Ventcroft Track & Trace

Thesis Bachelor of ICT & Technology

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Foreword

My name is Collin Kleine. From April 2012 to August 2012 I've been on placement at Actemium Final Assembly Systems (FAS) in Birmingham, United Kingdom (UK). This was my final project to graduate for my Bachelor of ICT & Technology at the Fontys University of Applied Sciences in Eindhoven, The Netherlands. During this placement I've developed a part of a project for the Ventcroft factory in Runcorn (near Liverpool).

Placements at Fontys are scheduled to start in February, but at that moment I had not found a placement yet. This is why everything has been delayed for about two months.

In this thesis I'll give an overview of my process and products during my placement. I've developed a traceability system with automatic identification for a factory with a partial implementation for the Ventcroft factory.

Hereby I would like to thank all Actemium FAS personnel for giving me a great experience at their company, and accepting me as a colleague quickly. I would like to express my special thanks to my technical mentor David West who helped me on a day-to-day basis. Hereby I would also like to thank my manager Nick Chambers, who has helped me adopting to the UK way of life, monitored and mentored me through his busy schedule.

Also I would like to thank the personnel of Actemium Veghel who helped to get in touch with Actemium FAS and were involved as much as possible.

Also my university mentor Joeri van Belle has been very helpful and proved to be very flexible, acknowledging the added complexity for living abroad.

Collin Kleine - August 6, 2012

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Summary

A traceability pilot using RFID readers has been realised for a factory in Runcorn, by Collin Kleine. This graduation project to conclude the Bachelor of ICT & Technology at the Fontys University of Applied Sciences in Eindhoven has been done at Actemium FAS in Birmingham, United Kingdom. The traceability pilot successfully proved the concept of reading RFID tags to provide information about a product and it's location within the factory.

1 Preface

1.1 Introduction

Traceability within manufacturing is becoming the standard. Even with the best quality insurance, eventually problems may occur in products. This may be the result of for example a problem with any of the ingredients.

This thesis describes the project done by Collin Kleine at Actemium FAS in Birmingham, as a graduation project for his Bachelor of ICT & Technology at the Fontys University of Applied Sciences, Eindhoven. This project consisted of creating a more automatic traceability system for the Ventcroft factory. This factory manufactures products which are required to be certified, to endorse them as acceptable for releasing them into the market. The certification authorities require full product traceability of its ingredients.

1.2 Document Objective

The objective of this document is to account for the half year of industrial placement at Actemium FAS by Collin Kleine. This document is the basis for the assessors to grade the work and research done by Collin Kleine, and form a judgement about this. The document also forms the basis for the final presentation.

1.3 Intended Audience

Primary targets are the company supervisor, the assessors and any external experts.

1.4 Document Structure

The structure of the document is described as followed:

1. Foreword & Introduction
2. Company description
3. Assignment & Project goals
4. Approach
5. Software design
6. Project execution
7. Conclusions and recommendations
8. Evaluation

Where appropriate, a retrospective is present at every section.

1.5 Document Scope

This document will cover the project assignment, process, learning moments, product evolution, the research component and how actions from the personal development plan are being fulfilled. It also contains a personal evaluation about the entire project.

1.6 Document Conventions

A glossary can be found at the end of this document at page 36, containing all used abbreviations. a source is quoted, an indication will be placed using a footnote sign [1].

1.7 Change History

Issue	Comments	Date
0000	Draft version for comments on chapters	13/06/2012
0001	Changed introduction section, added research section	18/06/2012
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0100	Final release	06/08/2012

1.8 Distribution List

Issue	Comments	Distributed to	Date
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0001	Draft version for comments on chapters	Joeri van Belle [j.vanbellefontys.nl]	18/06/2012
0002	Draft version for comments by Joeri van Belle	Joeri van Belle [j.vanbellefontys.nl]	18/06/2012
0100	Final version for assessment	Internship office	06/08/2012

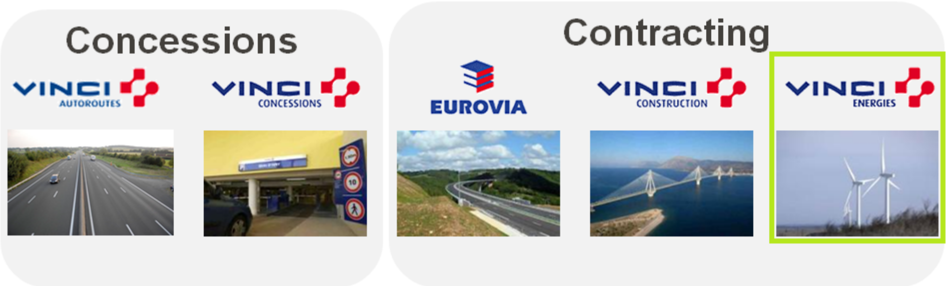
1.9 Document legal status

This document has no confidentiality, and may be (partly) reproduced and / or published in print or digitally. This work is published on August 6, 2012.

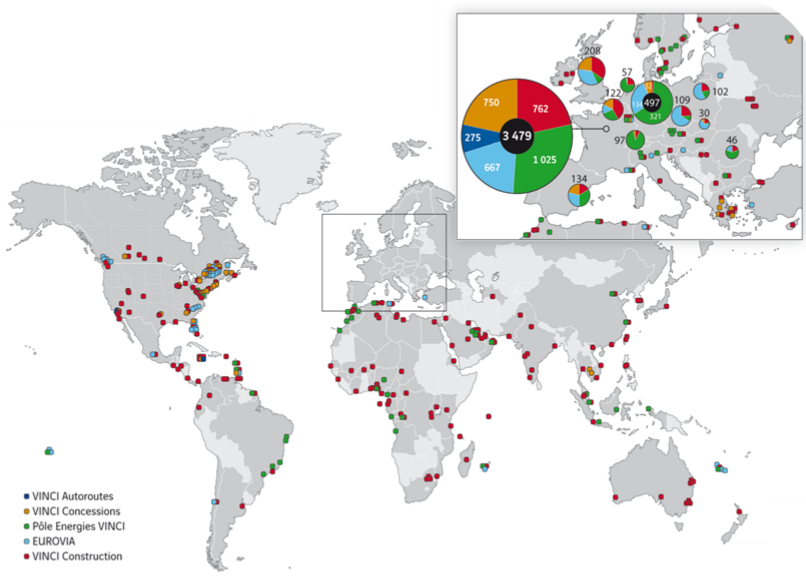
[1] A reference to the source will be placed here.

2 Company description

Actemium is part of the Vinci Energy group, which is one of the five parts of the Vinci Group. In 2011, the Vinci groups 167,000 employees worked on 264,000 projects in some 100 countries.
In 2012 Vinci Energy has 300 Business Units in 30 countries with 13,600 engineers & technicians.



Vinci has locations in all five continents, but has most locations in Europe and more specifically in France, the country where Vinci was founded.



Vinci is expanding it's business into the United Kingdom, where Actemium has multiple business units.

Actemium Final Assembly Systems is based in Birmingham, where it serves the automotive industry to a lot of clients, including these brands.

Actemium FAS is a small organisation with 9 employees, of which 6 are software or application engineers. The business has two main activities: Vehicle Test software and Automation.

The Vehicle Test part has it's own test framework for the automotive industry developed over many years and this is used at different clients. This suite contains an IDE to write tests, management seats to analyse test results, its own graphical user interface for the test areas (with main focus on consistency through different screens), hardware to connect to the on-board computers of cars and hardware to provide user input to the test engineer. They also provide programmers to flash programmable components on a car.

The automation side of the business is focused on factory automation, with currently one big project: Ventcroft. This part of the business is intended to grow in the next years.

3 Assignment

3.1 Project background

This project is completed by Collin Kleine, as the final internship before he can graduate his Bachelor of ICT & Technology at the Fontys University of Applied Sciences. His ambition is to start a master study after this internship.

As his first internship for his current study was Actemium Veghel, he got in to contact with Actemium Veghel when he was searching for a graduation internship abroad. Shortly after this contact, it was established that Actemium FAS was starting a project in co-operation with Actemium Veghel, this contact has led to the internship at Actemium FAS.

Ventcroft Ltd is the UK's largest independent manufacturer of cable and electronic products for the Fire and Security market, 3rd party approved by LPCB & BASEC for Ventcrofts' ISO 9001:2008 quality management system. Ventcrofts' core ranges are Fire Cable, Fire Alarm and Detection, Intruder Cable, Intruder Alarm and Detection and Medical Call Systems. The fire and intruder/safety cables are produced in its own factory, the detection and medical call systems are purchased from a third party company and sold directly.

The products Ventcroft manufactures are ones which are required to be certified to endorse them as acceptable for putting them into the market. Two important certification boards are applicable for the Ventcroft factory.

BASEC, British Approvals Service For Cables & LPCB, Loss Prevention Certification Board

(a) basec.org.uk (b) redbooklive.com

Due to the plans to build a second bridge across the river Mersey and the associated infrastructural changes (http://www.merseygateway.co.uk/), the English government mandated Ventcroft to move. They have built a new production facility on the same industrial estate (Astmoor Industrial Estate in Runcorn, Cheshire).

Actemium has been awarded the production automation project in the new factory which includes level 2 (PLC/SCADA) and level 3 (MES) activities. The key delivery for this project will be the replacement of the bespoke software developed continuously over a period of several years by several members of Ventcroft to satisfy the BASEC and LPCB conformance needed for their products.

The original Ventcroft factory had a simple, mostly manual, Track and Trace system. This Track and Trace system is build in what Ventcroft call the “Central DataBase” (CDB). This CDB will be replaced by the MES system of Actemium. This new MES system will have more communication with the machines on the production floor. The traceability system can therefore be more automatic than it used to be, reducing the amount of product tracking faults in the system. Common causes for faults in the system are typographical faults and mislabelling.

Actemium Veghel is developing the MES part of the project. They have developed their own SDK on top of the “G.E. Proficy Plant Applications” software suite and will engineer this solution for the Ventcroft factory.

3.2 Project goals

The goal of this project is to develop a new Track and Tracing system, applicable for Ventcroft and reusable by Actemium on other future projects. This has to be more automatic than the current system, fully integrated in the other SCADA / MES systems and provide more detail on the product and production batches. The exact requirements were identified during the research phase and are incorporated in the requirements document. Goal of the desk research was to identify the needs, possibilities, and the to be used methodology for traceability within the Ventcroft factory.

This project was not intended to provide a complete traceability solution, but rather to pilot the concept and develop software that can be used in the factory. This included doing desk research on traceability, identification and serialisation. The software developed must prove a working concept using all different software and hardware layers.

As part of this project, the following personal development plan goals are stated which are evaluated at page 35:

Improve programming skills As part of this, the realisation is an important part of the project. This should result in a good end product, which is evaluated at the end of the project.

Improve work organisation As part of this, detailed progress reports are being issued every week, and an evaluation of the planning is made at the end of each phase. At the end of the project, an evaluation is made to see if this improved work organisation, and if this led to a more predictable end result.

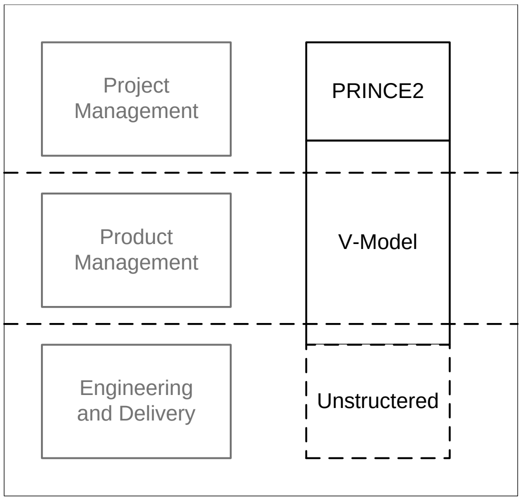
End results include:

Product	Description
Track and Trace general research document	Document about traceability. In this investigation, the possibilities to identify products or carriers, and the possibilities to store and look up data being generated for traceability usage.
Track and Trace for Ventcroft research document	Document outlining the traceability strategy. This document has not been created separately, but is integrated in the Functional specification.
Test results of the test-setup	Proof-of-concept in-house tests
SDK for integrating Track and Trace in MES or SCADA project with according documentation	Final software being delivered
Integration at Ventcroft site	Site acceptance test with a pilot program

4 Approach

4.1 Methodology

Figure 1: *Applied project model*



4.1.1 PRINCE-2

During this project, project management has been done using PRINCE2 methodology. Starting with a Project Initiation Document , this project has been further maintained using weekly Progress Reports and from time to time End Stage reports. Although some secondary stakeholders have changed during the project, no essential changes have occurred. Therefore, the organisational graphics in the PID may not represent the final project group.

4.1.2 V-Model

The software development has been done using the V-Model systems development lifecycle. This was used because the main project is being developedusing this methodology, maintaining the project's consistency.

4.2 Planning

The planning was initially done at product level, consistent with the PRINCE2 approach. Although the products were well defined, the requirements for the initial product changed over time, merging it with the final product.

4.3 Retrospective

As the project had to adapt to frequent changes in possibilities, this was not efficient for documents like the requirements and functional specification. Consequently the finalisation of these documents are very late.

As suggested by Joeri van Belle, this project could also have been managed using an Agile approach. This probably would have been better, since Actemium FAS normally uses iterative based development (which was later revealed). This is not done by a specific methodology.

In retrospect, an Agile approach like Scrum or DSDM Atern based methodology would have been a better fit for this project. This prevents spending a lot of time on documentation and rewriting documentation up front. It also gives a better grip on progress, as it acknowledges that frequent changes will be made.

As for the MES part of the project, although a Test-Driven Development (TDD) approach would have been very feasible, the SCADA and PLC software environments do not provide any possibilities for automated tests. Therefore methodologies with their roots from TDD, for example eXtreme Programming) would not have been suitable this project.

The way the weekly reporting has been done would still fit. End-stage reports would prove more usefull, as there would be more stages in development of the product to report on, instead of stages in the project (Requirements, Design, Implementation, Testing). Furthermore, the stage and product planning was not successful, due to hard to determine requirements and design. With an Agile approach, this could have been solved by just implementing, and changes made accordingly to results.

The chosen approach was not ideal, but the decision was made that it would be better not to spend more time on organising the project, but rather to just get on with the work in the best way possible.

5 Desk research

5.1 Goals

How can an end-to-end traceability system be implemented for the Ventcroft factory, where all ingredients can be traced back to sub-batches and products, and where all sub batches internally are traceable to carriers with their location?

The research has been conducted using the following research questions:

- What type of techniques can be used for serialisation, and what technologies exist to implement that?
- What are the available standards and what regulations apply?
- What are applicable areas of traceability?
- What are the possible Return On Investments (ROI)
- What are the possible supply chain strategies?

5.2 Introduction to traceability

Formal traceability was first introduced in the food industry due to regulations, and made savage animals registered products to verify it's origin. It then became possible to recall contaminated goods when required. This saves money as goods which are safe must not be recalled. [2]

In blood transfusions, traceability is particular important. Some infections have a large "window" between infection of the donor, and positive test results on the blood. This means people that can be infected with the blood must be informed and tested. In the Netherlands this happens with 0.012 % of the donations. Any traceability information for this industry is to be held for at least 30 years.[3]

In the medical industry, traceability is used for reducing counterfeit products and for making rapid recalls possible. Counterfeit medicinal products may have wrong or no active ingredients, have harmful ingredients or another substandard history. [4]

Now companies are introducing Traceability not only for law compliance purposes, but to comply with standardisation certificates and even for value-added customer service or in-house improvements.

[2]Source: http://ec.europa.eu/food/food/foodlaw/traceability/factsheet_trace_2007_en.pdf

[3]Source: http://www.sanquin.nl/repository/documenten/en/about-sanquin/sanquin/45297/45308/scientific_report_2002.pdf

[4]Source: http://www.imb.ie/images/uploaded/documents/Presentation%205%20-%20Traceability%20of%20product-counterfeit%20medicinal%20products%20-%20Alfred%20Hunt.pdf

5.3 Definition of traceability

Tracking and Tracing should be defined as [5]:

Tracking is the process of monitoring products, by means of a secure marker (identifier), as they make their way to the consumer. In this way, a time and location history is built for each product.

Tracing is the concept of being able to intercept and authenticate products and trace their route back to the manufacturer. In this way, the time and location history of a specific product is retrieved.

Serialisation is the unique identification of a (...) product (...) via printing a unique serialisation number on packaging units e.g. 2D bar code, RFID tag.

This is implicitly used by most vendors, as this definition is one of the few real definitions. Through this document, these definitions will be used for the according concepts.

The definition of traceability means that a complete traceability system can:

- Identify each product and raw material with an unique identification (ID);
- Keep track of where every product and raw material is and has been;
- Match relevant production data to the products and raw material;
- Be able to look up this data after the finished product has left the site.

5.4 Conclusions

5.4.1 Researching areas

It was important to determinate what type of techniques there are for keeping track of all ingredients. Therefore, multiple documents on traceability has been read.

In the Ventcroft factory a centralised system will keep track of all goods in, goods consumed and produced and goods out. In perspective to other suppliers and client, Ventcroft will be able to track the used goods through their system.

5.4.2 Serialisation

Before a traceability system can be set up, there needs to be chosen a form of identification / serialisation. Possible solutions include human readable, visual and sensor readable IDs. Most common are hybrid solutions, as the human readable solution is compulsory due regulations, but normally automatic identification is used. Of the possible solutions, an specific solution had to be chosen for Ventcroft, considering real world restrictions, usability and costs.

[5] http://www.werum.com/en/mes/products/special-packages/track_trace/track_trace.jsp?top=1

There are three solutions for serialisation proposed. These all require different levels of operator involvement, and are usable for different parts of the product chain:

Technique	Operator involvement	Rate of error	Used for
RFID	Low	Low	Places where automatic identification using RFID is possible / viable
Bar code	Medium	Low	Places where RFID is not viable
Human Readable	High	High	For manual look up / data insertion when automatic techniques are not available. Also needed for conforming with regulations.

5.4.3 Regulations

Information about all ingredients need to be traceable to batches in products, including information on the clients who got supplied with what batches. All products and (sub) batches need to be identifiable with human readable text. On automated identification systems are no regulations at this moment.

5.4.4 Applicable areas

In factories tracing can be used in manufacturing, picking, packing, and shipping. During manufacturing, each item is – where possible – tagged with a unique identifier. At any point in the production, on designated places, the location of the product will be recorded. This way a batch of products can be tracked in the line, and the customers can be informed where the order is in the manufacturing process.

When used in the picking or packing process, combining products for shipment to a customer, the identification can be used for checking if everything is correct. If something is not according to plan, this can be flagged for inspection.

In the shipping process, there can be done an additional check to see if the loaded pallet needs to go on this truck. Also, the progress of loading and performance can be extracted from this information. The identification can than also update the status for the customer.

5.4.5 Return on investment

Advantages of a automatic traceability system are the key component in a return on investment. Traceability is used[6]:

- To help support product claims and provide information to customers, for example to authenticate organic, non-GMO or country-of-origin claims. At Ventcroft it can prove it is produced in the United Kingdom, under the applicable laws.
- To identify and implement corrective actions to regain control of a problematic process. Batches that fail a test might be traced back to a wrong batch of a specific ingredient.
- To provide information for the disposition of any non-conforming product, including recall if necessary.
- To serve as a tool for process control in areas such as inventory control and quality control.
- To provide a mechanism for providing product information quickly, to regulators or customers. Customers can be updated with the status of their order more frequently and accurately.

5.4.6 Supply chain strategies

5.4.6.1 Centralised and decentralised systems Tracking can use a centralised system, or non-centralised system. Depending on the scale and geographic distribution, one of the two systems is being chosen. For internal use, a centralised system is more common than in an inter-business system. When not for internal use designed an one-up-one-down or two-up system is more common. This means the company keeps records of the supplier and the client. With two-up, records of the supplier and its suppliers are kept.

5.4.6.2 Centralised systems Centralised systems are often used for systems with a limited scope. There is a clear start of the process, and a clear end. Parcel operators for example have a limited scope: receiving, transporting and delivering. At every point the parcel is moved, it is recorded to a centralised database. The customer can see where it was last recorded, and it is clear where a parcel should be. One of the great advantages of a centralised system is the ease and speed of recovering any information. When applied correctly, near-real-time information can be visualised and read.

5.4.6.3 Decentralised systems When the scope is not so clear, a decentralised system could be used instead. When making a product, records of the company can tell what suppliers have delivered the materials for the product. This is very useful to dealers, because they have less risk to be bypassed by the customer.

[6] Source: http://www.etrace-eg.org/files/newsiteinfo/Publications/Etrace_Publication/Introduction_to_Traceability_Processed_Foods.pdf

A concrete case: dioxin contamination in potato peels, 2004 In autumn 2004, during standard random monitoring of dioxin levels in milk at a Dutch farm, national competent authorities found a high level of dioxin. They immediately barred the farm from trade, and initiated the tracing of the product through the food chain. This revealed that the source of contamination was clay, used in food processing to separate high quality potatoes from lower quality ones. The dioxin contaminated clay had contaminated potato peels used for feeding animals. The RASFF (see box) was used to trigger the swift exchange of information between national authorities on the problem. It was quickly established that the clay had also been supplied to several food processing companies located in The Netherlands, Belgium, France and Germany. Authorities swiftly identified these businesses and barred over 200 farms, which had received the potentially contaminated potato peels, from trading. Thanks to the traceability system, action was taken in time and contaminated products never reached the consumers.

Source: (European Communities, 2007)

This example shows why a decentralised system can be useful. No-one would consider clay being used in the potato industry useful information in a centralised system for traceability on milk. Because every link in the chain had kept its suppliers information, the source could be identified quickly. Because every link in the chain had kept its client information, any infected products were also identified quickly.

6 Software design

6.1 Physical architecture

Actemium uses the ISA95 system for naming parts and layers in factory system architectures. This divides the system in 5 different layers, with different purposes.

Level 0 is all Input / Output, sensors etc. This normally involves no software development. Exceptions for this would be complex sensors, for example: Vision camera and safety zone light screen.

Level 1 is PLC software / hardware and PLC supporting software (for example an OPC server). PLC software is responsible for interpreting inputs (sensors, buttons), and controlling outputs.

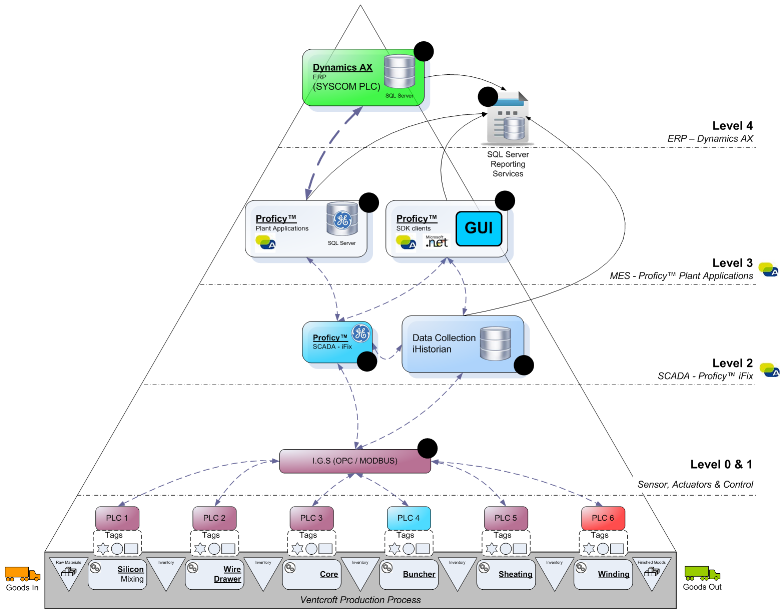
Level 2 is SCADA software. SCADA stands for "supervisory control and data acquisition" [7], and has as primary goals to monitor the processes executed by the PLC and modify this behaviour by modifying parameters in the PLC program. SCADA runs on normal PCs, and is usually used by operators.

Level 3 MES stands for "Manufacturing execution system" [8], and has as primary functions in this system capturing batch information from operators, and allowing them to do production planning. The MES system also provides all screens necessary for Ventcroft's Quality Management System. The traceability system will be shown in this system, but is currently not as this system is not implemented yet. Materials tracking during the pilot is done using separate software, and batch tracking is shown using screens in the SCADA.

Level 4 ERP stands for "Enterprise Resource Planning" [9], and is at Ventcroft responsible for all accounting and production scheduling. This layer is not applicable for the traceability project.

[7] Source: http://en.wikipedia.org/wiki/SCADA
[8] Source: http://en.wikipedia.org/wiki/Manufacturing_execution_system
[9] Source: http://en.wikipedia.org/wiki/Enterprise_resource_planning

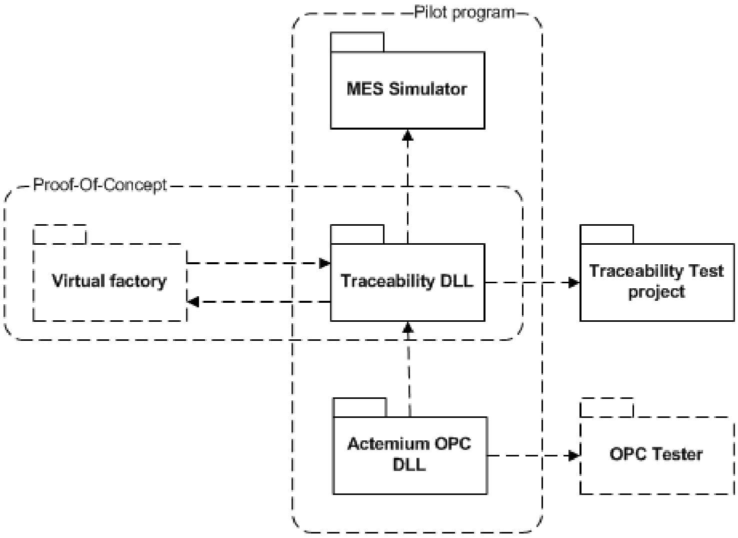
Figure 2: *ISA95 layers at Ventcroft*



6.2 Software architecture

The MES simulator is build up from as shown in figure 3.

Figure 3: *MES Simulator component design*



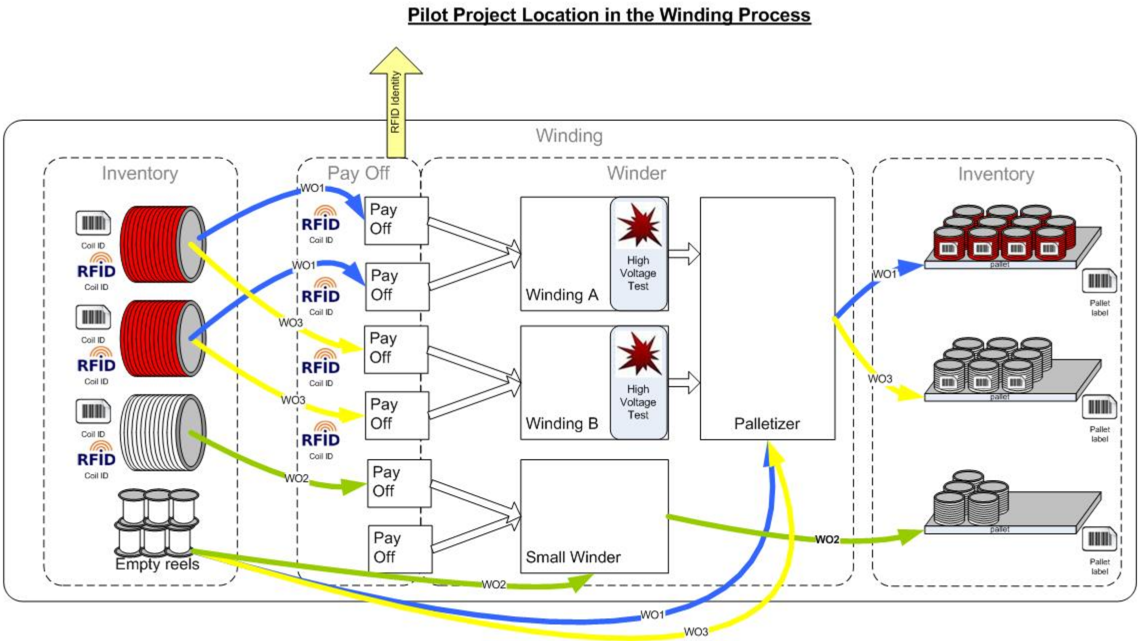
Pilot project scenario

The pilot project focuses on one particular scenario (See figure 4):

1. Product is created and put in a carrier with a unique identification for the batch. The used carrier is identified using a RFID tag.
2. Carrier gets stored until needed by next process.
3. Carrier is put in payoff of next process, RFID tag of carrier is read.
4. Batch information is fetched from the MES using the carrier RFID tag ID.
5. Show carrier and batch information in SCADA and MES, to be used for creating new product.

After this process, it starts over again. The product is moved to the next stage in the process.

Figure 4: *RFID Pilot project*



6.3 Software layers

The possibilities to communicate between industrial software is quite limited, due existing standards. These standards are currently being revised, but newer versions are not broadly adopted yet.

Software created in this project include:

6.3.1 MES Simulator

A .NET application with a database to store and retrieve traceability information from the SCADA system. This application can also be used to track ingredients and sub-batches.

6.3.2 SCADA

The SCADA system is used for two purposes. It translates the output registers from the PLC back in to a usable string which can be used for identification. This string is then saved by the historian, which is then used by the MES system. The SCADA system also provides an interface to read the current reader status, including an error handling section, to provide clear error messages.

Historian For data collection a historical database is used, called the Proficy Historian. This Historian fetches data from PLC's and SCADA, and stores this efficiently to be used for performance analysing, breakdown reports or traceability purposes. This database is to be used by the MES system to retrieve traceability data, but due lack of implementation so far of the MES system, this data for the pilot program has been stored in the pilot database itself.

6.3.3 PLC

In the PLC software, Function Blocks are used to create programs. The most important function block was an easy to use block for the RFID reader. An example was provided by the manufacturer.

This example had several problem:

- Not scalable, everything was defined global, so only one reader could be used.
- Required user input, using a very limited and inconvenient interface: the user needed to start the reading, clear the buffers after a read etc.

Figure 5: *Turck banner PLC*

The function block made for the reader is a read-only block, as this fitted the requirements. It uses instructions to bypass usual limitations, and copies an array of words (2-byte data), in several output registers. Software that runs on these

PLC's usually runs programs made using an IEC 61131-3 compatible programming languages. Supported languages are[10]:

- Ladder diagram (LD), graphical
- Function block diagram (FBD), graphical
- Structured text (ST), textual
- Instruction list (IL), textual
- Sequential function chart (SFC), has elements to organize programs for sequential and parallel control processing.

For different levels of complexity, different languages are used. In this project Turck banner PLCs are used. These PLCs use the programming system CoDeSys, which is compatible with IEC 61131-3.

On high level FBD are used, due to the complexity of the data connections. This way the system remains relatively simple.

Specific functions like data copy, for-loops, pointers etc were needed but not available as Function Blocks. For specific. These are written in Structured Text.

6.3.4 Layer design

Most design discussions were about which layer would be responsible for what, which depended on a lot of variables. Factors to be considered were:

Performance throughput and latency PLC and SCADA programs use OPC to exchange data points, which is based on a "pull"-mechanism. This means that every n milliseconds all data is fetched, which creates a lot of overhead on the network and CPUs. This is why the latency is as high as acceptable, to reduce load on all components.

Every layer that uses OPC to communicate adds significant time to the overall latency. The challenge here was to choose a sequence model that maintained the ISA95 structure but would still have an acceptable response time.

Maintainability The system needed to be designed to be capable of handling different sorts of serialisation, and be able to handle an imperfect system. The system should also record historical data, without the need of prior registration of carriers.

Extendability Because there will be used about 30 readers, it's essential that a change to a procedure in any part does not require changes for every reader, requiring all code to be modular by design.

[10]Source: http://en.wikipedia.org/wiki/IEC_61131-3

Data points being used The Historian is proprietary software, based on a data points system. Every data point stored in the Historian costs money on the licence. It was therefore essential to not store an RFID tag ID per Word (as it is served by the PLC), but rather to store a string, containing the whole ID. The SCADA system fetches the data from the PLCs, and using a script it encodes the Words in a hexadecimal string representation of the ID. This string is then imported in the Historian, saving 92% of data points needed in the historian. On a scale of potentially 30 readers saving over 300 data points needed for the same data.

6.4 Communication

6.4.1 Modbus

The Turck banner PLCs communicate using Modbus over TCP/IP. Getting the communication up and running wasn't as straight forwards as it should have been. About a week has been spent on researching how Modbus works and what was going wrong. This section therefore accounts for the time spent on researching this protocol. Modbus is a well known popular industrial protocol, initially designed for PLCs, but now also used on other industrial devices like power meters. It can be used as a protocol on top of TCP, UDP, RS485 or other transport layers.

6.4.1.1 Restrictions The protocol is in use since 1979, and has not been significantly changed ever since then. This leads to the following restrictions:

Supported data types One of the restrictions of Modbus is that the maximum lenght of data is 16 bit (known as a "word"). This means that if data is bigger than 16 bit, the data always needs to be split into 16 bit blocks which need to be reassembled later. The identifier of an RFID tag for example is 128 bits. The chosen solution is to put these words in the Modbus registers, read them using the OPC server, read those using the SCADA system, and convert the bytes to a Hex-coded string (as it does not fit in an integer as well). From that moment on, the string will be used to identify the tag.

Data fetching Another limitation is that due the Master-Slave principle, the data has to be polled from the PLC, which creates overhead and delays. It is therefore important to consider how fast the data has to be available, to reduce the network and cpu load.

Endianness Endianness is the order in which bytes are stored in memory. Little-Endian is a more efficient way to store data for modern computers, but Big-Endian is similar to a number written on paper (in Arabic numerals as used in most Western scripts). Modbus still uses by default the Big-Endian byte order (also known as Motorola byte order), where all modern system nowadays use Little-Endian byte order. This was in this project a problem, as the OPC server by default used Little-Endian byte order, and the PLC provided the data in Big-Endian order. The setting for changing this was Motorola byte order.

6.4.1.2 Modbus protocol layers The protocol does not by default include any physical / data / networking / transportation protocols. This makes it powerful, as different transportation techniques can be used easily using the same protocol. Most common are RS485 and TCP/IP (Ethernet). The Modbus over Ethernet protocol is build on top of TCP, compatible with the OSI model as shown in Figure 7. This means that the protocol can be debugged using network package capturing software like wireshark.

6.4.1.3 Modbus protocol The Modbus protocol is build as described in table 1.

Figure 6: *Endianness (byte order)*

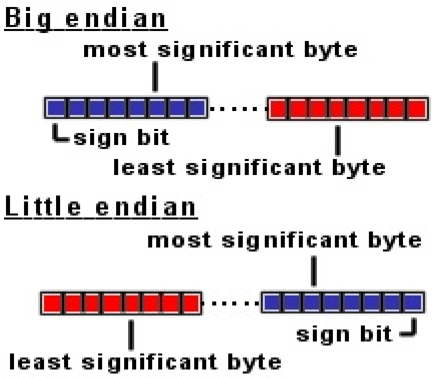


Figure 7: *Modbus OSI Model*

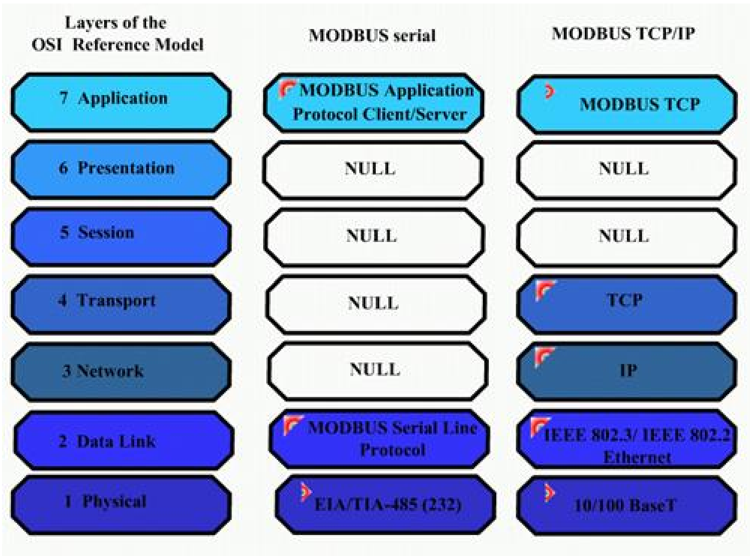


Table 1: *Modbus protocol*

Name	Description	Example
Transaction id	An incrementing number to identify induvidual messages and for synchronization between messages of server & client	630
Length Field	Identifies how much data will be transmitted	220
Unit Identifier	The modbus address	1
Function code	The command to excecute (e.g. read or write register)	3
Data bytes	Eighter the request data (addresses to read), write data, or response of a data read.	A8E1

6.4.1.4 Addressing Modbus over Ethernet is first identified using an IP address and port followed by a Modbus address (number 0 - 255), as one Modbus to Ethernet gateway can provide access over Ethernet for multiple Modbus slaves.

Both the IGS as the Turck banner make it possible to have read only data as the standard Modbus protocol does not support this. They use separate address ranges to achieve this.

All Modbus inputs and outputs have an address, called Modbus registers. The first Modbus output register in the Turck Banner PLC is given the Modbus address 0x4000 for read access, and 0x4400 for and write access.

The IGS OPC Server has its own conventions. Al their addresses are based on decimal numbers, not hex. IGS also requires a leading number, to indicate if the data need to be read only, or read/write.

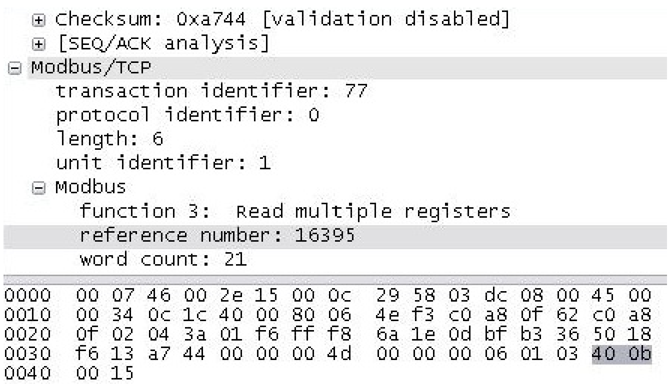
Due the challenges described above, the configuring of the software took about 1.5 weeks.

6.4.1.5 Wireshark capture To identify why the communication between the PLC and the OPC server didn't work, some research has been done on the protocol itself, and comparing the expected output with wireshark captures.

Wireshark is a popular network protocol analyzer. Using this program, individual network packages can be analysed.

In figure 8 is shown the query sent from the OPC server to the PLC. In table 1 . In the Modbus data part (in wireshark shown as the modbus part), the first byte is the function code: 0x03, Read multiple registers. This is followed by the address the OPC server wants to start reading from: 0x400b (16395 in decimal), which is the 11th address in the Read-Only range. The trailing two bytes indicate that the OPC server wants to read 21 registers.

Figure 8: *Modbus query*



In figure 9 is the response shown from the PLC to the OPC server. The Modbus data part acknowledges the function code by sending what command was received in the query. The following bytes indicate the amount of actual data will be send (which normally is double of the number of registers that was requested to read), which is in this example 42 bytes (21 registers * 2 bytes). The final Modbus part is the actual data from the registers. The fist 10 bytes are the bytes of the RFID tag, visualised in the SCADA test screen in figure 10.

Figure 9: *Modbus response*

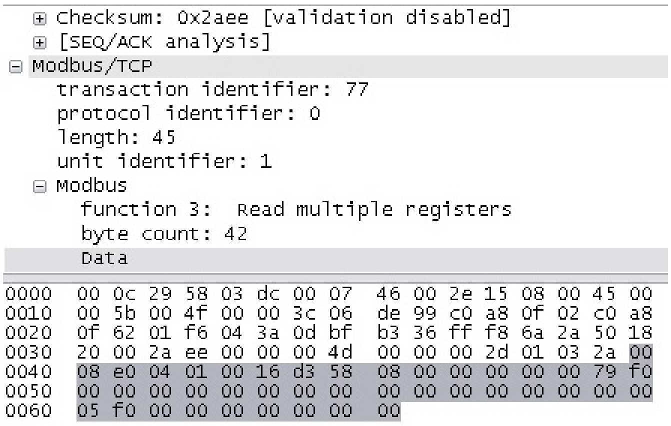
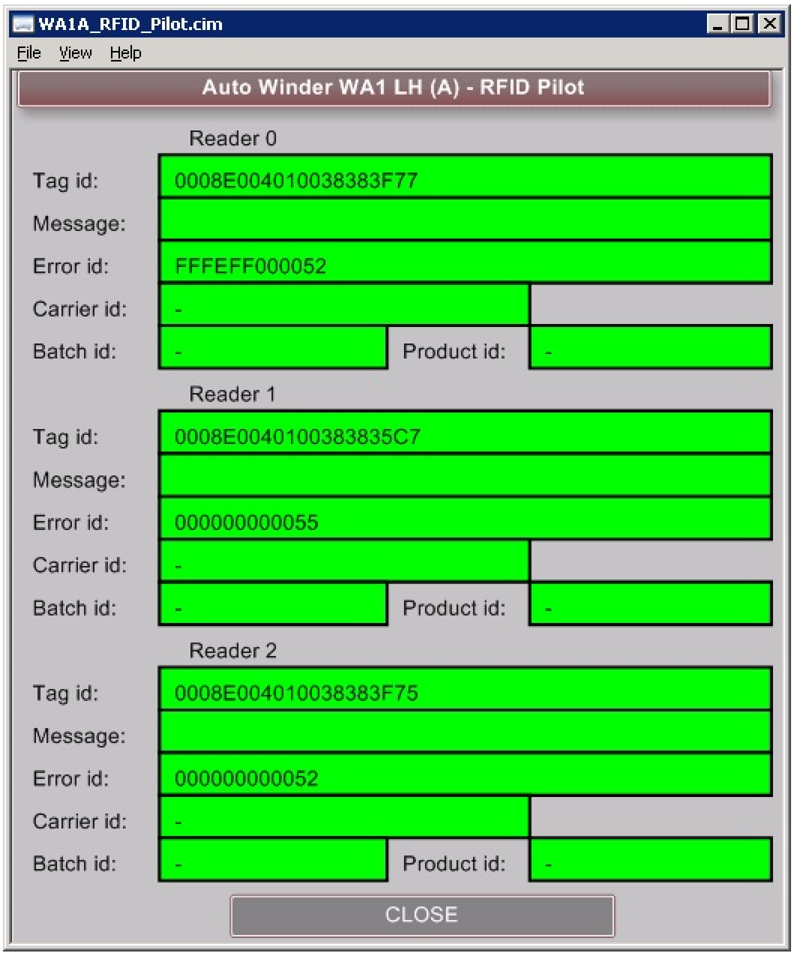


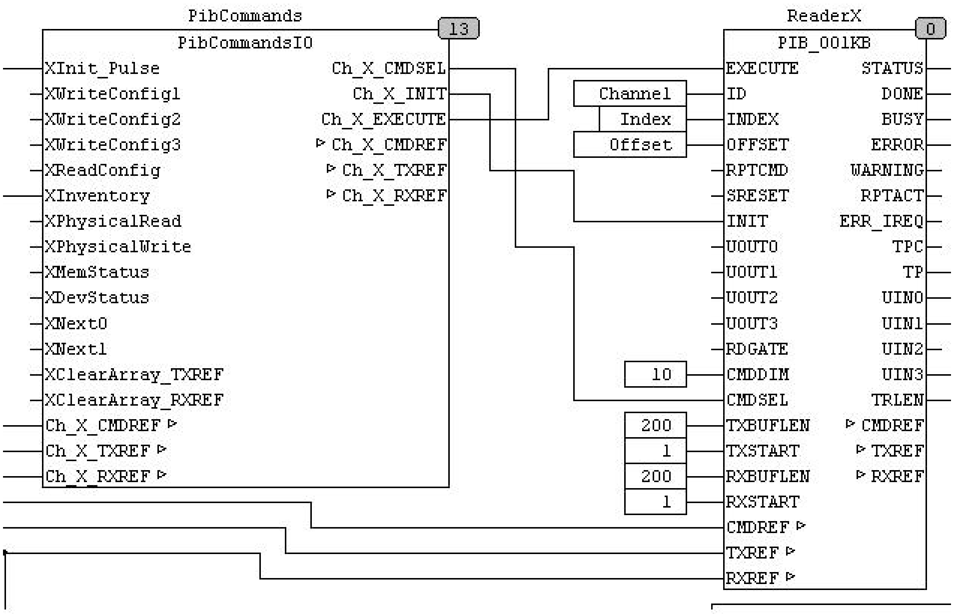
Figure 10: *Scada screen RFID tags*



6.5 Code examples

In figure 11 is an example of the function blocks being used to create top level programs.

Figure 11: *Function blocks*



In figure 12 is an example of structured text using pointers to transfer data for multiple words.

Figure 12: *Code example*

```
Counter := Offset; (* Reset counter (as this is a function
                      block this needs to be done manually *)

IF Enabled THEN
pt := StartOutput; (* Set the pointer address *)
FOR Counter := Offset TO NumberOfBytes BY 2 DO
    tempWord := Ch_X_RXREF[Counter];
    (* First, set the two bytes in one word *)
    newWord := ROL(tempWord, 8);
    newWord := newWord OR CH_X_RXREF[Counter+1];
    pt^ := newWord;
    pt := pt + 2; (* The pointer is per byte, so for
                     the next word (2 bytes) the pointer
                     needs to be added with 2 *)

END_FOR;
END_IF;

```

7 Project execution

7.1 Process

During the project, it became clear that the V-Model process as proposed in the Project Initiation Document was not used by Actemium FAS before. As this project is in conjunction with Actemium Veghel, they agreed with the V-Model process, for which Actemium Veghel took initiative.

Actemium Veghel has been working on the Functional Requirements Specifications (FRS) of the project since December 2011, and finished this in June 2012. The traceability part of the project (this sub-project) has not been elaborated a lot, as this has a low priority. Because there is not a lot specified by the FRS, the traceability project has it's own User- and Functional Specification. This has not been leading during the development, as it proved to be very difficult to get documentation, wishes of the client and reality lined up.

In retrospective, this project could have been more manageable with an agile approach as explained in paragraph 4.3.

7.2 Integration

Integration was a major part of this project. The solution needed to be suitable for the whole factory at some point, but needed to be proven to work with the available hardware already installed.

The implementation has been integrated in a pilot program at Ventcroft. The chosen location of the pilot was partly decided on the already physical availability of RFID readers on the specific machine. There are two identical machines, so one can be used for testing for the traceability pilot without disrupting the main process.

For working on site there are a lot of restriction and regulations. Health and Safety documentation has been read and applied where needed. Actemium uses a "Method Statement" for an on site installation. This states what will be done by whom, and how this is going to be done. A shortened example of such an Method Statement is inserted in appendix B.

This Method Statement is also the basis for a risk assessment, performed by the manager. This indicates all risks, and states precognitions to minimise the risk of an accident happening. This can be achieved by for example not performing certain actions like working on live equipment, but also wearing personal safety equipment like High Visibility Vests and Safety boots.

Integration with the MES system has not been started, as the development work on the MES system has not been started yet. This wasn't a real problem, as the traceability system is build on .NET as the MES system is. The DLL providing the traceability functionality has been tested with a separate program, and feeding back traceability information through the SCADA.

7.3 Results

The three main software parts of the project:

PLC The PLC part is ready for up scaling for the whole factory, which is a matter of configuring the PLCs per station.

SCADA For every extra reader all PLC tags need to be added, and a line in a configuration file has to be added. This is as portable as the system can be.

MES Simulator For a full-scale implementation there first needs to be done a pilot with integration in the Proficy MES system, using their database. Also any screens need to be modified or added to comply with the conventions used in the MES system.

Integration All code has been tested on site using the hardware at Ventcroft. The pilot has been recognised as a success, as the information that was required delivered by the system.

8 Conclusions and recommendations

8.1 Product

This project has successfully demonstrated the possibility to provide a traceability system at Ventcroft using Bar Codes and RFID. Therefore, a full scale implementation is viable to be made later on, by expanding the software created during this project. The integration in the MES system has not been started, as the development on the MES system has not been started by Actemium Veghel yet. This was not a major problem, but the scope has been changed from an integration to a simulation of the MES system.

It was also not possible to use the Proficy Historian database, because this also required the MES system to be up and running. This constraint was not properly identified as a risk at the start of the project, which was a mistake.

Not using the Proficy Historian database and MES database means that the communication from the MES simulation uses OPC and has it's own database. Before a full scale implementation is started, this part of the system should be tested for traceability use.

8.2 Process

This project was intended to be both V-Model and PRINCE-2 compliant. The PRINCE-2 part has been successful as far as the PID stated the goals for this. The V-Model gave to much overhead, specifically because the requirements kept changing. This has led to not meeting targets on the different stages. The planning therefore has not been met for most part of the project, which in turn was not good for morale. In retrospect an Agile project management would have been a lot better, combined with an PRINCE-2 reporting methodology.

Evaluation

I've gained a lot of good experience during my time at Actemium FAS. During the placement I managed to develop both my professional qualities as well as my personal ones. My English speech has also improved, which enables me to face international challenges with more confidence.

Major new experiences for me were the site visits to factories. I've been shown around at the Aston Martin car plant and have worked at the Ventcroft facility. Although I've been at plants before, I have never done diagnostics and site installation before.

I really enjoyed my time in the UK and with Actemium FAS. That's why I've applied to Aston University in Birmingham to follow a Post-Graduate program. I've accepted a conditional offer of Aston University, where one of the conditions is a successful graduation from Fontys.

I've also fully experienced the differences between the English and Dutch approach to software engineering projects. Actemium Veghel is very document driven, and uses a complex company architecture. Actemium FAS on the other hand seemed to be less structured, and very product focused. The best approach is probably a mix of both.

Evaluation of the goals of my personal development plan:

Improve programming skills On all platforms I've encountered new challenges on the programming level. In the PLC platform I've used pointers on the lowest level that I have done so far. On the SCADA part I've made as a first one for me Visual Basic scripts. On the MES part I've interfaced with an OPC wrapper dll made by Actemium Veghel, which required some optimisations before I could use it. The techniques used for OPC are not very recognisable from a .NET point of view.

Improve work organisation The reporting mechanism worked pretty well, but I would try to have a bit more pragmatic approach next time. The End-Stage reporting did not work well, due to the failing in planning. This goal must remain an important focal point for following projects.

Glossary

Carrier Anything that can carry or contain a product or ingredient in the factory. Examples are a box, pallet, drum or reel.. 36

IGS Industrial Gateway Server; the G.E. Proficy implementation of an OPC server.. 36

ISA95 ISA95 is an international standard for developing an automated interface between enterprise and control systems [11]. 36

OPC Server Application interface to communicate on windows machines between windows programs and PLCs.. 36

[11] Source: http://en.wikipedia.org/wiki/ISA-95

A Project Initiation Document

Project Initiation Document

Ventcroft Track & Trace

Issue 0100
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Change History

Issue	Comments	Author	Date
0000	Initial document, input for phone conversation with Joeri van Belle	Collin Kleine	03/04/2012
0001	Feedback from David West and Joeri van Belle on the project organization diagram incorporated	Collin Kleine	04/04/2012
0002	Input for feedback from Nick Chambers	Collin Kleine	11/04/2012
0003	Processed feedback from Nick Chambers, David West and Joeri van Belle	Collin Kleine	16/04/2012
0004	Processed feedback from Stephan Verhofstadt	Collin Kleine	23/04/2012
0100	Final version approved by Nick Chambers	Collin Kleine	24/04/2012

Distribution list

Issue	Comments	Distribution list	Date
0001	Draft version for feedback	Joeri van Belle [j.vanbelle@fontys.nl]	04/04/2012
0002	Draft version for feedback and sharing planning	Stephan Verhofstadt [sverhofstadt@actemium.nl]	13/04/2012
0003	Draft version for feedback	David West	16/04/2012
0004	Release candidate for approval	Nick Chambers	23/04/2012
0100	Final version for rating	Nick Chambers, Joeri van Belle, David West, Stephan Verhofstadt	24/04/2012

Introduction

Objective

This is the Project Initiation Document (PID) for the Track and Trace part of the Ventcroft project. This project is to be completed by Collin Kleine, as a graduation intern at Actemium FAS in Birmingham UK, and student at Fontys University of Applied Sciences in Eindhoven in the Netherlands.

This document provides an overview of how this project will be managed and completed, and forms the basis of what is being delivered and when final decisions will be made.

Intended Audience

This document is intended for the project members of Actemium FAS, the company supervisor as well as the university supervisor and the university assessors. This document will be an appendix of the thesis.

Background

This project is to be completed by Collin Kleine, as the final internship before he can graduate his Bachelor of ICT & Technology at the Fontys University of Applied Sciences. His ambition is to start a master study after this internship.

As his first internship for his current study was Actemium Veghel, he got in to contact with Actemium Veghel when he was searching for a graduation internship abroad. Shortly after this contact, it was established that Actemium FAS was starting a project in co-operation with Actemium Veghel. Now this contact has led to the internship at Actemium FAS.

Ventcroft Ltd, are the UK's largest independent manufacturer of cable and electronic products for the Fire and Security market, 3rd party approved by LPCB & BASEC for Ventcrofts' ISO 9001:2008 quality management system. Ventcrofts' core ranges are Fire Cable, Fire Alarm and Detection, Intruder Cable, Intruder Alarm and Detection and Medical Call Systems. The fire and intruder/safety cables are produced in its own factory, the detection and medical call systems are purchased from a third party company and sold directly.

The products Ventcroft manufactures are ones which are required to be certified to endorse them as acceptable for putting them into the market. Two important certification boards are applicable for the Ventcroft factory.

BASEC
British Approvals Service For Cables
http://www.basec.org.uk/

LPCB
Loss Prevention Certification Board
http://www.redbooklive.com/

Due to the plans to build a second bridge across the river Mersey and the associated infrastructural changes (http://www.merseygateway.co.uk/), the English government mandated Ventcroft to move. They have built a new production facility on the same industrial estate (Astmoor Industrial Estate in Runcorn, Cheshire).

Actemium has been awarded the production automation project in the new factory which includes level 2 (PLC/SCADA) and level 3 (MES) activities. The key delivery for this project will be the replacement of the bespoke software developed continuously over a period of several years by several members of Ventcroft to satisfy the BASEC and LPCB conformance needed for their products.

The original Ventcroft factory had a simple, mostly manual, Track and Trace system.

Because all of the MES software is to be replaced, the Track and Trace system will also be replaced.

Actemium NL is developing the MES part of the project. They have developed their own SDK on top of the “G.E. Proficy Plant Applications” software suite and will engineer this solution for the Ventcroft factory.

The main project will be managed by Actemium Final Assembly Systems (FAS). They will be responsible for the SCADA and machine interfaces required for providing data to the MES part of the project. Actemium FAS has two main activities: industrial automation and vehicle test software. The automation part of the business currently employs two software engineers, the vehicle test part three software engineers and one application engineer.

Project definition

Project goals

The goal of this project is to develop a new Track and Tracing system, applicable for Ventcroft and reusable by Actemium on other future projects. This has to be more automatic than the current system, fully integrated in the other SCADA / MES systems and provide more detail on the product and production batches. The exact requirements will be identified during the research for Ventcroft phase and will be incorporated in the requirements document.

This project is also the graduation project for Collin Kleine, and therefore regulations of the Fontys University must also be complied with to ensure this project will lead to a successful graduation.

Ventcroft has already completed some tests with new traceability technologies and has purchased some RFID hardware to test this. Research must determine if RFID is the best technology for this and in which form. Furthermore, this Track and Trace system will be realized in a Test-setup, and when successful this will be integrated in to the GE Proficy™ Plant Applications software. This is the software to be created by Actemium NL.

Occasion

The general project for Actemium is replacing the whole MES and SCADA setup, and make some modifications and extensions on the PLC software.

This Track and Tracing part of the project will not prevent any other progress and has no pressure on it, as the current Track and Tracing system still works. That's why this part of the main project has been chosen as a suitable separate project by an intern.

Personal development plan

As part of this project, the following personal development plan goals are stated:

- Improve programming skills. As part of this, the realisation is an important part of the project. This should result in a good end product, which is evaluated at the end of the project.
- Improve work organization. As part of this, detailed progress reports are being issued every week, and an evaluation of the planning is made at the end of each phase. At the end of the project, an evaluation is made to see if this improved work organization, and if this led to a more predictable end result.

End result

End results include:

- Track and Trace general research document;
- Track and Trace for Ventcroft research document;
- Test results of the test-setup;
- SDK for integrating Track and Trace (for example bar-code or RFID) in MES or SCADA project with according documentation;
- Integration at Ventcroft site.

This end product provides a required Track and Trace system in the new software, to comply with regulations of certification authorities. This will also provide the employers and management of Ventcroft with a more detailed Traceability system, so a more efficient production can be realised.

Exact specifications of what the end product must do will be defined later in the User Requirement Specification.

Approach

This project will be divided in to the following phases, which have an overlap to make sure no time is wasted by waiting for approval.

Project start-up

This phase began on 26th of March 2012 which was the start of the project. In this phase, all required procedures are being read and all forms are being filled in. This document is also part of the start-up phase, within it the project plan. After this phase it should be clear what is going to happen when, and what the end results will be.

End-results: Project Initiation Document

Traceability research

In this phase will general research on traceability be performed. This includes technologies of traceability (e.g. barcodes, QR codes, RFID), as well as example cases. This research will not be focused upon the Ventcroft implementation. The research is competed in accordance with Fontys guidelines.

End-results: General traceability research report

Traceability Ventcroft research

After the general traceability research, this study will identify the needs, the already available software and hardware and possible implementations for the Ventcroft factory with recommendations. This also includes a test setup. The research is competed in accordance with Fontys guidelines.

End-results: Ventcroft traceability research report, tests documentation

Traceability Ventcroft software realisation

In this phase the actual software product will be designed, created and tested. A specification of what exactly will be delivered derives from the research completed in the previous phases.

This phase of the project will use the V-model software development process. First a User Requirements Specification (URS) will be created, which forms the basis of the project. This document describes what needs to be the end result for the end users.

After this a Functional Design Specification (FDS) will be created, which describes what will be the end results in a functional way and makes design decisions on a functional level. This includes how the end product will communicate with other components and definition of any user interfaces.

After this the Software Design Specification (SDS) will be made, which describes how all software components created are designed. This will partly be done during the software development to have an up-to-date document at the end of the project.

The SDS and FDS are being tested in the Site Acceptance and Factory Acceptance Tests (SAT and FAT). The FAT is a test of the system without the customer, and is repeated if not all tests are completed successfully, or the tests are changed in accordance. The SAT describes the same tests, but this should be done in conjunction with the customer or end user.

The requirements of the URS are tested with the Operational Acceptance Test (OAT).

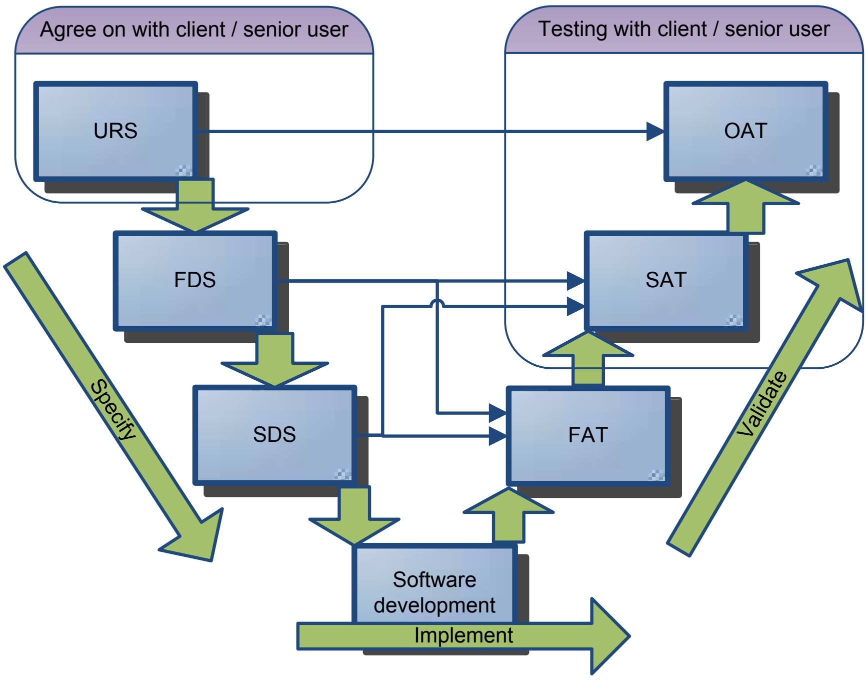


Figure 1 V-model development process

Software components that will be realized are:

- PLC Software for reading identification
- SCADA support for the traceability
- Logging identification information to the historian
- MES compatible software to trace back information

End-results: Software documentation, Software implementation

Thesis

The thesis will be created at the end of the project to include any knowledge obtained during the project. Before this phase will start some part may already be produced due to research findings or university requirements. In this phase the final presentation will also be created.

The latest date for submitting the Thesis for feedback of Joeri van Belle is 6^{th} of July 2012, the feedback will be sent at 13^{th} of July 2012 at the latest. The final version of the Thesis must be delivered at 7^{th} of August 2012 between 13:00 and 18:00 (GMT+2). There might be finishing activities after this date.

End-results: Thesis, final presentation

Presentation

After these phases there is a final presentation by Collin Kleine at the university in Eindhoven, The Netherlands. There will be two assessors (of which Joeri van Belle is one), if available an independent expert, and the company mentor Nick Chambers. This presentation will be between 20^{th} and 22^{th} of August 2012.

Scope of the project

This project must fulfil at least 85 working days, to meet the regulations of the University. The scope is defined in the paragraph "Approach" on page 9.

Product plan

See the attached Product plan on page 20 for an overview of the delivered products over time.

Project budget

There is no fixed budget for this project, as there are no direct costs expected. Any costs will be discussed with Nick Chambers who will control the costs on the project. Any expenses that are required and approved by Nick Chambers will be reimbursed.

Needed resources

To successfully complete this project, the following resources are required as a minimum;

- Laptop or workstation with:
    - Microsoft Office Word;
    - Microsoft Office Excel;
    - Microsoft Office Visio;
    - Internet and email access;
    - Microsoft Visual Studio (for Actemium SDK / MES integration);
    - PLC Software;
- PLC Hardware;
- Telephone;
- Other required software and hardware as agreed after research.

Exclusions

This project will not cover:

- Any electrical or mechanical installation;
- Negotiation or mediation with the client;
- Administrative or financial work;
- Manual data entry;
- Any other non-related work.

Dependencies

For this project to complete successfully, support is needed from:

- Actemium NL on the MES side;
- Actemium FAS David West and Ewa Grzywaczewska on the PLC and SCADA side;
- Actemium FAS Nick Chambers on the overall project support on a daily basis;
- Fontys Joeri van Belle on the overall project support and assessment;
- Ventcroft Technical staff.

Also frequent access to the factory is expected, for example to determine what is needed, what is already in place, to make local modifications, to install and test new software etc.

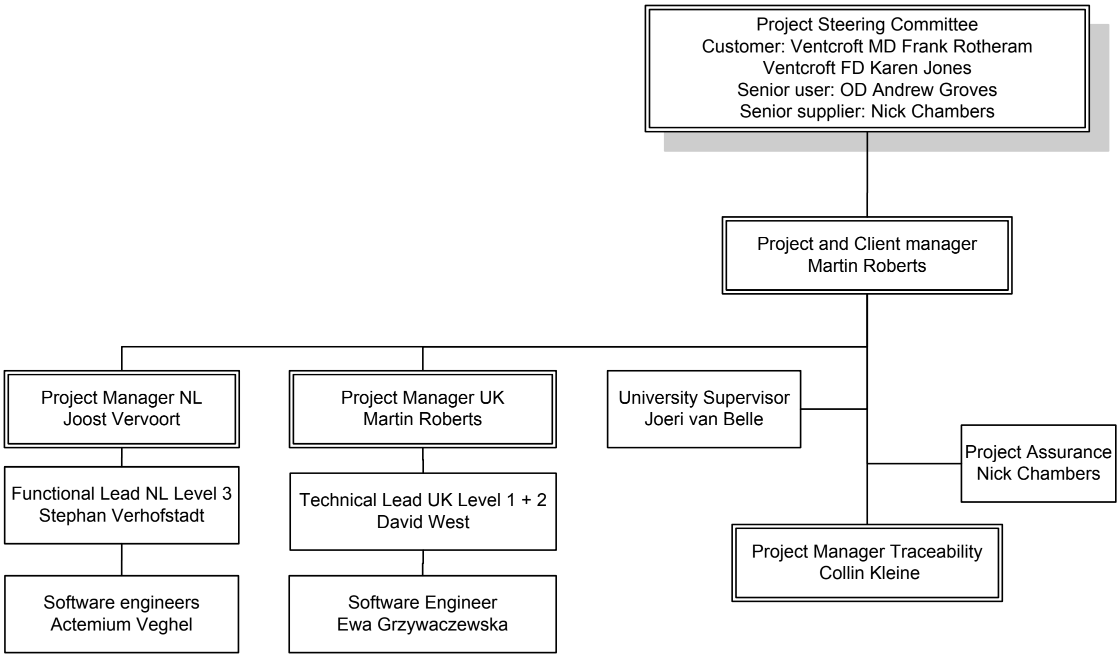
Preconditions

Any documents sent for feedback to Joeri van Belle will be responded to within a week. If it is not possible to provide the requested feedback within the week, an acknowledgment will be sent as soon as possible to confirm a new date of reply.

Assumptions

Nick Chambers, David West and the Ventcroft factory are available during the entire internship. Joeri van Belle is available until 13th of July.

Project organization



Customer

The customer is represented by the Managing director Frank Rotheram and Financial director Karen Jones. They make decisions on the project as for budget and strategic requirements.

Senior user

Andrew Groves makes decisions on changes in the factory and the internal IT-systems. Technical details are not handled by him but by his employees.

Senior supplier

Nick Chambers represents the interests of all engineers, to deliver a good product.

Project assurance

Nick Chambers also verifies the project results as the role of “Project assurance”.

Project and client manager

Martin Roberts is project manager, and makes sure the project remains on schedule and within the budget.
Any mail conversations with the client must be copied to this project manager.

Project manager Traceability

Collin Kleine runs the project on a day-to-day basis. He makes sure the work is being completed and does most of the project related work.

Project management

Reporting

During this project, reporting to different entities is vital to keep track of the project progress.

Report matrix

See attached Communication plan for the Report matrix on page 19.

Minutes

Minutes are being produced and sent to the appropriate persons including important phone calls and meetings, for example meetings with clients and weekly meetings with Nick Chambers. This depends on the severity of the subject and type of agreements made on these events.

Progress report

Every week a progress report will be produced and sent by email on the first working day of each week, before 10:00 AM (GMT+1).

This report will include:

- Period reporting on;
- Remarks on previous report;
- Overall remarks;
- Progress last week;
- Scheduled next week;
- Next report;
- Updated product plan;
- Work-log past week;
- Progress reports distribution list.

This report will be sent to the company and university supervisor (Project Assurance), as well as to David West (Project Support), and administration.

End stage report

After a phase has been completed, an end stage report will be produced. These phases are defined in the Phase planning on page 21.

This report will include:

- Work completed in this phase;
- Products finished;
- Evaluation of previous phase;
- Revised detailed planning next phase.

Progress monitoring

Weekly the personal development plan will be evaluated in a conversation between Collin Kleine and Nick Chambers, to make sure there is progress on a personal level.

On a technical level there will be a weekly discussion with David West to make sure we are on track and to make a plan for next week.

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www.actemium.co.uk/fas

Final Assembly Systems Limited
Registered Office: 2050 The Crescent,
Birmingham Business Park, Birmingham B37 7YE
Registered No: 06340348

Communication plan

Contacts

Name	Company	Function	Project function	Phone 1	Phone 2	Email	Comments
Nick Chambers	Actemium FAS UK	Business Unit Manager	Client / Project assurance	+441212506000	+447903763573	nchambers@actemium.co.uk	
David West	Actemium FAS UK	Senior Technical Engineer	Project Support / Senior Supplier	+441212506000	+447538444925	dwest@actemium.co.uk	Overall technical support
Ewa Grzywaczewska	Actemium FAS UK	Software Engineer	Project Support	+441212506000	+447767353191	ewa@actemium.co.uk	PLC and SCADA support
Collin Kleine	Actemium FAS UK	Technical Engineer Intern	Project Manager	+441212506000	+447825363147	ckleine@actemium.co.uk	
Pam Frankel	Actemium FAS UK	Administration	None	+441212506000		pfrankel@actemium.co.uk	Will receive the progress report for the personnel file
Joeri van Belle	Fontys University of Applied Sciences	Lector	Project Assurance / Assessor	+31885082297		j.vanbelle@fontys.nl	
Frank Rotheram	Ventcroft	Managing Director (MD)	Client				
Karen Jones	Ventcroft	Finance Director (FD)	Client	+441928581098		karen@ventcroft.co.uk	
Andrew Groves	Ventcroft	Operations Director (OD)	Senior User	+441928581098	+447885320767	andy@ventcroft.co.uk	
Stephan Verhofstadt	Actemium NL	Senior Business Consultant	Project Support	+31413349879	+31652482297	sverhofstadt@actemium.nl	Overall functional lead, MES support

Report matrix

What	Who	Frequency	When	Goal	Subjects	Form of report
Progress report	Joeri van Belle, Nick Chambers, David West, Pam Frankel, Stephan Verhofstadt	Once a week	First day of the working week at 10:00 GMT	Monitoring of progress, evaluating project goals		PDF sent weekly
An hour personal development discussion	Nick Chambers	Once a week	To be decided on a weekly bases	Monitoring of personal development		PDF sent when finished
End Stage Report	Joeri van Belle, Nick Chambers, David West, Pam Frankel, Stephan Verhofstadt	After a project phase is done (5 x)	After a project phase is done	Determine if the goal of the phase was achieved	Work done in this phase, products finished, evaluation previous phase, revised detailed planning next phase	PDF sent when finished
Technical week planning	David West	Once a week	At the end of the week	Agree on work schedule next week	Progress report last week, upcoming week, technical progress, visits to Ventcroft	This will form the basis of the 'Scheduled next week' section in the 'progress report'

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Initial project plan

Product plan

Product	Start date	Deadline
PID	26/03/2012	18/04/2012
Traceability research report	03/04/2012	23/04/2012
URS - Test setup	17/04/2012	23/04/2012
FDS - Test setup	19/04/2012	25/04/2012
FAT Protocol - Test setup	23/04/2012	24/04/2012
FAT Report - Test setup	25/04/2012	01/05/2012
URS - Ventcroft Track and Trace	01/05/2012	03/05/2012
FDS - Ventcroft Track and Trace	03/05/2012	09/05/2012
OAT - Ventcroft Track and Trace	08/05/2012	09/05/2012
SDS - Ventcroft Track and Trace	10/05/2012	22/05/2012
FAT Protocol - Track and Trace	20/05/2012	22/05/2012
SAT Protocol - Track and Trace	20/05/2012	22/05/2012
Developed software - Track and Trace	08/05/2012	10/08/2012
FAT Report - Track and Trace	27/06/2012	10/08/2012
Integration Plan - Track and Trace	02/07/2012	11/07/2012
SAT Report - Track and Trace	05/07/2012	27/07/2012
OAT Report - Track and Trace	11/07/2012	27/07/2012
Thesis	04/06/2012	07/08/2012

Phase planning

Project week no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Week no.	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
	26/03	02/04	09/04	16/04	23/04	30/04	07/05	14/05	21/05	28/05	04/06	11/06	18/06	25/06	02/07	09/07	16/07	23/07	30/07	06/08
Project start-up																				
Traceability research																				
Traceability Ventcroft research																				
Traceability Ventcroft software realisation																				
Thesis																				

Attachment 1: Graphical planning

Project week no.	1					2					3				
Week no.	13					14					15				
Day of the week	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
Date	26/03	27/03	28/03	29/03	30/03	02/04	03/04	04/04	05/04	06/04	09/04	10/04	11/04	12/04	13/04
PID															
Traceability research report															
URS - Test setup															
FDS - Test setup															
FAT Protocol - Test setup															
FAT Report - Test setup															
URS - Ventcroft Track and Trace															
FDS - Ventcroft Track and Trace															
OAT - Ventcroft Track and Trace															
SDS - Ventcroft Track and Trace															
FAT Protocol - Track and Trace															
SAT Protocol - Track and Trace															
Developed software - Track and Trace															
FAT Report - Track and Trace															
Integration Plan - Track and Trace															
SAT Report - Track and Trace															
OAT Report - Track and Trace															
Thesis															

Project week no.	4					5					6				
Week no.	16					17					18				
Day of the week	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
Date	16/04	17/04	18/04	19/04	20/04	23/04	24/04	25/04	26/04	27/04	30/04	01/05	02/05	03/05	04/05
PID															
Traceability research report															
URS - Test setup															
FDS - Test setup															
FAT Protocol - Test setup															
FAT Report - Test setup															
URS - Ventcroft Track and Trace															
FDS - Ventcroft Track and Trace															
OAT - Ventcroft Track and Trace															
SDS - Ventcroft Track and Trace															
FAT Protocol - Track and Trace															
SAT Protocol - Track and Trace															
Developed software - Track and Trace															
FAT Report - Track and Trace															
Integration Plan - Track and Trace															
SAT Report - Track and Trace															
OAT Report - Track and Trace															
Thesis															

Project week no.	7					8					9					10	
Week no.	19					20					21					22	
Day of the week	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T
Date	07/05	08/05	09/05	10/05	11/05	14/05	15/05	16/05	17/05	18/05	21/05	22/05	23/05	24/05	25/05	28/05	29/05
PID																	
Traceability research report																	
URS - Test setup																	
FDS - Test setup																	
FAT Protocol - Test setup																	
FAT Report - Test setup																	
URS - Ventcroft Track and Trace																	
FDS - Ventcroft Track and Trace																	
OAT - Ventcroft Track and Trace																	
SDS - Ventcroft Track and Trace																	
FAT Protocol - Track and Trace																	
SAT Protocol - Track and Trace																	
Developed software - Track and Trace																	
FAT Report - Track and Trace																	
Integration Plan - Track and Trace																	
SAT Report - Track and Trace																	
OAT Report - Track and Trace																	
Thesis																	

Project week no.				11					12					13			
Week no.				23					24					25			
Day of the week	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T
Date	30/05	31/05	01/06	04/06	05/06	06/06	07/06	08/06	11/06	12/06	13/06	14/06	15/06	18/06	19/06	20/06	21/06
PID																	
Traceability research report																	
URS - Test setup																	
FDS - Test setup																	
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FDS - Ventcroft Track and Trace																	
OAT - Ventcroft Track and Trace																	
SDS - Ventcroft Track and Trace																	
FAT Protocol - Track and Trace																	
SAT Protocol - Track and Trace																	
Developed software - Track and Trace																	
FAT Report - Track and Trace																	
Integration Plan - Track and Trace																	
SAT Report - Track and Trace																	
OAT Report - Track and Trace																	
Thesis																	

Project week no.		14					15					16					17
Week no.		26					27					28					29
Day of the week	F	M	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M
Date	22/06	25/06	26/06	27/06	28/06	29/06	02/07	03/07	04/07	05/07	06/07	09/07	10/07	11/07	12/07	13/07	16/07
PID																	
Traceability research report																	
URS - Test setup																	
FDS - Test setup																	
FAT Protocol - Test setup																	
FAT Report - Test setup																	
URS - Ventcroft Track and Trace																	
FDS - Ventcroft Track and Trace																	
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FAT Report - Track and Trace																	
Integration Plan - Track and Trace																	
SAT Report - Track and Trace																	
OAT Report - Track and Trace																	
Thesis																	

Project week no.					18					19					20		
Week no.					30					31					32		
Day of the week	T	W	T	F	M	T	W	T	F	M	T	W	T	F	M	T	W
Date	17/07	18/07	19/07	20/07	23/07	24/07	25/07	26/07	27/07	30/07	31/07	01/08	02/08	03/08	06/08	07/08	08/08
PID																	
Traceability research report																	
URS - Test setup																	
FDS - Test setup																	
FAT Protocol - Test setup																	
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URS - Ventcroft Track and Trace																	
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Developed software - Track and Trace																	
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Integration Plan - Track and Trace																	
SAT Report - Track and Trace																	
OAT Report - Track and Trace																	
Thesis																	

ACTEMIUM

Project week no.			21					22				
Week no.			33					34				
Day of the week	T	F	M	T	W	T	F	M	T	W	T	F
Date	09/08	10/08	13/08	14/08	15/08	16/08	17/08	20/08	21/08	22/08	23/08	24/08
PID												
Traceability research report												
URS - Test setup												
FDS - Test setup												
FAT Protocol - Test setup												
FAT Report - Test setup												
URS - Ventcroft Track and Trace												
FDS - Ventcroft Track and Trace												
OAT - Ventcroft Track and Trace												
SDS - Ventcroft Track and Trace												
FAT Protocol - Track and Trace												
SAT Protocol - Track and Trace												
Developed software - Track and Trace												
FAT Report - Track and Trace												
Integration Plan - Track and Trace												
SAT Report - Track and Trace												
OAT Report - Track and Trace												
Thesis												

B Example Method Statement

Method Statement

Quote ref.: 01942

PART 1 – GENERAL DETAILS

Work Activity:	Installation of SCADA Viewnode PC in Production Office		
	Upgrade SCADA Software version		
	Installation of Chiller Interface		
	RFID Pilot installation		
Site:	Ventcroft		
Client:	Ventcroft, Runcorn		
Project Manager:	Nick Chambers (07903 763 573)		
Technical Engineer:	David West Collin Kleine	(07881 711 996)	
Ventcroft Engineer:	Andy Seymour		
Location:	Offices, Winder Payoff, Chiller, Server room		
Start Date:	13th July 2012	End Date:	13th July 2012
On-Site Arrival:	10:00	Departure:	17:00

Work Description:

PART 2 – PLANT AND EQUIPMENT

	Licence required? (yes/no)	Certificates? (yes/no)
Laptops	n/a	n/a

PART 3 – PERSONAL PROTECTIVE EQUIPMENT

	to be used:
Safety Boots	At all times.
High visibility Vests	At all times.
Hard hats	Not required
Harness	Not required
Gloves :	Not required

Eye Protection:	Not required
Ear protection:	Not required

PART 4 – SUBSTANCES HAZARDOUS TO HEALTH

Non recognised directly relating to the works being carried out.

PART 5 – PERMITS TO WORK

Authority to work on Ventcroft site

PART 6 – ENVIRONMENTAL CONCERNS

Not applicable.

PART 7 – PRINCIPAL CONTRACTORS DUTIES

Not applicable

PART 8 – WORK CONTENT

1. Site induction is required and this is be carried out prior to any work taking place

2. Obtain relevant permit to work from Ventcroft

3. RFID Pilot Installation

   WA1 Side A - Check wiring RFID reader and possibly change – **Ventcroft to provide safe power isolation environment and will be responsible for locking out power to WA1 Side A until work completed.**

   Download software to Turck Banner PLCs on WA1 Side A

   Test SCADA to run new script with tags installed on IGS

   Configure laptop to connect to network communicating with SCADA

   Test software by running MES simulation on laptop and placing reels in payoffs

4. Addition RFID Work

   WA1 Side B - Change RFID modules on Turck Banner PLC

   Download software to both Turck Banner PLCs on WA1 Side B

GENERAL

1. Part of the above RFID work additionally requires assistance from an operator and Andy Seymour.
2. The Chiller work requires assistance from Andy Seymour (Ventcroft).
3. Ventcroft to provide safe power isolation environment and will be responsible for locking out power to the work areas until work completed.