# The Incorporation of Hammermen Of Edinburgh Scholarship Report 2022

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## Executive Summary

I visited the Volvo CE excavator factory in Changwon, Korea for five days between the 17th and 21st October 2022. I had previously worked for two years as a summer worker at the Volvo CE articulated hauler factory in Braås, Sweden. £1000 was given toward the visit by the Incorporation of Hammermen of Edinburgh and was matched by Heriot-Watt University. During the visit, I met with three to four departments every day. Most departments showed me a presentation on their basic functions and responsibilities, and where relevant, I was given tours of the manufacturing and assembly lines. The visit gave me a chance to speak to engineers in different roles in the company and broadened my view on what roles an engineer can have in industry. It also gave me a perspective of how international companies work and how factories can differ based on the country and culture where they are located.

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## Purpose

This report outlines the visit of Izabela Nowakowska to the Volvo CE factory in Changwon, South Korea. The visit occurred between the 17th and 21st of October 2022 and was funded by a scholarship of £2000 that was paid in equal parts by the Hammerman scholarship and Heriot-Watt University.

## Student background with company

I spent the summers of 2021 and 2022 as a summer worker in the Volvo CE articulate hauler factory in Braås, Sweden. As an industry worker, I worked on the assembly line in the quality control department. The role included control checks and occasional assembly and filling of liquids along three different stations over the two summers.

## The Plant

Volvo Construction Equipment is a global construction equipment manufacturer, part of the Volvo Group. Founded in Sweden in the 1800's, the Changwon factory became part of Volvo CE in 1998 when it was acquired from Samsung Heavy Industries. The factory specialises in excavators, and is the largest excavator plant within Volvo CE with approximately 1,500 employees.

The plant holds assembly lines, fabrication of certain components, research and development, as well as a testing site. Models produced in the factory range from 5-90 tonnes as classified by their own weight. The excavators are highly adjustable, and can be modified into demolition equipment and pipe layers. At the time of the visit, the factory was pioneering their electric excavator and adjusting the site to its future mass production.

# The Visit

I spent 5 days visiting the site. I visited up to four departments each day where I received a presentation on the core structures and functionalities of each department as well as any major challenges that they were facing, followed by discussions with the presenters. These presentations did not only introduce the workings of each department, but also how Volvo CE works as a global company. I was shown the manufacturing lines, the assembly lines and the test sites of the machines. Not only did I see the standard assembly lines, but also the modified assembly line for the plant's electric excavator. I had a chance to talk to the engineers responsible for its development about the unique challenges encountered with the electric excavator compared to the diesel driven models. The visit also showed me the structure that allows a major plant to operate and innovate.

## Departments visited

The following section gives an outline of some of departments visited and a quick overview of the function of each department.

### HR

The HR department is in charge of hiring and managing of people.

### Health and safety

The health and safety department analyses the working conditions at the plant and works to reduce risks and hazards by physically limiting the possibility for accidents to occur. This is done by adding barriers and harnesses to relevant work stations, as well as automating any hazardous tasks as much as possible to limit human contact. As in most workplaces, health and safety have to communicate with the industry workers on the manufacturing and assembly lines who have often worked in the same manner for many years, to convince them of implementing the changes.

### Purchasing development

Purchasing department determines the suppliers used by the factory. They both revise the current suppliers and find alternative ones when it is deemed beneficial as well as find new suppliers required for new models. The process can take some time, and analyses the parts, identifies key features provided by each supplier and determines the partnerships most beneficial to the company. There are several departments responsible for the material reaching the final product, and this department starts the process.

### Capacity requirement planning

The function of this department is close to what is taught in the Design and Manufacture course at Heriot-Watt university. In the Changwon factory, the capacity requirement planning was conducted on several levels. The yearly production is first broken down to a monthly basis. The monthly plan is then broken down into daily plans which dictate the order the machines are assembled in and the number of machines produced each day. This plan is then used by other departments to plan the flow of material and work in the factory.

### Material requirements planning

Again, the visit to this department was a practical application of the Design and Manufacture course. Each machine in the factory has multiple options which the customer can choose, and more hidden options which have to be adjusted based on the selection of the customer. As the factory produces a large range

of excavators, each which comes with its own range of options, the task of the material requirements planning department is to determine what parts are needed to produce the machines scheduled for production by the capacity requirements plan each day and to ensure that the right amount of stock is kept for the production. This department uses the CRP to place the orders with the suppliers selected by the purchasing department and are responsible for the material arriving to the factory on the correct day. Their responsibility for the material ends once it arrives at the factory, at which point the material management team becomes responsible for its movement on site.

### Material Management

Once the material arrives at the factory, the material management department plans its flow through the site to ensure that it is at the site where it is needed only at the time that it is needed to minimise clutter. This is done with a vast fleet of forklifts, both man driven and automatic. The department also ensures the material is stored in the correct conditions when not in use.

### Fabrication Engineering

The fabrication engineering department are responsible for the parts of the excavator that are manufactured on site, and plan the step by step process to make these parts on the manufacturing line. They also plan the optimal layout of this line in the available space. The concept of poka-yoke, the principle of physically removing the possibilities for errors, is used throughout the factory to ensure high quality and functionality of the lines.

### Project management

The project management department oversees the implementation of new models and projects. They have an overview perspective of each new project and organise the overall implementation into the factory, including predicting changes to the site that have to be made to accommodate new models. For the electric excavator model, this includes planning the changes to the site necessary to work with high voltage batteries and the relevant safety precautions associated.

### Assembly engineering

The assembly engineering department are responsible for planning the assembly lines in the factory. This includes planning the assembly order, organising the workstations for optimised flow in the given space, and implementing systematic methods to prevent mistakes and ensure the highest quality of the machines.

### Quality Assurance

The overall quality of the machine is largely determined by the quality of the design. The job of the quality assurance department is to minimise the chance of errors during the production. This is done by breaking down the quality into quantifiable metrics which can be checked throughout the production process. Poka-Yoke is implemented throughout the factory to implement physical barriers to human mistakes. When errors occur, they are recorded and the quality assurance department analyses their frequency and nature and investigates whether anything can be done to minimise these errors on the line.

### Component Production

The factory manufactures certain critical parts on site. These are the parts that are Volvo’s specialty and which differentiate their excavators from their competitors. The component production department oversees the manufacturing of these components. They develop methods of production for new parts, oversee their current manufacturing and ensure the CRP is followed. The plant is on the forefront of the

automated manufacturing lines in the Volvo CE concern and utilize several CNC machines on the manufacturing line.

### Research and Development /Technology Development

I was shown around the research and development department and had a chance to talk with multiple engineers who develop new models in the company. Both the excavator plant in Changwon and the articulated hauler plant in Braås, Sweden where I previously worked use similar technology and work on similar projects independently, with some exchange of methods when relevant. The two plants are however in very different stages of development as the Korean legislation does not exist yet for some of the new technologies in development, which legally hinders the Changwon plant from further development in these areas.

### Testing

On the final day of the visit, I was shown the test site used when developing new machines. The tests used to ensure the quality of the machines were described, and I was shown some of the tests while they were carried out.

## Value to student

The visit had two main types of values to me; the chance to talk to engineers in different roles to understand the scope of work that is done by engineers, and the chance to see how a major international business operates and how the operations of the company can differ in different countries.

### Engineering value

The visit gave me an excellent perspective over the various roles that engineers work with and the variety of tasks that they are responsible for. It showed me how the material taught in many university courses, the Design and Manufacture courses in particular, is applied in practice. Many of the departments were responsible for the thorough organisation and planning required for the complex factory to work, such as planning the material flow starting with selecting the suppliers all the way to attaching the material to the machine. The factory works to create systematic approaches to minimise any mistakes on the lines. As a student, design engineering is quite often a well known role but the visit gave me a much larger perspective on the possible roles that I can work in in the industry as well as the people that I will have to work with in the future.

More importantly, the visit gave me a chance to speak to the engineers about their work. This was not only relevant in their direction of work, but also in the manner in which the work was set up. I had a chance to see how engineering work is effectively organised, how the work environment is arranged, the size of groups that are led by one manager and how engineers from different teams interact to bring the final product together.

### Cultural Perspective

The visit gave me an excellent insight into how global companies can operate. Although the articulated hauler factory in Sweden where I worked previously and the excavator factory in South Korea that I visited both belong to the Volvo CE company, the two factories operate very independently and have therefore several differences that stem from the different cultures in the two countries. Simple differences were present such as the food served in the cafeteria or that it is already paid for every worker from their pay in Korea while in Sweden the workers choose to buy the food or bring their own every day, as well as

systematic differences such as the availability of a bus to take employees from one end of the site to the other compared to the site in Sweden where the employees walk themselves. Overall, the corporate culture was much stronger in Korea than in Sweden.

The visit showed me just how much cultural differences can affect the technology in a country. This was tangible from the very first day in South Korea where five lane car intersections in Seoul were much quieter than single lane intersections in Europe. As a country, there is a much larger degree of automation in South Korea than in Europe and this can be seen carried through to how the manufacturing and assembly lines in the factory were organised as the factory in Korea is on the forefront of automation within the company. The legislations of the two countries affect how the work is carried out, on levels varying from the number of breaks throughout the day to the technology developed in the research and development department.

## Looking forward

The visit showed me that aside from research and development, component production, manufacturing and assembly engineering, project management, and testing are all departments that I would like to work in and will search jobs in. Furthermore, I would like to spend a longer time working oversees to have a better chance to experience the everyday culture in other countries and more importantly, understand how it affects the technology in those countries. I will attempt to work in several different countries over the course of my career as this will give me a broader perspective on the engineering in the world and the context in which it emerges and is implemented. This would also allow me to see how solutions from one end of the world could be implemented in other places.