artifacts and how to manage and document changing of requirements in the project.

3.1 Requirements Quality

Requirement artifacts have characteristics that are desirable in order for them to be perceived as quality. This project seeks to develop quality requirements. In order to ensure quality is maintained a set of heuristics for the requirement will be defined and applied to the artifacts. Requirement artifacts that meet a standard set of quality characteristics are easier to manage and trace.

Correct. A requirement artifact must describe a function or quality characteristic that is expressed by customers of the coffee shops (or other stakeholders such as the fair trade commission) through the elicitation process. A requirement is incorrect if it is not represented by a stated need of a customer. This would constitute insinuation of a perceived requirement.

Complete. Where possible, no requirement and information that supports that a given requirement artifact should be missing. A requirement artifact is complete if they meet the acceptance criteria set out in this document (Section 3.2) and if the artifact has all of the required information specified in the requirement artifact template (Section 3.3).

Consistent. Requirement artifacts are consistent if they do not conflict with one another.

Unambiguous. The requirement artifacts should have a clearly defined description that leaves no room for misinterpretation of the requirement. Given that target audience of this project is the management of the Catering and Bars department, this will be taken into consideration when defining the requirement artifacts.

Traceable. In order for the requirement artifacts of the coffee shops to be traceable they will be given a unique number. This can be use to uniquely reference the artifact. Each artifact will be linked to documentation that supported its creation and any changes that have been made to the artifact must be logged.

Verifiable. Requirement artifacts are verifiable if it can be demonstrated that a given requirement artifact has fulfilled its purpose. This should have clear and unambiguous verifiable properties where possible.

Rated. Where possible, requirement artifacts should have a rating. This takes the form of user informed priority rating that will be documented with a given requirement artifact.

Atomic. A requirement artifact is atomic if it pertains to one specific fact derived from the elicitation process. An artifact that contains multiple facts that could be defined as requirements themselves are not atomic.

These characteristics have been developed from a set defined by IEEE in their standard 830-1998 (IEEE, 1998). This standard is quoted in much of the literature regarding requirements engineering.

3.2 Acceptance Criteria for Individual Requirements

- Each requirement must have a valid unique identifier. The unique identifier must follow the structured scheme <Category>-<Number>. Category labels are E (Environment), P(Product), Q(Quality), S(Service).
- Each requirement must reference a source from where it originates. This must be unambiguously stated and referenced.
- Each requirement must be supported by a rationale of why it was created.
- The requirements must have a priority associated with them that is determined from feedback of the customers of the coffee shops where applicable.
- Each requirement must be described and must be done as unambiguously as possible.

A Requirement must meet all of these criteria if it is to be stated in the model.

3.3 Template of a Requirements Artifact

Developed on the basis of sections 3.1 and 3.2 with the quality and acceptance criteria in mind, this template was defined for a given requirement artifact (see Figure.4). 'Requirement ID' is a required field that follows the structured scheme

Figure.4

<Category>-<Number>. The 'Category' field is an explicit description of a
requirements category that is incorporated in its ID as a letter.
'Description' is a required field, and contains a description of a requirement artifact.
 'Rationale' is also a required field, there to contain a stated logical reason for a
given requirement artifact from a requirement elicited from a user.   'Priority' will
be informed by the elicitation process, this is also a required field. 'Supporting
evidence' is a required field that will contain a reference to any evidence that has
been used to formulate the artifact. 'Date Created' this is a required field. 'Date
Reviewed' is not a required field. 'Changes' this is not a required field, it will be
used to log any changes to the requirement over its lifetime. Referencing the old
versions of the requirement artifact.

3.4 Storage of the requirements artifacts

There are a number of different methods that can be used to sort requirement
artifacts that are mentioned in the relevant literature, ranging from paper based
recording to object oriented database. Many requirement engineering projects
carried out in industry can contain thousands of artifacts, developed by teams
which are often distributed; containing artifacts which have a complex matrix
links between them. This project will have requirement artifacts that number in
the hundreds, developed by a sole researcher.   The storage method should be
appropriate to the projects scale. Due to the relatively small number artifacts and
a one researcher developing the artifacts it has been decided that a spreadsheet
would be used to store the requirements.

'Google spreadsheets' offer a free web based environment to store the artifacts.

There are a number of different criteria (as mentioned in this document) that the artifacts have to conform to in order for them to be consistent and accepted. These criteria can be implemented simply in 'Google spreadsheets'. For example, artifacts must contain an ID that conforms to a scheme. This can be enforced using the rules in the spreadsheet. Required fields can be enforced in the environment of the spreadsheet. It is possible to link documents, images and online resources to fields in 'Google spreadsheet'. Having the ability to link resources in this way is very valuable given that requirement artifacts are based on documented stated needs, these will be sorted in a number of different repositories. These links can also be used to connect requirement artifacts to one and other, this means that simple relationships can be instantiated. 'Google spreadsheet's' allow exportation for the data that is stored to a number of different formats including: Microsoft's excel, HTML, open document format, etc. This allows greater data sharing and manipulation options. 'Google's' platform is web based, this offers flexibility to access of the artifacts and manipulation of them. It is possible to access the artifacts from a mobile phone, iPad, and any other devices with an up-to-dated browser.

Figure.5 is an example of a requirement artifact in the spreadsheet. It has been created on the basis of the feedback given through the questionnaire. This example demonstrates how hyperlinks can be used to link relevant resources to the requirement artifact. This artifact also conforms to the criteria set out in section 3.2 giving a working example how these will be applied in practice.

Requirement ID:	S001	Category:	Service	
Description:				
Coffee sold in the shops should be made by a barista.				
Rationale:	There is a high percentage of participants of the questionnaire that indicated there preference of a barista over a coffee machine			
Priority:	High			Low
Supporting evidence:	Questionnaire "Cardiff Coffee Shops". Hyperlink: https://docs.google.com/spreadsheet/gform?key=0AkhRtWh8r5asdFBDRDFSVkxwRy1lelUzY0VCdmotWHc&gridId=0#chart			
History:				
Date Created:	09.12.12	Date Reviewed:		
Changes:				

Figure.5

Section 4: Conclusions and Future Work

An important conclusion from the research into requirements elicitation is that no 'silver bullet' method. Multiple techniques have to be used, the methods chosen offer a good platform to gather qualitative and quantitative data to develop the requirements. Those that have been implemented so far have been fruitful in providing data from the students and staff that can be used to build an initial set of requirements and inform the next stages of the project. A critical success factor for this project is getting the right people involved. This can be a difficult task, as was highlighted through difficulties in encouraging questionnaire respondents. Also administering the questionnaire on a person to person basis is very time consuming. Subjects are sometimes unwilling to take part. To encourage participation it is important to limit the disruption that the elicitation methods can cause to the participants. Developing methods that are accessible, at the convenience of the subjects can limit the effort on participation. This is an important lesson to take forward when conducting the focus groups. Quality is a recurring theme within this document and it is important this is maintained throughout the project for both requirements elicitation and management.

The developing and administering a focus group is going to be a challenge going forward with the project into 2013. Identifying the students and staff who do not use the coffee shops in the university is important. This demographic could potentially provide a rich source of requirements that need to be explored. Successfully doing this is another critical success factor moving the project forward. Continuous development of the requirement artifacts has to be done on a regular babes, inline with the feedback gather from the elicitation processes. This is imperative, requirements are developed iteratively, the sooner in they are defined the sooner they can be refined. This task will be concentrated on moving forward with the project.

Disputed some takes that were initially identified becoming irrelevant, the project has remained on course track with the Gantt chart developed as part of the initial plan. An example such an activity that became irrelevant is the assessment of the business needs of the catering and bars department. This was stated and duped because of the focus on the customer side of organisation. The Gantt Chart has been kept up to date throughout the project and has been modified in light of the findings set out in this document. The revised Gantt chart can be seen in Appendix.5

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