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Analyzing the production process in Norwegian Homecare services

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Preface

The thesis is my final work at the study Master of Science in Logistics, at Molde University College. The thesis has been written between January and May 2016, and presents results from a research within Norwegian Homecare services.

It has been exciting to have the opportunity to do research in an area there has been done so little previous research. So thank you to my supervisor Berit Helgheim, for including me in her project, share her knowledge with me, as well as clear my mind when I needed. I`ve learned a lot, and it has been very exciting to use logistic within the field of health care services.

I would also like to thank the municipalities to spend some of their time in communicating with me, and for sharing information about their entities. It has been very exciting to work with the data, and detect potential differences between the different entities.

I would also like to say a great thanks to my family, especially thanks to my parents. Without you his had not been possible. You have been supported and encouraged me endlessly, in several ways. You are the best.

At last but not least, I would like to say thank you to my eight-year-old son. To give me break through playing as well as trips, and to be my greatest source of motivation, even though you don`t know it. You always use to ask me why "old" people as me want to do homework. In the end, I hope that you learned though these years as well, by the importance of using your curiosity, as well as the importance to find what you like the very best to do.

Line Slyngstad,
24/05-2015

Summary

The main purpose of this study was to analyze the production process in Norwegian Homecare system, and gain new knowledge about the consumption of time in different activities through analyzing the consumption of time spent on different activities within the production. Theory and previous research in the field is relatively scarce, so in a start point, this research had an aim to answer the two following research questions:

RQ1: Identifying the main cost drivers regard to distribution of time spent on the different activities.

RQ2: Investigate potential differences regarding time spent across the municipalities, as well as across activities.

The research method has been quantitative, but has also been supported by a certain extent of quantitative method through personal talks. The quantitative data analyzed is data collected within homecare services in three different municipalities, during a period between January to March 2016. After analyzing the data there were personal talks and e-mails sent between the writer and the municipalities.

The main cost drivers were found through analyzing the overall consumption of time in the different activities. This seems to be direct patient care activities, driving and walking, and administration in Fræna. Direct patient care activities, driving and walking, and documentation and communication in Rauma and Vestnes. There were found several differences in time spent across the different municipalities, as well as across the activities. The municipalities were especially different regard to time spent documentation and report, as well as different in the percentage of time spent on administration activities. There were also somewhat differences in time spent pr. visit of homecare between some of them, as well as differences in time spent pr. drive. In addition to this, they were also different in how the different professions spend their time within the different activities, which might either indicate differences regard to group of recipients, of differences regard to how they organize their work.

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1.0 Introduction

The purpose of this study is to gain new knowledge about the production process in Norwegian Homecare Services, and find where there might be potential for improvements. The research is a part of a project between Molde University College and three municipalities, Fræna, Rauma and Vestnes, OMHOMES. The initiative to the project were taken by the municipalities themselves, where they wanted to focus more on logistics. The overall outcome of the project is to create new models in homecare services that are cost efficient, has a high level of resource utilization, and that delivers a high level of quality. The data to the research were collected through eight weeks from January to March in 2016, and received to be analyzed in the beginning of April. Since the project is still in its initial phase, the data collected are restricted to the use of descriptive and inferential statistics. The results of this analysis, might give indicators in which areas that deserve more attention, and make the foundation to more sophisticated models.

The Health Care system has been an important part of developing the Norwegian welfare system, and are founded by tax-income through transfers from the government. Homecare Services are a part of Primary Care Services, and are managed by local authorities. The services provided by homecare services are many, and ranges from medical administration to treatment of lifelong diseases. Even though we know that Norwegian Homecare services are delivering services of high quality, they have some challenges related to an increased pressure on the system, through an ageing in population and an increased proportion of recipients with more complex health conditions.

1.1 Purpose and focus

The Norwegian health care system has been an important part of developing the Norwegian welfare state. International reports suggest that Norwegian health care services in general, delivers a high level of quality even with comparable countries, such as Denmark and Sweden, and give Norway a high rate of score in quality indicators as in for instance life expectancy, mortality rates after surgery and breast cancer survival rate (OECD 2014).

Homecare service is a part of primary health- and care services. Some of the main focuses in primary health- and care services are related to create an efficient system, that delivers high quality, and that are able to handle future challenges. There is also a question related to create a health care service which are sustainable for the future economy. Norway spend about 9% of the BNP on health care services (Statistics Norway 2015), and in 2014 the public expenditures in Norwegian Health- and Care services reached 100 billion NOK, where half of the expenditures are spent on homecare services (Statistics Norway 2014).

An increased ageing in population as well as a decreased average length of stay in hospitals, are also present in Norway. The age group above 80, are expecting to increase with 9% by 2050, which would lead to an increased pressure on the Norwegian Health Care system (OECD 2014). Because of the above mentioned challenges the government is expecting increased expenses according to official financed services, and there will be a need to take initiatives related to an increase in revenue and a decrease in the expenditures (Regjeringen 2014).

To coop with the challenges there has been done some initiatives in strategic level through implementing reforms, where the Coordination reform is one of them. The main objective of the reform is to move some of the treatment of patients from hospital to the municipalities, such that health care services in a higher degree would be local, and that the recipients would have a health care system that is easier to relate to (Regjeringen 2014).

The above mentioned factors indicates that homecare services would have a far more central role in the Norwegian health care system in future. Even though it has been an expected outcome for a long time, there is scarce of knowledge about the production process in Norwegian Homecare Services, and how the consumption of time is divided between the different activities in the production process. The lack of knowledge about the production process, would also imply that there are scarce of knowledge about how the system is able to handle future problems.

This thesis aims to do an analyze of the production process in Norwegian Homecare services, through the consumption of time spent on 25 different activities. This might gain more knowledge about where there are potential to improvements.

1.1.1 Research area

Within the field of production of health care services, there has been done most research in hospital settings. Research in homecare services are relatively scarce, but has been done in some cases.

There has been developed framework to characterize the homecare services (E, Valentina og Vidal 2013), there has been done research to evaluate health care supply chain management processes to place more emphasis on interactive customer relationships, collaborative communications, and more effective support to health care operations (VanVactor 2013), and there has been done research in Optimization of daily scheduling for homecare services (Trautsamwieser og Hirsch 2011). There has also been done research in operation modelling to eliminate manual planning of homecare services (Eveborn, et al. 2012). And there has been done research about the consumption of resources within homecare services, which especially pays attention to the driving (Holm og Angelsen 2014).

In hospitals, there has been done some studies which especially pays attention to nurse shortage, where the research found that there is a significant scope for efficiency gains by re-deploying scarce nursing staff, and that other staff may be inappropriately employed to undertake nursing activities (Thomas og Davies 2005). There has also been done studies that conclude that nurse shortage might have an negative effect in the quality of care (Buerhaus, et al. 2007).

Even though there exist some research, there has not yet been provided a study that analyzes the production process, through the consumption of time spent on 25 different activities. Understanding how the situation are today, might give insight in how to create an efficient homecare service in the future, with benefits to the public, the recipients as well as the employees.

1.1.2 Research gap

Based on the former research and challenges discussed, this thesis aims to gain more knowledge about the production process in Norwegian Homecare services, through

analyzing the consumption of time spent on 25 different activities. The overall research problem would be:

Analyzing the production process in Norwegian Homecare services

There are of course some restrictions to how deep it`s possibly to fill the gap during the limited time to write a master thesis, but the research could form the basis to new and more detailed research. Analyzing the production process based on the consumption of time, would in an overall basis gain more knowledge about how the consumption of time are distributed between the different activities, enlighten differences between the different municipalities, and the gain knowledge in where there might are potential to improvements and reducing costs. Some of the earlier research mentioned, could be partly used to argue on the findings in the research, while others might be used to support the findings.

2.0 Research questions

On basis of the research gap and research problem, there has been outlined some research questions. The data analyzed are the time spent in three Norwegian municipalities in the Westcoast of Norway, collected by the employees themselves.

The research questions for the study are:

RQ1: Identifying the main cost drivers regard to distribution of time spent on the different activities.
RQ2: Investigate potential differences regarding time spent across the municipalities, as well as across activities.

The first part of the study would be to analyze the data, to be able to identify the main cost drivers. Answering **RQ1** would do the participants in the research aware of in what activities they spend most of their time, and what processes they might should reconsidering to be able to reduce the costs. Answering **RQ1** would also reveal if there are any differences regard to time spent between the municipalities, and would be elaborated further in **RQ2.** In **RQ2**, there would be investigated potential differences between the

municipalities. Since the restricted time limit and variable information received from the municipalities, there are of course some limitations to how detailed it`s possible to answer. However, if compare them, the participants would be aware of the differences, as well as lead to more detailed research.

3.0 Background

The thesis deals with a part of the Norwegian Health Care system. This section would give a briefly description of the Norwegian Health Care system in general in section **3.1**, and further describe Homecare Services in section **3.2**.

3.1 The Norwegian Health Care System

The Norwegian health care system are organized nationally through the government, and founded though the tax system through transfers from the national budget. Figure 3-1 gives a picture over the different parts in the Norwegian Health Care system, where the solid lines represents areas where the government has direct control, and the stipple lines represents areas where the government has indirect control.

The Government has the overall responsibility of the Norwegian health care system, and has the direct responsibility of the Ministry of health- and care services. The Ministry of Health- and Care Services has responsibility to develop good and adequate health care services to the inhabitants, and manage the health- and care services through a large number of legal requirements, annual appropriations, and in cooperation with other government agencies and authorities (Regjeringen 2016).

The Ministry of Health- and Care Services has direct overall responsibility to the four Reginal Health Authorities; West, Southeast, Mid of Norway, and North. Each of the Regional Health Authorities, provide special health care services through somatic hospitals, psychiatric hospitals, and are providing ambulance services. The psychiatric services are, in addition to be provided through the special healthcare services, partly delivered through primary care services.

Norway consists of 19 counties, where every county has the responsibility of public dental services. The counties have the responsibility to deliver good and adequate dental services through a selected group of the inhabitants. The purpose is that the inhabitants should have equal rights to receive dental services of high quality, that in turn would create a solid foundation for good dental health.

Figure 3-1 The Norwegian Health Care System. The idea behind the model is derived from another model, but contains changes (Study blue 2014)
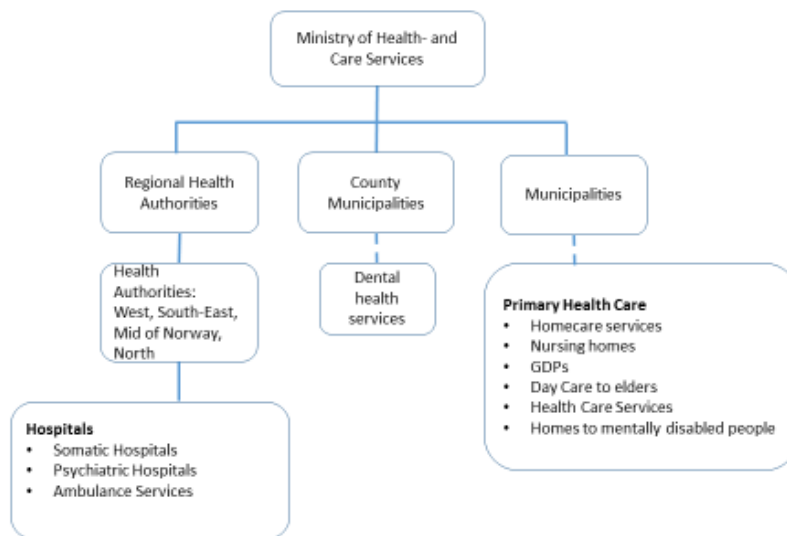
The government has direct control over the municipalities, but only indirect control over the primary health- and care services. The municipalities have the direct responsibility of Primary Health- and Care Services, which is financed through tax income and transfers from the government. The money spent on Primary Care are considered as free income, which means that the money is not specified to be spent on specific services. However, the municipalities are committed to provide specified services with a particular content, a certain level of quality, according to a large number of legal requirements (see section **3.2.1**). Primary Health Care services consists of homecare services, nursing homes and other institutions, GDPs, day care to elder people, school health services, services provided to humans with mentally disables etc., where each of the services are regulated through their own set of legal requirements (Regjeringen 2013).

3.2 Norwegian Homecare Services

Homecare Services are a part of Primary Care Services, and makes out the greatest proportion of Primary Health- and Care Services. The municipalities have the responsibility to provide good and adequate Homecare Services, according to a large number of legal requirements. The services are reached by the recipients through applying to the local authorities, which has the responsibility to handle the application. The assessors in the local authorities, further considering what kind of service the recipient has the right to receive.

An important concept of homecare services or health care services in general, is that the treatment and care should consider the recipient as an individual when designing the care plan. This results in a highly customized service. Services provided by homecare services ranges from medical administration and practical assistance, care of persons with short term diseases, to care of patients with lifelong diseases or conditions, both somatic and/or psychiatric. Because of the range of different health conditions among the recipients, homecare services are a production that require collaboration between different professions within health care, consisting of nurses, health care professionals and assistants, as well as ergo therapists and physiotherapists. Lead by a unit leader, they have the responsibility of the daily operations. They work closely with other units in primary care as well as the Regional Health Authorities, to be able to give the recipients a holistic service. The legal requirements to follow, makes homecare services a complex issue to manage, and give the recipients strong rights. Section **3.2.1** would further elaborate some of the legal requirements.

3.2.1 Legal requirements

Even though the money that finance homecare services are considered as free income to the municipalities, Norwegian health care services are, compared to other countries, regulated through a large number of legal requirements. This ensures a high level of quality on the service provided (OECD 2014). Important legal requirements concerning homecare services are rendered in the Law of health- and care services (Lovdata 2015) and the Law of Patients and users right (Lovdata 2015).

The Law of health- and care services obligates the municipalities in several areas. The municipalities have overall responsibility of health- and care services, and are committed to ensure that all potential users have access to health- and care services, and to plan, implement, and evaluate the entities through the legal requirements. The requirements do also obligate the municipalities to coordination and cooperation with other health care entities, both other entities within primary care, as well as the regional health authorities. This should ensure a holistic service. There are further a number of requirements governing the cooperation between the different entities. For instance, there need to be an agreement between the different entities about what kind of responsibility they have according to what services the different entities are offering. They are also committed to cooperate with other municipalities when it is considered as necessarily to achieve and adequate healthcare service.

Further, the municipalities should also make sure that the production are justifiable, to secure patient safety, as well as ensure quality. Justifiability implies that the health- and care services provided are coordinated such that the patient are provided a holistic and commendable service, and that the employees involved in the production has an adequate expertise. They are also committed to work systematically to improve the quality and patient safety, and to inform the patients and recipients about their rights to receive the health care services.

The municipalities are also committed to develop an individual plan to patients and recipients with a long-lasting need to receive services, as well as provide a coordinator to such patients and recipients. They should have a coordinated service to habilitation and rehabilitation, that should have the overall responsibility to individual plans, as well as training and supervision for the coordinator.

On the other hand, the recipients' rights are secured through the Law of patients and users' rights, and contains the recipients' rights in relation to receive health- and care services (Lovdata 2015). Purpose and the scope of the law are to give both temporary and permanent Norwegian inhabitants, equal access to health- and care services of high quality, as well as promoting trust between recipient and health care services. The law applies to everyone residing Norway.

The Law of patient and users' rights gives the recipients rights to receive urgent care, receive necessarily care, receive a commendable service, as well as receive necessarily information from the municipalities about their rights to receive the service. The law contains a number of requirements that gives the recipients right to participate in deciding how the health care service should be designed. This implies that the service, as far as possible, should be designed as a result of collaboration between the recipient and the provider. If the recipient is not competent to consent themselves, the recipients' relatives or dependents have the right to have an influence on the health care service performed.

In addition to the above-mentioned obligations and rights, there are a multitude of additional laws and requirements which must be taken into consideration in the production. There are for instance laws that regulate the privacy to the recipient, law of health care personnel etc. All the requirements give a picture of the complexity in the production of health care services, and the different considerations to take when planning the production.

3.2.2 Cost conditions and demand

Total expenses of Primary Health- and Care services reached 100 billion NOK in 2014, where homecare services account for over 40% of the expenses (Statistics Norway 2014). Table 3-1 shows the expenditures distributed on the different areas within primary health care, where there has been an increase in total expenses to homecare services in 34,4 percent from 2010 to 2014, which is the largest increase in money.

Table 3-1 Total expenses in Primary health- and care services. Derived from Statistics Norway (2015)

			Change %	Change %
	2014		**2013 - 2014**	**2010 - 2014**
	Absolut numbers	%		
Gross operating expenses	**121703543**	**100,00 %**	**6,9**	**35,4**
Prevention, health clinics and school health services	3045226	2,50 %	9	33,2
Other preventive health care	1199825	0,99 %	4	42,5
Activities and services for seniors and persons with disabilities	5461011	4,49 %	8,1	27,4
Diagnosis, treatment, rehabilitation and habilitation	10713083	8,80 %	8,1	31,4
Health- and care services in institution	41485362	34,09 %	5,4	23,8
Health- and care services to people live at home	**49683784**	**40,82 %**	**8,2**	**34,4**
Co-financing somatic health care services	5452472	4,48 %	3,3	.
Emergency health and care services	375099	0,31 %	80,2	.
Institutional facilities	4287681	3,52 %	3,4	12,2

Table 3-2 shows the total number of recipients by age, from 2011 and 2014. Regard to age group, the most increasing proportion of recipients are under the age of 67, while the main proportion of recipients are above the age of retirement (Statistics Norway 2014). Since there is an increase in the age group below 67, and a general increase in ageing, this reflects that homecare services would have a far more central role in the future, regard to demand as well as expenditures.

Table 3-2 Total number of recipients in Homecare services. Derived from Statistics Norway (2015)

	2011	**2012**	**2013**	**2014**
Sum	**177 094**	**178 687**	**179 859**	**180 027**
Under 67 years	68 782	71 127	:	73 316
67-79 year	32 666	33 006	33 642	34 059
80-89 year	56 188	54 425	53 236	51 624
90 <	19 458	20 129	20 782	21 028

One of the main reasons that there has been an increasing in the age group below 67, is the Coordination Reform, which the next section would concern about.

3.2.3 Coordination reform

Even though Norway has a well-developed health care system, they are, as mentioned, expecting to meet some future challenges; aging in population, falling length of stay in

hospitals. To the health care system, the challenges would in a highly degree be related to increased costs and increased pressure on the health care system's capacity. An action made to be able to meet the future challenges, is the Coordination Reform. The reform was implemented 1. January 2012, and the outcome of this should cause a shift from hospital care setting towards primary care settings. In addition to meet the challenges, another purpose of the reform was to give the recipients health care services that is easier to relate to and that are local. To be able to pay the increased share of the expenditures, 5 billion NOK are transferred from hospitals to the local authorities (Regjeringen 2011).

The reform has been showed to have very different effects in the different parts in the Health Care System. Hospitals experience they are more efficient, while homecare services experience challenges regard to at least three points (Helsedirektoratet 2016):

- An increase in demand of homecare services. The Coordination reform are the main reason to the increase in demand in the age group below 67.
- Recipients with more complex health conditions. The Coordination Reform results in that Homecare Services need to handle more complex health conditions, with an increase in recipients with cancer, cardiovascular diseases, geriatric diseases, infections etc.
- An increase in the proportion of recipients with temporary health conditions.

These changes have resulted in a decrease in recipients receiving practical assistance, because the increased demand of more complex issues has displaced less complex health conditions (Helsedirektoratet 2016). The overall changes within homecare services gives a picture of services that becomes more complex, regard to handle more fluctuations in demand as well as handle health conditions that require more educated skills. There are in general a deficit of information of the patterns of care and outcomes in primary level. While there exist measures of primary care quality at a broader level, there are known very little about the quality and productivity at the operational level. This means that there is no possibility for authorities to benchmark quality and performance, either against other authorities or national guidelines, as well as control if the implementation of Coordination reform is successful (OECD 2014).

3.3 Research context: The municipalities

The research is done in the context of home care services within three different municipalities; Fræna, Rauma and Vestnes. The municipalities are located in the west coast of Norway in the county of `Møre and Romsdal`, which make them similar in geography and landscape. Vestnes and Rauma are neighbours, while Fræna is located further north. The municipalities' location is pictured in figure 3-2.

Figure 3-2 Fræna, Rauma and Vestnes, map

The municipalities differ somewhat in the size of area, where Fræna and Vestnes has similar size of land area, and Rauma has a larger size of land area in 1502km^2, as represented in table 3-3. Except the differences in size, the municipalities are similar in the landscape; they are rural and has fjords. Because of the geography there would in general be some challenges related to coordination. For the same reason there could more easily be challenges according to emergencies among the recipients, cause more disruptions in the production process.

Number of inhabitants range from 6700 to 9800, where Vestnes is the municipality with lowest number of inhabitants and Fræna is the municipality with the highest number of inhabitants (Statistics Norway 2015).

Table 3-3 Fræna, Rauma and Vestnes

Municipality	Fræna	Rauma	Vestnes
Number of Inhabitants	9787	7445	6708
Area	369,73km²	1502km²	352km²
Number of employees	57	65	-
Number of recipients	230	288	175
Hours of resolution	3047,12	6923	-

Rauma has a number of recipients on 288, Fræna has 230, and Vestnes has 175. They are organizing their homecare services somewhat different, and that the total number of recipients in Fræna include both recipients receive homecare, as well as recipients that receive practical assistance. In Rauma and Vestnes, practical assistance, as cleaning houses, function as an own unit, and are not a part of this research.

4.0 Theoretical framework

Understanding the production process within companies are substantial to manage costs as well as quality. How the production process is designed, do also have an influence on the organizations ability to deliver the quality products in an efficient way. The theoretical part will elaborate the homecare service production in section **4.1**, be continued with process design in section **4.2**, and concluded to the research in section **4.3.**

4.1 Homecare service production process

A production process could be defined as `any part in an organization that takes inputs and transforms them into outputs that are of a greater value to the costumer`. In manufacturing companies, labor, equipment and components, are transformed into products in assembly plants that in the end should give value to the end costumer (Chase, Jacobs og Aquilano 2006). In a home care service production, nurses, health care workers, assistants etc. use different types of consumables and physical capital, goes through the organization structure and a process, and are transformed into health care services, as pictured in figure 4-1.

Figure 4-1 Homecare service provision. Derived from WHO, but contains minor changes (World Health Organization 2002)
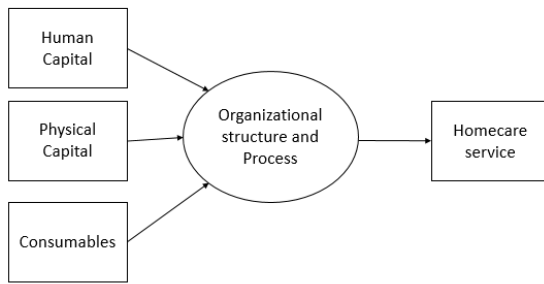
Since a health care services could be defined as a service, there are some distinctions from manufacturing products in at least four different points. They are:

- Intangible (Bateson 1977),
- Inseparable (Carman og Langeyard 1980),
- Heterogeneous (Parasuraman, Zeithaml og Berry 1985), and
- Perishable (Kotler 2005)

A home care service is intangible, means they are not possible to see, taste, feel, hear or smell. The recipients are not able to see the outcome before the service are received. Because of this, the recipients would look for indicators that would tell something about the quality on the service when it`s delivered. The health care services are also inseparable, produced and consumed at the same time. Since production of health care services require the recipients' presence, the recipients are an important part of the production process, that happens through an interaction with health professionals. Home care services are also in a highly degree heterogeneous. This would lead to variations, to for instance in when and where they are executed, as well as who is performing the services. In home care services, the variation would also be dependent of variables as for instance the degree of care. The degree of care could vary between the recipients' diseases and conditions, as well as differences between periods because of the cycle of their disease. As for instance would diseases as Multiple Sclerosis and Parkinson would have period with attacks, which would lead to periods with an increased level in the degree of care, and thus require that the production is adaptable though such periods. The last distinction between the production of manufacturing goods and a health care services, are that health care services are not able to be stored with the purpose of later use. They are perishable. This make challenges

according to planning. Due to various reasons, as for instance the above-mentioned example with Parkinson and Multiple Sclerosis, or because of acute needs with the recipient, the demand of healthcare services could vary tremendously between different periods. With manufacturing products, this is different because we are able to have buffers between the different activities to prevent that activities do not stop (Chase, Jacobs og Aquilano 2006).

The fact that the health care services are heterogeneous, become especially apparent in homecare services. While in care institutions, the patients typically reached a certain level in their cycle of disease or condition, in homecare services the group of recipients range from every level in the different diseases and conditions. This means, that homecare services serve recipients with a range of differences regard to the degree of care. The degree of care could be seen as to which extent the different users need to receive comprehensive care. They could provide recipients with a gentle degree of Alzheimer disease, or they could serve recipients with a prominent degree of Alzheimer disease. They could serve recipients that has recently been diagnosed with Parkinson, or they could serve recipients that has had Parkinson for years, that need extensive care. This would further do that even though with the same type of diagnosis, the receipts have different needs regard to the degree of care. This could also be reflected between different periods, dependent on diagnosis. As earlier mentioned with diseases as for instance Parkinson and Multiple Sclerosis, would typically have periods with attacks, that create differences in the degree of care between periods, event with same recipient.

Because of the high variety in the need of the recipients, the production of healthcare services has a strategy with a process focus. An organization with a process focus is a production facility organized around processes to facilitate low-volume, high-variety production. In manufacturing companies, the highly customized products usually are produced in job-shops, where they in manufacturing companies might be departments as welding, grinding and painting (Heizer og Render 2004). In hospitals, the different departments may be orthopaedic, dermatology, emergency, premature etc. In homecare services, we are not able to distinguish between different job shops, simply because an important part of the facility is the recipient's home.

From a head office, the employees are coordinated to the different recipients through different zones and worklists. The head office serves as a main base where the employees exchange information and knowledge about the recipients to be able to give them a holistic care. Rather than describe the production through departments and job shops, a better approach might see the jobs shops as activities. It`s a multiple stage process with multiple groups of activities that are linked through flows (Chase, Jacobs og Aquilano 2006). The production process could be seen as the sum of a range of different activities, where the aim is to give the recipients care that is customized to each of their needs, regard to the cycle and degree of their disease or condition.

Figure 4-1 *Homecare production process* represents a thought production process within homecare services. The production process might be explained through six levels; identifying the recipient's needs, planning, interaction between the employees, travel, the recipient is involved in the production, and potential disruptions, where the six levels represent different stages in the production process. At level 1 the production in homecare services are trigged by the need of care by a recipient. Because of the above-mentioned characteristics, the end product is not produced before it`s needed. It`s much like in production theory are called pull system, that pulls a unit to where it`s needed, when it`s needed (Heizer og Render 2004). In homecare services the demand is trigged by the recipients need to receive care, and is done visible when the recipient is applying to the local authorities. Further, the appliance is handled by the Management Office to identify what actions could be made to satisfy the recipient's needs. At level 2, the employees in homecare services becomes a part of the production, or at least those who has administrative responsible. Level 2, represents activities that are necessary to run the daily operations, as scheduling, designing care plans, workforce planning etc. The high level of customization naturally would make some constraints regards to standardizing and planning. Each recipient is different, which means that all of them has special need in order to be satisfied.

Figure 4-2 Homecare production process
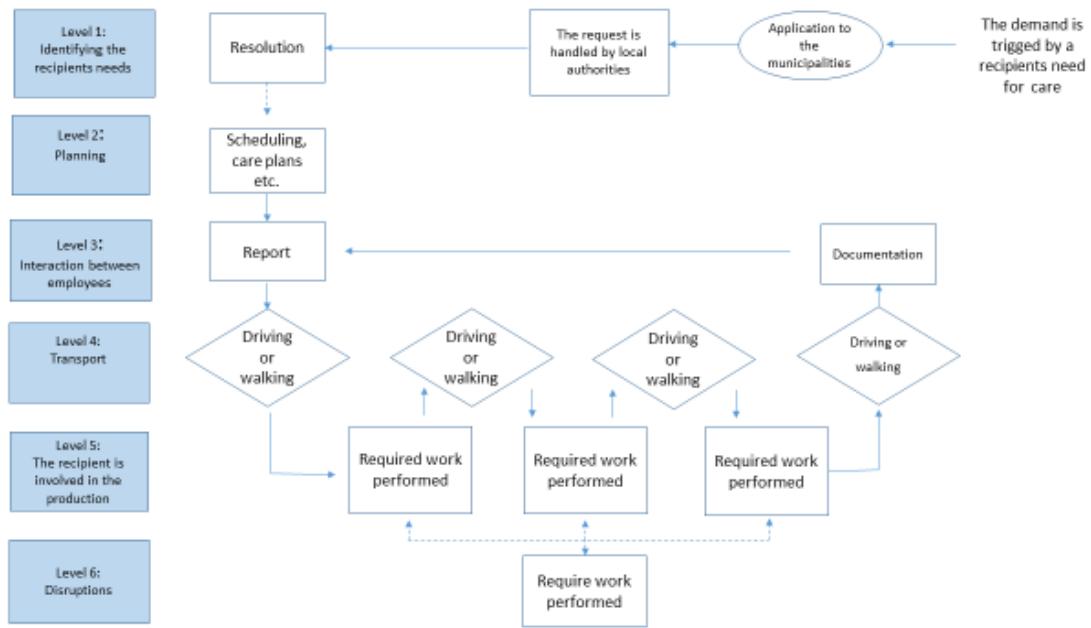
Level 3, 4 and 5 are a part of the daily operations that is able to be planned, and where nurses, health care workers, assistants and other professions become involved in the production. In level 3, the employees exchange knowledge about the recipient, and preparing to execute the designed care plan to be able to give the recipients care of a high quality. This could be an oral report, as well as written from the documentation system. Since the production facility, in addition to the head office, is the recipients' homes or other establishments, the employees usually need to drive or walk to reach the activity, as represented by level 4. This might also be the greatest different between an institutional context and a homecare context, where the production in an institution usually are done in the same building. At level 5, the health care services are produced, either in the recipients' home through an interaction between the health care professionals and the recipient, or by the employees themselves by doing other required services. This could be several things, as for instance pick up medications to the recipient at the pharmacy, delivering blood sample to the laboratory etc. The process at level 4 and 5 are repeated by *n* numbers of assignments, until the health care professional are done with his or her schedule.

Level 6 represents potential disruptions in the production process, which they are not able to schedule. To call them disruptions might be misleading, since they are an important part

of the production as well. It has more intension to enlighten the differences between this type of demand, and the demand in level 5. They should be take into consideration when planning, to avoid delays in the rest of the production. If recall the main differences between services and manufacturing products, the services are inseparable and perishable. These characteristics would lead to disruptions in the production when something extraordinary happens. We are not able to store them, and make buffers with the purpose of later use. In homecare services, these disruptions could be security alarms, it could be incoming phone calls, or other extraordinary situations, which would cause that the employees, need to disrupt their ongoing planned work. Unless there are a certain level of slack in the production process, it may lead to major delays.

After performing required work n at the end of the schedule, the employee returns to level 3 to the head office through level 4, by either driving or walking. At level 3 exchange of information repeats, and so do the whole process in a new shift, with a new personnel. The outcome of the production, preferably are a recipient that has a higher degree of satisfaction in his or her health condition.

4.1.1 Cost drivers in production processes

Behind every activity performed in the production, there could be something that is defined as cost drivers. Several methods have been developed to defining cost drivers; Porters structural cost drivers (Porter 1985), AIM&DRIVE approach (Anklesaria 2008), ABC approach (Kaplan og Cooper 1997) etc., where the approach to find them might differ. Porter define cost drivers as `structural factors that decides an activity`s cost` (Porter 1985), and the AIM&DRIVE approach define cost drivers as `the variables, that if changed, will have the biggest impact on the cost you are trying to manage` (Anklesaria 2008). Even though the definitions are relatively similar, it seems like the methods differ somewhat in the purpose. While Porter, in addition to reduce costs, also have the purpose of better understand them, the AIM&DRIVE approach is most concerned about that what we define as cost drivers, we should also be able to control and reduce.

Porter says that cost drivers decide the cost behavior, and that the company may have different control over these. He says that the activities should be analyzed in a cost analysis if they represent a substantial or an increasing part of operating costs. However,

it`s also important to remember that even though companies could easily detect high costs, they would often neglect activities that seems to have a less important role in the cost structure. Activities should be seen in separate if they have different cost drivers, if the company share it with others, or if it has a link with other activities. In his literature, Porter distinguish between 10 structural cost drivers that might have an effect in the production.

Anklesaria is more concerned about that we should not only be able to define them, but that is a necessity that what we define as cost drivers and analyze in a cost analysis, is possible to reduce. He explains the process of defining cost drivers through eight steps, which preferably should lead to cost reduction through the supply chain. Step 2 include activities as process mapping, identifying critical costs, and developing master worksheets. Step 3 include activities as writing formulas to each of the activities, and identify the cost drivers. The formulas should end up being a revenue driver, consisting of variables or sub costs elements, where the variables represent the cost driver. When the formulas are complete, there should be decided, which one of the driver has the most impact on the costs to the activity.

Another well-known approach is the ABC model. The ABC model, is an econometric map of the organization`s expenses and profitability based on organizational activities where the company's activities are identified, by its indirect and support activities (Kaplan og Cooper 1997). This part has to some, resulted in comprehensive models, and for the same reason lead to that the approach has been criticized to be too consuming to handle (Anklesaria 2008). However, Kaplan and Cooper (1997) says that a rule of thumb are used by some ABC teams, ignoring activities that use less than 5% of an individual's time, and that an activity dictionary could be brief, including only 10-30 activities, especially when the focus is to estimate product and customer costs. More extensive models could be used when the purpose is process improvement, which is either the purpose in this thesis. After dividing the production process into different activities, there need to be defined a cost driver to each of the activities. For instance, in a manufactory, the activities could be run machines, set up machines, schedule production jobs, receive materials, with the cost drivers machine hours, setup or setup hours, production runs and material receipts.

The Pareto principle, also called the 80-20 rule, is a well-known principle suggested principle by Alfred Pareto, concerns that in many events, 80% of the costs come from 20%

of the activities. The origin of the principle is wealth economy, where Pareto used it to describe the unequal distribution of wealth in countries, which has been shown to hold in a wide range of situations. However, the percentages might differ somewhat from organization to organization (Johnson, Leenders og Flynn 2011). The theory has been applied within many fields, economy, business, risk analysis, purchasing, inventory etc. and has been highly acceptable in the literature.

Even though there exist a lot of theory about cost drivers and how to find them, they are similar at one point. The common to all the theoretical concepts is that they focus on the activities that accounts for the highest share of costs.

4.2 *Process design in health care services*

How the process is designed, are closely related to which extent the organization are able to be efficient and deliver quality. Efficiency could be defined as a ratio of the actual output of a process relative to some standard, but it`s also used to measure loss or gain in a process (Chase, Jacobs og Aquilano 2006). The definitions reflect that efficiency are closely related to the quality concept, and that a company are not able to be efficient without delivering a certain level of quality.

How the production processes within a company are designed, is the sum of many choices, regard to for instance job design or the company's use of technology. Some of the technology used within homecare services has had a tremendous development the recent decade and are elaborated in section **4.2.1.** A job design is defined as the function of specifying the work activities of an individual or group in an organizational setting, and elaborated in section **4.2.2.** Since it in health care services are of particular importance to produce quality, this is discussed in section **4.2.3.**

4.2.1 Use of technology

An important part of designing the production processes is the organizations choice of technology. Even though it is not possible to elaborate the entities entire use of technology, it is of importance to mention briefly, since the technology could have an effect on the

consumption of time spent in some of the activities measured. In Homecare services, there would naturally be some constraints due to the facts that a huge part of the production process is no able to be automatized, it requires an interaction between the provider and the recipient. However, the recent years, there has been a tremendous development in the use of technology within homecare services, which in turn would have an impact on the processes is designed: new types of documentation systems, and an increased use of personal health- and care technology. The last mentioned is a relatively new area, but has been tried implemented through pilot projects, and yield good results (Helsedirektoratet 2015).

In home care services, the flow of information system is represented by the documentation system. Information flow are in logistics and SCM theory defined as the flow of `demand data from the end customer and back to purchasing suppliers, and supply data from suppliers to the retailer, so that material flow can be accurately planned and controlled` (Harrison og Van Hoek 2011). In homecare services, or health care services in general, the flow of demand data concerns information about the recipients' condition and/or disease, care plans, medicine lists, and other things that are crucial to give the recipient adequate care. In addition to this, the employees do documentation regard to which activities has been performed, as well as other things regard the recipient, as for instance change in health condition. The information flow conducted from the documentation system could be seen as a quality assurance to both the employees and the recipients themselves, but it has also been described as the greatest obstacle to achieve good results in accordance to the development within homecare services related to the coordination reform (OECD 2014). The development in homecare services requires that information about the recipients be efficiently handled internally, as well as between institutions and entities. How efficient and safe the flow of information is, would in turn be dependent of the homecare entities choice of documentation system.

Personal health- and care technology is a huge area, and is the sum of many different technological aids, as digital security alarms, localization technology, electronic medication support, electronic door locks etc. Personal health- and care technology is technological assistance that improves the safety, security, social participation, mobility and physical and cultural activity, and strengthens the ability of individuals to fend for themselves in everyday life, despite illness and social, mental or physical impairment

disability. Welfare technology can also act as technological support to families and otherwise help to improve availability, resource utilization and quality of service provision. Welfare Technological solutions could also in many cases prevent the need for services or institutionalization. Gains derived from the use of personal health- and care technology has shown to be increased quality, savings in time spent, and avoided costs. Increased quality is related to beneficial effects that recipient, relatives and employees' experiences themselves, or increased quality on the service that are provided. Savings in time spent, are related to reduced time to deliver the required service. Avoided costs are gains arising through that assignments are reduced or new initiatives are not implemented because the personal health- and care technology covers the need to follow-up, and gives necessarily degree of security to the recipient. The choice of technological aids should be dependent on each recipients needs as well as the recipients' assumptions to use the technology (Helsedirektoratet 2015).

4.2.2 Job design and organization structure

Job design could be defined as the function of specifying the work activities of an individual or group in an organizational setting, where the aim is to meet the requirements of the organization and its technology and to satisfy the jobholders' personal and individual requirements. Questions to be answered in a process of job design could be related to who, what, where, when, why and how, and are related to decisions regard to the use of temporary workers, specialization of labour, cross-training of personnel, employee involvement and team approaches to design work, automation of heavy manual work etc. (Chase, Jacobs og Aquilano 2006).

In homecare services, this planning would be related to decisions about scheduling and designing of procedures. The employees are working shifts, between day, evening, nigh and weekends. There are several types of skills within homecare services; assistants, health care workers, and nurses etc. Both health care workers and nurses could be further specialized in different directions, as cancer, palliative care, rehabilitation, psychiatry etc. How the skills are spent in each organization might be different, and there are also a range of legal requirements to follow when designing the schedules. This could for instance be the level of education on the workers at each shift, or it could be legal requirements

deciding which of the professions is execute the different procedures, as for instance regard to the different injections, treat the different wounds etc.

An organization structure in a manufacturing firm, would be related to the different job shops. An entity with homecare services, covers the area of an entire municipality, where it in large municipalities usually is divided into different zones as pictured in figure 4-2.

Figure 4-3 Homecare job design
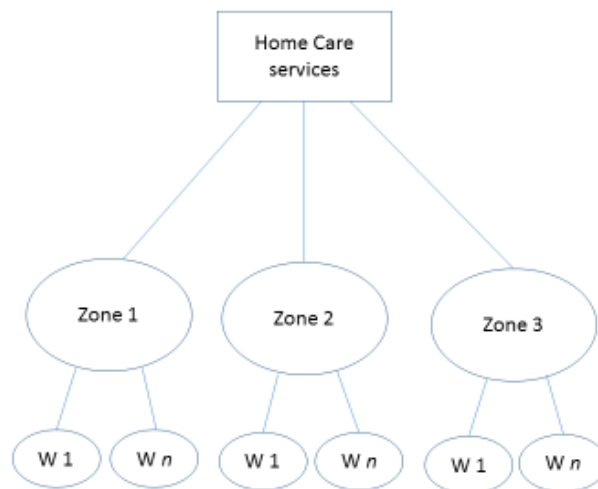
Every zones have *n* number of worklists, usually within a defined geographic area. Further, the different worklists have *n* number of recipients, which can vary from day to day depending on the recipient's needs. The different considerations to take, makes scheduling a demanding job.

4.2.3 The quality content in process design

Production processes that has a high service content should focus on the customers and providers' interaction (Heizer og Render 2004). How the different municipalities do their processes- and job design, might also have an impact to which extent they are able to deliver quality. Quality is a complex issue, and not possible to elaborate in details in a single thesis. However, it deserves some attention, especially since the data in the thesis

concerns about the production process, analyzed through the consumption of time spent on different activities.

The overall goal in production theory are often related to cost reduction. In addition to this, some theory also suggests that to achieve cost-reduction, the system need to meet three other sub goals (Monden 2012);

- Quality control
- Quality assurance, and
- Respect for humanity

Quality control enable the production process to adapt daily and monthly fluctuations in the demand of quantity and variety. Quality assurance assures that the process would supply only good units, and respect of humanity, or moral, are also important since the system utilizes human resources to attain its cost objectives. These three objects cannot be achieved independently without influencing each other, or the primary goal of cost reduction (Monden 2012). Since the thesis is restricted to the consumption of time spent on the different activities, and not include a more in-depth analysis of the processes, sub goal two is discussed, which is quality assurance.

The way of thinking on quality assurance might give the need to think somewhat different in the production of health care services. Unlike a manufacturer which is delivering units to subsequent processes, in health care services we are not able to control whether the process is delivering good or bad units. The units in the production of health care services are, in addition to consumables, health care professions and the recipients themselves. The production is inseparable, the health service is produced and consumed at the same time. Since health care services are mainly delivered by health care professions, nurses, health care workers, and assistants, they would have a more central role in the production to deliver quality than in a manufacturing firm, where we might be able to automatize the processes. Bad quality could be defined as waste, because when delivering bad quality, there will be a need to go back and correct the defected product in order to satisfy the customer. Since the delivered product in health care services are related to the recipients' health condition, we might not be able to correct the defected product, which in turn would have tremendous consequences. We can`t only repair recipients' health condition.

Since the service is produced by an interaction between health care professionals and recipients, there would be a need, to find what conditions make it possible to employees to deliver health care services of high quality, as well as what conditions the recipients perceive as quality. From a health care professional point of view, we do know that the workload would have an impact on their ability to deliver quality, and that if an employee is overloaded, this would have a negative effect in health care service quality (Kc og Terwiesch 2009). The organizations use of resources might also have an effect on the recipients, and to which extent the recipients feel satisfaction. Patient`s perceptions on quality of the care given are a result of their encounter with the existing care structure and by their own norms, expectations and experiences (Wilde, et al. 1993). Especially two aspects from same theory are of importance to this research; Medical-technical competence, and identity-oriented approach.

Medical-technical competence is related to that patient's desire that those who provide care should have a level in their competence makes them capable to meet their needs, and that the qualified personnel has the right knowledge to give the patient the right treatment, are available. Identity-oriented approach is related to the desire the patients has to have a face relation to the caregivers that are able to see the recipients' unique situation. The caregivers should also have the right qualifications, with knowledge and empathy to meet the unique condition of the patient.

The required conditions from both employees and recipients side would end up in two conditions from employees side, and three from the recipients side, pictured in figure 4-4.

Figure 4-4 Service quality from a resource consumption point of view
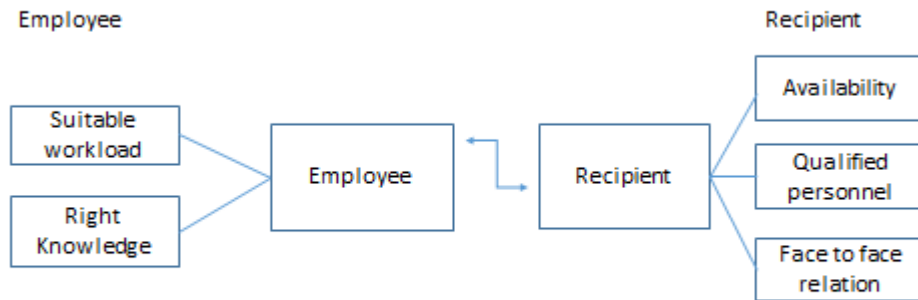
The employee need to have a decent workload to be able to deliver quality. He or she do also need a suitable workload to be able to cover the recipients' desire of availability, as well as cover the recipients desire to have a face-to-face relation. The health care professional would also need to have a certain degree of knowledge, but that of course would be dependent of what tasks is performed. The right qualification and the decent workload to the health care professionals, would in turn give the recipient a feeling of satisfaction in the way of receiving quality. Even though this is simplified, and preferably should contain more conditions, this could be referred back to the importance of focus on the interaction between employee and costumer in production with a high degree service content.

4.3 Concluding the theoretical framework to the research context

The input to the research is 25 activities with related time data, recorded or registered by the employees themselves. The activities are aggregated up to categories regard to the different levels referred to in figure 4-1 *Homecare production process*. The list of the 25 different activities being measured, are shown in the table below, which range from homecare and nursing to administration activities. Each of the activities measured belongs to one of the 8 categories.

Table 4-1 Activities measured to the research

Category	N	Activity
Administration	1	Activities to other entities
	2	Administrative tasks (including carwash)
	3	Case management
	4	Contact with management office
	5	Meetings
	6	Meetings related to defined user
	7	Training of personnel
Break	8	Break
Direct patient care	9	Ergo- and physioservices
	10	Homecare
	11	Practical Assistance
Potential Disruprions	12	Incoming phone calls related to define user
	13	Security alarms administration/documentation
	14	Security alarms, include driving
Documentation/communication	15	Documentation
	16	Internal communication
	17	Report
Driving and walking	18	Driving and walking
	19	Food delivery, driving only
Indirect patient care	20	Medical handling
	21	Grocery shopping without end user
	22	Laboratory visit
	23	Other activities concerned defined user
	24	Pharmacy visit without end user
Preparedness	25	Preparedness

The consumption of time, could then be defined as the sum of all categories. The only way to decrease or reallocate the time spent, is to get rid of unnecessary activities or change the efficiency in one of the activities. In which degree we are able to increase the efficiency in the processes, are dependent of the activities cost drivers, mentioned in section **4.1.1.**

Administration activities are activities are described in level 2 in figure 4-1 *Homecare production process*. This could be case management, contact with management office, meetings, activities to other entities and training of personnel, and meetings related to defined user. Administrative tasks include activities that concerns planning, scheduling, as well as washing and maintenance of home care services cars. Meetings related to non-defined user, could be for instance meeting between administrative staff about the daily operation in homecare service, it could be information meetings between the employees and the management etc. Contact with management office could be collaboration and contact to elaborate the recipients need. All these activities have in common that they function as a support to the daily operations, which is necessary to be able to perform the

other activities in a proper manner. Meetings regard to defined user, involve planning, exchange of experiences regards to the user etc.

Documentation/communication are activities which involves interaction between the employees, mainly conducted in level 3 in figure 4-1 *Homecare production process.* They do also serve as an input to level 5 in production process, since they involve communication between the employees about recipient's condition that are necessary to give them proper care. Documentation, report and internal communication are activities that are represented in this category. They all are activities where employees exchange knowledge about current stage in recipient's condition, and would make the employees in the next shift able to perform care efficient as well as high quality. Example on this could be to register relevant information into the entities documentation system, or it could be oral reports. The activities are also closely connected to the organizations flow of information and documentation system, elaborated in section **4.2.1.** The choice of documentation system might vary between the different municipalities, and would in turn have an effect in the municipalities ability to be efficient, deliver quality, and to be able to recipients a service customized their needs.

Driving and walking is the sum of the time the employees use in travelling between the different activities, either by walking or by car, and represents level 4 figure 4-1 *Homecare production process*. The municipalities are rural, and in the majority of the activities they need to have access to a car, at least they need to walk. As mentioned in section 4.1 this might be the main difference between doing research in and institution environment and a homecare service environment, and function as a link between the activities performed.

Direct patient care, indirect patient care, break and preparedness are executed in level 5 in figure 4-1, and should be a part of the scheduling. Since the different activities are produced in different ways, and/or has different purposes, they have been split up to present 4 different categories.

Direct patient care are activities directly spent on the recipient. This category includes nursing and homecare activities, practical assistance, ergo- and physio services. This is the part, where the health care service is produced by an interaction between an employee and a recipient. Homecare activities include a range of different activities as simple care, visits

of patients with dementia, different nursing procedures related to wounds or catheterization, it may be nursing of terminal patients, nursing of patients with lifelong diseases etc. Practical assistance includes activities which is intended to be facilitating to the recipients. This could be preparing meals, cleaning house, taking laundry, taking dishes, change the bed clothes, and more. Ergo- and physio services are services that has been outlined by a third part, as for instance an ergo therapist or a physiotherapist, and further conducted by an employee in homecare services. These activities could differ as well, from everything as stretching of muscle and joints to more advanced programs related to for instance rehabilitation or habilitation.

Indirect patient care are activities that are aimed at a defined user, but not directly involve the recipient in the production process. Activities that are included in this category, are; grocery shopping, medical handling, laboratory visits, pharmacy or laboratory visits without recipients. The activities have in common that they are meant to be a facilitator to the recipient, but without the recipients' direct involvement. This could for instance be that the recipient is not able to control the medicine themselves, it could also be delivering a blood sample at laboratory which are taken by a nurse, or it could be grocery shopping to recipients that are not able to go to the grocery by themselves.

Break is the amount of paid break, which usually is half-an hour during the day, and could also be considered as a part of level 4. In many cases legally required, and a part of the daily operations. Since it not involves an interaction between the employees or between the employees and recipients, it has been categorized by itself. In homecare services the employees are usually committed to handle situations where the recipients have a need, and would because of this have paid break.

Preparedness, in addition to be included in the model, could also be connected to the theory in section **4.2.3**. Time of preparedness represents the time during the day without specific tasks, and as remember from the theory a decent workload is a criterion to produce quality. It would also have an impact in the employees' ability to perform the activities in level 6 in figure 4-1, which could for instance be handling security alarms.

Potential disruptions are activities performed in level 6 in figure 4-1 *Homecare production process*. The activities are an important part of the production, but are triggered

by an acute need of the recipients or that lead to that the employee need to disrupt their ongoing work. They are double processing, do several activities at the same time. This do also represent the uncertain part of the demand, and are related to which degree homecare services needs to be flexible. Some of the recipients has received permission to wear a security alarm to use in acute situations. The recipients wearing security alarms could be, but not necessarily need to be, recipients that receive homecare services in a daily manner. In some cases, this applies to false alarms where the recipients by an accident has pushed the alarm button. In other cases, there are an emergency where the homecare employees has to interrupt their ongoing activity and deploy to an emergency. This may be regarding acute disease, changes in medical condition, cases where the recipients have fallen, as well as cases where the homecare staff don't succeed by making contact by phone. Incoming phone calls do also present a certain degree of disruptions, since the employees in many cases need to set their ongoing work on hold to handle the phone call. In this case it represents phone calls related to defined user defined user from either recipients themselves or relatives, which for instance could be related to answering question to care given, or feedback about the given care.

5.0 Methodology

This section concerns about the methodology used in the research and how the data is collected. Section **5.1** elaborate the general approach, section **5.2** concerns about data collection, section **5.3** about validity and limitations, data analysis in section **5.3**, and research bias in section **5.4.**

5.1   General approach: Case study

In every research, there should be selected an overall approach. A case study approach, might be appropriate when have a contemporary set of events and where the researcher has little or no control (Yin 2014). The research questions, **RQ1** and **RQ2** meets Yins criteria to use a case study approach. The researcher has no control over the events, since the events are both planned, executed and recorded/registered by the municipalities and employees. The events are also contemporary, they measured in a given period of eight weeks. The case study is exploratory, which means that the purpose is to identify research questions to be used in a subsequent research, which might or might not be a case study

(Yin 2014). Since the research project is in its initial phase, there are some restrictions in how descriptive and explanatory the findings could be, but the findings might give information about what areas deserve more attention.

The construct of the research design, are presented in table 5-1.

Table 5-1 Construct of the research

Level of analysis	Production process
Unit of analysis	Time spent on the different activities
Research approach	Empirical
	Quantitative
	Qualitative
	Inductive
Overall theoretical framework	Production Process and process design. See section 4
Empirical data	Quantitative data, collected in the weeks from 2-10 in 2016. See section 5.2
Theory development	The theory is applied to homecare services, as well as concluded to connect the theoretical framework to the research and activities recorded

The analysis is done at the level of production process, and the unit of analysis are time spent on the different activities. Although there are limitations to how deep it is possible to go in the different subjects and activities, there would, to some extent be possible to get an overall view of the production. The theoretical framework is elaborated in section 4.1 and 4.2, where the general theory about production processes is adapted to homecare services. Further, the theoretical framework is concluded in section 4.3, to connect the research to the theoretical framework.

The research is empirical, quantitative, qualitative and inductive. Empirical research is a research that seeks to gain new knowledge (Jacobsen 2010). Since there is relatively scarce of research done in homecare services, it would become a contribution to the literature, as well as function as a foundation to further research. The research is also quantitative as well as qualitative. Quantitative research contains data in numbers, and not words as collected from interviews. The data collected are elaborated in section **5.2**. A quantitative

approach is an advantage when we want to study several units and would like to generalize, but a disadvantage because it gives relatively superficially information (Jacobsen 2010). The best results would be achieved through a combination between the two of them. In addition to quantitative data, there has also been conducted personal talks with the leaders in each of the municipalities, as well as e-mail correspondence, which could be referred to as qualitative. Qualitative research could be selected when we are trying to explain a phenomenon (Jacobsen 2010). The data analyzed, do not explain everything that is relevant to answer alone, such that there would be a need to find information that could explain the findings in the quantitative data. Preferably, there should been conducted interviews after analyzing and comparing the quantitative data. Good questions should be elaborated behalf on the findings. Since the data were received in the period between the middle of April, to the beginning of May, this was not possible regard to the restricted time. Conducting interviews and transcribing the information would take far more time than the remaining weeks of writing the thesis. Because of this, the leaders were asked relatively open questions, which has been referred to in the discussion.

The research is also inductive, which means that the researcher did not have assumptions about the results before the research was done (Jacobsen 2010). The activities were elaborated through the project OMHOMES, through a collaboration between a researcher and the municipalities themselves. The data analyzed in the research were also collected by the project. The remaining information and personal talks referred to were collected after analyzing the data. Because of this the writer had no possibility to have assumption before the research.

5.2 Data collection

The data analysed in the research are obtained from two different sources: time data recorded or registered by employees in homecare services themselves, and from the leaders in the entities, through personal talks and e-mails sent between the writer and the municipalities.

Table 5-2 Sources of evidence and research activities

Research question	Sources of evidence	Research activity
RQ1	Time data	Organizing of primary data
		Data analysis and results
RQ2	Time data	Data analysis and results
	Secondary data from the entities	Personal talks, both face-to-face and e-mails
	Information from the personal talks	

5.2.1 Primary data used in the research

The primary data has been submitted from the OMHOMES project to the writer, and represents the time spent in each of the activities as presented in the theoretical framework section **4.3**. The data were collected in three different municipalities, Fræna, Rauma and Vestnes, basically between 13th of January to 9th of march 2016, resulting 8 weeks of collection. The data is collected by the employees themselves, either with Yast or written on schedules. Yast is an app downloaded at the employees' cell phones, that allowed them to record type of profession and activity performed, with related time data. They push an activity when starting, and stop it when it ends. For instance, when start driving, they push the activity driving, and when they stop, they stop the activity and start a new activity, for instance homecare. The records proceeding in to a data system, and into excel. The same procedure is done with the schedules, only in this case it`s written. The written schedules are further inserted into excel before they were handed over to the writer, which merged the data with the records from Yast, and corrected them for errors and extreme values. Total number of data collected to the research were 50334.

There were also private talks with the leaders in the three different municipalities after analyzing the above mentioned primary data. They were asked open questions, where the aim was to find information that could explain the differences between the municipalities. However, important to mention, is that the information received from each of the participants regard to supplementary information, is various, in some cases absent, which make it challenging to compare all of them in some of the activities. The question asked the municipalities could be found in the appendix.

5.2.2 Secondary data in the research

Secondary data used in the research are obtained from the municipalities' data system and schedules, and have been submitted from the municipalities to the writer. This is information as number of recipients, number of employees, hours of resolution, and information about number of employees on the different shifts. Some of this information are used in the discussion part of the article. Important to mention in this case as well, is that the information received from each of the participants vary, and are in some cases absent.

The question asked the municipalities are found in the appendix.

5.3 Data analysis

To read and compare the collected data, there would be a need to find values that makes it possible to read and compare the data. This could be done by descriptive statistics, percentage of time, as well as inferential statistics. The formulas with description in this section is derived from Løvås (2012). The used formulas are elaborated in **5.3.1**, and the used test within inferential statistics, are elaborated in section **5.3.2.**

5.3.1 Descriptive statistics

Descriptive statistics is basic statistics, consisting of different formulas, which organize and present the information found in the data analyzed. In this thesis, statistics is used to present the results for each of the municipalities, as well as to compare them.

5.3.1.1 Central tendency

Central tendency is a range of different measurements that describe the middle information in the data analyzed, consisting of measures as mean, median, mode.

The **mean** value, also expressed as μ, is the most common measure for central tendency, and could be expressed by the formula,

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} xi$$

means that the mean is equal to the sum of the whole data, divided by *n* number of observations. The mean value is suitable to tell something about the total size of the sample and the population, especially when the data is normal. However, even though the mean is the most common measure, in not all cases, it is representable to describe the middle information. This applies to cases where the data are affected by extreme values, either small or large, where we could risk that the mean is either overestimated or underestimated. In such cases the median is a more appropriate value.

The **median** is a measure that is stable to extreme observations in the dataset. The median is centered in the middle of the dataset, if the data are sorted. If the size of the data is an odd number, the median would the number in the middle of the data. If the number of data are even numbered, the median is defined as the number between the two middle values.

The **mode** is defined as the most frequent observed value in the data, and would in a histogram, be the data that has the highest column in the histogram.

5.3.1.2   Statistical dispersion

Statistical dispersion could be interpreted as the opposite of central tendency, and is measures that tells something about the spread in data. Variance, standard deviation, range, min and max value is common measures.

The **variance,** also expressed by σ^2, and in general describe in which degree the data tends to vary. The variance could be found by the formula,

$$S^2 = \frac{1}{n-1}\sum_{i=1}^{n}(xi - \bar{x})^2$$

The **standard deviation**, also expressed by σ, is a measure that describe in which degree the data tends to deviate from the mean value, and is a typical measure to apply on samples to find the deviation from the mean. The standard deviation could be found to take the square root of the variance, and are expressed by the formula:

$$S = \sqrt{S^2}$$

5.3.1.3 Percentage

When you have several sets of data you would like to compare, you would need to make them comparable, which in all cases are not representative by using the exact numbers derived from the samples. As in this thesis, the data collected comes from three different municipalities, and there are of relevance to compare them to be able to find the equalities, as well as the inequalities. However, they might differ in number of employees, as well as number of recipients, such that using the exact numbers, would not be directly comparable. This could be done by take the percentage of time spent on each of the different activities. This could also be done if comparing different groups within the different samples, for instance the different professions. If we have n different activities, and the time spent in one activity is expressed by t_n, and the total time spent in all activities is expressed by t, this is could be expressed with the formula:

$$t_n = \frac{t_n}{t} * 100,$$

means that the percentage of time spent on activity n, equals to the sum of time spent on activity n divided by the sum of time spent in all activities.

5.3.1.4 Distribution measures

Applying statistical tests there would be of relevance to tell something about the distribution of the data, since the different tests has different assumptions accord to distribution. Skewness and kurtosis are measures, which together with the other statistics, define the distribution of the data, and tell what kind of tests are appropriate to apply.

Skewness is a measure that describe the asymmetry in the data. A perfectly normally distributed data has a skewness value in 0, means that the data are perfectly asymmetric and has a form like a bell. Normally, data used in empirical studies are not perfectly distributed, and the skewness are used to tell something about the asymmetry of the data. The skewness could be found by the formula:

$$Skewness \approx \frac{1}{n}\sum_{n=1}^{n}\left(\frac{x - \bar{x}}{s}\right)^3$$

A positive value in skewness, indicates that the distribution is skewed to the left, and that the mass of the distribution is centered to the left. Negatively skew value, indicates that the distribution is skewed to the right, and that the mass of the distribution is centered to the right.

The **kurtosis**, is a measure that tell something about how the distribution is spread between min and max value, and how "sharp" the data look like. In a normal distribution, the kurtosis is equal to 0. A higher the value on the kurtosis, the sharper the distribution would look if considering the data in a histogram, and if the kurtosis has a negative value, the distribution would be more complementary when considering the histogram. The formula of the kurtosis is written as:

$$Kurtosis \approx \frac{1}{n} \sum_{i=0}^{n} \left(\frac{x_i - \overline{x}}{s} \right)^4 - 3$$

5.3.2 Inferential statistics

Statistical inference is to find information about a large group of objects based on a small sample of the population, and could been used to find differences between different samples. The different tests to use have different types of assumptions. While some assume that the data are normally distributed, some of them assume that the data should have equal homogeneity of variance. Since the data did not fulfill either of the assumptions, it was chosen to standardize the data. After standardized the data, it was tested with Welsh and Brown-Forsythe.

Welsh calculates the Welsh statistic, and Brown-Forsythe calculates the Brown-Forsythe statistics, where both of them test of the equality for group means. The statistic is preferable to F statistic when the assumption of equal variances do not hold (IBM Knowledge Center 2016). If the test is significant we could reject the null hypothesis, and assume that the samples are significantly different from each other. Based om this, there should be further choose a appropriate test

Post Hoc pairwise multiple comparisons could detect where the differences are. When equal variances are not assumed, there should be choose a test, which is suitable to the

data. The Games-Howell test is suitable when the variances are unequal (IBM Knowledge Center 2016), as well as when the samples has different sizes.

When compare three samples, the null hypothesis would be,

$$H_{0:} \mu_1 = \mu_2 = \mu_3$$

which is tested against an H_1 hypothesis. These could have the form,

$$H_{1:} \mu_1 \neq \mu_2 \neq \mu_3$$

If the p-value is significant $p < 0.05$, we could say that the samples are significantly different from each other and reject the null hypothesis. The benefit with Games Howell tests, as well as other post-hoc tests, are a pairwise comparison of the different samples in the test, which make us able to see the where the differences are.

5.4 Validity and limitations

There are some researchers that argue of how valid a case study approach is as a method. One of them concerns the ability to generalize the results. (Yin 2014). However, this research contains three different entities, which should make it possible to compare them in pattern in some of the activities. There are also tests which has been commonly used to find the quality in case studies. These tests regard to construct validity, internal validity, external validity and reliability (Yin 2014). In this study, the level of confidence can be increased by the test of construct validity, which could be found in some of the activities measured in earlier published research.

There are also some limitations regard to the data collected. As mentioned and quantitative study, has the weakness that it gives relatively superficially information. Since the data used in the research are measure on the time spent on the different activities, there are also some limitations, regard to the degree of care, frequency of the visits to each recipient, driving routes etc. Good and adequate data about the recipients' degree of care, should contain diagnosis, hours of resolution and frequency of visits pr. recipient. Since homecare

services has a greater range of differences regard to the cycle of the disease than for instance an institution, there should preferably also been done observations by the researcher as well, or a close cooperation regard to those who serve the recipients'.

There has either been collected data regard to driving routes. This would imply that writer would have collected data about the driving routes, for instance through GPS, both regard to distance and location of each recipient. The discussion in this research would then be concerned about the total land area of each municipality, and not driving routes.

Since the data are collected by employees themselves, makes it difficult at this point to find an exact response rate at this point. To find a response rate, there would be a need to go into each employees' schedule, and subtracting the total time recorded. Regard to the time schedule to write a master thesis, this has not been done, but preferably should be.

Some of the municipalities did also suggests that if the project should be done several times, the period should be shorter, for instance 4 or 5 weeks. Since the employees are an important part of the data collection, there has been concerns about the validity of the data during the last weeks, about that the employees might be tired of recording.

There might also be some concerns about validity regard to that some of the respondents have registered manually, while some has recorded electronically. This especially regards to the parts in the production process that are efficient, since a manually registration not is able to consider seconds, but only minutes. This might lead to that some of the values are overestimated. However, the personal talks have served as a confirmation that these values are correct. At least the manually registered contained less errors than the records collected by Yast.

5.5 Contribution to the literature

All the research questions represent a contribution to the literature as presented below:

RQ1   Identifying the main cost drivers regard to the distribution of time spent on the different activities.

- Overall consumption of time in 25 different activities performed within homecare services
- Defining the main cost drivers within homecare services
- The use of Pareto Principle within homecare services

RQ2   Investigate the potential differences regard time spent on activities across the different municipalities

- Pattern matching of the level of activity of three different municipalities, between three different categories of activities in the production
- Potential differences in consumption of time spent, regard to the use of different documentation systems
- Use of inferential statistics to find differences between the municipalities

6.0 Results and discussion

Table 10-1 represents the total number of data collected, as well as data removed. The column upper right represents the total number of data collected, and the column in the lower right represents the total number of remaining data analysed in the research.

Table 6-1 Total number of data collected

	Fræna		Rauma		Vestnes		
	Electronical	Manually	Electronical	Manually	Electronical	Manually	Total
Total	16356,00	403	1048	13308	15267,00	3952	50334,00
Week 1 & 8	4684,00	121		3899	3629,00	836	13169,00
Night	787,00			1000	703,00	32	2522,00
Weekends	2876,00	125		2243	2873,00	1239	9356,00
Errors	253,00		8		229,00		490,00
Leader	56,00					10	66,00
Empty				6			6,00
Remaining	7857,00		7200		9668,00		24725,00

From Fræna there were 16759, 16356 electronically recorded and 403 manually registered. Data from first and last week were first removed, consisted of 4805. There are assumed, that in the first week of collection, the employees still spend time to get used to the app, and that the data because of this might give wrong predictions, and that in the last week they might be somewhat tired. Data from week 2-7 of collection was therefore retained to analyse and assumed to give the most accurate picture. Since there is a difference in the level of activity from day/evening and night, between a day in the week and the weekends, these were also removed, consisting of 787 from nightshifts and 3001 from the weekends.

The dataset did also contain some errors. The errors mainly consisted of registrations where workers obviously pushed wrong activity, immediately turned off and further recording the right activity. These records had the value of 0, and were removed. There were also some errors where the same activity was registered several times. The municipalities themselves, reported that several of the employees complained about the app, and reported the same weakness, that obviously were found in the data. To get a correct picture of the time spent such errors were also removed. Total number of errors were 253. Since the leader in Rauma did not register the time, the records from the leader

position in Fræna were also removed, which consisted of 56. Remaining data to analyse in Fræna were 7857.

In Rauma the total number of registrations and records were 14356, were only 1048 recorded by Yast. The manually registered data were subsequently registered into excel, and after this taken over by the writer which cleared and cleaned the data from errors by the same procedure as with Fræna. Data removed from week 1 and 8 were 3899, 2243 from weekends, 1000 from nightshifts, and 8 errors of the same type as with Fræna. In addition to this, there were removed 6 registrations that did not contain either date, time or profession. There were also some of the registrations that did not contained profession and time. To be included in the overall analysis, they were noted with **not specified.** Total remaining data to analyse were 7200. Because of the manual registering, there were more difficult in this case to distinguish between nightshift and dayshift. This because the written schedules did not contain as good information as the app. However, registrations between 06:00AM to 08:00AM, 22:00BM to 23:00BM was gone through to carefully in order to assess whether it belongs to day or night.

The total number of records and registrations from Vestnes were 19219, 15267 records and 3952 registrations. Same procedure was followed in this data. From week 1 and 8, there were removed 4465 records, 735 from nightshifts, 4112 from the weekends, and 10 from the leader. There were also removed some errors as described with Fræna, consisted of 229. Remaining data to analyse were 9668. From the written schedules, there was also some missing information about profession in this data as well. To be included in the overall analysis, they were noted with **not specified.**

There were also some extreme values in the datasets. In some cases, they could be tracked, and in some cases not. The values that could be tracked, were in cases where an activity obviously were not tuned of before starting a new activity started. Then the end time on the activity were changed in order to fit the beginning of the next activity. In this way it was prevented to estimating too many values. There were also values that not were able to track. To be included in the analysis, these values were replaced by the mean of the same activity to the remaining data. There were also take into account type of profession, since the mean between the different professions were somewhat different. There were 140 missing values in Fræna, 97 missing values in Rauma, and 66 missing values in Vestnes.

The remaining data to analyse in the research were 24 725. The total number of data in each of the municipalities, distributed pr. profession are pictured in table 5-2.

Table 6-2 Total number of data analysed, pr. profession

	Fræna		Rauma		Vestnes	
Profession	N	Minutes	N	Minutes	N	Minutes
Assistant	862	29218,92	842	26172,5	912	15614
Health Care Worker	3940	57162,25	3007	46302,7	5417	93770
Student	72	1332,04	0	0	0	0
Nurse	2983	61705,89	3111	56068,2	3261	62160
Not Specified	0	0	240	5370,1	78	1278
Total	**7857**	**149419,1**	**7200**	**133913,5**	**9668**	**172822**

Before running the analysis, the different activities were subdivided into the 8 different categories as elaborated in the theoretical framework. The different data were given a number to present what hour the activity starts, for instance 6 to 06:37, 7 to 07:21 etc. They were also given a number to present dayshift and shift in the evening, where a dayshift present time between 06-15, and a shift in the evening present time between 15-23.

Fræna and Rauma provided some information about number of recipients', hour of resolution and number of employees. Number of recipients are 213 in Fræna and 288 in Rauma, where Fræna has 3047.12 hours of resolution and Rauma has 6923 hours of resolution during the total period. According to number of employees Fræna has 57 and Rauma has 65. They did also provided information about number of lists a day. Fræna has 12 different lists during a dayshift, and 5 in the evening, while Rauma has 16 in a dayshift and 8 in the evening. Vestnes has 12 lists a day and 6 in the evening, with 175 number of recipients.

Since their information received from the municipalities is varying, and in some cases inadequate, there were not possible to do an extensive analysis, for instance regression. Because of this, most of the numbers in the thesis are presented as the percentage of the total time spent, in addition to descriptive statistics. Inferential statistics has also been applied, using post hoc Games Howell test to compare the different samples.

6.1 Overall consumption of time

Table 6-3 gives the overall picture, of the consumption of time spent in the different categories and activities, in Fræna, Rauma and Vestnes.

Table 6-3 Overall consumption of time

	Fræna	Rauma	Vestnes
Administration	**17,90 %**	**10,51 %**	**8,81 %**
Activities to other entities	0,24 %	0,22 %	0,39 %
Administrative tasks (including carwash)	12,92 %	5,96 %	4,62 %
Case management	0,51 %	0,09 %	0,01 %
Contact with management office	0,04 %	0,00 %	0,01 %
Meetings	1,89 %	1,19 %	0,31 %
Meetings related to defined user	0,44 %	0,18 %	1,26 %
Training of personnel	1,85 %	2,87 %	2,21 %
Break	**6,07 %**	**5,25 %**	**5,04 %**
Break	6,07 %	5,25 %	5,04 %
Direct patient care	**39,28 %**	**45,12 %**	**42,43 %**
Ergo- and physioservices	0,16 %	0,02 %	0,27 %
Homecare	25,15 %	31,98 %	38,98 %
Practical Assistance	13,97 %	13,12 %	3,18 %
Potential Disruprions	**0,16 %**	**0,75 %**	**1,24 %**
Incoming phone calls related to define user	0,07 %	0,40 %	0,80 %
Security alarms administration/documentation	0,00 %	0,18 %	0,04 %
Security alarms, include driving	0,08 %	0,17 %	0,40 %
Documentation/communication	**6,89 %**	**12,94 %**	**17,94 %**
Documentation	1,74 %	4,35 %	5,60 %
Internal communication	0,46 %	1,31 %	0,83 %
Report	4,70 %	7,29 %	11,52 %
Driving and walking	**21,47 %**	**21,17 %**	**19,09 %**
Driving and walking	20,31 %	20,47 %	19,07 %
Food delivery, driving only	1,16 %	0,70 %	0,02 %
Indirect patient care	**4,25 %**	**4,20 %**	**4,78 %**
Dosage/multidose	3,52 %	3,52 %	3,20 %
Grocery shopping without end user	0,25 %	0,21 %	0,26 %
Laboratory visit	0,07 %	0,06 %	0,21 %
Other activities concerned defined user	0,27 %	0,29 %	0,56 %
Pharmacy visit without end user	0,13 %	0,12 %	0,55 %
Preparedness	**3,99 %**	**0,06 %**	**0,67 %**
Preparedness	3,99 %	0,06 %	0,67 %
Totalsum	**100,00 %**	**100,00 %**	**100,00 %**

The results show that in all three municipalities, 3 of the categories accounts for a huge proportion of time spent, while the rest of the activities count for less. Thee of the categories account for around 80% of their time spent, in about 37,5% of the categories. As remember from section **4.1.1** and the Pareto principle, 80% of the organizations total costs, wold often be represented of a minor of the organizations activities, but that the percentage often could distinguish between the different organizations.

In Fræna, most time are spent on direct patient care, driving and walking, and administration, which makes out 78.65% of their total time spent. In Rauma they are spending most of their time in direct patient care, driving and walking, and documentation/report, that becomes 79.24% of their total time spent. This is the same in

Vestnes, where the same categories account for 79.46% of their total time spent. The categories with percentage is pictured in the table 6-4.

Table 6-4 The Pareto Principle

	Cost drivers	Percentage of total costs	Percentage of all categories
Fræna	Direct Patient Care	39,28 %	
	Driving	21,47 %	**37,5%**
	Administration	17,90 %	
Total		**78,65 %**	
Rauma	Direct Patient Care	45,12 %	
	Driving	21,17 %	**37.5%**
	Documentation/Report	12,94 %	
Total		**79,24 %**	
Vestnes	Direct Patient Care	42,43 %	
	Driving	19,09 %	**37.5%**
	Documentation/Report	17,94 %	
Total		**79,46 %**	

These costs, are represented of about 37.5% of the organizations categories. Since the theoretical disciplines about cost drivers, did all have in common that they focus on the activities that accounts for the organizations highest share of costs, we might define them as main cost drivers. Behalf on this information, Direct patient care, driving and walking, documentation/report are further elaborated.

6.2 Direct Patient Care

As elaborated in the theoretical framework, direct patient care activities are the activities where the health care service are produced through an interaction between the provider, and the recipient. Because of this, direct patient care activities are the activities in the production, where the recipient most likely look for indicators that would tell them something about quality the delivered, and though the most essential part from the recipients' view.

In table 8-1 total consumption of time in direct patient care activities represents 39.28% in Fræna, 45.12% in Rauma, and 42.43% in Vestnes, and one of the main cost driver in all

three municipalities. Figure 6-1 represents the percentage of total time spent in direct patient care activities pr. hour.

Figure 6-1 Total consumption of direct patient care, pr. hour
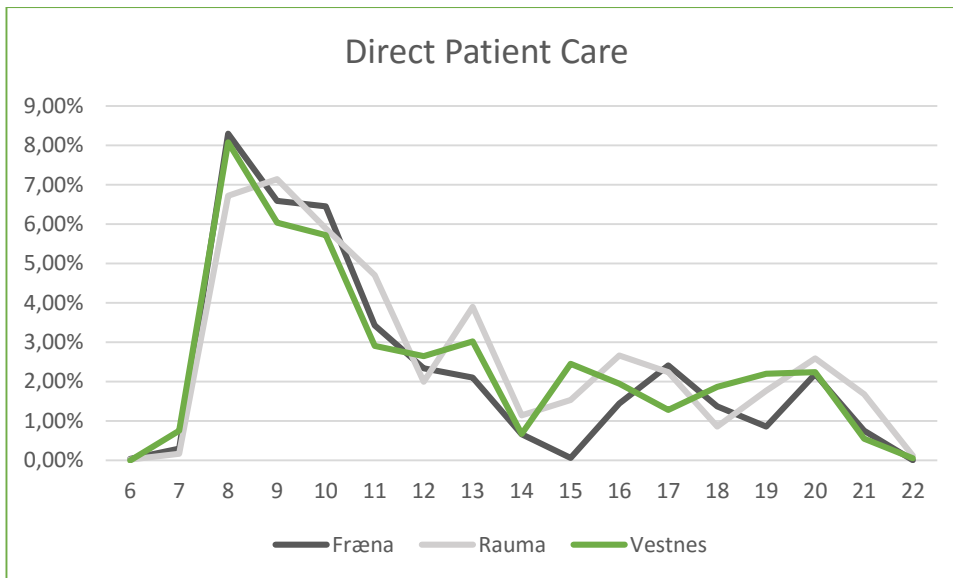
The pattern in activity is similar in all three municipalities. A dayshift usually starts between 07:00-07:30, where the day starts with a peak around 8, and then decrease towards 14 and 15 when they have a shift. The hours of direct patient care do also increase somewhat after 15, towards 19 when the employees have a break. The same thing repeats until the shift ends between 22-23. The table do also indicate that there are some differences in activity between dayshift and nightshift, where they in the shift in the evening, have less recipients, also confirmed by the municipalities. Fræna has 12 different lists a day, and 5 in the evening. Rauma has 16 in a dayshift and 8 in the evening, and Vestnes has 12 lists a day and 6 in the evening. Less demand of homecare services in the evenings, as well as less employees.

Direct patient care includes activities as homecare, ergo physio services and practical assistance. However, the municipalities organize somewhat different. In Fræna practical assistance, as for instance cleaning house, is a part of homecare services, while in Rauma and Vestnes this function as an own department and are not a part of the data sample. To the data, this means that the amount of practical assistance in Fræna, there is not possible to distinguish between assignments as cleaning houses and more easy practical assistance as for instance facilitating food, make up the beds etc., where the last mentioned most

likely represents practical assistance in Vestnes and Rauma. A better approach to compare them is to take a closer look at homecare activities in separate. Table 6-5 shows descriptive statistics in homecare.

Table 6-5 Descriptive statistics homecare

Statistics

		H1	H2	H3
N	Valid	2162	2476	3158
	Missing	7442	7128	6446
Mean		16,7085	17,2952	21,3304
Median		12,0150	14,0000	12,6600
Mode		6,00	10,00	10,00
Std. Deviation		15,96686	14,73663	30,32888
Variance		254,941	217,168	919,841
Skewness		2,484	3,250	5,678
Std. Error of Skewness		,053	,049	,044
Kurtosis		9,110	21,072	49,988
Std. Error of Kurtosis		,105	,098	,087
Minimum		,01	,03	,01
Maximum		127,83	195,00	418,60
Sum		36123,86	42822,89	67361,50

The mean values suggest that Fræna spend 16,7 minutes pr. visit of homecare, Rauma spend 17.3 minutes pr. visit, and Vestnes spend 21.3 minutes pr. visit of homecare. The median is values is 12, 14, and 12.6, where the greatest difference in mean and median value is in Vestnes. The skewness is positive in all three municipalities with 2.5 in Fræna, 3.3 in Rauma and 5.7 in Vestnes. The kurtosis in all three municipalities, are positive as well, with a value in 9.1 in Fræna, 21 in Rauma, and almost 50 in Vestnes. The standard deviation is 16 in Fræna, 14.7 in and 30.3 in Vestnes. The numbers indicate that the distributions are not normal. To find if there are any differences between the municipalities in time spent pr. visit, there could be of relevance of multiple comparisons between the different variables. Since the data are not normal, they were standardized before running the testes. The distribution measures after standardizing the data are shown in the appendix. Since the assumptions for some of the tests in addition to normality are homogeneity of variance, there were done a test in welsh and Brown-Forsythe test of equality of means, to find if they differ. The results are shown in table 6-6.

Table 6-6 Welsh and Brown-Forsythe, homecare

Robust Tests of Equality of Means

HOME

	Statistic[a]	df1	df2	Sig.
Welch	13,292	2	5019,342	,000
Brown-Forsythe	10,455	2	7459,690	,000

a. Asymptotically F distributed.

.

The tests showed that the samples were significantly different from each other. Behalf on this information there was decided to do a Games-Howell test. The results from the Games Howell test are shown in table 6-7.

Table 6-7 Games-Howell test, homecare

Multiple Comparisons

Dependent Variable: HOME

Games-Howell

(I) Municipality	(J) Municipality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1,00	2,00	-,05909*	,01180	,000	-,0868	-,0314
	3,00	-,02293	,01340	,201	-,0543	,0085
2,00	1,00	,05909*	,01180	,000	,0314	,0868
	3,00	,03616*	,01206	,008	,0079	,0644
3,00	1,00	,02293	,01340	,201	-,0085	,0543
	2,00	-,03616*	,01206	,008	-,0644	-,0079

*. The mean difference is significant at the 0.05 level.

1, 2 and 3 represent Fræna, Rauma and Vestnes. The results show a significant p-value between Fræna and Rauma, and Rauma and Vestnes, but a not significant p-value between Vestnes and Fræna and, which indicates that Rauma differs from Fræna and Vestnes.

Comparing the statistics from the municipalities, shows that even though Rauma has a lower mean value, they have a higher median, compared to Vestnes that has a higher mean value, but less median. Vestnes do also have a higher value in their skewness and kurtosis, indicates that they might have more extreme values in their data, which was also observed. Fræna has somewhat lower less mean value and less median, and a lower value at their kurtosis, indicates that they might have, in an overall view, a lower mean minutes pr. visit. This might also be reflected in the number of recipients and hours of resolutions provided

by Fræna and Rauma, where Rauma have more hours of resolutions pr. recipient than Fræna. Fræna has provided information that tells they have 3047.12 hours of resolution during the period and 230 number of recipients. Rauma in the other hand has twice as much hours of resolution than Fræna, in 6923 during the period but 288 recipients, which results in a far higher mean value pr. recipient in Rauma, than in Fræna, and might give support to the results. In Vestnes, the hours of resolution are not received, since they were not able to bring it out from their system.

The overall results, from the descriptive statistics, Games-Howell test, and hours of resolution, might indicate that Rauma, in total, has somewhat higher value pr. visit than Fræna and Vestnes. Even though Vestnes as well had some large values, they do, in an overall basis have smaller values than Rauma. Rauma, were asked about the degree of care, where the answer was that they do have recipients with a high degree of care, but that they do also have a large amount of recipients that has a need of frequent visits, as for instance recipients with dementia. The reason they differ from Fræna and Vestnes, could be many. For instance, they might have recipients that has chronical diseases, which requires an extensive care.

The descriptive statistics might also indicate that that Vestnes has the largest range in differences in time spent pr. visit. Vestnes did have some large records that lasts almost the entire shift. In these values the shift started with a report, further homecare, and then ended with a report. Since there is no information about the recipients' disease or condition, Vestnes was asked about the degree of care as well, and said that they have a high amount of recipients requiring extensive care. But again, is difficult to interpret, since there is no information about the recipients, and either hours of resolution. However, the large values could indicate that they have some recipients with the need of extensive care, but it could also be temporary situations where they have recipients that has a higher need in the degree of care during a period. For instance, from the theoretical framework in section **4.1,** there were mentioned that the health care services in a highly degree are heterogeneous. Not only because of who and where the service is executed, but also because health care services could vary tremendously between the periods, even with the same recipients. To some of the recipients the cycle of the disease is in a way that they have periods with a larger need of care, followed with periods with less need of care, which would cause differences between the periods, even with the same recipient. They could also have

recipients which is temporary, such as recipients who have recently been hospitalized, and that need a large extent of care only during a period. Or they could have had recipients' that has been terminal, which could lead to that they need health care professions around them continuously.

There has been revealed that a main cost driver within all three municipalities is direct patient care activities. Even though it`s a cost driver to all of them, they could have differences regard to how they organize their human resources and job design across direct patientcare activities, which was ergo and physio services, homecare and practical assistance. Table 6-8, represents the same percentage of total time spent on direct patient care as table 6-3 (column to the right), but in addition contains the total time spent on direct patient care pr. profession. These values are reached by dividing total amount of minutes spent on direct patient care activity pr. profession, by the total amount of minutes pr. profession. The table indicates that they have a similar pattern regard to the total percentage of time spent in Direct patient care activities, regard to profession. Further, they are somewhat different regard to how the professions spend their time across the different activities within direct patient care; ergo- and physio, homecare and practical assistance.

Table 6-8 Total time spent in direct patient care activities, pr. profession

	Assistant	Health care worker	Nurse	Student	Not specified	Total
Fræna	**75,57 %**	**38,76 %**	**22,55 %**	**40,69 %**	-	**39,28 %**
Ergo- and physio services	0,00 %	0,42 %	0,00 %	0,00 %	-	0,16 %
Homecare	9,77 %	35,52 %	22,51 %	39,68 %	-	25,15 %
Practical Assistance	65,80 %	2,83 %	0,04 %	1,01 %	-	13,97 %
Rauma	**70,80 %**	**42,09 %**	**36,88 %**	-	**32,22 %**	**45,12 %**
Ergo- and physio services	0,11 %	0,00 %	0,00 %	-	0,00 %	0,02 %
Homecare	16,67 %	36,75 %	36,00 %	-	23,44 %	31,98 %
Practical Assistance	54,02 %	5,34 %	0,88 %	-	8,77 %	13,12 %
Vestnes	**57,36 %**	**48,05 %**	**30,09 %**	-	**47,34 %**	**42,43 %**
Ergo- and physio services	0,00 %	0,10 %	0,60 %	-	0,00 %	0,27 %
Homecare	53,27 %	43,42 %	28,52 %	-	47,34 %	38,98 %
Practical Assistance	4,10 %	4,54 %	0,97 %	-	0,00 %	3,18 %

The table shows that the employees with most specialised skills, nurses, spend least time with the recipients, with a percentage of 22.5 of their total time spent in Fræna, a percentage of 36.9 in Rauma, and a percentage of 30.9 in Vestnes. This is the opposite of

the assistants, which spend most of their time in Direct Patient Care, with a percent of 75.8 in Fræna, a percent of 70.8 in Rauma, and a percent of 57.8 in Vestnes. The table also indicates that assistants spend most time in practical assistance in Rauma and Fræna, and that skilled workers, as health care workers and nurses, spend most of their time in homecare activities. In Vestnes, this pattern is somewhat different where the assistants as well are spending a greater amount of time in homecare activities as well.

The demand and cost conditions elaborated in the background of the thesis, indicates that the future demand of homecare services is rising, as well as the complexity in care given. This is a consequence of increased ageing, as well as the implementation of the Coordination reform. With an increased pressure and an increased complexity of care given, there would most likely be a greater need of resources in general, as well as skilled workers. The reason that nurses spend less time among the recipients could be many, but are most likely explained by that the nurses are tied up in other activities, as medical handling, administration etc. However, it`s an important issue to enlighten, and it should be a goal to increase the proportion of time spent in direct patient care activities, not only to nurses, but in other professions as well.

The municipalities are somewhat different in how the different professions spend their time across the different activities within direct patient care. In Fræna assistants are dedicated to practical assistance, while health care workers and nurses spend most of their time in homecare activities. This is also similar to Rauma. In Vestnes they have a less amount of practical assistance, and assistants and health care workers spend more time in homecare activities than Rauma and Fræna. In the case of Fræna, there are known that practical assistance and homecare, functions as an own unit, which might also be the explanation of the proportion spent on practical assistance. Regard to Rauma and Vestnes, where practical assistance function as an own unit, there are some differences in the proportion of time spent in practical assistance. Rauma has almost the same amount as Fræna even though practical assistance is not a part of homecare unit, where Fræna has 13.97% and Rauma has 13.5%, as could be read from the column to the right in table 6-8. Vestnes has less with only 3.2%, even though they organize them in the same way as Rauma. There is of course some uncertainty to the dataset, which means that there could be a different interpretation between the municipalities of what should be registered in practical assistance and not. If this is not the case, there could be differences in the types of

recipients, and that Rauma has recipients that has a higher need of easy practical assistance than Vestnes has. If remember the results from the Games Howell table 6-6, the descriptive statistics in table 6-5, and hours of resolution, the test indicates that Rauma differs from Fræna and Vestnes, and might has a higher value pr. homecare visit in an overall basis. It could also be that they design their production processes somewhat different relate to easy practical assistance, as for instance that in Vestnes, more of the practical assistance are been taken care of by those who are employed at the unit of practical assistance.

6.3 Driving and walking

Driving and walking were also one of the main cost drivers to all three municipalities, and are conducted in level 4 in figure 4-2, Homecare production process. Table 6-3 give support to results in earlier research. Holm and Angelsen (2014) concluded that travelling time in homecare services often are an underestimated part in daily planned schedules, and represents between 18% to 26% of the working time, in municipalities with a land area on $405.58km^2$ and $698.22km^2$. From the results in this research Vestnes spend 19.09% on their time in driving and walking, Rauma 21.17%, and Fræna 21.23%, which is between the percentage on time spent on driving that Holm and Angelsen (2014) suggested.

The land area in the municipalities in this research vary from $352km^2$ to $1502km^2$, where Rauma is the largest municipality, and Vestnes is the smallest. Since there exist no further information about driving routes and zones, the size of land area would be used in the discussion. Figure 6-2 represents the percentage of total time spent in driving pr. hour during a day.

Figure 6-2 Percentage of total time spent in driving and walking, pr. hour
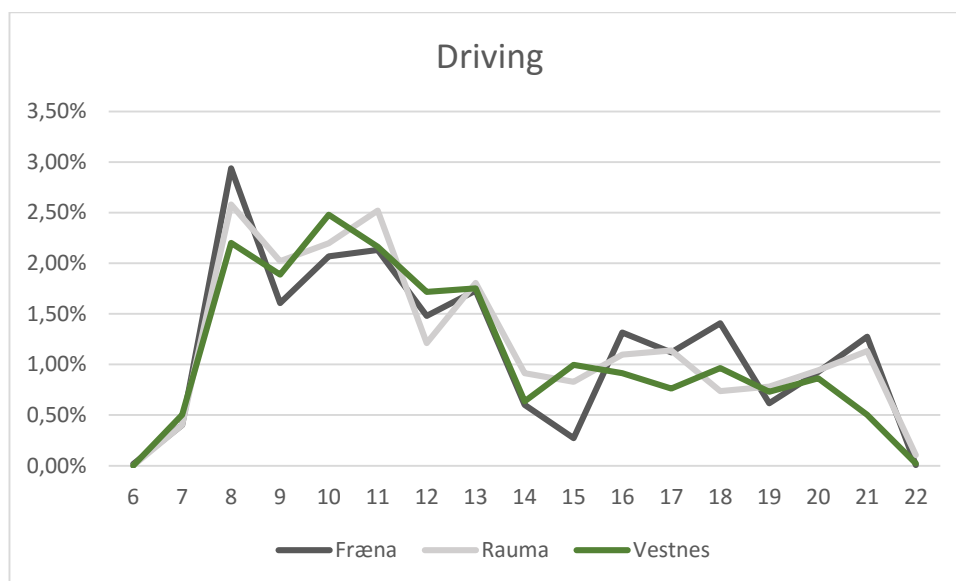
As the same as figure 6-1 in direct patient care, figure 6-2 shows that the level of activity are higher during the hours in a day shift than a shift in the evening, with a peak around 8, decreases towards the shift between 14-15, and is relative stable towards 22. The difference between the graph in figure 6-1 and 6-2 is that the percentage of time spent in direct patient care activities are decreasing by 4-5% from dayshift to a shift in the evening, the proportion of time spent in driving, only decrease with around 1,5%. This applies to all three municipalities.

Since proportion of time spent in driving measured in percent is vague, there could be of relevance to see the mean number of hours spent on driving during a dayshift and during a shift in the evening, which is represented in table 6-9.

Table 6-9 Mean hours a day in driving and walking, dayshift vs. shift in the evening

	Day	Evening
Fræna	11,7	6,1
Rauma	10,7	5,0
Vestnes	12,8	5,5

All three municipalities spend more than twice as many hours in driving during a dayshift, then during a shift in the evening. This could have several reasons. The total area covered by a homecare entity, are usually the entire municipality. The total area is divided into different zones, and the different zones are divided into different worklists, where all three

municipalities have more worklists during a day, than during an evening. Because of more worklists and employees during a day, they would then use several times more in driving back and forth within a different zone. In a shift in the evening, they have less worklists, still covering the same area, but since they are less employees, they do not spend that much time in driving back and forth to the different zones. The overall consequence would though be more driving in daytime than in the evening, even if they cover a similar size of area.

The reason for less worklists in the evening could be explained by several things, as for instance the recipients' needs, or the employees' wages. Some of the recipients has a need to have visits during both day and the evening, while some of the recipients only has the need to visit during the day. This would cause differences in hours of resolution between day and evening. However, some of the visits, as delivering medicine or other equipment, are often activities performed during a dayshift. This might be explained by differences in wages, during day and during evening. In Norway, employees have strong rights regard to wages, and has more after 17. This would make it very expensive to similar level of activity during a shift in the evening, as during a shift in the day.

Since the municipalities differs somewhat in land area, there could also be interesting to compare the municipalities in time spent pr. drive. Table 6-10, presents the descriptive statistics in driving and walking.

Table 6-10 Descriptive statistics, driving and walking

Statistics

		Frana	Rauma	Vestnes
N	Valid	2864	3003	3737
	Missing	6740	6601	5867
Mean		10,8077	9,4424	8,8283
Median		7,1600	5,0000	5,7000
Mode		1,00	5,00	2,00
Std. Deviation		10,91167	10,08925	9,94534
Variance		119,065	101,793	98,910
Skewness		2,208	2,701	2,971
Std. Error of Skewness		,046	,045	,040
Kurtosis		6,809	10,022	13,727
Std. Error of Kurtosis		,091	,089	,080
Minimum		,01	,05	,01
Maximum		87,15	90,00	96,36
Sum		30953,22	28355,49	32991,25

The municipalities are relatively similar both mean and median, as well as skewness. They differ somewhat in kurtosis, where Fræna has the lowest value in 6.8 and Vestnes has the highest in 13.7. Since the data are not normally distributed in this case as well, they were standardized, before taking a Welch and Brown-Forsythe tests. The values after standardizing the data, are shown in the appendix. The results from the test are shown in table 6-11.

Table 6-11 Welsh and Brown-Forsythe, Driving and walking

Robust Tests of Equality of Means

DRIVE

	Statistic[a]	df1	df2	Sig.
Welch	47,526	2	6262,320	,000
Brown-Forsythe	52,990	2	9284,253	,000

a. Asymptotically F distributed.

The result from the test shows that the samples are significantly unequal to each other, such that there were decided to do a Games-Howell test in this case as well. The results from the Games Howell test are shown in table 6-12.

Table 6-12 Games-Howell test, driving and walking

Multiple Comparisons

Dependent Variable: DRIVE

Games-Howell

(I) MDrive	(J) MDrive	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
1,00	2,00	,02679	,01217	,071	-,0017	,0553
	3,00	,11635[*]	,01285	,000	,0862	,1465
2,00	1,00	-,02679	,01217	,071	-,0553	,0017
	3,00	,08956[*]	,01159	,000	,0624	,1167
3,00	1,00	-,11635[*]	,01285	,000	-,1465	-,0862
	2,00	-,08956[*]	,01159	,000	-,1167	-,0624

*. The mean difference is significant at the 0.05 level.

The tests show significant differences between Fræna and Vestnes, Rauma and Vestnes, and not significant differences between Fræna and Rauma. Consider the land area, it is reasonable to think that Rauma spend more time pr. drive than the other municipalities,

which is not the case. They do not spend more time pr. drive than Fræna and Vestnes, even though Fræna is one of the smallest municipalities, they have the same amount pr. drive as Rauma. This might be explained by the number of recipients, which is 230 in Fræna, and 288 in Rauma. More recipients on the list, would do that the employees need to stop more frequent in Rauma, than in Fræna. The more recipients on the list, the less mean value in minutes pr. drive, and the less recipients on the list, the higher mean value pr. drive. However, this is only an assumption since we do not know anything about the different worklists.

The numbers indicate that Vestnes spend least time pr. drive, even though they have least number of recipients. However, they are affiliated to a complex of care homes, located close to their main office, which might have an effect of their total time spent, and results in a lower mean pr. drive and walk. However, driving and walking is an issue that need to be further elaborated in another research. Since there is no information about the worklists, driving routes and recipients' location in this case as well, there is neither possible to tell how closely the recipient are located, or how many recipients that are listed on one worklist.

The recipients need and geography could in some degree be a constraint to optimizing the driving routes. Some of the recipients' needs are more urgent then others. For instance, there are limits to how long you could allow a recipient that has a need for help to dress up in the morning to wait in a dayshift, even though the recipient is located in such a way that it`s not cost efficient in terms of driving. On the other hand, there are not necessarily limits regard to how long a recipient could wait to get delivered a week of medicine.

6.4 Documentation and communication

Table 6-3 do also indicate that there are great differences in the proportion of time the municipalities spend on documentation and report. This was some of the main cost drivers to Rauma and Vestnes. Important to mentioned is that Rauma revealed that they have been in a period where they had a higher level of activity than usual regard to documentation, since they are changing documentation system. This was often whole days. However, such values were not observed in the data.

In documentation, Fræna spend 1.74% of their total time, Rauma 4.35%, and Vestnes spend 5.6%. Table 6-13 shows descriptive statistics regard to documentation in each of the municipalities.

Table 6-13 Descriptive statistics, documentation

	Fræna	Rauma	Vestnes
Mean	3,2	26,2	24,9
Standard Error	0,2	1,2	1
Median	1,13	20	19,9
Mode	0,88	15	10
Standard Deviation	6,6	17,6	19,8
Sample Variance	43,9	309,5	390,6
Kurtosis	24,4	2,4	3,9
Skewness	4,5	1,5	1,7
Range	61,7	89	131,7
Minimum	0,01	1	0,01
Maximum	61,8	90	131,7
N	813	222	388

Both mean and median value shows that Fræna spend less amount of time in documentation in each record, than Rauma and Vestnes. The mode tells that the most frequent observed value from the data, are 0.88min in Fræna, 15min in Rauma and 10 min in Vestnes. The sum of hours spent in documentation and the number of records, tells that even though Fræna are doing their documentation more frequently, they still use only half of the time Rauma spend on documentation, and only a third of the time Vestnes spend on documentation. Figure 6-3 shows the percentage of total time spent in documentation during the hours of the day.

*Figure 6-3 Percentage of total time spent in documentation, pr. hour*
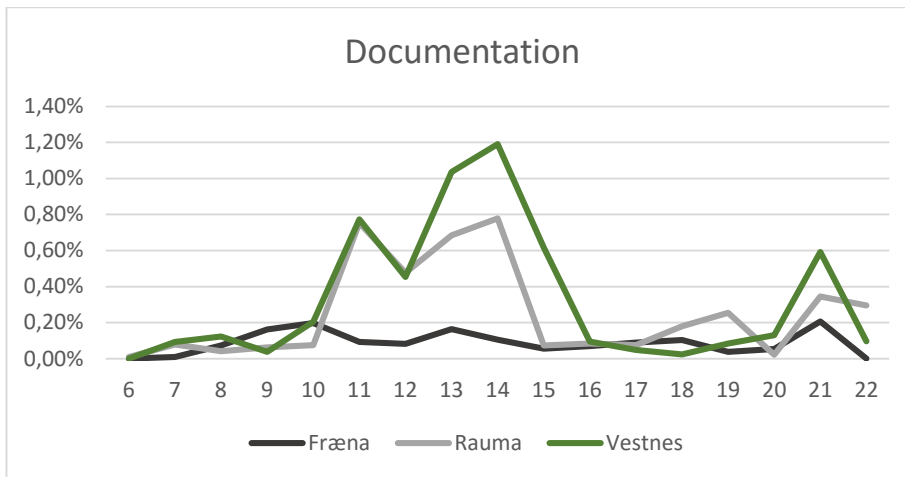
The pattern in documentation do also reflect differences. The pattern is similar between Rauma and Vestnes, but different compared with Fræna. The reason for this are most likely different types of documentation system. Fræna use an electronic documentation system, Gerica, available through the employees' cell-phones. Rauma and Vestnes write their documentation into the data system, Vestnes use Cosdoc and Rauma use Profil. Frænas documentation system Gerica allows the employees to retrieve all necessarily information about the recipients regardless where they are, as medicine lists or care plans, as well as register what activity has been performed at the worklist, right after it has been performed. The only time they need to do documentation is if there has been performed activities which not is a part of the care plan. In Vestnes and Rauma, they usually spend half an hour in documentation at the end or in the middle of the shift. This pattern is also reflected in the in the data. Comparing the municipalities, Frænas pattern reflects that they have the opportunity to do their documentation after every visit, where almost 85% of their records lasts less than 4 minutes, as also reflected in the descriptive statistics. They do also have less time spent in documentation after the shift, while Rauma and Vestnes spend a longer period during their shift to do their documentation, most frequently around 11, between 13 and 15, and between 21-22, as presented in figure 11-6. The results indicate that different types of documentation systems, lead to different types of production process design. The different patterns in the data between Fræna and Rauma, are also shown in the appendix.

The complexity among the recipients would, because of the effects from the coordination reform and ageing in population, most likely increase, and require an efficient exchange of

information both internal as well as between the different health care entities. The Norwegian information infrastructure has been described as the greatest obstacle to achieve good results from the Coordination reform (OECD 2014). It is not possible to tell if Gerica is the best option regard to this, but it`s still the best option regard to efficiency in this research, and there are most likely time savings to retrieve with an electronical system. Since the amount of information registered in systems like Gerica, there is also likely to assume that it`s a safe option on documentation system, regard to both employees as well as the recipients. The employees have better control over performed activities, and are able to more efficient retrieve required information about the recipients' when needed.

There are also great differences between the municipalities regard to the proportion of time spent on report. Fræna spend 4.7% of their total time in report, Rauma 7.29% and Vestnes spend 11.52% of their total time in report. In hours during the period this becomes 117 in Fræna with a mean value in each report in 21.5min, 162 hours in Rauma with a mean value in 34.4min, and 331 hours in Vestnes with a mean value in 30min. Figure 6-4 shows the percentage of total time spent in report pr. hour.

Figure 6-4 Percentage of total time spent in report, pr. hour
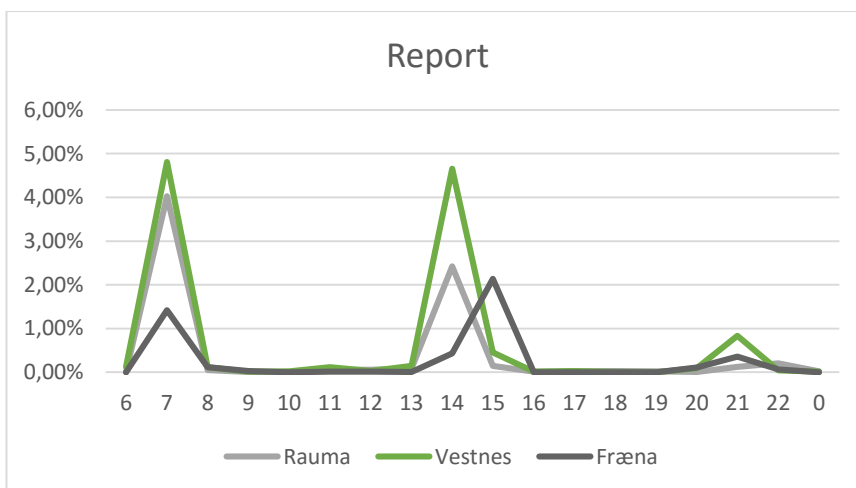
The pattern regard to time spent pr. hour, are similar between all three municipalities. The report is executed mainly between seven and eight in the morning, 14 and 16 in the middle of day, and 21 and 22 after shift in the evenings. However, the municipalities are different regard to the amount of time spent on report, where Rauma and Vestnes spend more time than Fræna. There has already been elaborated, that the municipalities use different types of documentation system. The different types of documentation system might also have an

effect in the amount of time spent on report. A poor documentation system, would most likely do that the employees has a greater need for oral messages and communication, since they not that easily access the needed information efficiently by their own. In documentation systems like Gerica, there are also registered the different worklists. At the beginning of a shift, the employees are assigned the different worklists, without the need to do writing. When the municipalities have more manual systems, they might need to spend more time writing and coordinate the worklists, compared to if the worklists already existed in the documentation system as in Gerica.

There are some variables that might have an effect in the need to do documentation, as well the need to have report. This regards to the complexity in the group of recipients. It is likely to assume, that a municipality that has a higher degree of care and complexity in their group of recipients, would also have a higher need of spending time in documentation, as well as report. For instance, a recipient with cancer, would most likely require frequent change in medicines and care plan to receive optimal care. A recipient with a chronical disease which has periods with changes in disease and condition, would require that the employees do documentation as well as oral reports, such they are able to give the recipient an adequate care. This is examples that would require that employees spend more of their time, in documenting changes, as well as they need more time in report to make sure that right information are received by colleagues. However, no such variables are assumed in this research, but would enlighten the importance of an adequate flow of information.

6.5 Administration

Table 6-3 do also indicate that there are differences between the municipalities in Administration, especially in Fræna where this is one of the main cost drivers. Administration activities do often concerns planning, and are executed in level 2, in figure 4-2 in homecare production process. The greatest proportion of time spent within this category, were on administration tasks, where Fræna spend 13.02%, Rauma spend 5.96% and Vestnes spend 4.62%. Since Fræna was the municipality that handed the most adequate information about administration, these would be further elaborated. From the other municipalities there were received to little information, that would make it possible to compare. Figure 6-5 shows the total time spent in administration activities pr. hour.

Figure 6-5 Percentage of total time spent in administration, pr. hour
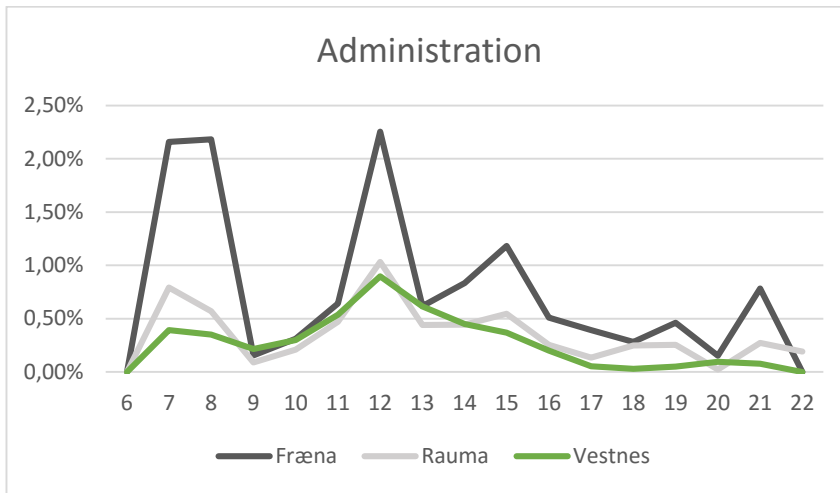
One of the leaders in Fræna revealed that the reason to the big differences from Fræna compared to Rauma and Vestnes, most likely is related to that Fræna were in a period, where a lot could affect the results regard to administration. During the period, four of the nurses, spent 1.25 days a week in administration regard to a project, about follow up recipients. Filtering out the relevant nurses, and measure the proportion of time spent of the remaining workers, the time spent on administration decreased to 9,87%, which means that the nurses involved in the project account for 7% of the administration activities in the overall view, table 6-3. However, it would still be one of their main cost drivers, since Fræna did not have that huge proportion of time spent in documentation. In addition to this project, Fræna did also have 6 students during the period, which also would have an effect on the amount spent on administration activities. Follow up students, would normally require some administrative work, by those who are supervising. Further, they did also tell that they are participating in a project related to health- and care technology.

Even though their time spent on courses and projects in Fræna seems to be high, it could be seen as an investment, and would in the long run create gains, to employees as well as recipients'. Health- and care technology has in other projects had gains, in savings as well as quality (Helsedirektoratet 2015), and good follow up of recipients' would be more critical as the complexity in the group of recipients' increase. The time savings, could in turn decrease the pressure on the system, which is important to deliver care of quality (Kc og Terwiesch 2009). If needed, they could also reallocate the released resources to other activity, as direct patient care activities. Decent time, available resources as well as right

knowledge, are important to some of the recipients', to feel that they receive care of high quality (Wilde, et al. 1993).

The leader in Fræna did also reveal that there are some differences between health care workers and nurses regard to administration. This is also reflected in the data in table 6-12. Column left, shows the total percentage spent in administration activities, which is the same number as found in table 6-3. The remaining numbers represents the total percentage of time spent in administration, pr. profession.

Table 6-14 Administration activities, pr. profession

	Assistant	Health care worker	Nurse	Student	Not specified	Adm. Total
Fræna	**2,49 %**	**8,31 %**	**34,36 %**	**4,35 %**	**-**	**17,90 %**
Activities to other entities	0,00 %	0,49 %	0,14 %	0,00 %	-	0,24 %
Administrative tasks (including carwash)	2,04 %	4,63 %	25,95 %	4,35 %	-	12,92 %
Case management	0,00 %	1,35 %	0,00 %	0,00 %	-	0,51 %
Contact with management office	0,00 %	0,00 %	0,10 %	0,00 %	-	0,04 %
Meetings	0,45 %	1,15 %	3,29 %	0,00 %	-	1,89 %
Meetings related to defined user	0,00 %	0,00 %	1,06 %	0,00 %	-	0,44 %
Training of personnel	0,00 %	0,70 %	3,83 %	0,00 %	-	1,85 %
Rauma	**3,09 %**	**9,23 %**	**13,48 %**	**0,00 %**	**26,80 %**	**10,51 %**
Activities to other entities	0,00 %	0,01 %	0,51 %	-	0,00 %	0,22 %
Administrative tasks (including carwash)	1,83 %	4,32 %	8,12 %	-	17,78 %	5,96 %
Case management	0,00 %	0,15 %	0,10 %	-	0,00 %	0,09 %
Contact with management office	0,00 %	0,00 %	0,00 %	-	0,00 %	0,00 %
Meetings	0,57 %	1,07 %	1,69 %	-	0,07 %	1,19 %
Meetings related to defined user	0,00 %	0,00 %	0,42 %	-	0,00 %	0,18 %
Training of personnel	0,69 %	3,68 %	2,64 %	-	8,94 %	2,87 %
Vestnes	**4,01 %**	**3,61 %**	**18,03 %**	**-**	**0,78 %**	**8,81 %**
Activities to other entities	0,00 %	0,08 %	0,97 %	-	0,00 %	0,39 %
Administrative tasks (including carwash)	0,29 %	0,89 %	11,42 %	-	0,78 %	4,62 %
Case management	0,00 %	0,01 %	0,02 %	-	0,00 %	0,01 %
Contact with management office	0,00 %	0,00 %	0,02 %	-	0,00 %	0,01 %
Meetings	0,78 %	0,00 %	0,66 %	-	0,00 %	0,31 %
Meetings related to defined user	0,54 %	0,42 %	2,73 %	-	0,00 %	1,26 %
Training of personnel	2,39 %	2,21 %	2,21 %	-	0,00 %	2,21 %

Table 6-14 shows that nurses spend most of their time in administration activities, which applies to all three municipalities. Within the administration category, all three municipalities do also spend most of their time in administration activities, with 12.92% in Fræna, 5.96% in Rauma, and 4.62% in Vestnes.

The leader in Fræna delivered good information about the administration activities, and the differences between health care workers and nurses. Health care workers are responsible to book appointments to the doctor and taxi, and order diapers. Nurses responsibility regard to administration is, on the other hand, significantly larger and consists of a range of different activities. In relation to medical handling this could be following up medicine changes among the recipients' and updates of the medicine lists, coordination of ordination cards every second week. They do also have responsibility to IPLOS and ADL, which regards identification of the recipients' abilities and their need for services. They have the responsibility to do visits and evaluation of recipients, follow up changes in the recipients' resolutions, and receive notifications from management office if changes. Internally among the employees, they have the responsibility to training of colleagues in Gerica, hiring of personnel, internal messages, coordinate daily activities, update information about each recipient and archiving. They do also have the responsibility to continuing information about the recipient to the hospital in case of hospital admission via e-link, follow up patients regard to doctors and hospital, and registration of temporary stop in health care services in Gerica if some of their recipients are hospitalized. In addition to this, they participate on different meetings.

Since administration activities is the group of activities that contains the highest range of different activities, it is not possible to elaborate all the activities, and it`s either possible to tell how much time is spent on each of them. But what all of them have in common, is that many of them are related to coordination of activities and information. Some of the activities regard coordination of daily activities, scheduling and planning of personnel. Seen in separate they might not seem to require a significant of time and effort to those who perform the them. However, earlier research done in operational modelling, have shown an efficiency gain by 10-15% by eliminate manual planning of staff scheduling and routing of activities, which within 200 units of homecare becomes 20-30 million euros (Eveborn, et al. 2012). The results from the research indicate that time spent on such activities should not be underestimated, and that there are gains, both regard to efficiency

as well as quality to implement systems that replaces manual work. However, there exists little information about their systems regard to planning of staff scheduling and routing of activities at this stage in the research. But is of importance to mention, since an increase in efficiency in such activities could have a major impact on the consumption if time, as well as overall quality.

Some of the activities do also regard to continuing information about recipients to other care activities, as hospital and doctors, communication and collaboration with other entities. Though they do have a documentation system functional efficiently between the activities, it might seem that they need to spend some of their time in both update and disseminate information about the recipients to other health care institutions. The leader told that they spend a significant amount of time a day, around 3-4 hours, on updates in Gerica, regard to around 7 users pr. day. This updates regard to worklists and care plan, medicine lists, changes in the need of care etc. This is necessarily to have the system function efficiently, and for the workers be able to give the recipients proper care. The leader did also tell that the system function efficiently across other health care entities, but it is a need that the information in the system is updated. As mention in the background this were one of the obstacles to achieve good results from the coordination reform (OECD 2014). On the basis of the information from Fræna, it indicates that even though they spend less time in documentation and report, they spend more time in administration activities. If they don`t, Gerica would not function optimally. However, in the end a seamless flow of information should not be underestimated, even though they do spend an amount of time un updates. Most likely, as seen in the section of documentation, the system allows a more efficient production, as well as increased quality.

Even though administration activities were only a cost driver to Fræna, it is most likely to assume according the numbers, that this would become one of the main cost drivers in Vestnes and Rauma, if change documentation system. A more detailed research in these activities should be preferred. In the end, the overall goal, on the basis on background and theoretical framework, should be to release capacity in such activities, to be used in direct patient care activities.

7.0 Conclusion

The research found that the main cost drivers in Fræna are direct patient care, driving and walking and administration, represents 78.65% of their total time spent. In Rauma and Vestnes, the main cost drivers are direct patient care, driving and walking, and documentation and report, represents 79.24% and 79.46% of their total time spent.

In direct patient care activities, the municipalities have similar pattern regard to proportion of time spent pr. hour during the day, but are different regard to minutes pr. visit of homecare. Rauma seems to spend most minutes pr. visit, while Vestnes seems to have the greatest differences in min pr. visit. The municipalities are also different in how they organize their entity regard to direct patient care activities. In Fræna, practical assistance is a part of homecare services, while in Rauma and Vestnes, this function as an own unit. The municipalities do also seem to be different regard to how the different professions spend their time within direct patient care activities. Even though Rauma and Vestnes organize similar, they spend unequal proportion of time in practical assistance. This may be caused by different group of recipient, or it could be caused by different organization or job design.

The municipalities do also have the same pattern in driving pr. hour, with more driving in a dayshift than in the shift in the evening. This might be caused by more employees in the dayshift, which leads to more driving within the different zones. Even though the municipalities are different regard to land area, where Rauma is the largest, Rauma do not seem to spend more time pr. drive than Fræna which is smaller, which might be explained by that Rauma has more recipients, and cause more frequent stops.

Further, the municipalities are also different regard to documentation and report, where Fræna spend less amount in documentation and report than Rauma and Vestnes. This most likely is a consequence of different types of documentation systems, where Fræna has an electronic documentation system, and Rauma and Vestnes use a manual type of documentation system. This would in turn would change the process design, and allow to have a more efficient flow of information regard to the recipients. This is similar with report, where Rauma and Vestnes spend more time in report than Fræna, which might also

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be explained by different types of documentation systems, since a manual type of report systems in turn would cause a need to more oral messages.

Fræna spend more time in administration than Rauma and Vestnes, most likely as a consequence of a period with courses among the nurses, as well as project within health- and care technology and supervising of several students. Regard to profession, nurses spend more time in administration than health care workers and assistants, which applies to all three municipalities. Studying the activities in administration regard to Fræna, suggests that even though Fræna spend less time than Fræna and Vestnes in report, they spend some amount of time on administration because of Gerica, by updating information about the recipients'. This is necessary for the system to function optimal. Fræna do also seem to spend some time on daily scheduling and planning of personnel. However, we know little about the exact time spent on the different activities within administration, as well as little about some of the municipalities, makes it difficult to compare as well as conclude.

8.0. Suggestions to further research

Since the thesis is limited in how detailed there has been possible to elaborate the different activities, it would lead to many possibilities within further research.

There could be done more detailed research in direct patient care activities, which include the degree of care and complexity among the recipients', as well as research which investigate the pressure on the system. It is reasonable to believe that a decent is of importance within homecare services as well, but there has not yet been done studies that investigate the effect of workload on the homecare service system. This could include both employees as well as recipients', to find if there are any effects of workload on direct patient care activities. We for instance do know that shifts in a day might be more hectically regard to demand and activities during the shifts in the evening.

There could also been done more research in driving, including worklists and driving routes. It could for instance be interesting to find if there are differences in how they

organize their worklists regard driving routes, and if there is possible to find a more optimal solution.

Further, there could be done a more detailed research revealing the entire flow of information, both internally as well as between health care entities. In this research, the activities seem to be not appropriate to deal with such a research, since some of activities regard to information flow is registered in documentation, and some of the activities regard to information flow is registered on administration. An efficient flow of information about the recipients' and work done is crucial to the employees as well as the recipients, in order to have control over activities performed, as well as the recipients' safety.

There could also be done more research regard to administration activities. Coordination of internal daily activities and information, should preferably be done efficient, to release capacity, as well as increase the quality. Since little is known about their different administration systems, there could be done research involves a closer study of the administration activities, find where there could be done improvements, and develop new and better administration systems.

Since this research did not involve the activities regard to security alarms and incoming phone calls, there could be interesting to find in which degree the activities has an impact on the production. Security alarms is an important part of production process, and study the frequency of incoming security alarms and phone calls, as well as the time consumption, would give valuable information in which degree these activities should be taken into account in the daily planning in order to avoid major disruptions.

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Appendix

Distributions measures after standardizing, homecare

	Fræna	*Rauma*	*Vestnes*
Mean	1,04739508	1,10648251	1,07032245
Standarddeviation	0,00930839	0,00725539	0,00963629
Kurstosis	5,44472527	2,17996181	6,02190803
Skewness	-1,18233856	-0,72982323	-1,47820518
N	2162	2476	3158

Distributions measures after standardizing, driving and walking

	Fræna	*Rauma*	*Vestnes*
Mean	0,81070632	0,78391613	0,69435412
Standard deviation	0,50605796	0,41939789	0,53231112
Kurstosis	2,40057511	0,54651779	1,85754128
Skjevhet	-1,04185159	-0,23060368	-0,8992475
N	2864	3003	3737

Differneces in pattern regard to documentation

Fræna				
Reise- / gangtid	08.02.2016	16:55	17:15	20,93
Hjemmesykepleie	08.02.2016	17:16	17:32	16,85
Dokumentasjon	08.02.2016	17:32	17:33	0,18
Reise- / gangtid	08.02.2016	17:33	17:41	8,60
Hjemmesykepleie	08.02.2016	17:41	18:02	20,65
Dokumentasjon	08.02.2016	18:02	18:03	0,78
Reise- / gangtid	08.02.2016	18:03	18:06	2,93
Hjemmesykepleie	08.02.2016	18:06	18:09	3,56
Dokumentasjon	08.02.2016	18:09	18:10	0,08

Rauma

Hjemmesykepleie	26.01.2016	20:10	20:30	20	20,00
Reise- / gangtid	26.01.2016	20:30	20:35	05	5,00
Hjemmesykepleie	26.01.2016	20:35	21:05	30	30,00
Reise- / gangtid	26.01.2016	21:05	21:10	05	5,00
Hjemmesykepleie	26.01.2016	21:10	21:30	20	20,00
Reise- / gangtid	26.01.2016	21:30	21:35	05	5,00
Hjemmesykepleie	26.01.2016	21:35	22:00	25	25,00
Reise- / gangtid	26.01.2016	22:00	22:05	05	5,00
Dokumentasjon	26.01.2016	22:00	22:30	30	30,00

Questions to the municipalities

1. Number of employees
2. Number of recipients
3. Hours of resolution during the period
4. Differences in number of employees/worklists in a dayshift vs. a shift in the evening
5. How they organize in an overall basis regard to practical assistance
6. Degree of Care
7. Documentation system and report
8. Administration activities, which activities has been registered on administration tasks, as well as the differences between nurses and health care workers regard to administration activities