

**Design of a System to Track  
Work Progress for Raysonics**

by

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Submitted in partial fulfilment of the requirements for

the degree of

**BACHELORS OF INDUSTRIAL ENGINEERING**

in the

**FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND  
INFORMATION TECHNOLOGY**

**UNIVERSITY OF PRETORIA**

**PRETORIA**

**October 2008**

## **Executive Summary**

Raysonics is the leading non-destructive testing company in South Africa. Raysonics is contracted by Eskom to undertake non-destructive testing of maintenance work carried out at some of their power stations, mainly in Mpumalanga and Gauteng. This project will be done at a power station called Kendal.

The project evolved from a problem that Raysonics experiences particularly during Eskom maintenance outages, when they struggle to follow work progress. This has a negative influence on their control of tasks being performed, which in turn impacts on their overall work performance. In addition, Raysonics has no system in place to track the movement of equipment, with the result that equipment is frequently lost or stolen, which has a negative effect not only on the company's work performance but also its profit margin.

This project started with an analysis of the problems Raysonics wanted to solve. This generated an overall view of the flow of information and tasks that are performed during an outage. The work procedures and protocol were also discussed.

The analysis phase was followed by an examination of literature sources and a literature study was undertaken on information on possible solutions as well as a review of tools and techniques that could possibly be used. After the literature study the development of the logical design was described, containing first an analysis of the interaction with the system and system requirements, second a top down analysis of both phases and third an analysis of the data flow for each phase. Data models for both phases were constructed. Systems for both phases were built according to the logical design and were implemented.

The systems that were developed were designed to ensure a quick fix solution for Raysonics. The systems are therefore not built exactly according to the logical design. The systems are implemented prototypes that will be re-developed to ensure better maintainability, flexibility and customer satisfaction.

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## **1. Problem background**

Raysonics is a company that mainly undertakes non-destructive testing (NDT) on power stations, draglines, railways and castings. The company has three branches, namely in Middleburg, Secunda and Vereeniging and is contracted by ESKOM to undertake all NDT relating to scheduled and unscheduled maintenance carried out at their power stations. The proposed project will be undertaken for the Middleburg branch, and pertains specifically to a power station called Kendal.

Most Raysonics testing takes place during a shutdown of the units at a power station. The main NDT consists of wall-thickness testing, and is performed to determine the thickness of the tubes on the inside and outside of the boiler (units). The results of the wall-thickness test reports are analysed by Eskom's engineering team to determine which tubes have to be cut and replaced. The replacement is performed by a company called Babcock, who cuts out the damaged tube segment and welds in an undamaged new segment. During the repair process Raysonics tests the new welds to determine if the welding is secure/adequate, by means of radiographic techniques.

Raysonics also uses a number of other non-destructive tests, such as magnetic particle inspection (MPI, which is used to reveal cracks on surfaces), liquid penetrating testing (DIPEN, which is also used to reveal surface defects), ultrasonic testing (UT, which is used to detect defects within the metal) and various visual inspections. Although all these inspections are used at a power station, the majority of work consists of the wall-thickness testing and radiography testing.

Currently the work progress is tracked only by reviewing the reports that have been completed.

Raysonics have contracts at a number of power stations. Raysonics staff members are not assigned their own equipment and neither are they assigned to specific power stations. Rather, staff (with the required equipment and tools) is assigned tasks on an ad hoc basis. Equipment used for maintenance travel between these power stations as the equipment is needed. The current system does not provide for monitoring of the movement of equipment, nor does Raysonics keep track of what equipment has been assigned to whom.

## **2. Project aim**

Eskom loses money for every day that a unit at one of their power stations is not running. Therefore it is essential to know the exact status of the work progress. With the current power shortage in South Africa it is even more important for Raysonics carry out the testing in the least amount of time, and know exactly at all times what the status of work is.

The site manager at Kendall power station was the one who realised the need for a new system. He approached the student, explained the problems they are having and asked if he could possibly devise a solution. The project was undertaken to solve a Raysonics problem, but Eskom is certain to derive benefit from it.

The current system is that the work progress is followed by means of Excel spreadsheets and by reviewing completed reports. This system is inadequate, for it takes a great deal of enquiry from various parties to determine the status of work progress at any point in time.

The aim of this project was first to enhance the ability of Raysonics to follow work progress, taking the shortest possible time to enter necessary information into the system, and second to have more up-to-date information on employee activities and the work that is being done at all times. This will ensure better control over the work and potentially accelerate the workflow. Raysonics also requested that a system to ensure efficient tracking of the movement of equipment (between different power stations) and assignment of equipment (to specific employees) be developed as part of the project.

Ultimately, it should be possible to integrate the final solution into the current overall system so that it complements the maintenance schedule followed at the Eskom power stations.

## **3. Problem rationale**

The contract that Raysonics has at Kendal power station is one of their biggest contracts and it is therefore essential that they continuously improve the quality of work and stay ahead of their competitors. Raysonics has to submit tenders for the contract on an annual / five-yearly basis.

In view of the current power shortage in South Africa it is essential that Eskom keep maintenance time as short as possible. This impacts on Raysonics, too, for if the company is

able to improve the quality of inspections, it will result in more efficient and better quality maintenance, which will in turn mean not only that less time will be spent on scheduled maintenance but that there will be a smaller probability that unscheduled maintenance will be required.

If a faulty tube or weak tube occurs it could result in a tube leak, which means that the power station has to shut down so that unscheduled maintenance can be carried out. Raysonics must then be in a position to not only test the maintenance work as it is performed, but also to know at all times what the progress is of each segment of the work – how far it has progressed, how long it will take to complete, what problems are being experienced, and so on.

If Raysonics is able to add value to the work they perform for their clients, in the form of a realistic assessment of how long testing will take, the company will be able to retain its position as the leading NDT company in South Africa and enhance its status in the industry.

The other side of the equation is that lack of an adequate system to track the work progress is negatively impacting on the work performance of Raysonics, for a number of reasons:

- It is time-consuming to check the work progress at present;
- If a problem occurs, one of the other stakeholders could easily blame Raysonics, and Raysonics would find it difficult to defend itself without the necessary underlying documentation;
- Raysonics does not always know what each employee is doing (at present it is not possible to determine how much time an employees spends on a particular task, particularly with regard to a comparative standard of how long it should take); and
- It is almost impossible to determine if all required inspections were actually carried out – it is very difficult to pick up that an inspection was missed.

## **4. Deliverables**

### **4.1 Raysonics deliverables**

- Project proposal and proposed solution 5 April 2008
- Progress report July 2008

- Preliminary solution implementation August 2008
- Prototype implementation and integration October 2008

#### 4.2 BPJ deliverables

- Project proposal for assessment 18 March 2008
- Preliminary project for assessment June 2008
- Presentation and oral examination June 2008
- Final project for assessment 25 October 2008
- Final presentation and poster 29 October 2008
- Project seminar 5 November 2008

### 5. Problem analysis

The following table describes the stakeholders involved in an outage, which will enhance a better understanding of the overall business context and interests involved in the business:

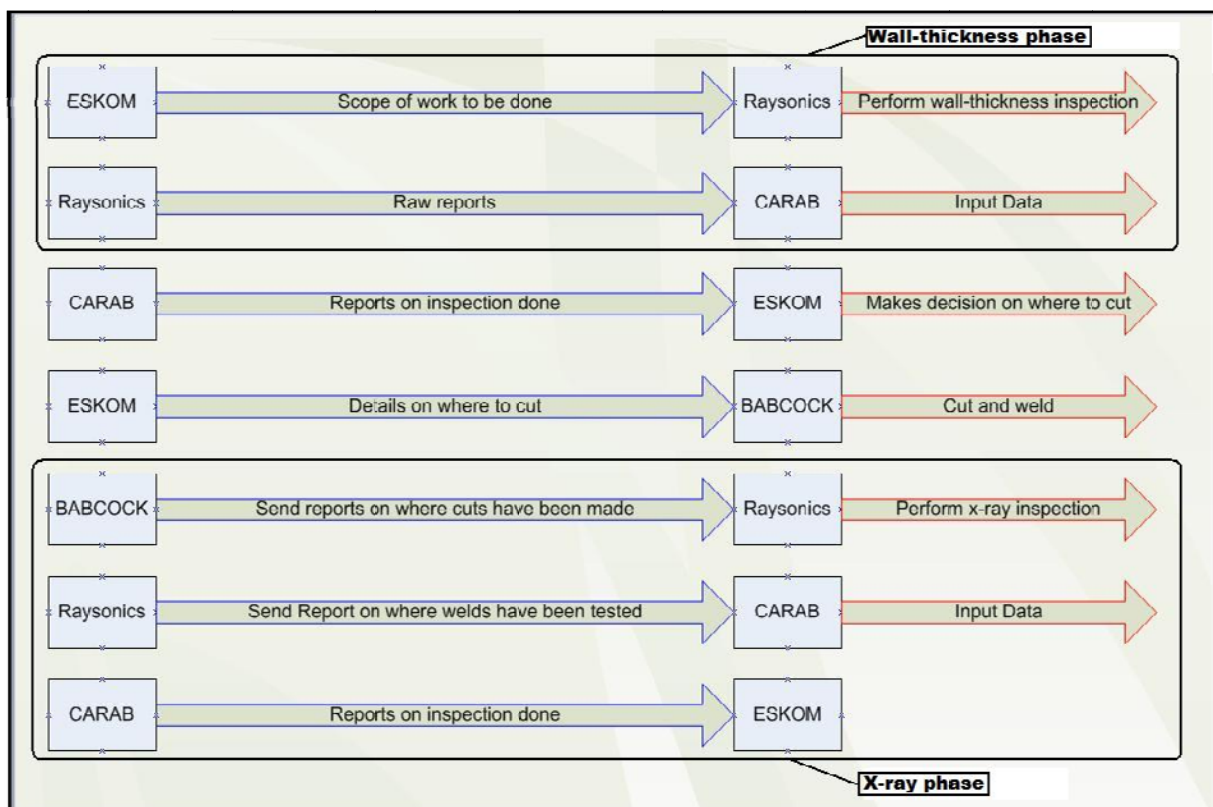
**Table 1: Description of stakeholder involvement in outages**

Stakeholder	Description
Raysonics	Raysonics is contracted by Eskom to inspect all replacement parts installed during the maintenance process
Babcock	Babcock is contracted by Eskom to perform the cutting and welding on components that have to be replaced
Eskom	Eskom is the main contractor and all maintenance takes place at Eskom locations
Carab	Carab is under contract to Raysonics, who uses their system to enter readings obtained by Raysonics. Raysonics also uses the Carab system for the generation of reports that are sent to ESKOM's engineering team.

The table shows not only that each of the stakeholders performs a vital function, but that there is an interactive relationship between them. The information flows from one stakeholder to the next, forming an essential link in the chain of work to be performed and checked. All stakeholders play a crucial role in completing a successful outage: If one fails to perform its function it impacts on the performance of the whole maintenance process and the quality of service to Eskom.

The flow chart below illustrates the chain of events that take place during maintenance. The blue arrows indicate the flow of information while the red arrows indicate tasks to be performed.

**Figure 1 - Information flow during outage**



For the purpose of this project the student concentrated on the two segments that form the *wall-thickness phase* and the *x-ray phase*, as these are the phases which the student was appointed to improve. It is evident from the chart that these phases take into account all the areas in which Raysonics is involved.

The three other inspections that Raysonics performs at the power station, namely magnetic particle inspection, liquid penetrating testing and ultrasonic testing, follow the same path as the wall-thickness testing. However, these inspections make up only 10% of the total workload and the tasks involved in their performance do not form part of the critical path of outages. For this reason the processes involved in these inspections did not form part of this project.

## 5.1 Work protocol

Three types of scheduled maintenance outages occur, namely a GO (general outage), GI (general inspection) and BTI (boiler tube inspection). The scope of work is determined by the type of outage. A GO outage is the biggest outage, followed by a GI and then BTI outages. From the point of view of Raysonics the type of work is the same, but the size (and urgency of completion) varies. For purposes of this project only the work protocol followed during a GO outage is described.

From the nature of the work most of the Raysonics tasks are performed at the power stations. Obviously this is where the testing has to be done, and to save time and for the sake of convenience, Raysonics has a permanent office at each major power station and erects a cabin inside the unit itself, where the data are processed and the final reports prepared to facilitate Raysonics activities. However, the cabins inside the unit itself are temporary structures, built and used only during the outage itself.

In order to determine the exact location where the inspections have to be performed, the work is divided into segments called *where failures*. Each *where failure* consists of a *component*, *sub-component* and *area number* to identify a certain area. Each area has a certain number of *tubes* (carbon steel pipes) and *elements* (row of tubes). Most of the wall-thickness testing is done on these tubes. Raysonics stores all the templates for the GO outage in Excel format, sorted under the heading of *where failures*.

## 5.2 Wall-thickness phase

This phase takes up about 50% of the workload and is the most crucial part of an outage.

Once the scope has been determined by ESKOM and passed on to Raysonics, templates are handed out to the wall-thickness supervisor. The supervisor in turn hands the templates to the

wall-thickness technicians. The technicians take the actual measurements on site and fill them in on the templates. An assistant, who is responsible for writing down the measurements taken by technicians, is assigned to each technician. These steps are performed on a daily basis.

Before any area can be inspected (tested), it has to be prepared by Eskom:

- The area must have been washed, as a lot of ash settles when a unit is shut down. The unit must be tested for any harmful chemicals.
- Technicians must have proper access to the area (via scaffolding).
- The area must be properly lit.

Each piece of equipment that the technicians use is assigned a unique identity number. The equipment includes the following:

- Wall-thickness meter;
- Probes (to use on the wall-thickness meter);
- Safety belts (technicians often have to work on high structures and temporary scaffolding); and
- Step wedges (used to calibrate their wall-thickness meters).

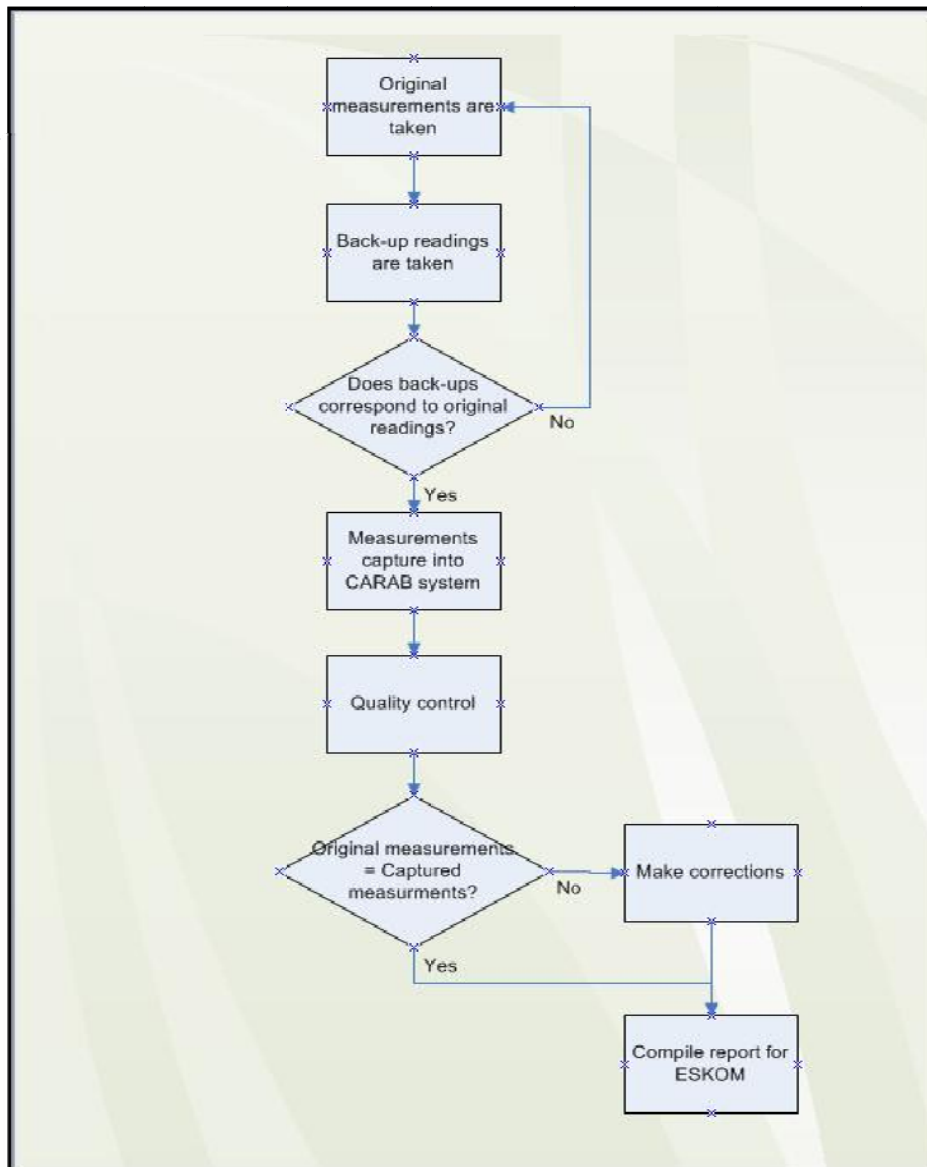
Keeping track of the equipment is a serious problem for Raysonics, as no records kept on what equipment is assigned to which technician.

Predetermined numbers of each type of equipment is kept on each site, but if necessary equipment may be sent to or received from other sites (power stations). At the moment recordkeeping on the movement of equipment is poor.

Once the original and back-up measurements have been completed, the technicians hand the templates (which have now been filled in by hand) in at the cabin on site where data capturers input the measurements into the Carab system. The next step after all the measurements of a *where failure* have been captured, is to print a report of the measurements. The printed report goes through a quality control process, in which it is compared with the original (written) measurements on the template. Once corrections have been made, the corrected report is compiled and sent to Eskom. Eskom uses the report to decide on the acceptable cut-off

measurement, and thus determines which tubes need to be cut and replaced. The flow chart illustrates the tasks that are performed during the wall thickness phase:

**Figure 2 - Wall-thickness phase flow**



The following personnel are involved in the wall-thickness phase:

- 1 site manager
- 1 supervisor
- 2 office personnel

- 5 to 20 wall-thickness technicians (depending on the type of outage)
- 2 to 3 data capturers
- 1 employee to perform quality control

ESKOM requires that every Raysonics employee working at any of its sites undergo a medical inspection at least once a year. Certain jobs are also subject to a minimum qualification in terms of the ESKOM contract. Both the medical inspection and qualifications have an expiry date. If the medical or qualification certificate of any employee on site has expired, Raysonics will be held accountable.

### 5.2.1 Problems experienced during this phase

- No record is kept on where the technicians are working or which *where failures* were assigned during a particular day. This makes it very difficult to locate a technician or determine how long the technician took to complete his tasks on one area.
- Measurements are only captured into the system after *back-ups* have been taken and verified. No records are kept on the status of templates. This adds to the difficulties in determining the status of work – completed, incomplete, not yet started.
- Few records are kept on the movement and assignment of equipment or assistants. Because it is difficult to determine responsibility if equipment is stolen, broken or lost.
- Before reports can be sent to Eskom, original and back-up measurements must be taken, measurements must be captured and quality control must be performed. Little to no record is kept about the status of these tasks. Again, this adds to the difficulties in determining the status of work projects.
- No records are kept on the medical or qualification expiry dates. Given that Raysonics employs up to 50 persons at various sites, it is very difficult to keep track of the situation regarding medicals and qualifications from a managerial point of view.
- There is a lack of communication between supervisors, data capturers and technicians.

### 5.3 X-ray phase

This phase takes up about 40% of the workload.

X-rays are a very good method for detecting defects within metals. The x-rays are taken by means of radiation: gamma rays are sent through the metal which creates an image on a film which is placed on the other side of the metal. This process makes it possible to see defects by inspecting the film.

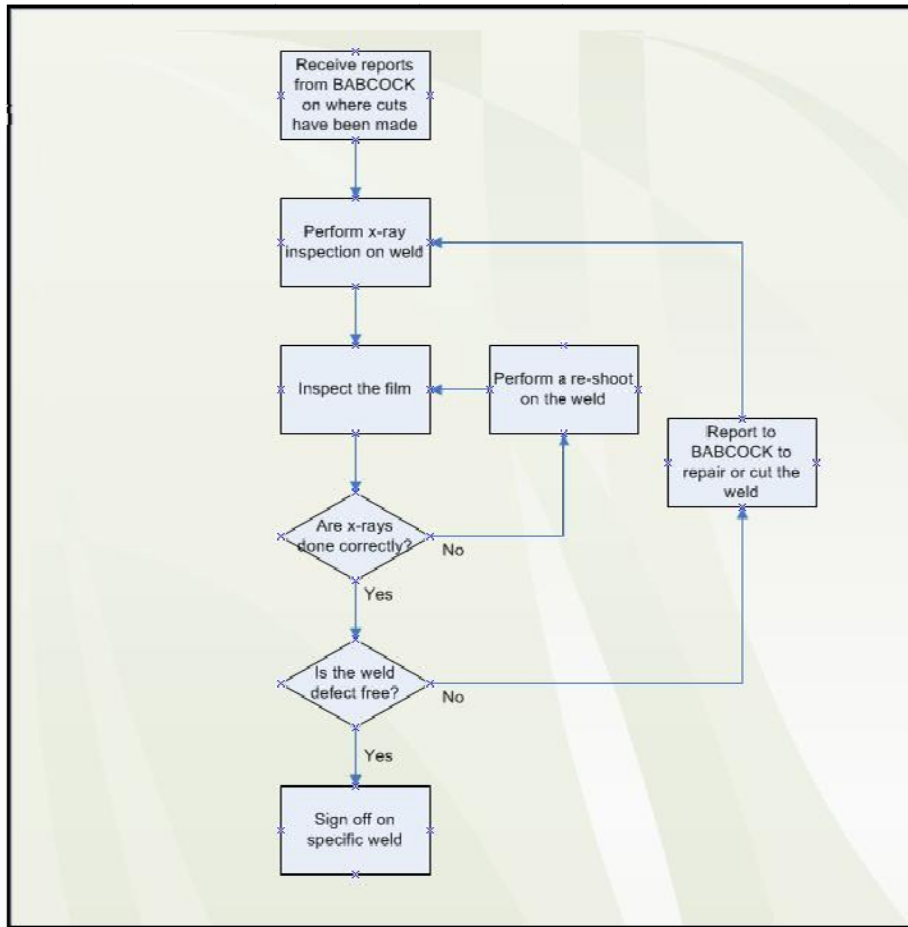
In order to keep the time of an outage as short as possible, the x-ray inspection takes place in parallel with the other phases. The x-ray inspection starts as soon as the first cuts have been made by BABCOCK. Because radiation is used during the inspection process, most tests are performed during the night (19:00 to 07:00 shifts) to limit exposure to other workers.

Once BABCOCK has made the cuts they send a report to Raysonics, which indicates the location of the welds. A *process card id* is also assigned to each weld for identification purposes. Each *process card id* is unique and identifies a specific weld.

Once the films of the x-rays have been developed, they undergo an accept / reject process by three people, namely the x-ray supervisor, the quality controller and a third party. The accept / reject decision is based on two criteria: First, was the x-ray taken accurately enough to pick up the defects, and second, was the welding done correctly. If the image on the film is not accurate, the x-ray has to be repeated. This is called a *re-shoot*. If the weld was not done correctly BABCOCK is informed and they have to repair the weld or cut it again. In such cases a new *process card id* is assigned to that weld.

The x-ray phase is diagrammatically illustrated in the flow chart in figure 3.

Figure 3 - X-ray phase flow chart



Currently no records kept on *re-shoots*, *repairs* or *cuts*. Neither is it possible to determine which technician did which x-ray. No records are kept on the welds, regardless whether they have been signed off or not.

Although the x-ray phase does not make up the largest percentage of the Raysonics activities, it is extremely important that it is executed correctly as this is the last inspection before the unit goes back on line. Eskom loses millions of rand for every day that one of the units is not running. As an unscheduled maintenance event means that the unit will be off for at least three days, it is of the utmost importance that Raysonics exercises control over the flow and correctness of information during this phase.

The following personnel are involved in the x-ray phase:

- 1 site manager
- 1 supervisor
- 1 office employee
- 3 to 7 x-ray technicians (depending on the type of outage).

### 5.3.1 Problems in this phase

- The present system does not detect duplicate *process card ids* that may be assigned to the same weld.
- If an inspection is requested on a weld that has already been tested, it will only be discovered once the technician is at the weld.
- It is very difficult to determine the progress of work.
- It is not possible to determine what or how much work each technician did.

### 5.4 Restrictions and constraints

- BABCOCK was not willing to co-operate with the project.
- The budget for the purchase of a system is limited at R10 000.
- The designed/purchased system must be able to work over a network.
- The data capturers and office personnel only have grade 12 qualifications, which mean that the system must be easy to operate.
- Raysonics wants to implement a self-hosting system, that is, not one which is internet based.

## 6 Literature study

The project aim is to improve Raysonics's management of work progress. There are also two subsidiary aims, namely to improve control over equipment and medical and qualification expiry dates. In view of the varied flow of information and the amount of data that must be acquired, captured, processed and stored, the most effective means of solving the problem was to put in place some kind of computer information system.

According to pcmag.com (2004) an information system may be defined as "A business application of the computer. It is made up of the database, application programs and manual and machine procedures. It also encompasses the computer systems that do the processing".

The student had to make a decision about whether a product should be bought or whether a system should be designed and built. This section documents the research the student undertook with regard to systems that are currently available as well as his evaluation on whether one of the available products could be used to satisfy the needs of the client as set out above.

Products that were considered are provided by the following companies:

## **6.1 Companies and products**

- HighOrbit
- Lombardi
- TIBCO.



### **6.1.1 HighOrbit**

HighOrbit specialises in business process automation. HighOrbit (2008) defines business process automation as the utilisation of computer software to design, execute, track and archive business processes that require manual interaction by employees.

According to the company “HighOrbit Workflow is a Business Process Management system developed with the dynamics of corporate processes in mind. With little more than an internet connection, the HighOrbit Workflow system allows you to regain control of your company's processes and develop new business processes with ultimate efficiency. The product is so easy to use that its process design tool requires little or no technical experience. This feature makes HighOrbit Workflow ideal for your entire team, regardless of their experience” (HighOrbit 2008).

This company offers the following products:

**Table 2: HighOrbit product description**

Product	Description
<p data-bbox="188 383 464 524">HighOrbit Workflow Web Service</p> 	<p data-bbox="486 383 1399 745">For smaller companies (up to 125 users) HighOrbit offers a workflow web service for workgroups. This allows an organisation to automate and access their process data using only an Internet connection. All of the back-end hardware, databases, backups and maintenance are handled by HighOrbit. The costs add up to a R2 250 initial cost and a R1 200 monthly cost. There is no hardware or software to maintain, and all software upgrades are available immediately.</p>
<p data-bbox="188 786 464 927">HighOrbit Workflow Automation Server</p> 	<p data-bbox="486 786 1399 1149">For companies with more intensive needs, HighOrbit offers process automation software for standalone and dedicated servers. HighOrbit's software works with a variety of operating systems and back-end databases such as the Microsoft SQL Server and MySQL. Running a dedicated server will allow companies an easy tie-in to their existing systems and data and integrate their processes and workflow. The total cost of this server is R24 750.</p>

The biggest advantage of both products is that they are user friendly, thus satisfying one of the essential requirements for the chosen system.

The HighOrbit Workflow Web Service is not suitable for this project because it requires an internet connection, which is not available on the sites. In the case of each outage a cabin is set up in the unit where maintenance is scheduled. This means that in order to have an internet connection during an outage, it would have to be set up in the cabin before each outage. Although this would still be possible during a scheduled outage – albeit very time consuming and expensive – it would not be feasible during an unscheduled outage at all. Raysonics would thus only be able to use such a system part of the time. On the other hand, a network is already in place which would make it possible to set up a self-hosted system. The cost would furthermore make the system too expensive, given the budget constraints of the project.

The Workflow Automation Server was also rejected, as it is primarily designed for product flow. The system required for Raysonics is one that would be suited to the tracking of jobs/tasks rather than products, as Raysonics is a service company. This product will also exceed the project budget.

Solutions that HighOrbit provide have been set out in appendix A.


### 6.1.2 Lombardi

Lombardi specialises in business process management.

Lombardi believes that a process-driven approach is the best approach for solving the type of problem this project needed to solve. They deliver a suite of Business Process Management (BPM) software and services that enable organisations to become process-driven in a very short time.

There was one Lombardi product that seemed to have application possibilities for the project and was investigated further, namely Teamworks 6.

**Table 3: Lombardi product description**

<b>Product</b>	<b>Description</b>
Teamworks 6 	This product controls the key processes of a company. The BPM suite allows a company to build, manage and optimise the way in which its people and processes work

The product focus here is more on the analysis and improvement of business processes, based on an overall inspection. With this product it would not have been possible to follow the work process in as much detail as was required by Raysonics. The aim of this project was to enable Raysonics to follow, and not primarily optimise, work processes (and progress) and therefore this product was not suitable. Because of its total unsuitability, it was not considered necessary to even enquire about the cost.

Research also indicated that there are disadvantages to using Teamworks 6. One of these is that although Teamworks uses standard Business Process Modelling Notation for designs, its runtime engine is proprietary. Furthermore, according to Borck (2007) “the business rule

development tools are well put together, but not quite as easy to use”. With regard to Raysonics, the employees who will work on the selected system only have grade 12 qualifications and are thus likely to find it difficult to operate if the software is complicated.

A positive feature of this BPM suite is that extensive use was made of charts and graphs to analyse tasks. This could potentially be a very useful tool, and if at all possible should form part of the chosen system.


Further features of Teamworks 6 are set out in appendix B.

### 6.1.3 TIBCO

The product of TIBCO that on the face of it seemed suited to the project was its business activity monitoring (BAM) software.

According to TIBCO (1999) “Business activity monitoring (BAM) refers to the aggregation, analysis, and presentation of relevant and timely information about business activities inside your organization and involving your customers and partners. BAM provides more accurate information about the status and results of various operations, processes, and transactions so you can make better decisions, more quickly address problem areas, and reposition your organization to take full advantage of emerging opportunities.”

**Table 4 - TIBCO product description**

<b>Product</b>	<b>Description</b>
<p>TIBCO BusinessFactor</p> 	<p>This product provides powerful business activity monitoring software. It provides a visual and interactive interface that makes it easy to analyse operations in the context of business objectives, past performance, and current conditions. The product makes it possible to identify and address risks and opportunities quickly and intelligently.</p>

TIBCO BusinessFactor only provides packaged solutions for certain areas, which have been set out in appendix C. However, none of the packaged solutions provided a solution to the problems related to this project. This meant that TIBCO BusinessFactor would have had to

design a new solution, which would have resulted in the project exceeding its budget as the quote for a new design was R25 000.

#### **6.1.4 Product decision**

After an analysis and comparison of the off-the-shelf products that were available, the conclusion was that a system would have to be built. This decision was based on the following reasons:

- A product could not be found which would allow the project to stay within budget.
- By building an information system it would be possible to create a system specifically to solve the problems related to this project. This would allow for a smaller but more specialised system.
- A custom designed system will allow Raysonics to have full control of the functions and workings of the system.

#### **6.2 Tools and techniques to be used**

The tools and techniques that could possibly have been used to analyse and design the information system are listed below.

##### **6.2.1 Object-oriented analysis and modelling**

Object-oriented analysis is defined Bentley and Whitten (2007) as “an approach used to (1) study existing object to see if they can be reused or adapted for new uses and (2) define new or modified objects that will be combined with existing objects into a useful business computing”. They further state that object-oriented approach is centred round a technique called object modelling. This technique prescribes the use of methodologies and diagramming notations that are completely different from the ones used for data modelling and process modelling.

Establishing an object model in general consists of a consideration of the following elements (as are defined in TIME Electronic textbook v 4.0 1999):

- Object classes with attributes, relations and connections
- Relations
- Attributes
- Connections

- Generalisation/specialisation
- Aggregation
- Classes with constraints on their environments
- Behaviour associated with the object model
- Localisation.

Definitions and explanations of elements are provided in appendix D.

### 6.2.2 Unified modelling language (UML)

Song (2006) defines UML as follows: “The Unified Modelling Language (UML) is a general-purpose visual modelling language that is used to specify, visualize, analyze, and document the artefacts of a software system. It captures decisions and understanding about systems that must be constructed. It is used to understand, design, browse, configure, maintain, and control information about systems.”

### 6.2.3 Use case diagrams

Use case diagrams are used frequently in object-oriented design and more specifically in UML and can be defined as a diagram that depicts the interactions between the system and external systems and users (Bentley & Whitten 2007). In other words, it graphically describes who will use the system and in what ways the user expects to interact with the system.

According to Ambler (2006) a use case diagram depicts the following elements:

- **Use cases.** A use case describes a sequence of actions that provide something of measurable value to an actor and is drawn as a horizontal ellipse.
- **Actors:** An actor is a person, organisation or external system that plays a role in one or more interactions with your system. Actors are drawn as stick figures.
- **Associations:** Associations between actors and use cases are indicated by solid lines in use case diagrams. An association exists whenever an actor is involved with an interaction described by a use case. Associations are modelled as lines connecting use cases and actors to one another, with an optional arrowhead at one end of the line. The arrowhead is often used to indicate the direction of the initial invocation of the

relationship or to indicate the primary actor within the use case. However, because arrowheads are typically confused with data flow, the student avoided their use.

- **System boundary boxes (optional):** A rectangle can be drawn around a use case, called the system boundary box, to indicate the scope of the system. Anything within the box represents functionality which is within the scope whereas anything outside the box is not.
- **Packages (optional):** Packages are UML constructs that enable one to organise model elements (such as use cases) into groups. Packages are depicted as file folders and can be used on any of the UML diagrams, including both use case diagrams and class diagrams.

A use case diagram is a handy tool for analysing the phase of an information system that is being built and has both positive and negative features. According to Henney (2007) use case diagrams are useful for showing the system context and could also provide a diagrammatic summary of the functional goals that have been fulfilled by the system. A large drawback of this type of diagram is that the diagrams do not present architectural models, user-interface models or workflow models (Henney 2007). An example of a use case diagram is provided in appendix E.

#### 6.2.4 Microsoft Access and SQL

According to PROACE (1999), MS Access, a database software provided by Microsoft, is the bestselling database in the world because it comes bundled in Microsoft Office Products. Access is noted for its friendly user interface and ease of use. It is an excellent tool for small to medium size applications.

Squared (2007) noted that one problem with Access is that no more than 12 users can successfully use a networked Access application before the delay in connections through the file system becomes problematical. Therefore a determination will have to be made of the (maximum) number of users that are likely to use the system at any specific time before Access can be seriously considered for the project. Squared (2007) also states that Access has a file size limitation of 2 gigabytes of data. This means that unless the proposed system falls within this limitation, it will not be suitable.

Microsoft Access is also not the most secure system. Therefore the required security level of the system could mean that this system would not be acceptable.

From the above it is clear that Access does have limitations, but would work well in some instances. According to Rhine (1996) MS Access is a powerful, Windows-based database management package with excellent sort and retrieval options, internal calculating capabilities and a desktop publishing component.

A second option is the SQL Server. Chung and Haught (2005:2) performed a very useful comparison of the features of Access and the SQL Server, which is summarised in table 5.

**Table 5: Access and SQL comparison**

	Access	SQL Server
Description	A database development environment that supports tables, queries, forms, reports and programming logic	Scalable and reliable. It offers a more secure client/server database engine than access.
Maximum database size	2 gigabytes	1 terabyte
Maximum concurrent users	Up to 20 concurrent editors Up to 100 concurrent reports being run	Unlimited
Security	File access-based security	Enterprise-level security
Performance	Limited by file share model	Limited only by hardware and application design
Reliability	Adequate for use by individuals and small teams Recovery from network failures cannot be rolled back	High reliability. The SQL server is a mission-critical database Backup and administration tools are available

In sum it would seem as if Microsoft Access offers a cost-effective and quick solution for a wide range of common database challenges in Windows, whereas the SQL Server would be the best option for more complex solutions (Chung 2004).

Further advantages and disadvantages of Microsoft Access and the SQL Server are provided in appendix F.

For purposes of this project Microsoft Access was considered to be the best database software choice for the following reasons:

- The proposed system will not exceed the complexity limitations of Access;
- A maximum of five users will use the system at the same time. This means that even if the company expands considerably during the next few years, the system will remain adequate;
- The required capacity of the system will not exceed Access limitations;
- The security level provided by Microsoft Access is sufficient for the proposed system;
- The Microsoft Access report generator is excellent; and
- Microsoft Access is designed for file server solutions on local area networks.

## **7 Design approach**

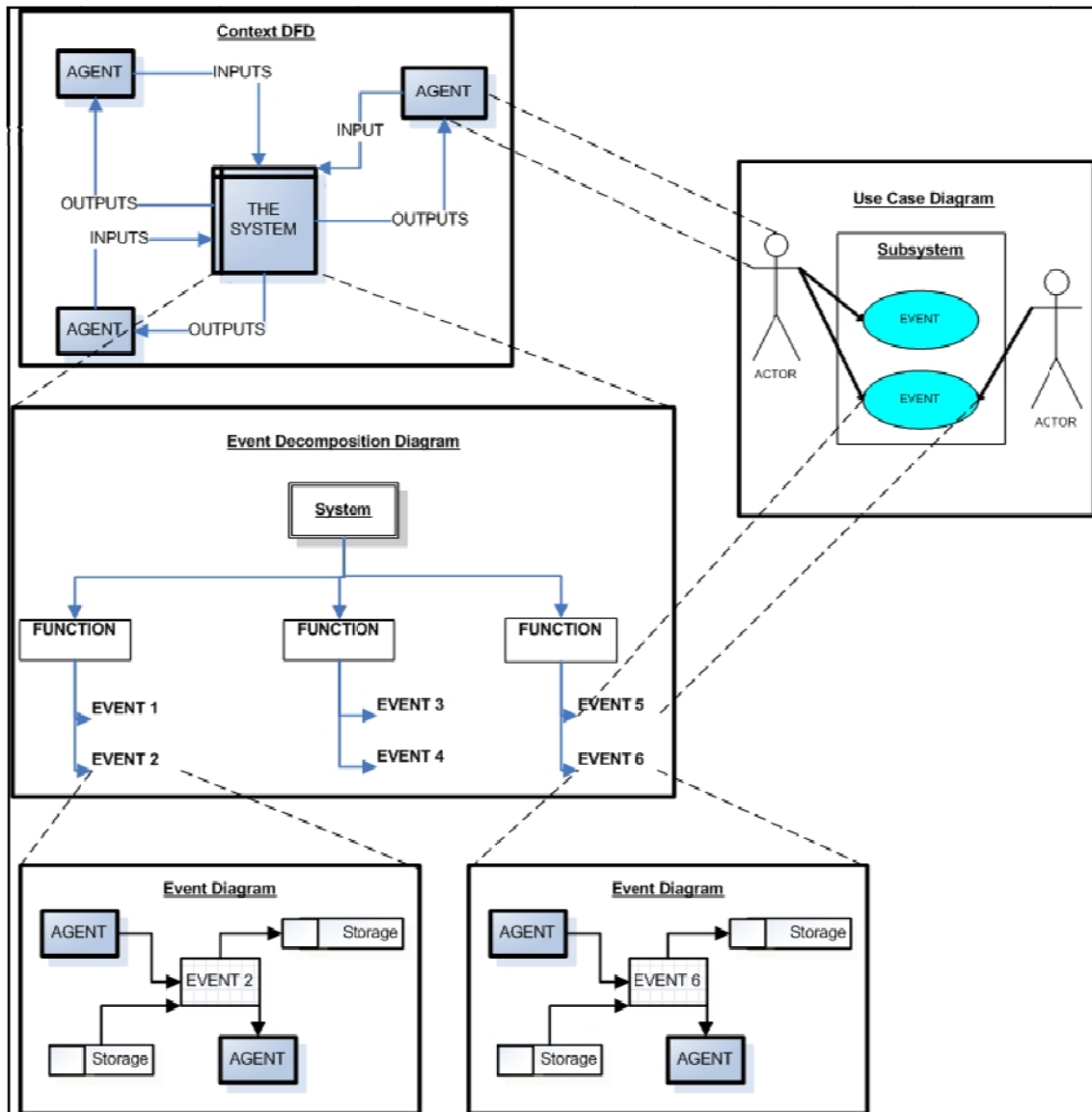
In view of the results of the literature study a meeting was held with the site manager, a director of Raysonics and supervisors to gain a better understanding of the functional and non-functional requirements of the system. The final decision was that the most effective solution to the problems would be to design a separate information systems for each of the two phases, for the following reasons:

- Actors from one phase are independent from the actors of another phase.
- Tasks performed during each phase are done by different technicians.
- Different personnel are used in each phase.
- Tests concerning each phase are performed during different shifts.
- Management may want to use only one of the systems at some sites, because both systems may not necessarily be required at all sites.
- User experience/interface simplicity may be compromised if system components are not separated.

Before the development of the conceptual design could commence a design approach had to be identified. Fortunately, despite the decision to use different systems, the same design

approach could be used for both phases. The design approach was put together by using elements from both object-orient (such as use case diagrams) and structured design (such as decomposition diagrams) elements. The design approach is illustrated in the following figure.

**Figure 4: Design approach**



### 7.1 Context data flow diagram

The context data flow diagram (DFD) shows the interaction with the system, in that the system is regarded as a black box and the inputs and outputs are defined in terms of the

external agents that impact on it. The context DFD was used to define the scope of the system.

## **7.2 Event decomposition diagram**

The decomposition diagram was used to analyse the system by means of a top-down approach. This diagram shows the decomposition of the system down to the events that the system must be able to handle, as well as the hierarchy of components (events) within the system.

## **7.3 Use case diagram**

The use case diagram illustrates the interactions between the system and users/actors. It shows not only a decomposition of the system as a whole, but also in what events each user/actor will be involved. Both the use case diagram and the context DFD were used to analyse the system interaction.

## **7.4 Event diagram**

The event diagrams demonstrate the data flow for each event, in each case showing the agents and data stores involved in each event.

## **7.5 Entity relationship diagram**

The ERD (entity relationship diagram) is not shown in the figure but will be used to depict data in terms of the entities and relationships described by that data. The ERD was used during the physical construction as the data model.

# **8 Development of the logical design**

## **8.1 Wall-thickness phase**

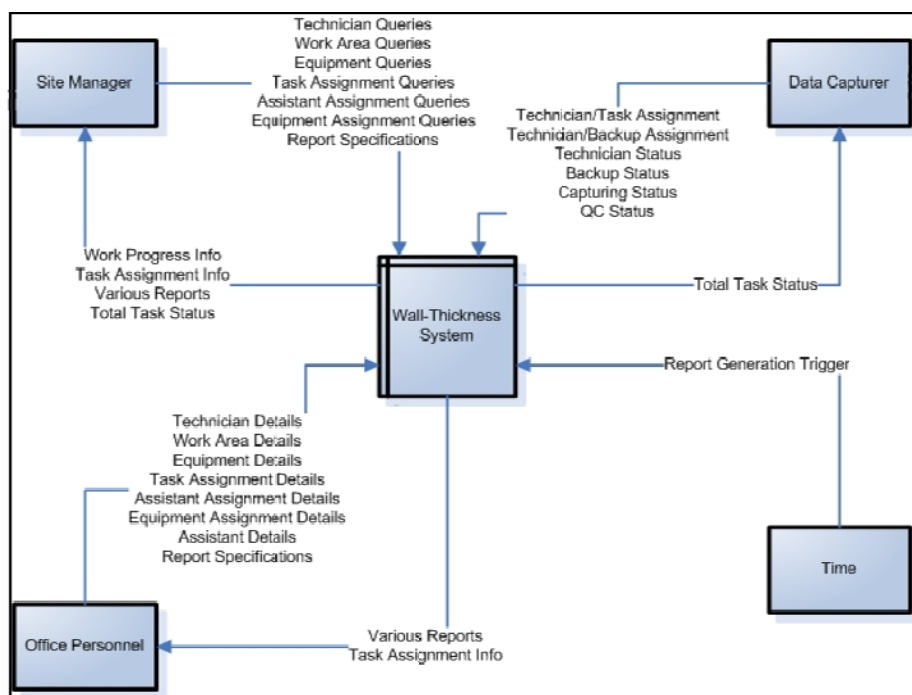
The design for the wall-thickness phase concentrates on management of equipment as the most equipment is used during this phase. However, Raysonics has requested that it should be possible to apply the same system to equipment used for the other inspections, with the exception of equipment for the x-ray phase.

Because some the equipment used during the x-ray phase could be very dangerous, it is already managed by means of well-designed company procedures. Furthermore, the equipment used for the x-ray phase requires different procedures than the other equipment.

### 8.1.1 System interaction

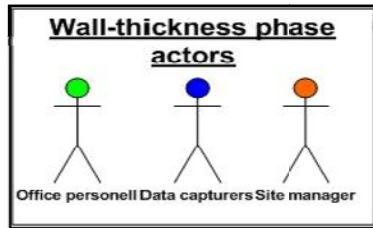
The content DFD approach, based on the black box concept to define inputs and outputs of the system, was used to determine the scope of the system and define it. The information flow for the wall-thickness phase is depicted in the following figure:

**Figure 5: Wall-thickness phase context data flow diagram**



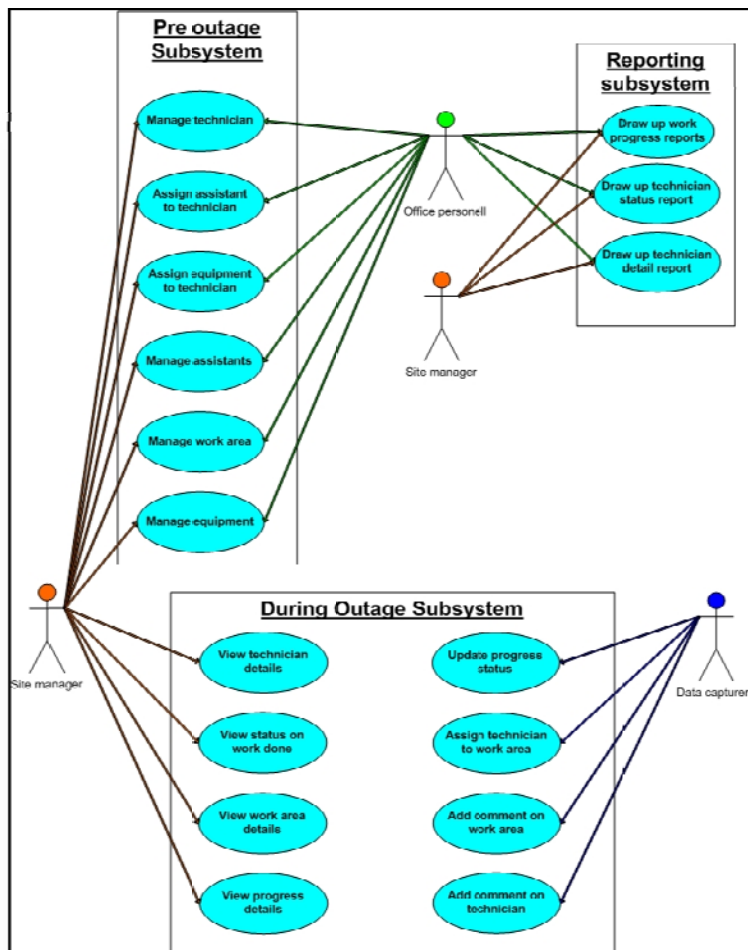
After the analysis of the current system had been completed, the actors who were involved during this phase were identified:

Figure 6: Wall-thickness phase actors



Once the information flow and actors had been identified, it was possible to construct a UML use case diagram, which served as the basis for an in-depth analysis the functional requirements of the system.

Figure 7: Wall-thickness phase use case diagram



The analysis of the use case diagram revealed the following requirements for the system:

- The system must be able to follow work progress.
- It should keep information on when work was assigned (Excel *where failures* spreadsheets) and where technicians are actually performing tests.
- Track the work that each technician has completed.
- Track what work still needs to be performed.
- Keep and track information on technicians (what equipment was assigned to them, based on identification numbers assigned to meter equipment, safety belts and other equipment, and so on).
- Keep track of equipment (assigned to technicians and booked in/out to/from site)
- Track the status of each work area, with regard to
  - inspection,
  - data capturing,
  - quality control, and
  - overall status.
- Show relative information of work areas.
- The system should be able to provide accountability.
- It should be possible to print/view reports on the work progress.

The reporting must be as easy to extract and present as possible as at least one meeting takes place every day between the outage stakeholders. The Raysonics site manager must be able to print out up-to-date reports on the work progress for these meetings. This was not possible previously.

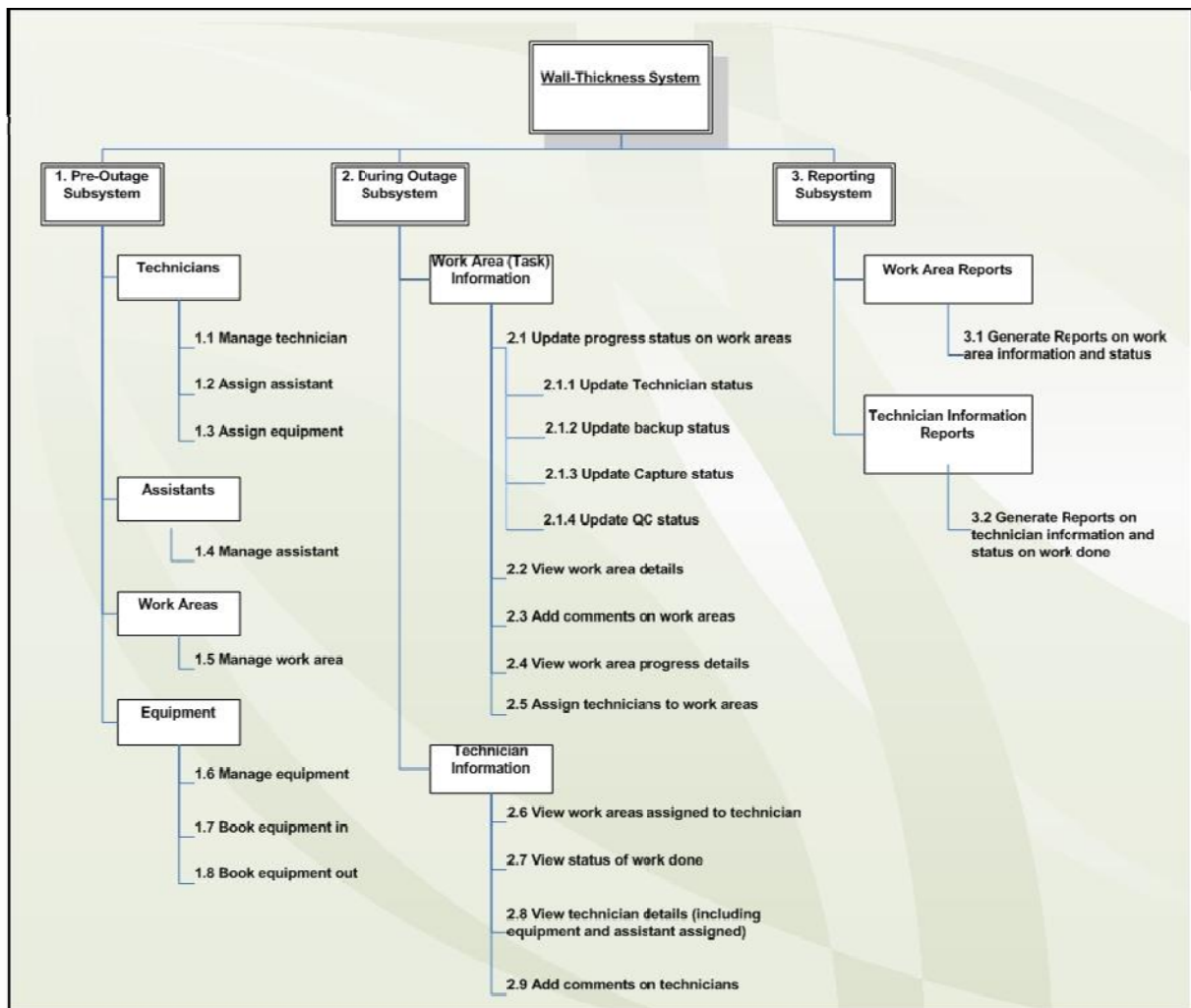
Some of the non-functional requirements that would improve the system include that

- the system must be as easy to use as possible;
- there should be minimum time consumption in entering data (Raysonics should not have to employ more data capturers); and
- data must be easy to retrieve.

### 8.1.2 Top down analysis

Before the physical building of the system commenced, an event decomposition diagram was constructed. The event decomposition diagram provided a further breakdown of the information in the functional decomposition diagram (the latter only depicts the system which is broken down into subsystems). The event decomposition diagram takes it a step further by breaking down the subsystem into components or events.

**Figure 8: Wall-thickness phase event decomposition diagram**



From the diagram it is clear that the system can be divided functionally into three subsystems, based on the work phases, namely a pre-outage, a during-outage and a reporting subsystem.

The **pre-outage subsystem** concerns all the events that occur before each outage. This includes the registration of all the technicians, assistants, work areas and equipment. These entities may also be modified and assigned under this subsystem. This subsystem will mainly be used before an outage, although it should also be possible to use it during an outage to update equipment, technicians, assistants, work areas and assistant/equipment assignment.

The **during-outage subsystem** concerns to the events that occur during a maintenance outage. This includes the assignment of technicians to work areas and the viewing of some statistics. The work area and technician status will also be updated here. The work area status will be divided into five elements, namely

- the technician work status,
- technician backup status,
- capturing status,
- quality control status, and
- total work status.

A work area will only be marked as completed if a true value has been assigned to each of the five elements.

The **reporting subsystem** will mostly be used during an outage and it should be possible to generate the following reports:

- Work area reports:
  - Work areas completed
  - Work areas not completed
  - Work areas in progress
  - Work area overall status
  - Work area with technician information/status.
- Technician information reports
  - Technician information on work done
  - Technician information on backup done
  - Work areas in progress
  - Work area status concerning technicians

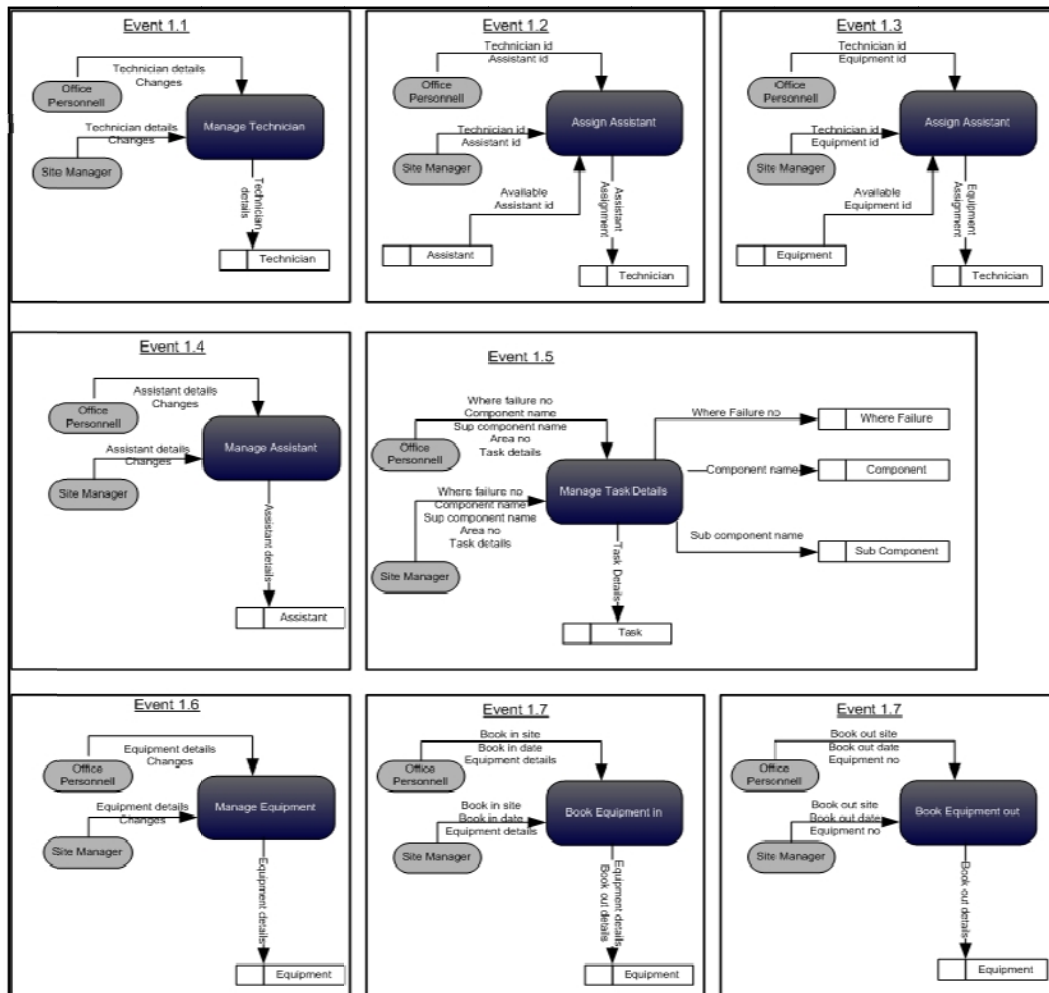
- Overall technician work performance.

The users must be able to specify beginning and end dates of the information with regard to some reports.

### 8.1.3 Data flow analysis

The office and administrative personnel are the only actors that will work on the pre-outage and reporting subsystems. The following DFD was constructed to analyse the data flow of the pre-outage subsystem:

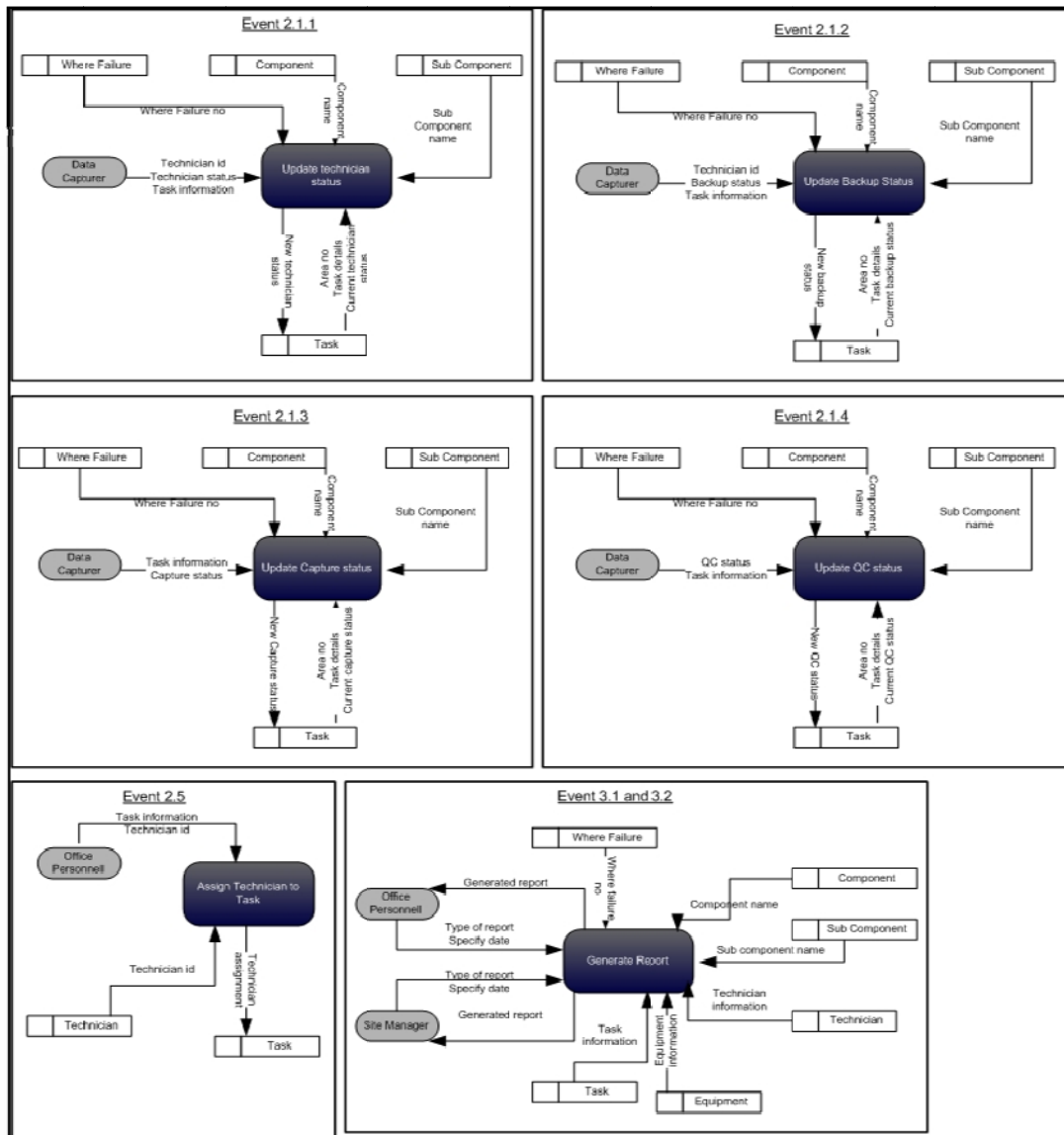
**Figure 9: Wall-thickness phase event - data flow diagram 1**



The site manager and data capturer will work on the during-outage subsystem. The data capturer will enter the assignment of work as received by the wall-thickness team supervisor

and update the work status as the work is assigned and completed. The site manager will mainly use the subsystem to view work assignments and work status but will also be able to change information. The following event DFDs were constructed to analyse the data flow concerning the during-outage and reporting subsystem.

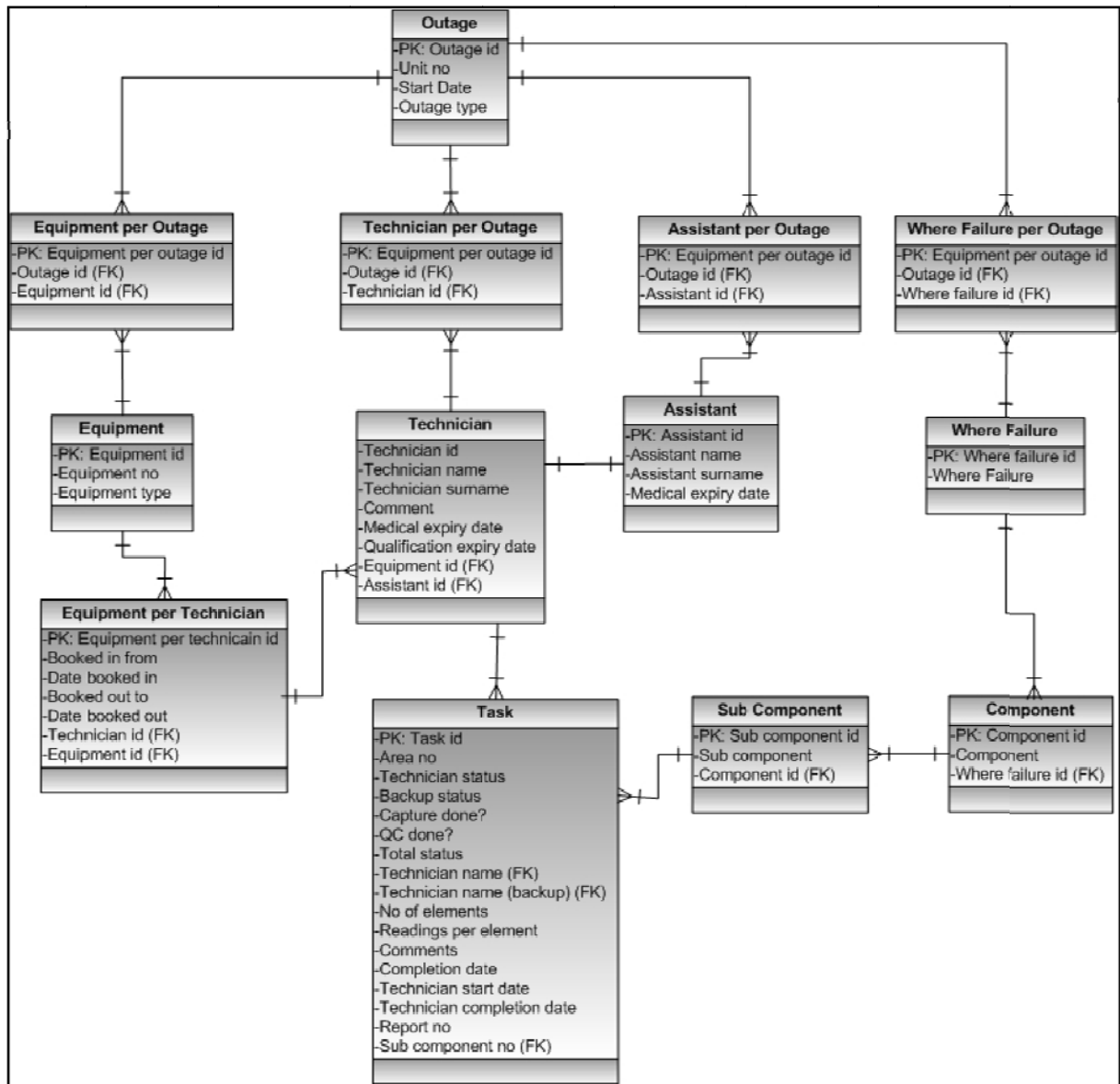
**Figure 10: Wall-thickness phase event - data flow diagram 2**



### 8.1.4 Data modelling

An ERD was constructed to analyse the entities and relationships between them:

Figure 11: Wall-thickness phase - entity relationship diagram



This ERD formed the basis for the information system that was built.

## 8.2 X-ray phase

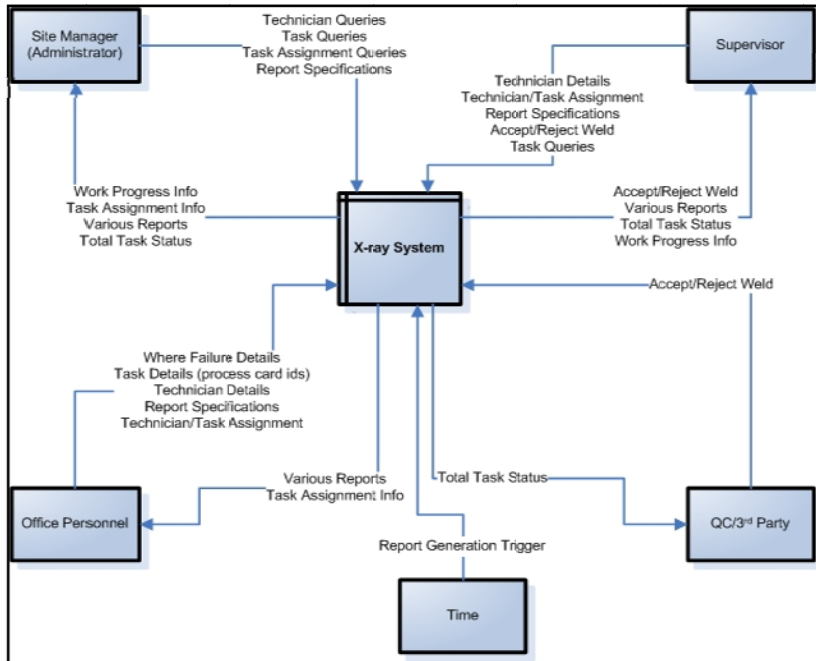
The information system required for this phase is much smaller than the information system that was designed for the wall-thickness phase. The main reason for this is that the whole inspection scope of work will not be entered into the system, as this would increase the time spent on entering data into the system while that data would in the end not be used. Therefore the decision was made to that only the specific areas that are tested will be entered into the system. In addition, the movement of equipment did not have to be handled by the system. The equipment for this phase is in the first place already managed according to well-designed company procedures and secondly the management procedures used during this phase to track equipment differ from the procedures used for the other equipment.

An additional requirement for this system is that it must incorporate some level of security, because three persons – the supervisor, quality controller and third party – must all sign off on a weld individually. A security element therefore had to be built into the system so that a distinction could be made about what data each actor would be able to enter/alter/view, depending on the status of the particular person.

### 8.2.1 System interaction

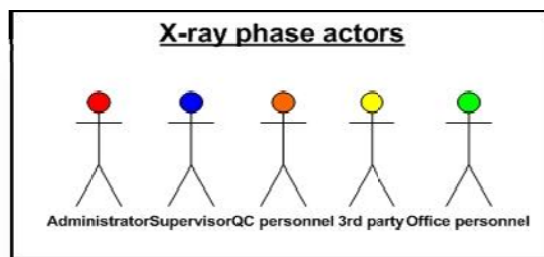
As in the case of the wall-thickness phase system, the scope of the system was defined by viewing the system as a black box and defining relevant the inputs and outputs. The information is depicted in the following context DFD:

**Figure 12: X-ray phase context data flow diagram**



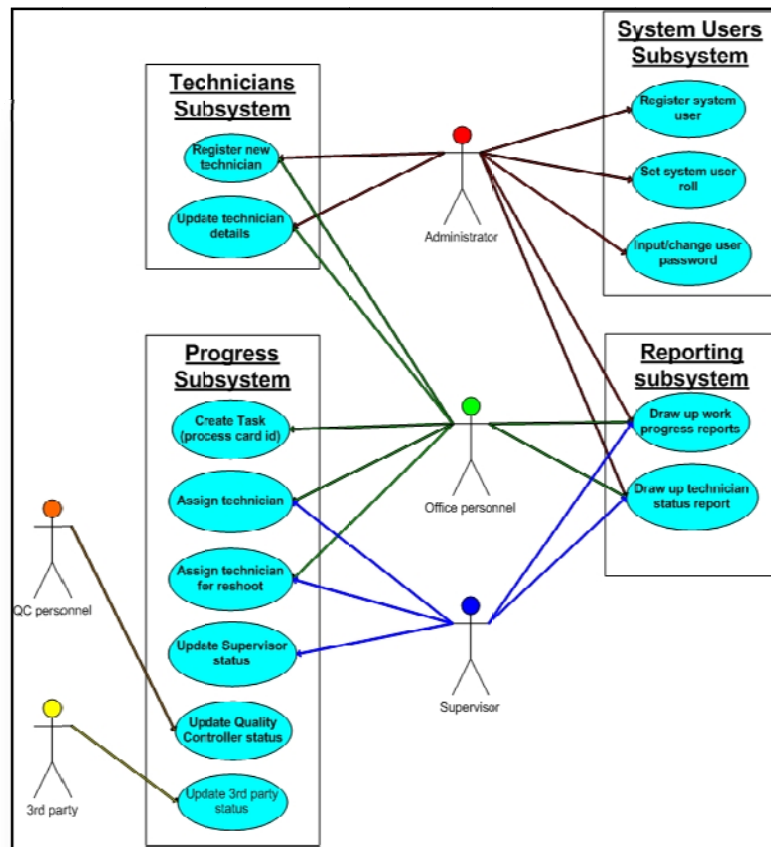
An analysis of the current system revealed that the following actors are involved in this phase:

**Figure 13: X-ray phase actors**



The requirements of these actors played a vital role in the design of the system, because each of them will interact with the new system. To analyse their roles, a UML use case diagram was constructed:

Figure 14: X-ray phase use case diagram



From an analysis of the use case diagram it was established that the system requirements are as follows:

- Keep track of the shoots and re-shoots each technician has performed.
- Keep track of what welds still need to be inspected.
- Keep track of when inspections were completed.
- Show relative information on work areas.
- Provide accountability.
- Print/view reports on the work progress.

The non-functional requirements were the same as for the wall-thickness phase.

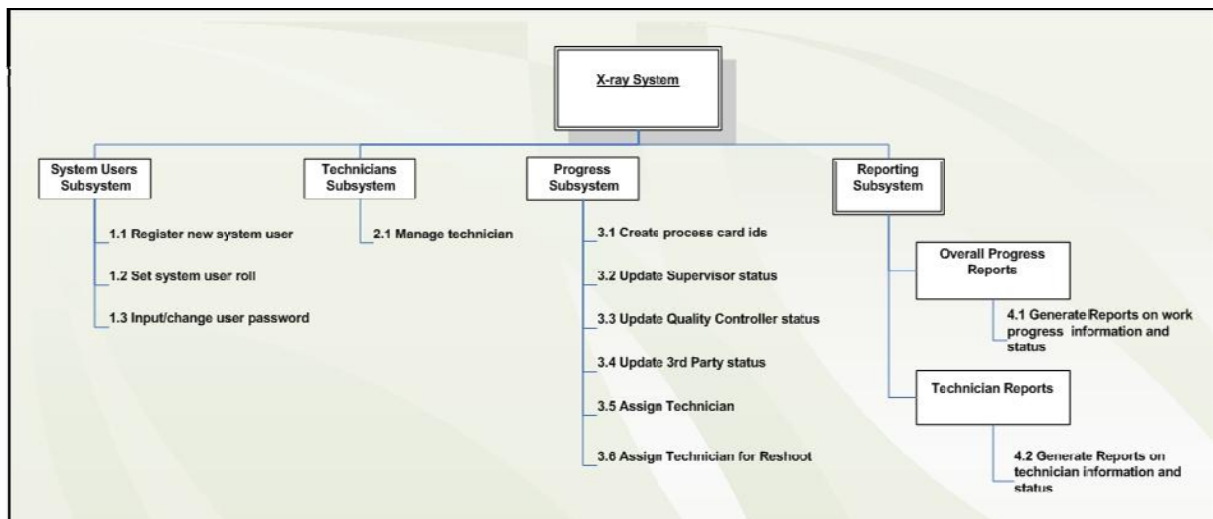
Again, the reporting must be as easy to extract and present as possible as at least one meeting takes place every day between the Raysonics site manager and other stakeholders.

## 8.2.2 Top down analysis

In the current system *process card ids* are assigned to each weld that needs to be inspected. These printed *process card ids* are based on a report by BABCOCK and handed to Raysonics each morning. The new system had to be designed in such a way that the *process card ids* could be entered into the system by the office personnel because BABCOCK did not want the new Raysonics system to be integrated with their system. This could be a time-consuming task, as more than 200 welds are sometimes tested on a single day.

An event decomposition diagram was constructed to evaluate the overall system. A top down approach was used to analyse events, in which each event and the role of that event within the bigger system was studied. The event decomposition diagram made it possible to gain a better understanding of how the system should be built.

Figure 15: X-ray phase event decomposition diagram



The x-ray phase system will be divided into four subsystems, namely a technician, a progress, a reporting and a system user subsystem. The system user subsystem is concerned with the security element that was built in and is explained in section 8.2.3. The **technician subsystem** will allow the user to register and update technician details. The **progress subsystem** will be used during an outage and will be the component that keeps track of work progress. This subsystem is also the one that will be used to assign technicians to specific

tasks. The **reporting subsystem** will mostly be used during an outage and it should be possible to generate the following reports:

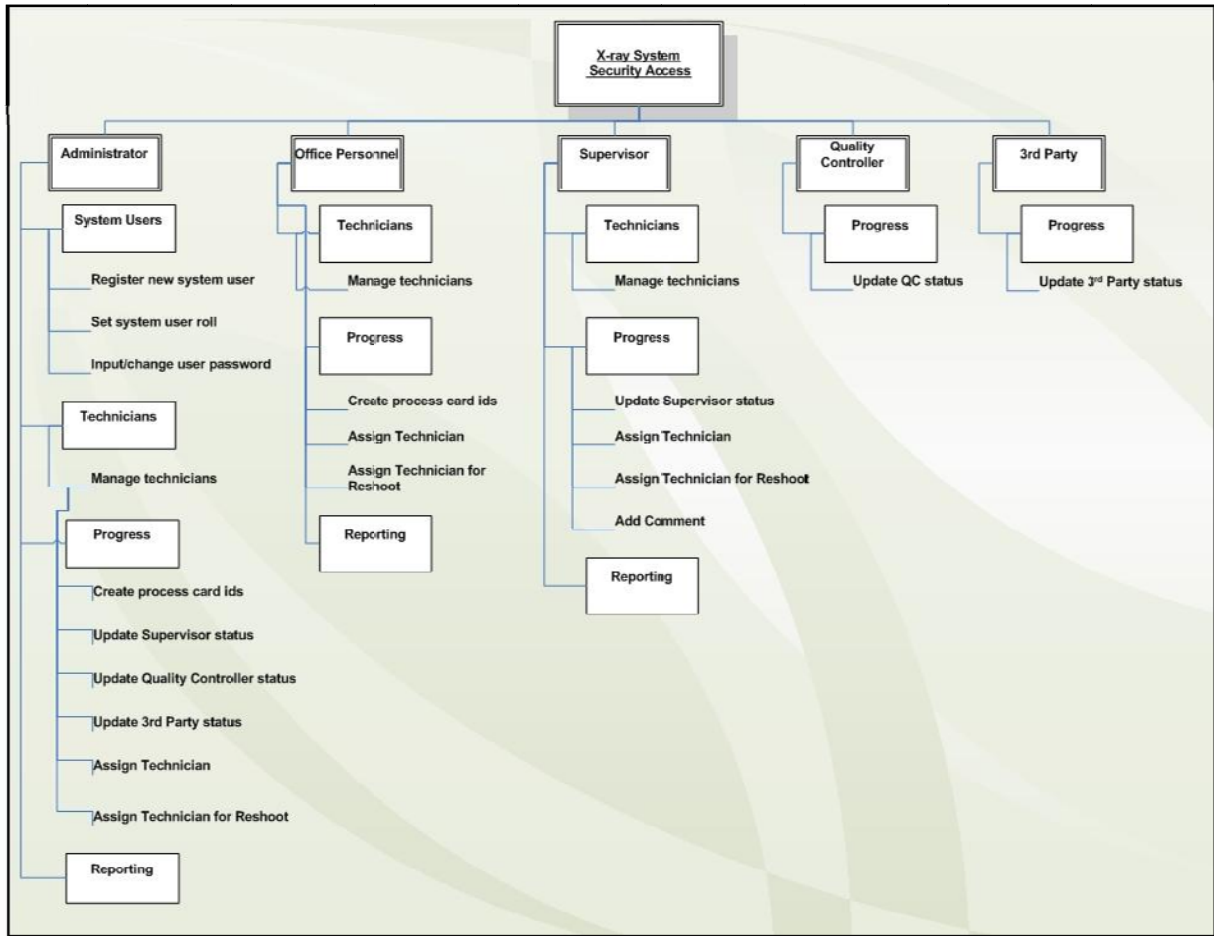
- Overall progress reports:
  - Overall status on work
  - Welds that are accepted
  - Welds that are rejected
  - Welds that are in progress.
- Technician information reports
  - Technician information concerning work progress.
  - Overall technician work performance.

The users must be able to specify beginning and end dates of the information on some reports.

### 8.2.3 Security subsystem analysis

The security element that will be implemented will work as follow: A number of users were defined. These users will have security measures restrictions according to the tasks that each type of user must be able to perform, information to which that class of user needs to have access and the information to which that type of user must not gain access. The system thus makes it possible to assign a specific role to each user, which defines the information to which he/she is allowed access. The roles also limit the information each user is able to enter/alter/view. This added elements of accountability and responsibility to the system. The following diagram was constructed to analyse the accessibility of each type of user:

Figure 16: X-ray phase user access



- The system access is as follows in terms of the diagram:
- The **administrator** has the most access. The administrator is the only user able to register system users.
- The **office personnel** are able to register technicians and *process card ids* (identification of a weld). They are allowed to access the reporting subsystem.
- The **supervisor** is able to register/update technicians but will not be able to register *process card ids*. The supervisor will also have access to the reporting subsystem.

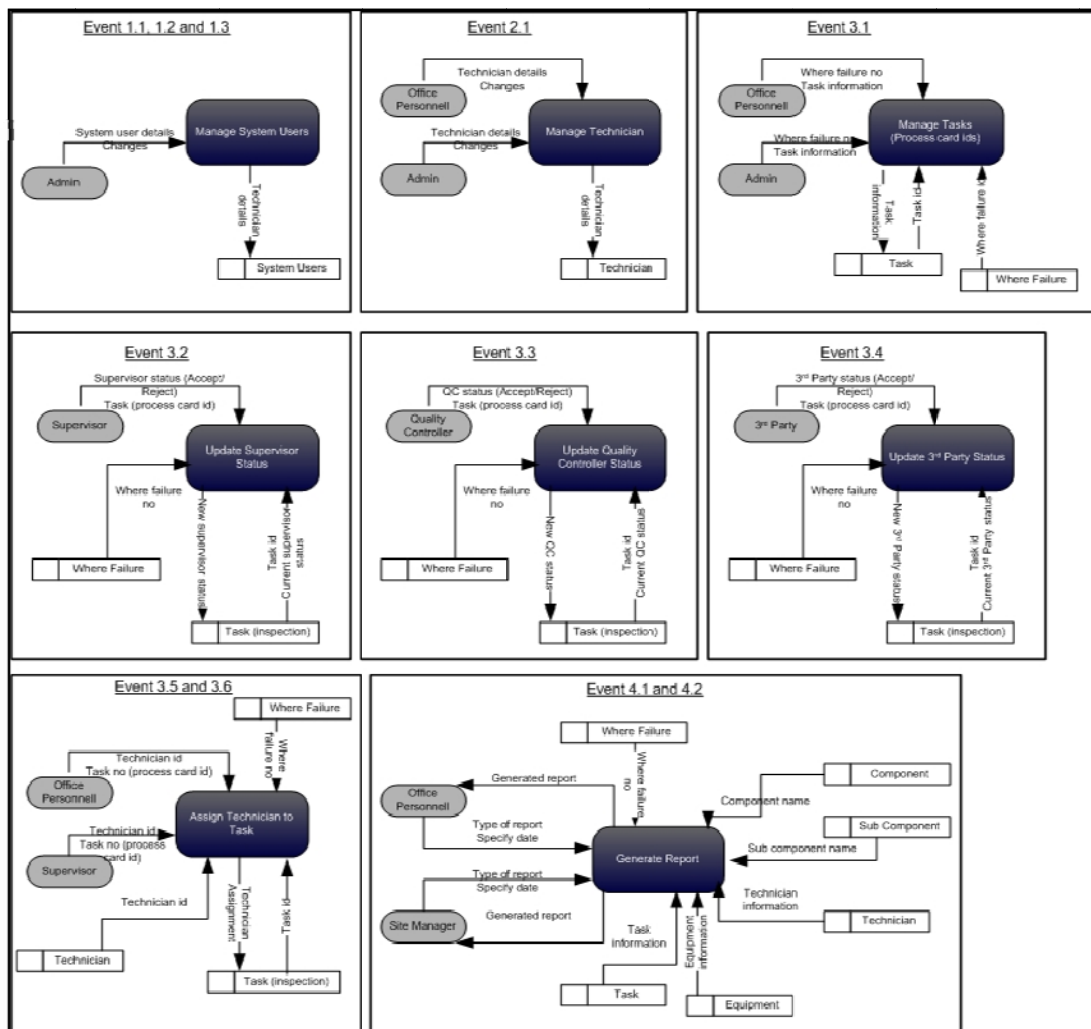
This security element makes provision for the supervisor, quality controller and third party to sign off on welds individually. Each user is only able to access a page that is unique to that user. Limitations have been placed on each unique page to ensure that a user will not be able

to change another user's data. Only the administrator, office personnel and supervisor are allowed to assign technicians to specific tasks. The quality controller and third party will not have access to the reporting subsystem, as these users are not Raysonics employees and may compromise accountability and confidentiality.

### 8.2.4 Data flow analysis

The data flow between actors, processes and the system was analysed and the following event DFDs were constructed of the critical events. All events are numbered as on the event decomposition diagram.

**Figure 17: X-ray phase event data flow diagram**

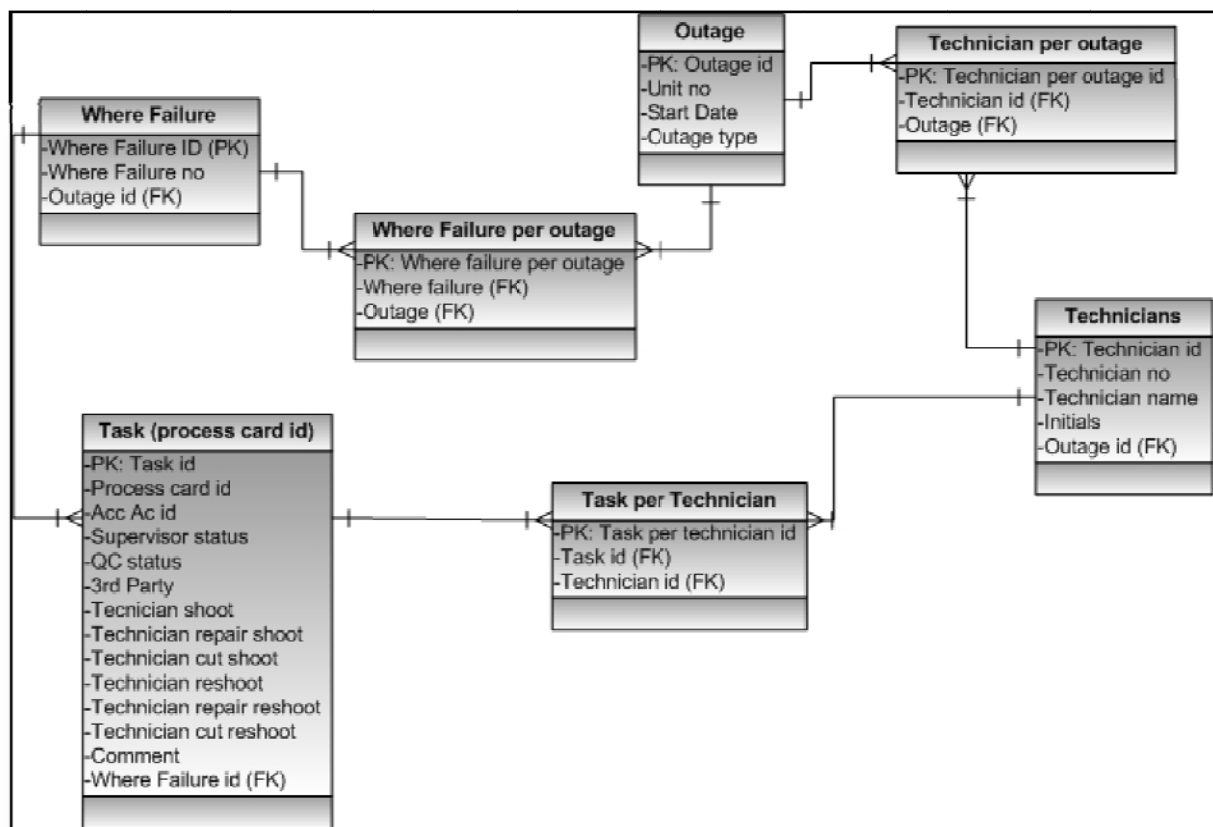


This DFD clearly shows the data input details, input sources, data output details, where data will be stored, flow of data and possible processes that will occur. This information made it possible to build an adequate system that would satisfy all the needs that were identified by analysis.

### 8.2.5 Data modelling

The following ERD was constructed to analyse the entities and relationships between them:

Figure 18: X-ray phase - entity relationship diagram



The information system was built according to this ERD.

## 9. Development and implementation

According to Bentley and Whitten (2007) the goals and prerequisites of Database design include the following:

- A database should provide the user with the ability to store, update and retrieve data efficiently.
- A database should be reliable – the user should be able to trust the data.
- A database should be adaptable – the database should be able to handle changes in requirements and applications.
- A database should support the business requirements of the information system.

The logical design provided the following information concerning the physical development:

- How each of the actors interacts with the system
- System architecture
- Events that will occur
- What happens during each event
- Data flow concerning each event
- Complexity of user interface
- Normalised data model (that could be used to develop data tables and relationships)

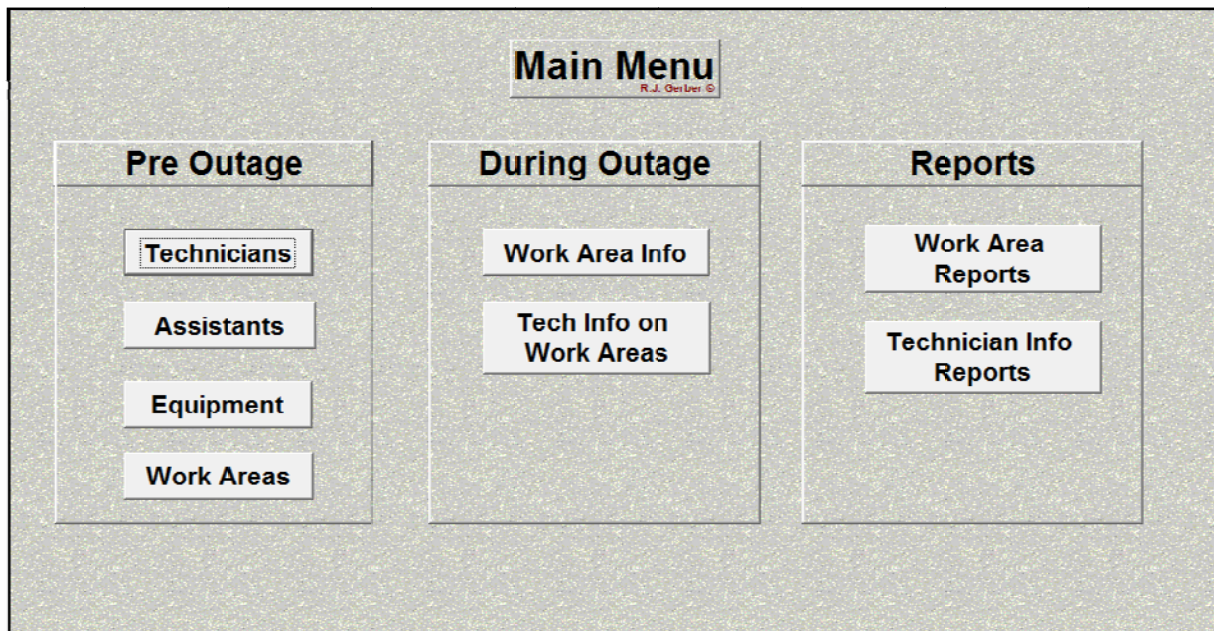
The system for each of the phases was developed to satisfy the requirements that were defined in paragraphs 8.1.1 and 8.2.1. Because the ultimate requirement was that they should provide a quick fix solution for Raysonics, they were not built precisely in line with the dictates of the logical design. In this respect both systems could be regarded as prototypes that will need to be modified or ‘re-developed’ to ensure they are easy to maintain and use but remain efficient, and have maximum flexibility and provide complete customer satisfaction.

## **9.1 Wall thickness phase development**

### **9.1.1 Main menu**

The following is the first screen a user will see when the program is opened is the main menu:

Figure 19: Wall-thickness phase main menu



The system was divided into the three subsystems, based on the top down analysis performed in paragraph 8.1.2:

**Pre-outage:** Input of information that is available before an outage (i.e. technician details, assistant details, equipment details, task details and assignment of assistants and equipment).

**During-outage:** Input information necessary to follow work progress (i.e. technician assignment to tasks and updating information on the status of technician progress, back-up progress, capturing progress and quality control (QC) progress).

**Reporting:** Generating reports according to specified dates.

## 9.1.2 The pre-outage subsystem

### 9.1.2.1 Technicians

When the user clicks on 'technicians' he/she will be presented with the following screen:

Figure 20: Technicians screen

The screenshot shows a web interface titled "Technicians" with a "Main Menu" button in the top right. A red flag icon is positioned above the "Technician name" field. The form contains the following fields and values:

Technician name	helgaard	Medical expiry date	25-Sep-08
Technician surname	Bezuidenhoud	Qualification expiry date	25-Sep-08
Meter no	Th14		
Stepwedge no	sw14		
Joke no			
Welding guage no			
Safetybelt no			
Assistant	riaan		

At the bottom of the screen, there is an "Add Technician" button, a set of four navigation buttons (Home, Previous, Next, End), and a trash can icon.

A record will be created for each technician before an outage. Fields labelled ‘assistant’, ‘meter number’, ‘step wedge number’, ‘joke number’, ‘welding gauge number’ and ‘safety belt number’ are drop down menus and will be used to link technicians to available equipment and assistants. If the ‘medical expiry date’ or ‘qualification expiry date’ is older than the current date, a red flag will appear above the technician name. This will inform management that that technician is unfit for work.

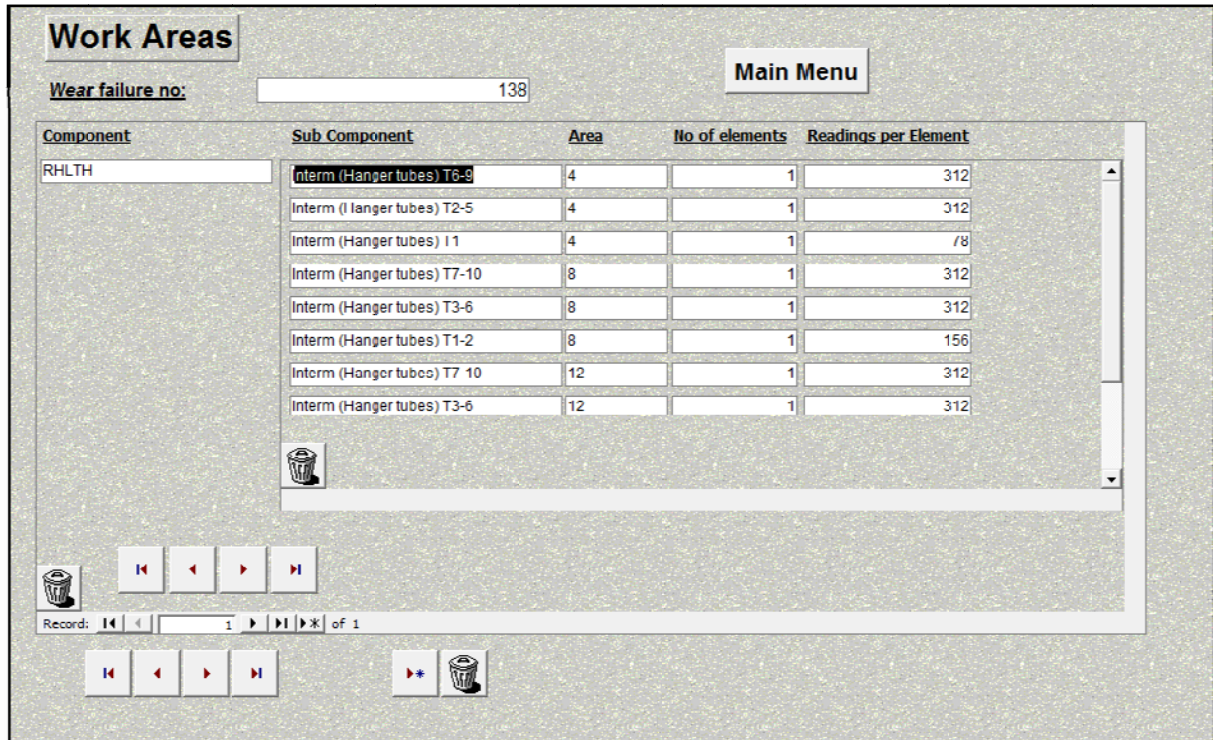
### 9.1.2.2 Assistants and equipment

‘Assistants’ and ‘equipment’ buttons are used to enter information before an outage begins. The screens for these entities are not shown as they are very simple. Assistants will have the same flagging feature as the technicians for the medical expiry date. Record for assistants and equipment must be created before it/they can be assigned to a technician.

### 9.1.2.3 Work areas

If a user wants to create a task, the user must click on the ‘work area’ button in the main menu. He/she will be presented with the following screen:

Figure 21: Work areas screen



All work areas (tasks) will be entered before an outage. Populating the tasks will be a once-off event, after which they can be used for any outage. The previous figure shows the details of 'where failure' 138. Each task will have a 'number of elements' and the 'number of readings' for each element. This information will later be used to compute the amount of readings each technician completed during a particular outage.

Even though all information relating to the pre-outage subsystem will be entered into the system before an outage, changes can be made during an outage if necessary. Once the scope of an outage is populated it can be carried over to future outages.

### 9.1.3 The during-outage subsystem

The during-outage subsystem will mostly be used by the data capturers, although it will also be used by the site manager to obtain information on the progress of the work.

#### 9.1.3.1 Work area information

Clicking on the 'work area info' button will present the user with a screen consisting of three tabs. The following figures show each of the three tabs:

Figure 22: Work area info tab 1

The screenshot shows a software interface titled 'Work Area Info'. At the top, there is a 'Wear Failure' field with the value '22' and a 'Main Menu' button. Below this is a navigation bar with 'Progress detail', 'Work Area info', and 'Comments' tabs. The main content is a table with columns: Component, Sub component, Area, Tech progress, Backup status, Capture done?, QC done?, and Status. Below each row in the table are fields for Technician name, Tech start, Tech finished, Date Complete, and Report no.

Component	Sub component	Area	Tech progress	Backup status	Capture done?	QC done?	Status
SHLTP	Outlet Leg (S.B. 101/1C2) I1	1	Complete	Complete	Yes	Yes	Complete
			Technician name:	koos	Whenda	Date Complete (mm/dd/yy):	09/10/2008
			Tech start:	09/10/2008		Report no:	
			Tech finished:	09/10/2008			
SHLTP	Outlet Leg (S.B. 101/1C2) T2-6	1	Complete	In progress	0	0	Not Complete
			Technician name:	Whenda	koos	Date Complete (mm/dd/yy):	
			Tech start:	19/08/2008		Report no:	
			Tech finished:	19/08/2008			
SHHPF	Outlet Leg (S.B. 101/1C2)	1	Complete	Complete	Yes	Yes	Complete
			Technician name:	Sato	koos	Date Complete (mm/dd/yy):	
			Tech start:	24/08/2008		Report no:	
			Tech finished:	14/10/2008			

Tab 1 (progress detail) will mostly be used during an outage. Tasks and features concerned with tab 1 are set out below:

- Every morning the wall-thickness supervisor will allocate tasks to be performed by the technicians (these tasks are printed out as templates with empty fields in which readings can be entered). The supervisor will make a note of which technician receives what task.
- The data capturers will locate each task and assign the technician to that task by means of a drop down menu. The technician status will now be 'in progress' and a 'technician start date' will automatically be entered.
- After a technician completes a task, he hands the template to a data capturer who changes the 'technician status' from 'in progress' to 'complete'. The 'technician finish date' will automatically be entered.
- The 'back-up status' will be handled exactly the same as the 'technician status'.
- After the data capturer has captured the measurements and the quality control has been completed, he/she will change the 'capture done' and 'QC done' to yes.
- The 'total status' will automatically change to 'complete' and a date will be generated under 'date complete'.
- The report field will be used to enter the report number.

A drop down menu was designed to enable the user to locate tasks with ease.

**Figure 23: Work area info tab 2**

**Work Area Info**      Wear Failure: 22      **Main Menu**

Progress detail | **Work Area info** | Comments

Component	Sub component	Area	No of elements	Readings per element	No of readings	20% of readings
SHLTP	Outlet Leg (S.B. 101/102) T1	1	39	1	39	7.8
			Technician name: knos      Whenda Tech start: 09/10/2008 Tech finished: 09/10/2008			
SHLTP	Outlet Leg (S.D. 101/102) T2-0	1	39	7	273	54.6
			Technician name: Whenda      knos Tech start: 19/08/2008 Tech finished: 19/08/2008			
SH-PT	Outlet Leg (S.B. 101/102)	1	0	0	0	0
			Technician name: Satn      knos Tech start: 24/08/2008 Tech finished: 14/10/2008			

Tab 2 (the work area info) was constructed so that task details can be viewed without having to return to the pre-outage subsystem. No information under this tab can be altered by the users.

**Figure 24: Work area info tab 3**

**Work Area Info**      Wear Failure: 22      **Main Menu**

Progress detail | **Work Area info** | Comments

Component	Sub component	Area	Comments
SHLTP	Outlet Leg (S.B. 101/102) T1	1	Broken shield on tube 3
SHLTP	Outlet Leg (S.B. 101/102) T2-8	1	
SH-PT	Outlet Leg (S.D. 101/102)	1	Hole in tube 5

Tab 3 (comments) can be used to enter any information relevant to a work area. This will typically be used when something has been noted through a visual inspection or if a task is delayed for any reason.

### 9.1.3.2 Technician info on work areas

Under ‘technician info on work areas’ the tasks are sorted according to the different technicians. This makes it very easy to see what task each technician has completed and also on what task they are working at that time. This screen for this section provides a list from which a technician can be selected. There are also three tabs available for viewing information.

Figure 25: Tech info on work areas tab 1

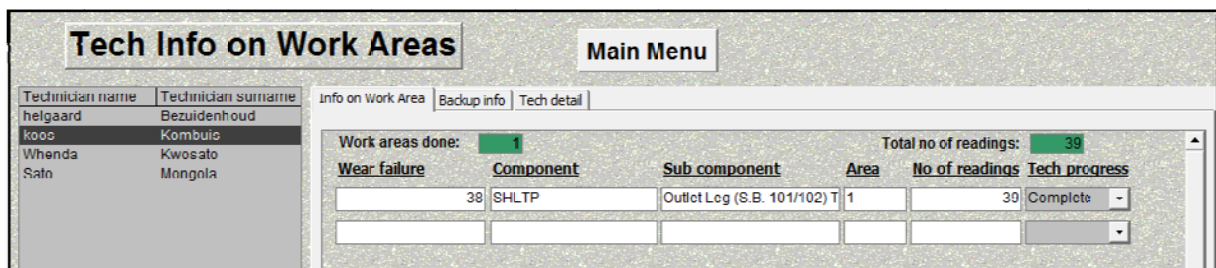
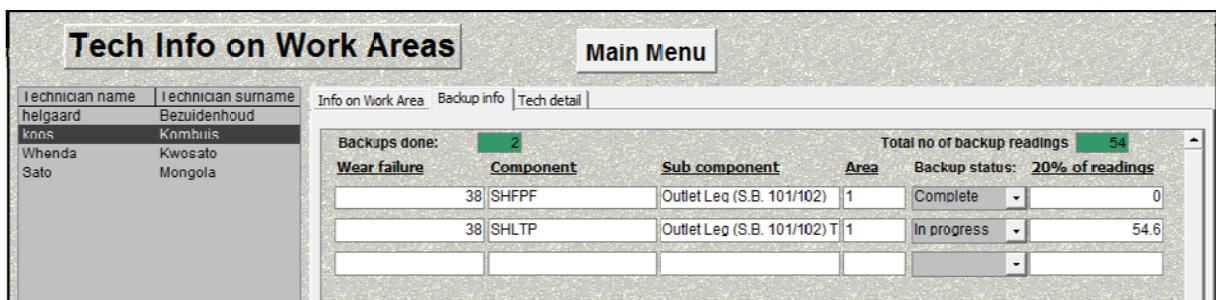


Figure 26: Tech info on work areas tab 2



Tabs 1 and 2 can be used to determine what each technician has done and where the technician is currently working. This will ensure better task and technician tracking and visibility during an outage.

Figure 27: Tech info on work areas tab 3

The screenshot shows a web application interface titled "Tech Info on Work Areas". At the top right is a "Main Menu" button. Below the title, there are three tabs: "Info on Work Area", "Backup info", and "Tech detail", with "Tech detail" being the active tab. On the left side, there is a table listing technicians:

Technician name	Technician surname
helgaard	Bezuidenhoud
koos	Kombuis
Whenda	Kwansan
Sato	Mongola

The main content area is titled "Tech Detail" and contains several input fields:

- Meter no: IH22
- Stepwedge no: SW001
- Joke no: [empty]
- Welding guage: [empty]
- Safetybelt no: 25541
- Comment: [empty text area]
- Medical expiry date: 31-Oct-09
- Qualification expiry date: 31-Oct-09
- Assistant: Dania (dropdown menu)

Tab 3 (tech detail) can be used to view the technician's details without returning to the pre-outage subsystem and it is also possible to enter comments. This will typically be used when a technician has a habit of making mistakes, sleeping on the job, always finishes timorously, etc.

#### 9.1.4 Reporting

The reporting for this phase was divided into two sections, with the first relating to work area reports and the second to technician reports. The work area reports convey the work progress by setting out the status of tasks. There are individual reports that show completed tasks, tasks not yet started, tasks that are in progress (together with technicians on that task) and task status (where completed and incomplete tasks are sorted under *where failures*). The tasks-in-progress report can also be used to view where a technician is working and when the technician started the task. Reports generated with regard to this section are set out in appendix G.

The technician reports provides an overview of the work progress by setting out what each technician has done. Here, again, two reports are available, one relating to the tasks that were performed, the other to back-ups performed by a specific technician. Both reports are sorted under each particular technician. Reports generated with regard to this section are set out in appendix H.

The site manager will use these reports to follow work progress and will also be used to present status updates during meetings. A begin and end date may be specified on all reports. The format of all reports has been constructed to ensure easy access to any of the information.

### **9.1.5 Implementation**

A network is already in place at Kendal power station, which will assist in implementation. It will be possible to access the program from two locations:

- Two computers in the cabin located in the unit where the outage is taking place – mainly for access the data capturers.
- Two computers in the Raysonics office on site – to be accessed by the office personnel and the site manager.

It will also be possible to access the program by means of a laptop that connects to the network by a wireless connection or by means of another computer, whether located in an office or the cabin.

## **9.2 X-ray phase development**

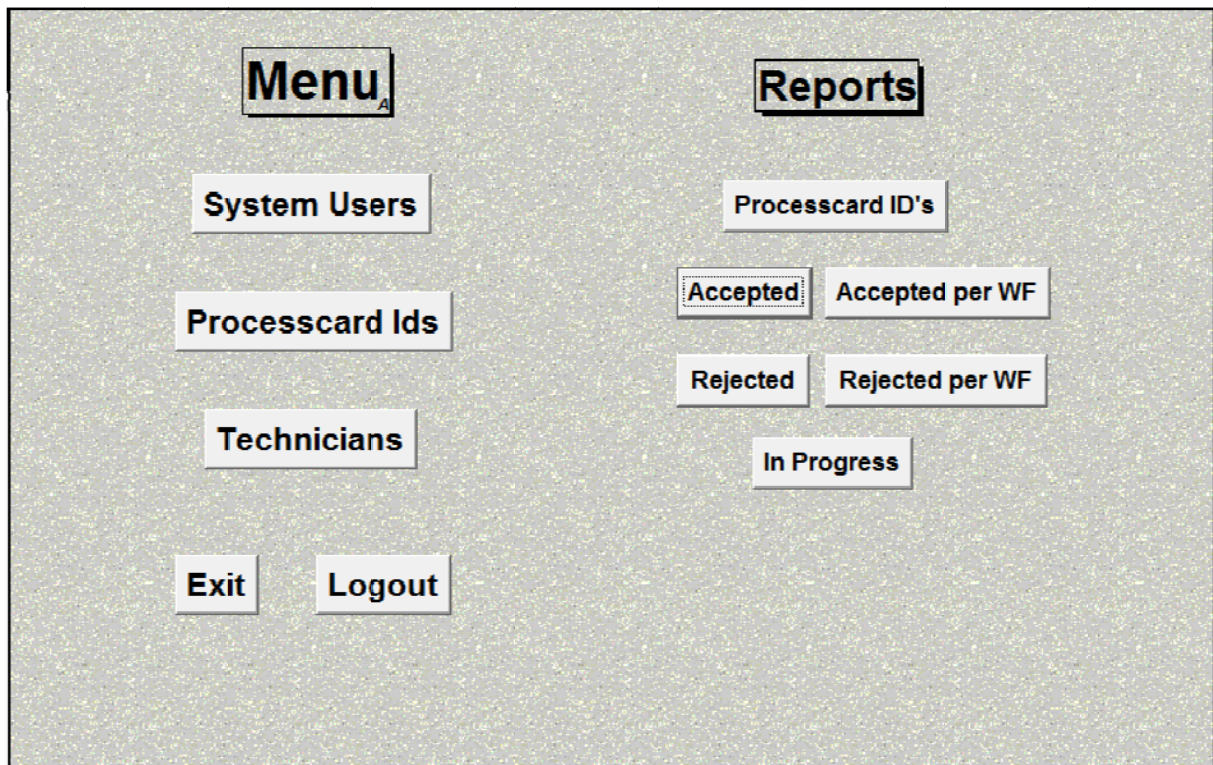
### **9.2.1 Login and main menu**

When a user runs the program they will be presented with a login screen requesting the user to input a user name and password. The system will then check if this is valid. The system will not allow an unauthorised user to gain access.

For the purpose of explaining the user interaction, only the screens for the administrator will be discussed – the administrator is the user with access to all screens. For information on the other user's limitations, see paragraph 8.2.3.

After the user has logged in he/she will be presented with the following screen:

Figure 28: X-ray phase main menu



Under system users, the user will enter a username, password and define his/her role (office personnel, supervisor, quality controller or third party). Each role will define the limitations of a particular user as well as what they can do on the system (see par. 8.2.3).

### 9.2.2 Process card ids

The *process card id* section will be used to follow the work process. The screen for this is depicted in the following figure:

Figure 29: Process card ids screen

The screenshot displays a software interface for managing process card IDs. At the top, there is a search bar with 'Search ID:' and 'Search by..' fields, and a 'Back to menu' button. Below this is a header row with columns: 'Processcard Acc Pr. Id:', 'Supervisor:', 'OC:', '3rd Party:', '3rd Party Comment:', 'Date:', and 'Technician(s):'. The 'Technician(s):' column has sub-columns for 'Shoot', 'Repair', and 'Cut'. The main area contains a table with 10 rows of data. Each row includes a process card ID, a status (e.g., 'In progress', 'Accept', 'Reject'), a date, and a 'Reshoot' button. The status is indicated by a colored bar: yellow for 'In progress', green for 'Accept', and red for 'Reject'. The date is shown as '14/10/2008'. The 'Reshoot' button is a purple button with three dropdown menus. The interface also includes navigation buttons at the top: 'WF no: 121', 'Add WF', and arrows for navigation.

Processcard Acc Pr. Id:	Supervisor:	OC:	3rd Party:	3rd Party Comment:	Date:	Technician(s):
						Shoot Repair Cut
122	6354r1	In progress	In progress	In progress		
4132132		In progress	In progress	In progress		
45665		Accept	Accept	Accept	14/10/2008	
456456		Reject	Reject	Reject	14/10/2008	
4564		Accept	Accept	Accept	14/10/2008	
4545		Reject	Reject	Reject	14/10/2008	
455	421r1	Accept	Accept	Accept	14/10/2008	
655		Accept	Accept	Accept	14/10/2008	

Each *process card id* represents one weld. Because up to 250 shoots can be taken in one shift, Raysonics has asked that tasks be classified in terms of *where failures*. The figure shows the tasks that were populated for ‘where failure’ 121.

Tasks and features concerned with the previous figure are described below:

- Office personnel create a ‘where failure’ and input the *process card ids* for that *where failure*.
- The technicians are assigned to tasks for that shift and perform the x-ray inspection on each weld.
- The films are developed by the technicians.
- The films are analysed by the supervisor, quality controller and third party.
- Each of these actors logs into the system and accepts or rejects each of the welds/tasks individually.
  - Here the tasks diverge:
  - If the weld is **not accepted**

- because image on the film is not accurate, the x-ray has to be repeated, a process known as a *re-shoot*.
- because the weld is incorrect BABCOCK is informed and they have to repair the weld or cut it again. In such cases a new *process card id* is assigned to that weld.
- If a repair or cut occurs the office personnel must locate the original *process card id* and fill in the new *process card id* in the 'Acc Pc Id' field, followed by a 'r' or 'c' indicating if it was a cut or a repair. The system will automatically change the 'supervisor', 'QC' and '3<sup>rd</sup> party' fields to 'in progress' to show that work is still being done on that weld.
  - For more information on the work protocol, see figure 3.
- The office personnel or supervisor will assign a technician to each weld. A technician may be assigned to a 'shoot', 'repair shoot' or a 'cut shoot'. Provision was made for a re-shoot on all three.
- Once a weld/task is accepted or rejected the current date will automatically be entered and a flag at the end of each line will change colour accordingly.
- The third party comment box can be utilised by both the quality controller and third party to notate any comments regarding any aspect of this part of the work.

Search functions (top left) and a drop down menu (top right) have been added to simplify user interaction.

### 9.2.3 Technicians

Under technicians the following screen will be presented (to facilitate understanding and the explanation that follows, some of the fields has been populated).

Figure 30: Technicians screen

	<u>Tech name</u>	<u>Initials</u>	<u>Shoots:</u>	<u>+ Reshoots:</u>	<u>= Total:</u>
1	johan	JD	2	0	2
2	Gerhard	GdL	2	0	2
3	Hendri	HH	1	1	2
4	rynard	RM	0	0	0
5		n/a	0	0	0
6		n/a	0	0	0
7		n/a	0	0	0

This is the screen on which technicians may be added or removed. Initials are included to enable users to assign technicians to tasks more easily. This is in line with the existing work process, in which the technicians write their initials on the films that they have shot. A further function was included to show the number of ‘shoots’, ‘re-shoots’ and ‘total shoots’. This will enable management to see how many shoots each technician did, and particularly the number of re-shoots will be an aid to determining which technicians may need further training.

### 9.2.4 Reporting

The first report that can be generated is the *process card id* report which shows all the tasks sorted under *where failures*. This report contains the exact information that is viewed when clicking on the ‘process card ids’ button on the ‘main menu’ screen. In addition, two ‘tasks accepted’ and ‘tasks rejected’ reports can be generated, with the first one showing the tasks sorted by date and the second tasks sorted according to *where failures*. The last report shows the tasks that are still in progress and why they have not been completed. All reports concerning the x-ray phase are provided in appendix I.

The site manager will be able to use these reports to follow work progress and also during meetings to provide status updates. A begin and end date may be specified on all reports. The format of all reports has been constructed to ensure easy access to the information.

### 9.2.5 Implementation

A network at Kendal power station is already in place which will make it easy to implement the system. It will be possible to access the program from four different locations:

- Two computers in Raysonics office
- Supervisor computer
- QC computer
- Third party computer.

The two computers in the Raysonics office will be used by office personnel and the administrator (usually the site manager). The other three locations may vary depending on the outage. It will also be possible to access the program by means of a laptop that connects to the network by a wireless connection or a computer located in an office.

## **10. Conclusion**

The problems found during the analysis of the as-is state combined with the analysis of the requirements provided a solid baseline for the development of the desired system. The logical design provided information of how the systems should work and what the systems must be able to do. The systems provide Raysonics with better visibility, accountability and traceability during outages. Raysonics will therefore be able to better analyse and improve their business processes.

The systems that were developed satisfy all requirements stated during the logical design and will enable Rysonics to follow work progress efficiently and effectively with accuracy. Even though the systems are adequate, it is recommended that the system be re-developed in the future to ensure better flexibility, maintainability and customer satisfaction.

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## 12. Appendices

### Appendix A: HighOrbit solutions

As viewed at <http://highorbit.com>

#### Solutions

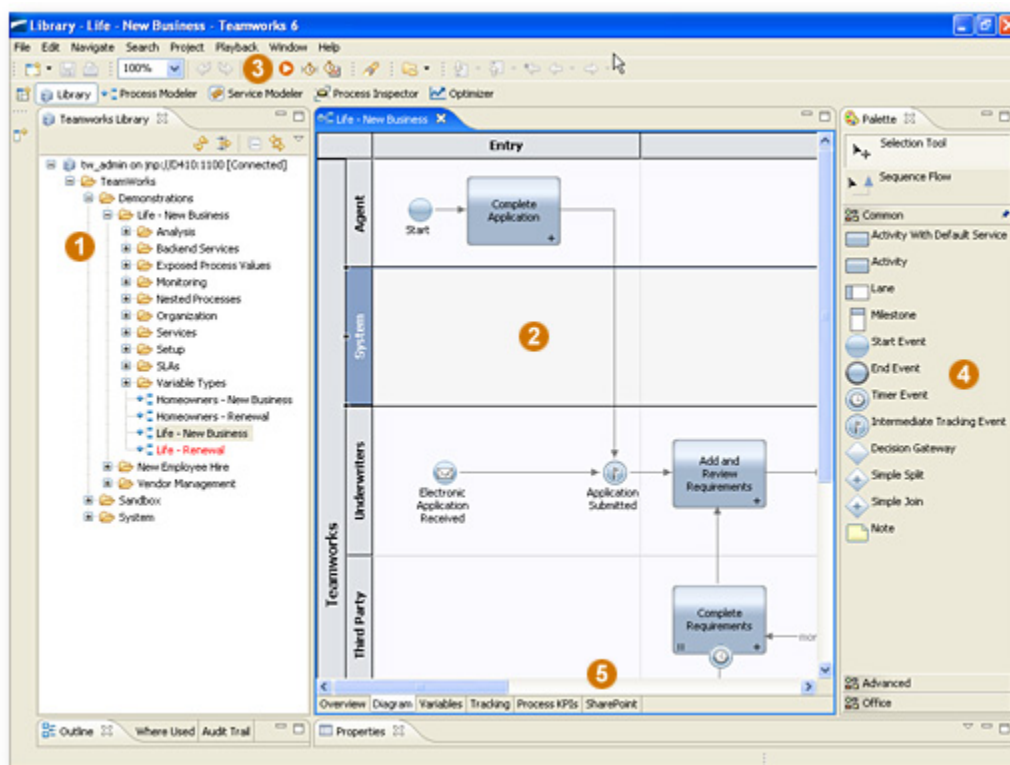
- ▶ **Human Resources**  
Whether you're reviewing applicants, completing background checks or managing day-to-day employee processes and benefits, there's an easier way to manage a whole host of functions in your HR department. HighOrbit BPM is the business process management solution providing a consistent, efficient, cost-effective alternative to ensure each and every step is processed in a timely fashion. It's easy, fast and affordable!  
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## Appendix B: Teamworks 6 features

As viewed at <http://www.lombardissoftware.com/enterprise-bpm-features.php>

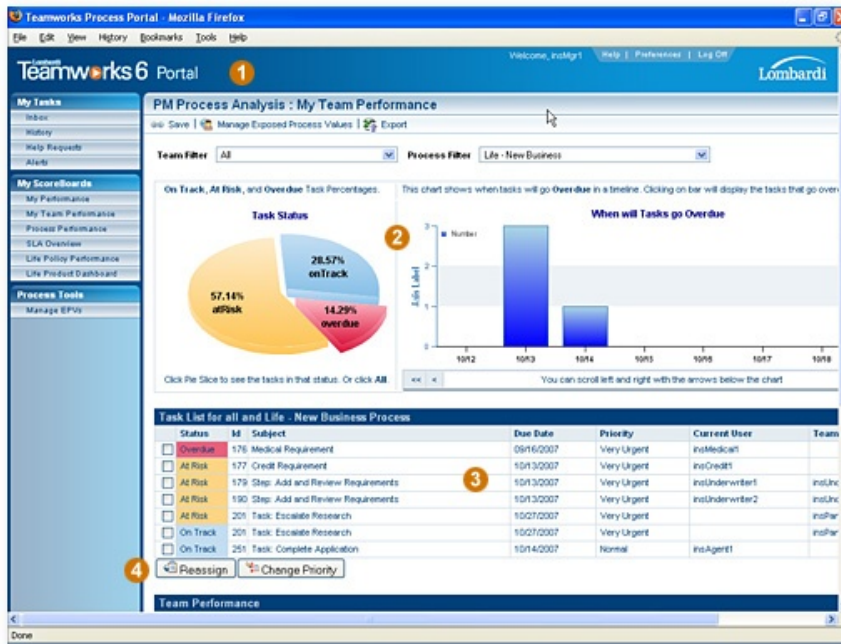
### Features

Save time building your applications in our unified Authoring Environment. Teamworks lets you quickly build and share every process element – from diagrams to forms, rules, and services.



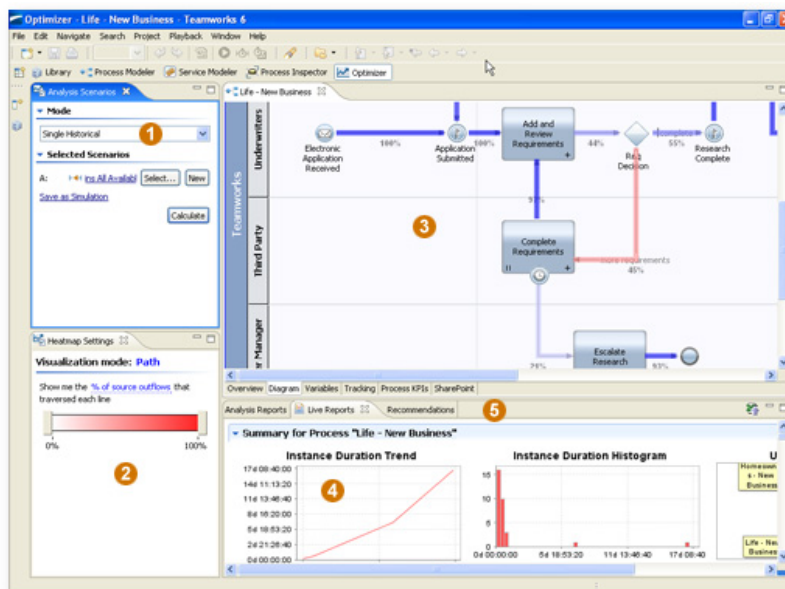
1. Shared Library for all process assets – facilitates reuse and collaboration
2. Graphical Workspace for building process diagrams and services
3. Interactive Playback for validating process requirements at any time without compilation
4. Standards-based process design using BPMN
5. Properties Sheets for all process elements help less technical users participate in design

Our standards-based work Portal helps users know what to work on and gives managers the tools to drive performance improvement.



1. Use popular browsers to complete process work or integrate with existing portals using JSR-168 or WSRP
2. Performance reports provide “work in progress” visibility for managers
3. Consolidated in-box lets users see all their tasks and work queues in one place
4. Interactive process controls let managers balance workload assignments, task prioritization, and overall process performance

Find the problems – whether simulated or real – faster with the Process Optimizer. Now you can make a strong case for what needs to change in the next version of your process.



1. **Analysis scenarios** let you focus in on specific problem areas and conduct “what if” analysis with past, present, and future performance data
2. **Multiple visualization modes** help identify diverse problems – long wait times, excessive re-work, or unexpected paths
3. **Heat-mapping** helps visually identify problem areas in your process
4. **Live Reports** provide instant access to trend information as well as drill-down options to specific instance data
5. **Streaming Recommendations** suggest possible improvements

Teamworks 6 enterprise-class interoperability, scalability, and governance lets you leverage and extend existing systems.

Deliver tasks and reporting to Microsoft Office and Sharepoint applications using Teamworks for Office and Teamworks for Sharepoint

Support for standards, including BPMN, BPD, BPEL, and web services simplifies interoperability with your SOA initiatives

Eclipse-based Authoring Environment integrates with your other development tools

100% J2EE with clustered deployment for high availability and scalability

Integration with Lombardi Blueprint for leveraging your process documentation work

## Appendix C: Information on TIBCO BusinessFactor

As viewed at <http://www.tibco.com>

### TIBCO BusinessFactor

In today's fast-paced and increasingly customer-driven business environment, it's not good enough to look back at what you've done, identify problems, and fix them for next time. You need to identify problems and opportunities in what you're doing right now so you can avoid them or capitalize on them this time.

TIBCO BusinessFactor™ is powerful business activity monitoring software that provides a visual and interactive interface that makes it easy to analyze your operations in context of business objectives, past performance, and current conditions so you can more quickly and intelligently identify and address risks and opportunities.

### Capabilities and benefits

TIBCO BusinessFactor leverages the power of TIBCO's proven business integration platform to give you an absolutely current and interactive view of your business.

It does this by incorporating real-time data from the systems and processes that make your business run into dynamic visual representations of your enterprise and the key performance indicators that you use to measure your success.

These visual representations can be images such as maps, blueprints, technical drawings, charts or graphs, and give users the ability analyze current conditions and performance for any level of location specificity or timeframe with a few clicks of their mouse, helping them quickly identify trends and predict likely outcomes.

TIBCO BusinessFactor also gives users the ability to collaborate with other users and interact with systems and processes so they can take appropriate action.

- Improves speed and effectiveness of business operations by providing visibility into the company's key performance indicators.
- Rapid opportunity and threat identification with tools to collaborate and take actions.
- Collaboration framework to share visual business context and execute or assign appropriate actions.
- Extremely fast user-adoption, with simple yet powerful interactive visualization.
- Can be integrated with your established security infrastructure.



TIBCO BusinessFactor's intuitive user interface shows critical performance indicators and supporting contextual information so users can perform quick historical analysis, drill into data and take action.

### Packaged solutions for rapid deployment

- **Healthcare Resource Optimization:** Emergency Center monitoring to quickly identify patient bottlenecks, perform short-term trending and identify process improvement and problem areas.
- **Healthcare Resource Optimization:** Daily productivity and revenue cycle visibility allowing healthcare administrators and doctors to monitor operational efficiency by region, hospital, department and doctor (appointment counts, patient visits, service provided, missing encounter data, insurance reimbursement timeframes and more).
- **Sales Demand:** Global hot spot identification for sales, forecast and inventory discrepancies across the enterprise. Visually perform historical comparisons and correlations with other activities including marketing, strategic initiatives and news.
- **Manufacturing:** Real-time monitoring of plant floor configurations and activity. More accurately identify product recalls and quality problems by correlating information.
- **Quality Of Service Control:** Continuous monitoring of service level agreements and operational targets including call center activities and service delivery performance. Easy identification of emerging trends and proactive notification to prevent shortfalls and overruns.

- **Homeland Defense:** Monitor real-time activity and gather intelligence about potentially hazardous situations going on in shipping ports, around airports or anywhere in the world. Integration with satellite imagery and biometric capability.

## Appendix D: Definitions of Object model elements

As viewed at TIME Electronic textbook v 4.0 (1999)

### Object classes with attributes, relations and connections

The identification of object class with attributes and relations is the most fundamental element of object modelling, and is supported by most Object Oriented Analysis tools.

The identification of objects is based on the idea that they shall model phenomena in the application area, and a classification of these phenomena.

So look for phenomena by considering the following aspects:

- Substance
- Properties of substance.
- Transformations on substance.

Note that normally a phenomenon will have several of the aspects, but some may be the dominant.

These aspects give certain guide-lines for selection of phenomena. We have to consider tangible things where the major aspect is substance. We have to consider properties and finally we have to consider transformation on the substance.

### Connections

Connections are put between classes for which the objects will communicate. Connections between classes will imply that there is a number of mscs describing the interaction pattern between objects of the classes.

### Relations

Relations come in two categories: constructions and illustrative relations. It is recommended to use UML relations for both kinds of relations. This implies that if relations are illustrative, then the UML notation for relations shall be used. The semantics of these may then not be defined in UML, but they have anyway to be implemented specifically.

### Attributes

When looking for attributes, consider typical “value” properties of objects.

The notation for attributes of identified classes is UML. They may either be collected in on diagram or combined with a class/relation diagram.

## Generalisation/specialisation

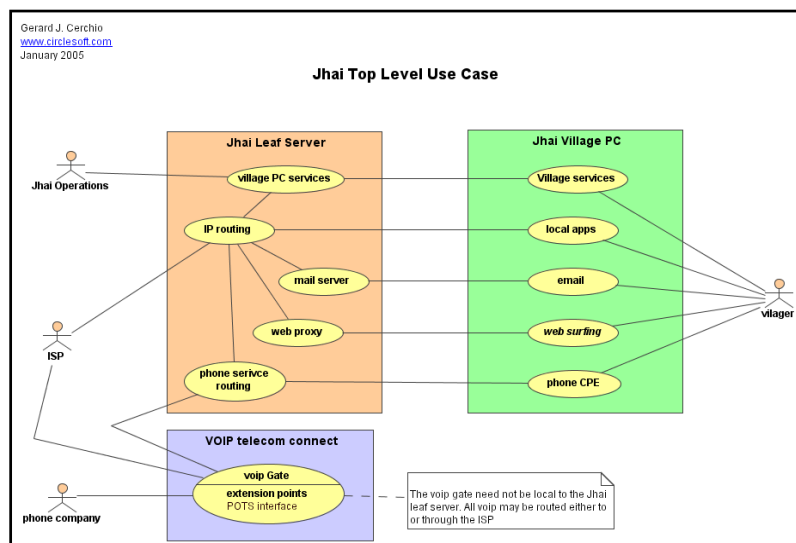
Specialisation/generalisation is a special relation between classes. The notation for this relation emphasizes that it is not just one among other relations between classes, but that it has to be supported by the design and implementation notations.

When describing generalisation/specialisation there are two different ways of doing it:

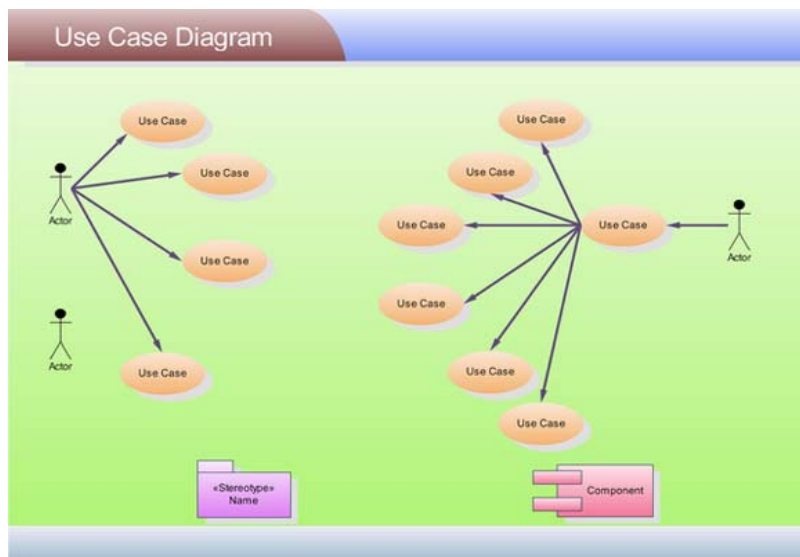
- Specify the relation between the classes as a whole, without considering the details of any of the classes. This is normally referred to as describing the generalisation/specialisation hierarchy.
- Specify one class as a specialisation of another, including the details of what is inherited and how the additional properties relate to these.

## Appendix E: Examples of Use case diagrams

As viewed at <http://blog.circlesoft.com/index.php?/archives/3-CircleSoft-publishes-Jhai-PC-Architecture.html>



As viewed on <http://www.edrawsoft.com/uml-usecase.php>.



## Appendix F: Advantages and disadvantages of Microsoft Access

Source: Chung (2004).

### Advantages of Access

Access is the most popular database program because those who are not IT professionals can cost-effectively solve a wide range of database problems, and professional developers can create sophisticated multiple user solutions.

#### **Return on Investment**

If it can be solved in Access, it's probably less expensive than alternative solutions, which maximizes return on investment.

#### **Rapid Application Development**

The Access development environment lets you create results quickly. Access solutions often require significantly less code than alternatives. It's an effective platform for prototyping.

#### **Integrates with Microsoft Office**

Access is part of Office, and integrates with other popular Office programs. Enabling users to view data and export (or paste) into Excel or Word is powerful to knowledge workers.

#### **Easy to Deploy**

Access databases are easy to deploy if the recipient has the same version of Access. From placing it in a shared directory to sending it as an e-mail attachment, an Access database can be distributed by end users, similar to the way they distribute Word or Excel files.

## **Windows versus Web Data Entry**

Web users are trained to accept behavior that would not be acceptable in Windows-based applications. Consider the example of changing a quantity and clicking **Update** to refresh total sales. Access easily (and inexpensively) supports this and other features, such as copying and pasting records, displaying multiple one-to-many relationships, and basic features, such as doing spelling checks. This provides a friendlier and richer data entry experience than Web solutions.

## **Interfaces with Numerous Database Formats**

Access links to many data sources, including SQL Server.

## **Excellent Report Generator**

The Access report generator is excellent. Subreports are useful for showing multitable relationships. Additionally, Access can link to many data sources. Many client database applications have significant report generation features.

Web reports have less functionality and often do not print properly, even with more effort.

## **Approachable Development Environment**

The Visual Basic for Applications integrated development environment (IDE) is similar to Visual Basic, and offers a productive development environment. Unlike .NET or Java, you can edit code while debugging, which is a timesaver.

## **Solutions with Less Code**

The less code required for a solution, the better. It's easier to create and easier to maintain. N-tier solutions are definitely not RAD, and are not beneficial if you don't need to share your data.

## **Ideal for Network Solutions**

Access is designed for file server solutions on local area networks.

## **Handles Disconnected Situations**

Access supports portable computers and disconnected solutions that can't be handled by Web applications. Access databases can also be easily sent using e-mail to others. In limited low data collision situations, Access replication is appropriate for remote database sharing.

## **Limitations of Access**

Although it has many advantages, Access has limitations that prevent its use in some cases.

### **Not for Web Solutions**

Access isn't designed to create Web sites. The Data Access Pages are of limited use in intranets, but not on the Internet. The underlying Jet engine is also not useful, except when the number of simultaneous users is low. Access is optimized for Windows, and not for the Web.

### **Security**

Although Access databases (using the Jet engine) can be password protected and encrypted, these databases do not have the same level of security as SQL Server or mainframe database systems. If data security is critical, a SQL Server solution is the better choice. SQL Server offers 128-bit encryption and storage in a remote location from the user and application. Combined with Web services, SQL Server allows distributed data in a controlled and highly secure manner.

### **Data Integrity**

Similarly, data integrity and recovery is not as robust on file-based databases using Jet, compared to SQL Server with its triggers, transaction logs, and repair processes.

File server databases using Jet may become corrupt and require regular maintenance to maintain optimal results. Even with maintenance, the chance of failure is much higher than with SQL Server.

The Total Visual Agent (<http://www.fmsinc.com/products/agent/>) product addresses the administrative needs of daily database maintenance (compacts and backups), but it's not the same as the built-in features of SQL Server.

### **Backups**

Access databases (using the Jet engine) are easy to back up (copy the .mdb file). However, these databases require user initiative, unless an automated process or tool, like Total Visual Agent, is in place.

If the Access database is open and the data is changing, it cannot be backed up while users are in it. This is a major problem, if the database is critical and used 24 hours a day, seven days a week.

The administrative tools for SQL Server have more features, compared to Access. Backups can run anytime, even if users are active. This is done through the use of transactions. Access supports transactions, but it is limited compared to SQL Server.

### **Transaction Logs and Rollbacks**

If you need to know who modified what data, and undo changes, SQL Server's built-in features and triggers support this.

An Access application can try to replicate the tracking of changes by managing user interaction with the data. However, it would require programming and could not be managed at the core data level. Mistakes in the application or other applications in contact with the Access data could cause data changes that are not documented. There are also no rollbacks in Access after a transaction is committed.

## **Network Bandwidth**

A well designed application using SQL Server can significantly reduce the amount of data moving across the network, because only the requested records are passed from the database to the application.

File server databases pass the whole table (or at least the index) across the network. This may not be significant for small files, but performance suffers as the data grows.

## **Scalability**

One Access database (using the Jet engine) is limited to 2 gigabytes (GB). If a database exceeds that, the solution can't be entirely solved by Access. Access databases also have problems with too many simultaneous users. The number depends on what they are doing.

If there's a lot of data, SQL Server is the better choice. SQL Server also supports more users and traffic, not only through its limited bandwidth traffic, but also with the ability to improve performance, by investing more in hardware through more memory, more CPUs, and more computers. This option is not available for file server databases like Access.

Related to scalability is the option of consolidating multiple Access databases into one large SQL Server database. Although you may combine several Access databases into one, if the size, security, or other requirements exceed Access capabilities, SQL Server is ideal. Having one large repository has the potential for using Business Intelligence (BI) tools and Web publishing with significant business and operational opportunities.

## **Limited User Interface**

Applications built in Access, unlike Visual Basic, are limited in appearance. Multiple document interface (MDI) applications cannot be built in Access. In general, users know if an application is written in Access. For some situations, programs such as Visual Basic or WinForms in Visual Studio .NET provide a more desirable user experience on Windows....

## Appendix G: Wall-thickness phase work area reports



### *Work Areas completed*

<i>Where failure</i>	<i>Component</i>	<i>Sub component</i>	<i>Area</i>	<i>Report no.</i>	<i>Date</i>
41	SHFPF	Outlet Leg (S.B. 101/102)	1		15/10/2008
	SHLTP	Outlet Leg (S.B. 101/102) T1	1		09/10/2008
24	EULA	UPPER (Front Wall bends)	1		15/10/2008
37	RHLTH	Upper (L-brackets) T3-6	5		15/10/2008
		Upper (L-brackets) T7-10	5		15/10/2008
25	RHLTH	Interm (Rear wall bends) T1-5	12		15/10/2008
		Interm (Rear wall bends) T6-10	12		15/10/2008
		Lower (Rear wall bends) T1-5	8		15/10/2008
		Lower (Rear wall bends) T6-10	8		15/10/2008
		Upper (Rear wall bends) T1-5	8		15/10/2008
		Upper (Rear wall bends) T6-10	8		15/10/2008
71	EULA				

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### *Work Areas not complete*

<i>Where failure</i>	<i>Component</i>	<i>Sub component</i>	<i>Area</i>
41	SHLTP	<i>Outlet Leg (S.B. 101/102) T2-8</i>	1
55	SHDP SCST	<i>SCST (S.B. 99/100)</i>	3
	SHFPF	<i>Outlet Leg (S.B. 99/100)</i>	3
	SHLTP	<i>Outlet leg (S.B. 99/100)</i>	2
157	FWW	<i>Front wall (dipper plate)</i>	7
		<i>LH &amp; RH side (dipper plate)</i>	7
		<i>Rear wall (dipper plate)</i>	7
25	RHLTH		

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**Work Area Status**

<i>Where Failure</i>	<i>Component</i>	<i>Sub component</i>	<i>Area</i>	<i>Status</i>	<i>Report no.</i>	<i>Date</i>
41	SHFPF	Outlet Leg (S.B. 101/102)	1	Complete		15/10/2008
		SHLTP				
			Outlet Leg (S.B. 101/102) T1	1	Complete	
		Outlet Leg (S.B. 101/102) T2-8	1	Not Complete		
55	SHDP SCST	SCST (S.B. 99/100)	3	Not Complete		
		SHFPF				
			Outlet Leg (S.B. 99/100)	3	Not Complete	
	SHLTP					
		Outlet leg (S.B. 99/100)	2	Not Complete		
24						

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**Work Areas that are in Progress**

<i>Wear failure no</i>	<i>Component</i>	<i>Sub component</i>	<i>Area</i>	<i>Technician name</i>	<i>Tech start</i>
138	RHLTH	Interm (Hanger tubes) T6-9	4	helgaard	19/08/2008
37	RHLTH	Upper (L-brackets) T3-6	9	Sato	15/10/2008
		Upper (L-brackets) T7-10	9	Whenda	15/10/2008
109	Screentubes	Row E (at roof level)	3	Whenda	15/10/2008
		Row C & D (at roof level)	3	Whenda	15/10/2008
		Row A & B (at roof level)	3	Whenda	15/10/2008
22	SHFPF	Outlet (Below roof) E13-19	5	Sato	15/10/2008

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## Appendix H: Wall-thickness phase Technician reports



### Technician Info on Work Done

Technician name	Wear failure no	Component	Sub component	Area	Tech status	Date
<i>helgacd</i>		138 RHLTH	Interm (Hanger tubes) T6-9	4	In progress	
<i>koos</i>		41 SHLTP	Outlet Leg (S.B. 101/102) T	1	Complete	09/10/2008
		25 RHLTH	Interm (Rear wall bends) T1-	12	Complete	15/10/2008
		37 RHLTH	Upper (L-brackets) T3-6	5	Complete	15/10/2008
		37 RHLTH	Upper (L-brackets) T7-10	5	Complete	15/10/2008
		25 RHLTH	Upper (Rear wall bends) T6-	8	Complete	15/10/2008
		25 RHLTH	Interm (Rear wall bends) T6-	12	Complete	15/10/2008
		25 RHLTH	Lower (Rear wall bends) T6-	8	Complete	15/10/2008
		25 RHLTH	Lower (Rear wall bends) T1-	8	Complete	15/10/2008
		25 RHLTH	Interm (Rear wall bends) T1-	4	Complete	15/10/2008
		25 RHLTH	Upper (Rear wall bends) T1-	8	Complete	15/10/2008
		37 RHLTH	Upper (L-brackets) T1-2	5	Not Started	
<i>Sato</i>		41 SHFPF	Outlet Leg (S.B. 101/102)	1	Complete	14/10/2008

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### Technician info on Backups Done

Technician name	Wear failure no	Component	Sub component	Area	Backup status	Tech Date
<i>helgacd</i>		37 RHLTH	Upper (L-brackets) T1-2	9	In progress	15/10/2008
<i>koos</i>		41 SHFPF	Outlet Leg (S.B. 101/102)	1	Complete	14/10/2008
		71 EULA	Upper (S.B. 171/172) T1	3	Complete	15/10/2008
		71 EULA	Upper (S.B. 171/172) T12	7	Complete	15/10/2008
		41 SHLTP	Outlet Leg (S.B. 101/102) T2-8	1	In progress	19/08/2008
		37 RHLTH	Upper (L-brackets) T7-10	9	In progress	15/10/2008
<i>Sato</i>		24 EULA	UPPER (Front Wall bends)	1	Complete	15/10/2008
		24 EULA	UPPER (Front Wall bends)	5	Complete	15/10/2008
<i>Whenda</i>		41 SHLTP	Outlet Leg (S.B. 101/102) T1	1	Complete	09/10/2008
		25 RHLTH	Lower (Rear wall bends) T1-5	8	Complete	15/10/2008
		37 RHLTH	Upper (L-brackets) T3-6	5	Complete	15/10/2008
		25 RHLTH	Upper (Rear wall bends) T1-5	8	Complete	15/10/2008

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## Appendix I: X-ray phase reports



### Processcard ID's Accepted:

Month	Date	WF	Processcard Id	Acc Pc Id	Status
October 2008					
	15/10/2008	131	113		Accept
	15/10/2008	123	12		Accept
	15/10/2008	121	455	421r1	Accept
	15/10/2008	121	4564		Accept
	15/10/2008	121	45665		Accept
	15/10/2008	222	564564		Accept
	15/10/2008	121	655		Accept
	15/10/2008	414	75		Accept
	15/10/2008	45345	7857		Accept

Elm 8 Tube 5 X01 Area 3



### Processcard ID's Accepted:

<u>WF no</u>	<u>Processcard</u>	<u>Acc Ac Id</u>	<u>Status</u>	<u>Date</u>
<i>121</i>	455	421r1	Accept	15/10/2008
	4564		Accept	15/10/2008
	45685		Accept	15/10/2008
	655		Accept	15/10/2008
<i>123</i>	12		Accept	15/10/2008
<i>131</i>	113		Accept	15/10/2008
<i>222</i>	564564		Accept	15/10/2008
<i>414</i>	75		Accept	15/10/2008
<i>45345</i>	7857		Accept	15/10/2008
		Elm 8 Tube 5 X01 Area 3		



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## Processcard ID's Rejected

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<u>Month</u>	<u>Date</u>	<u>WF</u>	<u>Processcard Id</u>	<u>Acc Pc Id</u>	<u>Status</u>
October 2008					
	21/10/2008	121	4545		Reject
	21/10/2008	121	456456		Reject
	21/10/2008	222	56456		Reject
	21/10/2008	414	7575		Reject



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## Processcard ID's Rejected

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<u>WF no</u>	<u>Processcard</u>	<u>Acc Ac Id</u>	<u>Status</u>	<u>Date</u>
121	4545		Reject	15/10/2008
	456456		Reject	15/10/2008
222	56456		Reject	15/10/2008
414	7575		Reject	15/10/2008



## Processcard ID's In Progress

<u>WF no</u>	<u>Processcard</u>	<u>Acc Pc Id</u>	<u>NDE</u>	<u>Supervisor</u>	<u>QC</u>	<u>3rd Party</u>
<i>121</i>	122	6354r1	In progress	In progress	In progress	In progress
	4132132		In progress	In progress	In progress	In progress
<i>123</i>	23		In progress	In progress	In progress	In progress
	34		In progress	In progress	In progress	In progress
	45		In progress	In progress	In progress	In progress
	56		In progress	In progress	In progress	In progress
<i>131</i>	112		In progress	In progress	In progress	In progress
	114	453r1	In progress	In progress	In progress	In progress
<i>222</i>	76866		Accept	In progress	In progress	In progress
	854666		In progress	In progress	In progress	In progress
<i>23</i>						



### Processcard ID's

WF no:	Processcard	Acc Pc Id:	Supervisor:	QC:	3rd Party:	Date:	Technician(s):		
							Shot	Repair	Cut
121									
122	6354r1	In progress	In progress	In progress					
Comment:							Reshoot:		
4132132		In progress	In progress	In progress					
Comment:							Reshoot:		
4545		Reject	Reject	Reject	15/10/2008	GdL			
Comment:							Reshoot:		
455	421r1	Accept	Accept	Accept	15/10/2008	JD			
Comment:							Reshoot:		
4564		Accept	Accept	Accept	15/10/2008	JD			
Comment:							Reshoot:		