Travel Data Analysis 3.0

Case: Wärtsilä Field Services/Marine Solutions

Philip Roddis

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EXAMENSARBETE

Författare: Philip Roddis
Utbildning och ort: Produktionsekonomi, Vasa
Handledare: Jukka Kauppinen och Diego Mazzonetto, Wärtsilä
Roger Nylund, Yrkeshögskolan Novia

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Abstrakt


I resultatet av arbetet ges förslag på var kompetenserna måste förnyas eller var det finns överflöd eller brist på resurser. Med verktyget går det att ta reda på information om enskilda länders eller företags nivå för att jämföra produkters och resursers tillgång och efterfrågan.

Språk: Engelska
Nyckelord: dataanalys, resedata, arbetskraftplanering
The purpose of this thesis is to analyse travel data. There are over 35,000 travels per year within Wärtsilä Field Services and today's huge amount of data is available for analysing. Many of the travels are cross-border which consumes both time, resources and money.

The goal is to optimise travelling and improve efficiency. To keep a continuous growth, the company needs to constantly change and adapt to the market. Products get older and competences need to be updated. The purpose of this thesis is to create a better overview of the travels and show where change and adaption needs to happen.

The result of this work shall give the company suggestions about where competences are in need of an upgrade and where there is an overload or lack of resources. With the tool created, it is possible to drill through an individual company to check travel activity and cross check product demand and resource supply.
ABBREVIATIONS LIST

ERP = Enterprise Resource Planning
FS = Field Service
ES = Energy Solutions
MS = Marine Solutions
GTV = Gross Transaction Value
SU = Service Unit
SAP = Systems, Applications & Products in Data Processing
KPI = Key Performance Indicator
PSM = Professional Skills Management
1 Introduction

In today’s world many companies are operating all around the globe. Globalisation is shaping the world and makes it possible for people, money and goods to move between countries and continents easier than earlier.

This thesis will analyse travel data to get a better picture of how service-engineers travel. To be able to make the right decisions one needs accurate, reliable, relevant and complete data, in other words, data with good quality.

This chapter will contain background, problem area, purpose, delimitation, confidentiality and disposition.

1.1 Background

The world is shifting towards a more interdependent and also more integrated global economy. This means that a customer is not limited to one country’s work and businesses, all businesses around the globe are available for consideration. This makes manufacturing cheaper in less developed countries and service work brings more focus in industrialized countries. Globalisation makes it possible for companies and countries to use cheaper labour and money can move more freely (Hill 2001). Globalisation can also damage local industries because of the great competition from other industries around the world.

The power industry is developing rapidly. Nowadays Wärtsilä focuses more on its core businesses. The company is a world leader in ship power systems and the company is a major supplier of decentralized power plants globally. Wärtsilä represents 47% of the market shares in Medium-speed main engines and 10% in Auxiliary engines. These numbers show the quality that Wärtsilä has to offer in the marine business. Wärtsilä have approximately 4500 Field Service professionals in 70 countries to be able to serve customers around the globe promptly (Services and workshops 2019).

Service work is a constantly changing field, new technology is always rising which leads to a constant need for training. The customer demands change continuously meaning Wärtsilä needs a flexible and competent workforce. Competence is a critical asset in Field Service, therefore the focus areas are: Competence and skill (to be able to support business growth), mindset and attitude (to show that Wärtsilä cares about safety, right the first time and the environment) and way of working (creating an easier life for both customers and employees).
Services use a matrix system to ensure a network with high competences, quick actions and to be close to the end customer.

The environment is a critical question within businesses today, there are constantly new regulations, customer demands and changes in company policies. Wärtsilä has long been working towards new efficient environmental solutions in order to keep up with new regulations while at the same time keep the environmental quality of the seas protected (Strategy 2019).

1.2 Problem Area

Annually there are more than 35 000 travels globally within Wärtsilä Field Services, among them there are close to 10 000 cross-border travels. It is not a necessarily a negative thing and it indicates that Wärtsilä have a successful service network.

If there are many cross-border travels to a specific area this could indicate that there is a lack of competence in the area or poor management. This can be seen if there are a lot of travels to different areas to do the same type of work that is done within their own area by other companies.

In earlier travel data analyses Wärtsilä has not been able to link the travels between countries to a specific product. This means that the only thing that can be analysed is the amount of travels from different areas and if the competences are missing in a country

There have been similar tasks done earlier but with less data. There have been lots of data available but no one to gather it and utilize it.

1.3 Purpose

The purpose of this thesis was to gather and analyse big data and utilize it into a tool which gives a visualisation of both travels and products.

The tools purpose is to show where Wärtsilä can minimize unnecessary traveling and where competences needs to be updated.

Wärtsilä also wants to know what kind of activity is done when cross-border travels have been made and what products have been the reason for the traveling.
1.4 Delimitation

This thesis was ordered to get an understanding of travels made within service work, billable service work and project related work. Technical Service and Energy Solutions Project related work is not taken into consideration.

The focus area is the number of products, travels, duration, competences and locations. This leads to the removal of ethincal, religious, and cultural factors. These have been overlooked here.

1.5 Confidentiality

This is the official version of the thesis and may be studied freely. The internal version contains sensible data and may not be viewed outside of Wärtsilä. Data seen in this thesis will be altered with and the final result will only be found within wartsila corporation.

1.6 Disposition

The chapters of this thesis are as follows

**Chapter 1** - Provides some background information and a description of the problem. The chapter will also contain the purpose, delimitations and confidentiality.

**Chapter 2** - Includes a brief description of Wärtsilä, the company segments meaning Marine solutions, Energy solutions etc.

**Chapter 3** – This chapter includes the theory of this thesis. It contains information to help the reader gain some knowledge about the subject and thereafter make the thesis easier to understand

**Chapter 4** – The methodology will be shown here. This chapter introduces the research approach and what methods have been used in this thesis

**Chapter 5** – The results of the thesis will be shown here. The results will be tampered with since this is the official version.

**Chapter 6** – A discussion regarding the thesis will be included in this chapter. Theories, methods and the result will be reviewed, and further research will be presented here.
2 Wärtsilä in Brief

The company was established 1834 in Tohmajärvi on the 12th of April. It started out as a mining company and became Ab Wärtsilä Oy in 1907. In 1938 did Wärtsiläs diesel engine era begin, the first engine is used in 1942 (History 2019).

The company is a leader in smart technologies and lifecycle solutions in both energy and marine markets. Wärtsilä is striving for a renewable energy future, they put their focus on high quality, innovation, cost effective, safety and committed people. In the company strategy can we find that “Wärtsilä’s purpose is to enable sustainable societies with smart technology”. The corporate values are Energy, Excellence and Excitement (Strategy 2019).

Wärtsilä offers both services and products which makes them well placed on the global market. In 2018 the company net sales totalled 5.2 billion euros with around 19 000 employees. They operate in more than 200 locations in more 80 countries globally (This is Wärtsilä)

Figure 1: Wärtsilä strategy (Strategy 2019)
2.1 Marine Solutions

Wärtsilä provides solutions that are environmentally sustainable, flexible, efficient and economically fair. Wärtsilä’s solutions include innovative products, services and systems and they are based on costumers needs.

The value Marine Solution brings is as follows:

Environmental Excellence – Eliminating or reducing polluting emissions and discharges. Making sure requirements are met and ensure that customers can continue to operate in sensitive areas globally.

LNG & Gas – Wärtsilä is a leader in the market including gas and multi-fuel engines, services, technology and fuel systems. The company have the expertise and experience covering the whole gas value chain – beginning to end – products and services for the whole LNG lifecycle.

Operational Efficiency – In order to optimise a vessel’s efficiency Wärtsilä looks at the whole picture. The company provides products, solutions and services for the entire lifecycle that will boost the vessel’s efficiency (Marine 2019).

2.2 Energy Solutions

Energy Solutions focuses on the energy market. Wärtsilä builds and designs power plants. The power plants are for industries, independent power producers and utilities. WES flexible and efficient energy solutions makes it possible to transition into a more modern and sustainable infrastructure with solar and wind power included.

WES provides efficiency, fuel and operational flexibility, dependability, lifecycle support and services (Wärtsilä ei pvm).

2.3 Field Services

Wärtsilä has the most extensive global network in the industry. The network includes service centers, service professionals and workshops. This network is spread around in 70 countries globally with 4500 Field Services professionals combined.
“Field Services (FS) is a function within 4-Stroke Engine Operations in Services. Field Services (FS) has two main roles and responsibilities:

- Develop and maintain Field Services expertise, know-how and superintendent level support, through a pool of highly skilled engineers and selected specialized support workshops.

- Define, monitor and review the strategies, procedures, the way of working, and KPI’s for the global Field Services organization.”

Field services can be organised in three main functions: FS Operations, FS Resources and FS Workshops. It is possible to structure every FS organisation into these functions based on size and dimensions (Jorge Saenz 2016)

3 Theory

The theoretical framework will be presented in this chapter. It will contain the choice of platform as well as workforce planning, data collection and data analytics.

3.1 Choice of platform

When performing an analysis or experiment of any kind of data, we need a good statistical tool. The accuracy of the work we are doing is depending on the precision of the tools we use (Bohm ja Zech 2010).

In this thesis, which contains a lot of data extracted from various places, we chose Microsoft Excel as our platform. Excel is also a known software within Wärtsilä which makes it easy
to use for others in need of a similar report. Wärtsilä uses SAP as an ERP (enterprise resource planning) system. This makes it possible to import data straight from SAP into Excel.

**Excel**

Excel is a tool to turn data into insights. Microsoft Excel can learn patterns, organise data, create spreadsheets, calculate and use formulas. The program gives you the possibility to get a better picture of the data with the help of graphs, charts, tables and so on. There are many possibilities with Excel and it is easy to share the workbook or even have a real-time collaboration with other users, which saves time (Microsoft Excel 2019).

**Power BI**

Power BI is an analytics service made by Microsoft. It is focused for businesses. It provides visualisations and have business intelligence capabilities. This makes it possible to create reports and dashboards for the user to use. With Power BI users can also collaborate on and share tailormade dashboards and reports (Microsoft Power BI).

**Workforce Planning**

Workforce planning requires reliable and available data. Workforce planning is about managing the manpower and ensure that the people with the right skills is at the right job at the right time (Cotten 2007).

A simple definition of workforce planning is “Getting the right number of people with the right competencies in the right jobs at the right time.” (Sinclair, 2004).

A more comprehensive one is as follows:

“A process in which an organisation attempts to estimate the demand for labour and evaluate the size, nature and sources of supply which will be required to meet that demand.” (Reilly, 1996)

Workforce planning has been used for many years but nowadays organisations have realised that it is needed more than ever. The benefits are many and varied, it gives a more efficient and effective use of the organisation and it helps with the reducing, restructuring and expanding the workforce.

HR researcher has estimated that many of the workforce planning fail and here are a few issues from which companies could learn.
• Workforce planning is not about predicting the future, it should be about setting a long-term context for issues within the business and provide a filter for decision-making.

• Often with workforce planning, the approach is misguided. Many try to make a perfect target and cover the whole organisation within a fixed time-period that is sometimes over several years. For Workforce planning to be effective it needs to be flexible, sensitive and ongoing. It should also be integrated with business plans and both should react on and inform each other.

• Workforce planning cannot even out troughs and peaks of the business world and should not be too ambitious. This does not mean it is an unimportant practise, on the contrary. It is better to gain an understanding of the present situation, consider the key future issues and then manage to work together between these two rather than leaving things to chance. (Sinclair 2004)

3.2 Data Collection

This thesis is built on big data. Many hours have been spent on collecting the data from different platforms to create one big report with all necessary data. The collecting was time consuming due to lack of access.

Data extracted and merged into Excel is order numbers, itineraries, report names, total costs, area codes, order types, product reference types, description of where the product is used and so on. In order to start the analysis, the data needed to be gathered and merged into one Excel-sheet and then extracted to Power BI.

3.3 Data Mining Process

Data analytics, data mining, is a process of discovering patterns and trends in big data sets.
In this list the data analytics process steps are broadly outlined:

- Develop an understanding of the database and identify the goal.
- Find the important data and create relationships between the variables.
- Collect the data and categories it.
- Summarize the data and use visualisation techniques.
- Find a model and add statistical methods.
- Interpret the result. (Fayyad; Piatetsky-Shapiro & Smyth 1996)

### 3.4 Conclusion

Based on this theory study made from books and journals it can be seen that using bigdata for analysis is popular today. It is important to understand the database and identify the goal when using bigdata. Almost all models are built the same way as (Fayyad; Piatetsky-Shapiro & Smyth 1996). The model itself will not automatically give you the result you are searching for but will work well as a guideline on how to achieve it.

In the next chapter, the methodology of this thesis will be presented.
4 Methodology

The methodology chapter will contain different methods that have been used to achieve the result. The chapter will be introduced with the research approach and the solution approach will follow.

4.1 Research Approach

Applied Research

This task was ordered in February 2019 by Wärtsilä Field Services. The first step was an arranged meeting with the supervisors from Wärtsilä and a brief discussion of the purpose was made. As the work has a specific aim it falls into the category applied research. According to (Kothari 1990) "Applied research aims at finding a solution for an immediate problem facing a society or an industrial/business organisation."

The approach was also inductive since it involves search for patterns.

Inductive Research

The analysis it both quantitative and qualitative. The first part is quantitative because the travel flow data is only gathered in quantity. According to Kothari “quantitative is applicable to phenomena that can be expressed in terms of quantity, while qualitative is concerned with qualitative phenomenon, i.e. phenomena relating to or involving quality or kind”. The second part of the analysis is more qualitative, according to (Bernard 2006) “The way I see it, analysis is ultimately all qualitative”. The second part is where the travels are analysed, both the origin and the purpose are taken into consideration.
Solution Approach
All methods used will be brought up in this section. The data included here will be altered with since the actual company-specific data is sensitive and confidential.

Platform Choice
As noted in the Theory chapter, Excel and Power BI was chosen as our platform because its user-friendliness and Wärtsilä uses Office365. The data gathering was made in Excel and the data was linked in Excel with formulas. Power BI worked as the final tool for the visualisation.

Data Sources
As the saying goes, “The more data, the better”, it is exactly what we were thinking. The first set of data I received from my supervisors from Wärtsilä was a similar analysis that had been made 2018. This file was to get a better understanding of what the thesis would be about and what kind of data that would need to get extracted.
Figure 5: Travel Report 2018

After receiving an old version of the travel report, it was time to create a new one. The first step was to extract an expense report from SAP. In this phase we faced the first challenge, a new system (Concur) for travel reports has been introduced and taken into use mid-year. This means there were two different reports which needed to be merged into one. This is the first step in the research process as seen below. It is also possible to see from which database the data is collected in the picture.

Figure 6: Research process made by Diego Mazzonetto
After the consolidated travel data was complete, the second step was to retrieve the organizational data and destination data. This data is cost centres, companies, countries, service units and areas.

The third step was to retrieve some additional Sap data but this time it is order data. The order data contains order type, order number, description, activity type, equipment, installation, portfolio, product reference type.

The fourth step was to gather the customer data. In customer data is the category (Marine/Power), type, and description of the where the product has been used.

When the four steps were done, the Consolidated Travel Database is produced and analysis can be made.

All the above steps were made in Excel with data from programs such as Concur, SAP and Qlickview. When the data was linked together we extracted it to Power Bi and then used the features of the program to get a good overlook over the travels that has been made the past year.

**Data Processing**

When all the data was collected, it was time to link the different sheets with each other. The first two reports we merged into one was an expense report with an itinerary report. This gave us an employee id, employee name, company name, cost center, report id, first arrival country, report name and the reason for the trip.

![Figure 7: Expense and itinerary report merged into one by Microsoft Query](image-url)
The report seen in Figure 6 was made two times. First one was made out of Concur data and the second one was made out of SAP data. These reports were then merged into another one by a simple copy paste function.

The next step was to link the cost center to different country organisations and destinations. This was possible by making an Excel list and then use the VLOOKUP-functions.

After the earlier step was done, we gathered data from service orders. By linking the order number with the travel report ID. When the order number we continued to use VLOOKUP and gathered the main activity type, order type, main activity type description, functional location, segment and different descriptions on where the product and job has been performed.

![Figure 8: Different categories within the data](image)

All the data is stored in Excel and the next and final step for the tool is to export it to Power Bi. Both Excel and Power BI are made by Microsoft and work well together, the importing of the data from Excel was made without complications.

![Figure 9: Imported data on Power BI.](image)

The final steps of the thesis were to focus on one country and filter the data, so the visualisation is clear and easy to interpret.

### Analysis and Visualisation

There are two different Power BI:s made. One for all cross-border travels and the other one is for a specific country.
All travels
The first visualisation is made for all cross-border travels. When seeing all the travels, it is easy to decide which country needed further investigations. It also shows what products are most worked on when traveling and what kind of competences are needed.

Figure 10: Visualisation over all cross-border travels.

When pressing a staple, the program automatically shows the duration of the work in days.
Figure 11: Example of clicking a staple

The yellow cluster chart works as a main chart. It is possible to drill through the data step by step until you have reached the necessary information. The green charts give an overview that quickly shows what to search for.
Figure 12: Example when drilling down one level

It is possible to choose one receiving/sending country and see what products are used, what activity is done, and which company travels to do the work.
PSM tool

When both the country is chosen and the products that uses international work force is known, we cross check the competences with the PSM tool.

For each product there are certificates that prove the competences are in order. If the competences are available in the country but the job is done by another country, it should be investigated.

![Figure 13: PSM tool](image)

All the competences are extracted to Excel. Afterwards pivot charts are made and competences are cross-checked with the Power BI visualisation.
5 Results

This chapter presents the results of this thesis work. First the Excel sheet will be presented, thereafter the visualisations made on Power BI will be discussed and analysed.

5.1 Data in Excel

All data retrieved is stored in one Excel sheet. This means that Power BI is not necessary, and analyses can be made on Excel using pivot tables and charts.

![Figure 14: Data in Excel](image)

By applying different filters in the columns, it is possible to dig through the data and use it for an analysis.

The data that is gathered per job done is following:

Column A – Employee ID
Column B – Employee Name
Column C – Company name
Column D – Cost center
Column E – Report ID
Column F – First departure date
Column G – First arrival date
Column H – First arrival country
Column I – Report name
Column J – Reason for trip
Column K – Total report amount
Column L – Reimbursement currency
Column M – Itinerary duration
Column N – M/km, travel costs
Column O – Reimbursement
Column P – Currency
Column Q – Report type
Column R – First arrival city/location
Column S – Sending country
Column T – Sending company
Column U – Sending service unit
Column V – Sending organization
Column W – Receiving country
Column Y – Service order
Column Z – Order type
Column AA – Main activity type
Column AB – Main activity type description
Column AC – Product reference type
Column AD – Functional location
Column AE – Segment
Column AF – Description
Column AG – Description 2
Column AH – Description 3
Column AI – Match

This data is gathered so different analysis can be made in the future if needed.

5.2 Power BI

Power BI is used for the visualisation of the data gathered in Excel. Itinerary days are used as value since it is the time per product we use as measurement. The data used in Power BI are as follows:

Column M – Itinerary days
Column T – Sending company
21

Column W – Receiving country
Column AB – Main activity type description
Column AC – Product reference type
Column AG – Description 2

For the visualisation part of the thesis, these were the only columns necessary.

5.3 Country investigated

We put the focus on the country which imports most resources in Europe. We checked which products are maintained by other countries and which products are being maintained by the country in focus.

A high amount of cross-border travelling indicates that there can be lack of resources or wrong competences or bad management of resources.

We chose the country that imported most resources in Europe.

Figure 15: Products imported, and products performed internally

The yellow chart in Figure 15, is the products that are imported. The red chart shows the top five products the company in the country works with.

The products in the yellow chart are new while the products in the red chart are old and limited.
Figure 16: Deviation in activities
To get an understanding of why the charts look this way, we can cross-check with the PSM-tool for competences.

6 Discussion

Analysing the travel data and making a visualisation of the products was the purpose of this thesis. This thesis could be used as a tool to back up decisions made in field service and get an overview of products that are more or less active in field services.

When reviewing the results, the thesis has fulfilled its purpose and can be used as a model if similar projects will be done in the future. The platform can be used for optimising the workforce and it shows in which countries/companies competences need to be added, removed or better managed.

Workforce planning is complicated and needs constant updating and analysing when implemented. This thesis could be a lot bigger if time and interest were not a problem. Due to the lack of time and data we finished the thesis with some limitations. The thesis was successful, and it is the first time that products linked with the travels and competences can be cross-checked.

Multiple other parties have been interested in the thesis since it can be used for many purposes. It could in example be used for estimation of travel costs, calculation of carbon footprint and planning future resource recruitment.
6.1 Problems

Even though clear steps have been laid out, there has still been plenty small complications during the process. A few major complications will be pointed out below.

Data

Already from the start, we hit problems with the data. Under 2018 there have been two different tools used during the same time. SAP and CONCUR, when we extracted the data from these tools the report came out differently and did not contain the same type of data. But after extracting multiple reports from both tools we managed to create a consolidated report. Because of this and some false reporting, some data had to be left out of the thesis. To avoid this problem in the future, is to use standardized reporting. There should be a list of different options and as few free text fields as possible.

Another problem was that some companies did not use SAP or CONCUR. Because of this we had to exclude them from the thesis and perhaps they can be included in future studies when they operate with the same tools.

Platform selection

In a later stage of the thesis we faced problems with Excel. The first problem was that formulas on Excel do not work well when there are duplicates of data. We removed the duplicates caused of false reporting which also meant the costs are not so accurate as they should be. We did not take any costs into consideration but if this is something for further research, actions need to be made. This can be fixed by changing the report setup or using another tool.

When the data and formulas were getting too many, the size of the file was getting too big. This made Excel too slow to operate with. After using binary workbooks without any improvement, we chose to import the data into Power BI. Power BI was a perfect solution for this and should be used from the beginning if a similar project is done in the future.

6.2 Further Research

As discussed earlier, a better way to extract the data and to use it in Power BI directly would be a major improvement. There could also be a new way of reporting the data, instead of using multiple tools everything essential could be done in one tool.
At the moment the competencies need to be looked up from another tool. To get a better picture of the competencies there should be a link between the main activity type and product that automatically shows what competences are needed or which certificates that should be acquired to complete the job. This would make it easy for the companies to know if the resources should acquire new certificates and shift their competences towards newer products.

A proposal for further research is also to keep a constant and updated view over the travels made within Wartsila there should be a similar report monthly instead of yearly. This would be beneficial for the efficiency in the company.

If necessary, the own cost per product could be calculated and a lump sum for the travel costs could be made. This would require a new way of reporting.

Carbon footprint is something that is getting more and more attention. Nowadays both taxes and brand image are making it more important, and of course the benefits for the environment. For further research this could be a topic of interest and can be calculated through various formulas when knowing the flight routes.

6.3 Final Conclusion

I wished to do something that was challenging, interesting and beneficial for me and the employing company. This fulfilled all criteria.

I have worked as a Service Coordinator in FS operations during this thesis. This helped a lot, I understood how the thesis would be beneficial and how to utilize the data. By doing this thesis I also learned much about the other perspectives. I got a broader and more understanding picture of why our way of working is set up the way it is.

The tool that is developed will help in many ways. It could reduce the unnecessary travels that are made and improve the efficiency. When competences are being balanced according to the countries own need, the responsivity improves. This leads to greater service and increase in profitability.

When reducing unnecessary travels, it will also have a positive impact on the environment as well as the engineers performing the work.
Throughout this thesis I have received great support and assistance. I would like to thank my supervisors at Wärtsilä, Jukka Kauppinen and Diego Mazzonetto, whose invaluable expertise have helped me complete this thesis. I would also like to thank my supervisor at Novia UAS, Roger Nylund, for his support and feedback.
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