HOW CAN WE CURE THE CARE SECTOR?

OPTIMIZATION OF THE HEALTH CARE LOGISTICS OF AMBIQ

FOR THE BENEFIT OF THEIR CLIENTS



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Management summary

Introduction

Ambiq is a health care organization that provides treatment and support for children and (young) adults with mild intellectual disabilities and additional problems. The organization observes a high need for the uniformity and optimization of their primary processes. Uniformity is needed because of significant differences in the execution of the processes between the different regions, which makes it much harder to exchange staff and gives uncertainty to clients, staff and external parties. Since 2015, the turnover is decreasing and the Child and Youth Act rates are relatively low. Therefore, efficiency is needed to ensure that Ambiq is able to deliver the same care as before against lower costs. The main purpose of this research is therefore to obtain uniformity and efficiency within Ambiq.

Problem statement

Interviews with employees from different regions and an analysis of Ambiq's current management, control and performance have shown that demand and supply do not match. This is caused by one of the core problems which states that the required capacity is not known early. Another cause is the overlooked tactical planning and control level. These problems together have three major consequences.

- Logistical problems arise at operational level, such as long access times and long throughput times for some treatments. The access times for "Diagnostiek", "EMDR/CGT", "Gezinshuisopname", "IOG", "PMT", "Speltherapie" and "Zelfstandigheidstraining" are not in line with the Treeknormen. The average access times are respectively 67.84, 43.92, 55.18, 14.59, 24.69, 21.94 and 44.73 days. The throughput times of "Intensieve behandeling" (on average 403 vs. 274 days), "PMT" (on average 297 vs. 140 days), "Speltherapie" (on average 254 vs. 140 days) and "Vaktherapie beeldend" (on average 313 vs. 140 days) are higher than targeted.
- 2. Cooperation and coordination between specialisms and different regions and teams is missing, also called chain cooperation.
- 3. The current ad hoc, operational planning creates a lot of variability which causes strong fluctuations in the workload.

So, a mismatch in demand and supply and an overlooked tactical planning and control level results in costintensive and inefficient care and no uniform processes.

Research question

Based on the problem statement, the following research question is formulated: *"How can Ambiq optimize their primary youth care processes on the resource capacity level for the benefit of their clients?"*. The primary processes consist of the ambulatory and inpatient care. Ambiq also delivers care to (young) adults and it provides emergency care, but these focus areas are not taken into consideration because Ambiq's main target group is the youth care and they aim to treat clients ambulatory unless it is no longer possible and admission is required.

Approach

To determine a more concrete ultimate objective of process optimization, first semi-structured interviews were held with the management team, behavioral scientists and (ambulatory) caregivers. Subsequently, literature research was performed regarding existing work on planning and control frameworks and on operational research in the mental home health care sector. Based on this literature review we proposed an integral planning and control framework for mental (home) health care organizations. By means of this integral framework, we aim to enable mental (home) health care organizations like Ambiq to better plan and control their primary processes.

Results

The literature review showed that planning and control frameworks can be positioned in hierarchical and managerial levels. One of the managerial areas is the resource capacity planning area, which is the main focus of this thesis. The hierarchical levels can be split into the strategic, tactical and operational level. We identified the following research gap: no publications are found regarding planning and control frameworks for (youth) mental health care organizations. Based on the frameworks and the operational research found in home health care organizations a framework for mental health care organizations is proposed.

The figure below shows the proposed resource capacity planning and control framework for mental (home) health care organizations. This framework shows the timespan when decisions have to be made on each hierarchical level. In addition, it shows the information needed to be able to make the decisions. Lastly, it shows which actors are responsible for the decisions on that hierarchical level.



Implementing integral resource capacity planning is a strategic, permanent choice concerning an inherently complete change of the current planning and control. Therefore, first an agreement must be reached regarding this implementation. As soon as it has been decided to apply integral resource capacity planning, the principles, and thereby the KPIs, can be determined.

The second step is to start implementing the tactical planning and control level as this is currently overlooked. To be able to implement tactical planning, aggregated forecasts are needed. These forecasts can be made based on clinical pathways. Although Ambiq developed clinical pathways a few years ago, these are not concrete, and they are hardly used in practice. Therefore, clinical pathways have to be developed based on the daily experience of the caregivers and data analyses. Also, the variability should be reduced as much as possible and the remaining variability must be predicted.

Conclusions and recommendations

We advise mental (home) health care organizations and so, Ambiq, to apply integral resource capacity planning and to implement the tactical planning and control level in this approach, such that demand and supply can be balanced and integration and coordination among departments, operation strategy and operational planning in the care chain can be enforced. In this way, these organizations can optimize their primary youth care processes for the benefit of their clients.

We recommend Ambiq to collect more data and to centralize these data in order to be able to measure the defined KPIs.

What's next?

Following this thesis, Ambiq has to get started to implement the tactical level. First, Ambiq has to map the clinical pathways. Second, Ambiq can forecast demand based on these pathways.

Management samenvatting

Introductie

Ambiq, een zorgorganisatie die behandeling en begeleiding biedt aan kinderen en (jong)volwassenen met een licht verstandelijke beperking en bijkomende problematiek, heeft een grote behoefte aan meer uniforme, efficiëntere processen. Er is een behoefte aan uniformiteit, omdat er aanzienlijke veranderingen in de uitvoering van de processen tussen de verschillende regio's zijn. Hierdoor is personeel veel lastiger uit te wisselen. Daarnaast geeft dit onduidelijkheid aan cliënten, personeel en externe partijen. Sinds 2015 is de omzet van Ambiq aan het dalen en zijn de jeugdwet tarieven erg laag. Efficiëntie is nodig om ervoor te zorgen dat Ambiq dezelfde zorg kan blijven leveren met minder geld. Het hoofddoel van dit onderzoek is daarom om uniformiteit en efficiëntie te bereiken binnen Ambiq.

Probleemstelling

Uit interviews met medewerkers vanuit verschillende regio's en een analyse van de huidige besturing en prestatie van Ambiq is gebleken dat de vraag en aanbod niet op elkaar aansluiten. Dit wordt veroorzaakt door één van de kernproblemen dat de vereiste capaciteit niet vroeg in kaart wordt gebracht. Een andere oorzaak is dat het tactische planningsniveau over het hoofd wordt gezien. Deze problemen hebben samen drie grote gevolgen:

- 4. Er ontstaan problemen op operationeel niveau, zoals lange toegangstijden en lange doorlooptijden voor sommige behandelingen. De toegangstijden voor "Diagnostiek", "EMDR/CGT", "Gezinshuisopname", "IOG", "PMT", "Speltherapie" and "Zelfstandigheidstraining" komen niet overeen met de Treeknormen. De gemiddelde toegangstijden zijn respectievelijk 67.84, 43.92, 55.18, 14.59, 24.69, 21.94 and 44.73 dagen. De doorlooptijden "Intensieve behandeling" (gemiddeld 403 vs. 274 dagen), "PMT" (gemiddeld 297 vs. 140 dagen), "Speltherapie" (gemiddeld 254 vs. 140 dagen) and "Vaktherapie beeldend" (gemiddeld 313 vs. 140 dagen) zijn hoger dan de norm.
- 1. Er mist samenwerking en coördinatie tussen specialisaties en verschillende regio's en teams, ook wel ketensamenwerking genoemd.
- 2. De huidige ad hoc, operationele planning veroorzaakt veel variabiliteit, wat zorgt voor sterke fluctuaties in de werklast.

Een mismatch tussen vraag en aanbod en een tactische planning wat over het hoofd wordt gezien resulteert dus in inefficiënte zorg en een proces wat niet uniform is.

Onderzoeksvraag

Op basis van de probleemstelling kan de volgende onderzoeksvraag worden geformuleerd: "Hoe krijgt Ambiq de primaire processen voor de jeugdzorg op resource capaciteitsplanningsniveau ten behoeve van de cliënt geoptimaliseerd?" De primaire processen bestaan uit ambulante en intramurale zorg. Ambiq biedt ook zorg aan (jong)volwassenen en biedt spoedeisende hulp, maar deze aandachtsgebieden worden niet meegenomen in dit onderzoek. De reden hiervoor is dat Ambiq's hoofddoelgroep de jeugdzorg is. Daarnaast proberen zij cliënten ambulant te behandelen tenzij dit niet langer mogelijk is voor de cliënt en een opname is vereist.

Aanpak

Om een concreter, uiteindelijk doel van procesoptimalisatie op te stellen, zijn er eerst semi-gestructureerde interviews gehouden met het managementteam, gedragswetenschappers en (ambulante) hulpverleners. Vervolgens is er een literatuuronderzoek uitgevoerd met betrekking tot bestaande planning en besturingsmodellen en operationeel onderzoek in de mentale (thuis)zorgsector. Op basis van dit literatuuronderzoek hebben we een integraal plannings- en besturingsraamwerk ontwikkeld voor mentale (thuis)zorgorganisaties. Met dit integrale raamwerk willen we mentale zorginstellingen zoals Ambiq in staat stellen om hun primaire processen beter te plannen en beheersen.

Resultaten

Het literatuuronderzoek heeft laten zien dat de planning en besturingsraamwerken geplaatst kunnen worden in hiërarchische en managementniveaus. Een van de managementniveaus is het resource capaciteitsplanningsniveau, wat de focus van deze thesis is. De hiërarchische niveaus kunnen opgesplitst worden in strategische, tactische en operationele niveaus. We hebben het volgende research gap geïdentificeerd: er zijn geen publicaties gevonden met betrekking tot planning en besturingsraamwerken voor (jeugd) mentale zorgorganisaties. Daarom wordt er op basis van de gevonden raamwerken en op basis van de gevonden literatuur over operationeel onderzoek in de mentale (thuis)zorgsector een raamwerk voor mentale zorgorganisaties voorgesteld.

De figuur hieronder laat het voorgestelde resource capaciteitsplanning en besturingsraamwerk voor mentale (thuis)zorgorganisaties zien. Dit raamwerk laat zien op welke momenten welke beslissingen gemaakt moeten worden. Daarnaast laat het zien welke informatie nodig is om de beslissingen te kunnen maken. Als laatste laat het zien welke actoren verantwoordelijk zijn voor de beslissingen op dat hiërarchisch niveau.



Het implementeren van integrale resource capaciteitsplanning is een strategische, permanente keuze voor een inherente, complete verandering van de huidige planning en besturing. Daarom moet er eerst overeenstemming worden gevonden over deze implementatie. Zodra er besloten is om integrale resource capaciteitsplanning toe te passen kunnen de uitgangspunten en daarbij de prestatie indicatoren worden bepaald.

De tweede stap bestaat uit het beginnen met het implementeren van het tactische planningsniveau, omdat deze momenteel over het hoofd wordt gezien. Om de tactische planning te kunnen implementeren zijn er geaggregeerde voorspellingen van de vraag nodig. Deze voorspellingen kunnen op basis van zorgpaden/cliëntstromen worden gemaakt. Hoewel Ambiq een aantal jaar geleden zorgpaden heeft ontwikkeld zijn deze niet heel concreet. Daarnaast worden ze in de praktijk nauwelijks gebruikt. Daarom moeten er klinische zorgpaden worden ontwikkeld op basis van de dagelijkse ervaring van de zorgverleners en data-analyses. Ook moet de variabiliteit zoveel mogelijk worden gereduceerd en moet de overgebleven variabiliteit worden voorspeld, zodat hier rekening mee gehouden kan worden.

Conclusies en aanbevelingen

Wij adviseren mentale (thuis)zorgorganisaties en daarbij Ambiq om integrale resource capaciteitsplanning toe te passen en om het tactische planningsniveau in deze aanpak te implementeren. Hierdoor wordt de vraag en aanbod in evenwicht gehouden en wordt de integratie en coördinatie tussen afdelingen, operationele strategie en operationele planning in de zorgketen versterkt. Op deze manier kunnen deze organisaties hun primaire processen van de jeugdzorg ten behoeve van de cliënt optimaliseren.

Als laatste bevelen we Ambiq aan om meer data te verzamelen en deze data te centraliseren, zodat de opgestelde prestatie indicatoren gemeten kunnen worden.

Hoe nu verder?

Uit dit onderzoek volgt dat Ambiq aan de slag moet om het tactische planningsniveau te implementeren. Hiervoor moet Ambiq eerst de zorgpaden/cliëntstromen in kaart brengen. Ten tweede moet Ambiq op basis van deze zorgpaden/cliëntstromen de vraag voorspellen.

Preface

It is over! My time as a student has come to an end by writing this thesis. After studying in Groningen for a year I made the move to Enschede. And although I had a great time in the student city of Groningen, I never regretted my decision to study in Enschede. With various side jobs, being involved in my studies, and lots of teamwork, I have always felt at home here and I had an extremely good time the past five years. In that regard, I think it is a pity that it is over.

This thesis was quite challenging. Especially because the research is performed in a health care setting where they don't use any operational research techniques yet. I hope that this thesis will contribute to the organization to become more uniform and efficient.

I really want to thank Marcel Hesselink and Ina Kuipers for their guidance through this project and providing this assignment. In addition, I want to thank them for all the opportunities they gave me to attend meetings of the project groups and the management team and to think along with the process optimization phase they are in now. It was very interesting, and I have learned a lot from it. I also want to thank all interviewees for their time and effort. And I want to thank the colleagues in Hengelo and Hoogeveen for a warm welcome and for always supporting me and have a little talk. I had a good time!

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I hope you enjoy your reading!

Laura Ooms

Enter, October 2019

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1 Introduction

Ambiq is becoming increasingly concerned with the efficiency of their processes. Due to differences in the planning and control of the execution of the primary processes in the regions Twente/Achterhoek and Noord/Midden and the decrease in turnover, the need for uniformity and optimization has never been greater.

This chapter describes the context of the problem. First, Section 1.1 gives a short introduction about Ambiq. Next, Section 1.2 describes the motivation of this research, followed by Section 1.3 that describes the goals of process optimization. Section 1.4 describes the problem cluster, followed by Section 1.5 that presents the core problem. Section 1.6 gives the scope of this research. Finally, Section 1.7 presents the research questions.

1.1 Research context: Ambiq

Ambiq is a health care organization that provides treatment and support for children and (young) adults with mild intellectual disabilities and additional problems. These treatments and support let Ambiq's clients live as independent as possible. Ambiq aims to treat their clients ambulatory unless the situation is that urgent that an admission is necessary. Their expertise is mainly in the field of trauma, sexuality, attachment and aggression.

Ambiq provides care in Twente, Drenthe, Groningen, Friesland, IJsselland and Midden IJssel/Oost Veluwe. In Twente, Drenthe and IJsselland, Ambiq provides inpatient care besides their preferred ambulant care. The organization is split up into two profit centers, namely "Noord/Midden" and "Twente/Achterhoek". Among these profit centers, Ambiq has 5 crisis centers, 38 family homes, 36 locations where an inpatient treatment is given, 6 adult care homes and 5 houses for day treatment and weekend and holiday care. Furthermore, Ambiq has 4 service centers and 3 support centers.

Approximately 950 employees (696.5 FTE) work at Ambiq. Together, they treat roughly 2,300 clients per year, 49% of these clients are treated in Twente/Achterhoek and 44% in Noord/Midden. The other 7% clients they treat each year do not reside in these regions as they belong to another organization. In total roughly 2,050 clients are treated ambulatory and 750 clients are treated inpatient. Of these, 500 clients are treated both ambulatory and inpatient (Ambiq, 2018). Appendix I shows the organizational chart of Ambiq.

This research is executed at the department 'Planning and Control'. This department pursues control of the business processes. In addition, the researcher is a member of the steering committee of process optimization. This steering committee aims to create a care process for Ambiq's clients that is as clear, unambiguous, effective and efficient as possible.

1.2 Research motivation

The need for uniformity and optimization has never been greater. Uniformity is needed because Ambiq notices the differences between the two regions now more than ever. Since November 2017, Ambiq works with two profit centers instead of three. As a result, the differences in work definitions and the execution of the processes

become exceedingly apparent. Because of these differences, it is much harder to exchange employees between the two regions. In addition, there is no uniformity for external parties.

Since 2015, the turnover of Ambiq is decreasing. This decrease can be explained by the fact that Ambiq receives less money for client care than before, while the demand for health care has not decreased and the wages are rising. Since January 1st 2015, child and youth care is financed by municipalities and no longer by the state. In addition to this shift in financing, the rate that Ambiq receives has fallen by 10% to 15%. As a result, the Child and Youth Act rates, from which the majority of Ambiq's clients are financed, are relatively low. Efficiency is needed to ensure that Ambiq is able to deliver the same care as before, with less money.

The main purpose of this research is to obtain uniformity and efficiency. Ambiq raises therefore the following question: "How can Ambiq optimize their health care logistics for the benefit of their clients?".

From May to December 2018, a consultancy firm carried out an investigation into the possibilities of process optimization for their primary processes, which are delivering inpatient care and outpatient care. This was the starting point of process optimization within Ambiq. One of the main findings of their investigation was that there is a significant number of differences in the execution of the primary processes between the various regions and that there is room for improvement in their care logistics. They have given a number of recommendations to solve these problems. According to the consultancy firm, Ambiq should make use of a central planning at all hierarchical levels to substantially contribute to a better match between demand and supply for care. Currently, the capacity planning at all hierarchical levels is done by different employees. At operational level, each employee is responsible for one specific part of the client process. Furthermore, many appointments are scheduled one at a time at the end of each session instead of scheduling the sessions all at once at the start of the treatment. This seems to be inefficient according to the consultancy firm. Therefore, a central planning is advised. The required capacity of the employees involved must be reserved as early as possible, causing that the client's process can be organized more efficiently. Moreover, performance indicators can be monitored during treatment, which makes it possible to examine whether the scheduling standards for this client process are met. Historical data of similar clients and similar pathways can be used to improve the scheduling function. We will give our view on this advice in the conclusion of this report.

In January 2019, an internal team was put together with the aim to create a clear, unambiguous and efficient health care process by evaluating and optimizing the care pathways together with the involved employees based on the outcomes of the investigation of the consultancy firm. This internal team is the steering committee 'process optimization'. This steering committee, together with the involved employees, started with the evaluation and subsequently the optimization of the front door process, the intake of the client, which will likely be completed in April of the same year. Other processes that will subsequently be evaluated and optimized are: emergency, diagnostics, therapies, Intensive Orthopedagogic Family Treatment (IOG) and Long-term Orthopedagogic Family Treatment (LOG) and inpatient care. The total process of evaluating and optimizing the various care pathways will take approximately two years.

1.3 Process optimization

The goal of process optimization at Ambiq is: create a clear, unambiguous, effective and efficient care process for clients of Ambiq. We define four sub goals:

- High quality of care (effectiveness)
- Pursuit of logistical objectives (efficiency)
- Pursuit of financial objectives (economy)
- The same type of care applies to every client with the same type of request for help (equity)

To determine a more concrete ultimate objective, semi-structured interviews (see Appendix II) were held with the management team, behavioral scientists and (ambulatory) caregivers. In summary, the following needs to be improved:

- The access times must be shortened, and processes should start earlier. In particular, the access time for diagnostics must be shortened. Clients need to know their diagnosis quickly.
- Ambiq must adhere to the agreed throughput times described in the care pathways. These throughput times must be made more transparent in the electronic health record User. Furthermore, control is needed to ensure that processes do not continue for too long.
- The total throughput time should be shortened where possible, such that the treatment goals of the client are achieved as soon as possible.
- There must be more unity and less variation in the processes.
- The job descriptions must be clearer. It must become clear who does what and when.
- The care must become more plannable, especially for the ambulatory care. This will be better for both the client and the employees as well as Ambiq. The client will know at the start of the process how long the treatment will take. Caregivers need more clarity. When the care is more plannable, the employee has a tighter schedule and knows all the appointments with a client on beforehand. Ambiq can better determine the deployment of their resources.
- The various software systems of Ambiq must be compatible with each other. There is a strong preference for having one system.
- The care must remain client-focused. Ambiq must continue to provide customized care.

1.4 Problem cluster

In this research we focus on the core problem. This is the problem that will yield the most if it is solved. One way to identify this problem is to create a problem cluster. The problem cluster gives insight in the relations between the various problems by representing the causes and consequences of all problems (Heerkens, Winden, & Tjooitink, 2017).

Before a problem cluster can be created, the existing problems must be identified. This identification is done by conducting 16 semi-structured interviews (see Appendix III) with various employees within Ambiq in different

regions. In Twente/Achterhoek, as well as Noord/Midden, we interviewed an intaker, a cluster manager, an ambulatory caregiver, two employees of the treatment secretary and two behavioral scientists. In addition, we interviewed a planner, a researcher and one manager client administration. The focus of these interviews was on the ambulatory care. There are, however, also some problems encountered in the inpatient care. The interviews were validated by presenting the interviewees the most important findings. Figure 1 shows the (comprehensive) problem cluster, that is created after mapping and validating the problems. With different colors the main action problems (bright colors) and their causes (light colors) are indicated.



Figure 1 Problem cluster following from the interviews

The main action problems found in the interviews are:

- Long access times (especially for the treatment programs: Eye Movement Desensitization and Reprocessing (EMDR), diagnostics, Cognitive Behavioral Therapy (CBT)) (1.4.1)
- Long internal throughput times (1.4.2)
- Cost-intensive and inefficient care (1.4.3)
- Current performance of Ambiq is not known (1.4.4)
- Many differences in the execution of the processes between the two regions (1.4.5)

1.4.1 Long access times

The interviewees perceive long access times for three treatment programs: EMDR, diagnostics, and CBT. The access time is defined as the time between placement on the waiting list and the first treatment. There are seven causes underlying this problem:

1. Labor scarcity of highly skilled staff, like behavioral scientists

Ambiq observes labor scarcity of highly skilled staff. Especially, behavioral scientists that can treat clients with complex issues are scarce. Due to the limited number of employees, there is no substitution in case of illness, and the access times will become longer.

2. Highly skilled staff are deployed in other locations (e.g. ZIT)

Employees that are authorized to give EMDR, diagnostics or CBT are deployed at other locations in the organization. An example is staff that is deployed at the very intensive trauma treatment (ZIT). This treatment program is relatively new and aims to treat clients who need EMDR intensively in a short time period. This approach would be more effective than a longer treatment process. Since this treatment is started, highly skilled employees are needed to give this treatment. These employees are therefore deployed to provide ZIT, but initially they should deliver ambulatory EMDR, diagnostics or CBT.

3. Fragmentation of tasks

Some highly skilled employees have multiple tasks. An employee can work for 8 hours in the intake and for 16 hours in the diagnostics, for example. In busy periods, the emphasis can sometimes be on one of these tasks, which means there is temporarily less time for the other task.

4. Caregivers spend a lot of time on scheduling, checking and other administrative activities

Caregivers spend a lot of time on scheduling, checking User and other administrative activities. An effect of these administrative tasks is that they have less time to treat clients.

5. Waiting list is not always up-to-date

The waiting list is not always up-to-date. Sometimes clients are on the waiting list, while they cannot be treated yet, for example because the regulation (Dutch: beschikking) is no longer valid. Besides, it can appear that a client no longer needs care or that he/she has already been

treated. Two causes are underlying this problem. The first cause is that the management of the waiting list is done manually. The secretary has various lists which they must keep up-to-date. Because the tracking is done manually, whether the indication is running is only checked when the client is placed on the waiting list. The second cause for that the waiting lists are not up-to-date is because information about previous treatments is missing in internal referrals. For example, it is not written down what happened per treatment. So, there are too few registrations within Ambiq.

6. Required capacity is not known at an early stage

Ambiq has insufficient insight into the expected demand and therefore does not know the size of the occupation and the number of the clients.

7. Some employees only schedule their appointment when the current client is treated

When caregivers have time left, they look on the waiting list to see if they can treat new clients. This usually happens when they have finished the treatment of a current client. If, for example, caregivers would look two weeks earlier on the waiting list, they could already plan a first appointment. This first appointment can be planned in the week that the caregiver would have time left. This will result in a faster process for clients and caregivers will not have a gap in their schedule.

One of the consequences of the long access time is that care is given prior to diagnostics. This means that clients are being treated before they are diagnosed. This is not desirable as it may occur that clients receive treatment that does not meet what the client actually needs as the client is not diagnosed. As a result, the client has been in care for an unnecessarily long time and has possibly received the wrong treatment. Another consequence of long access times is that clients receive interim care. This also means that clients are in care for an unnecessarily long time.

1.4.2 Long internal throughput times

Long internal throughput times are perceived in several treatment programs. Four main causes can be identified:

1. Need of interim care

Interim care may be needed due to long access times, due to clients that need other therapies that were not known in advance or due to long access times at external health organizations.

2. Employees schedule their appointments one at a time by themselves

Because employees schedule appointments with clients one at a time, it is quite possible that the treatment process will take longer than necessary. If a client indicates that they cannot come the following week, an appointment can easily be made a week later. Ambig is quite flexible here. Another result of self-scheduling is that the employees spend more time on administrative tasks.

3. Every client receives a personal care pathway and this care pathway can change during treatment

This is one of the reasons why the processes are not regulated and very flexible. Due to flexible and not regulated processes, there are many differences in the execution of the processes between the two regions.

4. Employees give treatment for a longer time than necessary, due to a high sense of responsibility for the client

This is possible since the processes are not that strictly regulated.

The consequence of long internal throughput times is cost-intensive and inefficient care, which we elaborate on in the next paragraph.

1.4.3 Cost-intensive and inefficient care

In addition to the long internal throughput times there are three other causes for cost-intensive care:

1. Travel time is relatively high

Employees often meet in or near the client's house and because the service area is large, the employees travel a lot. One of the benefits is that the employee can better observe the client's situation when the client is in his own environment. Moreover, the no-show appears to be lower when a client is visited at or near their home. So, there are quite some benefits of traveling to the client.

2. A negative occupation difference

Because the required capacity is not known early, the bed occupation (inpatient care) is not always fully occupied. However, it does not matter for the number of employees deployed whether the inpatient care is fully occupied or not. If there are fewer clients, revenues for Ambig is less, but the costs remain the same for the same number of employees.

3. Productivity of the employees appears to be relatively low

This means that the billable time for employees is currently too low.

1.4.4 Current performance of Ambig is not known

The fourth problem identified is the unknown performance. Currently, Ambiq is not fully aware of its performance. As a result, there are different views within the organization. Some employees perceive long access times for a treatment program and other employees perceive no problems with access times. The performance is unknown because not much (reliable) data is being collected and the waiting lists are not up-to-date.

1.4.5 Many differences in the execution of the processes between the two regions

The final identified problem has also been mentioned as research motivation: there are many differences in the execution of the processes between the regions and therefore uniformity is needed. The cause for these

differences is the fact that the processes are not tightly regulated and very flexible. This allows each caregiver to decide how to execute the work.

1.5 Core problem

The problem cluster yields 14 core problems:

- Employees can schedule their appointments by themselves and do not have fixed time slots for specific treatments
- 2. Labor scarcity of highly skilled staff
- 3. Highly skilled staff deployed in other places
- 4. Fragmentation of tasks
- 5. Waiting list management is done manually through various lists
- 6. Not much (reliable) data is being collected
- 7. Required capacity not known early
- 8. Act slowly when a place is released
- 9. Long access times external health organizations
- 10. Every client receives a personal care pathway
- 11. High no-show
- 12. Large service area
- 13. High sense of responsibility
- 14. Employee can better observe the situation at home of the client

The causes 2, 6, 9 and 13 cannot be influenced by Ambiq directly and therefore can be struck out immediately. In addition, the causes 10, 11, 12 and 14 are not easy to solve, and may even be not desirable to solve. Ambiq attaches great importance to the client, and therefore every client receives a personal care pathway. Every client is unique, and it adorns Ambiq that they view each demand for care individually. In addition, Ambiq does not refuse clients, which is a reason for the large service area. The high no-show rate largely depends on the target group. Ambiq treats children with mild intellectual disabilities and for this target group it is sometimes hard to recall appointments.

According to the interviewees, the problem that will yield the most if it is solved is the long access time and throughput times of diagnostics. It appears that there has almost always been a waiting list for diagnostics. Due to the waiting list, the care pathway of the client becomes longer. In addition, clients may receive the wrong treatment if interim care is offered. Another reason why it is good to focus on diagnostics is that this is a care module at the start of a treatment. If the access time is long here, it will affect all subsequent treatments. This problem is, however, not a core problem, because it has some underlying causes. Furthermore, to be able to optimize the access times, more detailed care pathways are needed to ensure that the client's process can be planned (Braaksma, Kortbeek, Post, & Nollet, 2014).

Therefore, we will try to solve the core problems that have caused the long access times: core problems 1, 3, 4, 5 and 7. These core problems belong to the resource capacity planning area. These problems originated in this managerial level, because not all decisions are known in this planning level and some decisions are made incorrectly. For example, core problem 1 can be solved by creating a block schedule and by determining which appointments need to be scheduled by a caregiver, and which appointments may be scheduled by a secretary or planning department. Another example is core problem 7. This problem can be solved by determining when the required capacity must be known and by indicating how this should be planned. Therefore, we will develop a framework for mental (home) health care organizations by identifying and classifying the decisions to be made in the resource capacity planning area.

1.6 Scope

This research concerns the ambulatory and inpatient youth care. Ambig also delivers care to (young) adults and it provides emergency care, but these focus areas are not taken into consideration. Ambig's main target group is the youth care and they aim to treat clients ambulatory unless it is no longer possible and admission is required. This research involves all primary processes of Ambig which is why the research scope is broad. This choice was made in order to develop a planning and control framework regarding the resource capacity planning area for the entire organization.

1.7 Research questions

Based on the problem identification described, the following research question is formulated:

How can Ambiq optimize their primary youth care processes on the resource capacity level for the benefit of their clients?

The main research question is divided into the following sub questions:

1. What are the current processes of Ambiq, how are these processes organized and what is the performance?

Chapter 2 gives an overview of the current processes of Ambiq and describes how these processes are organized. Furthermore, the current performance will be examined. This context analysis is the first step in this research and will yield the core problem that we will try to solve.

2. According to the literature, how can the care sector be planned and controlled?

Chapter 3 reviews the existing literature about three topics within the relevant literature: planning and control in home health care organizations, prior operational research in the care sector and methods for forecasting and care pathway modelling.

3. How can Ambiq plan and control their processes at the resource capacity level?

Chapter 4 presents a roadmap for Ambiq. This roadmap consists of an integral planning and control model proposed for Ambiq.

4. What is the conclusion of this research and what are the recommendations for process optimization?

Chapter 5 concludes this thesis. Furthermore, recommendations are given for process optimization that has direct and indirect influence on solving the core problem.

Context analysis

2 Context analysis

This chapter gives a context analysis that consists of three parts: process (Section 2.1), planning and control (Section 2.2) and performance (Section 2.3). This comprehensive analysis leads to various challenges for Ambig (Section 2.4). Section 2.5 concludes this analysis.

2.1 Process description

To describe the current process of Ambiq, first three client types are distinguished in Section 2.1.1. These different client types follow different care pathways. Section 2.1.2 describes these care pathways. Consecutively, Section 2.1.3 describes the scheduling process.

2.1.1 Client group

Ambiq can distinguish three client types: emergency, inpatient and ambulatory clients. There are two types of emergency clients: clients that need care immediately (emergent care) and clients that need care as soon as possible but could wait for one or two days (urgent care). Clients who need emergent care are helped through "Coördinatiepunt Spoedhulp Jeugd Twente". This coordination point collaborates with various sectors to provide first aid and reception. They can contact Ambiq to provide reception and/or care to a client. Clients that need urgent care are treated by Ambiq as soon as possible and therefore receive care earlier.

Ambiq's mission is to treat clients at home unless that is no longer possible. For clients who are unable to live at home, inpatient care is provided. A treatment location or family home is sought for these clients to provide 24-hour care. Most inpatient treatment programs last 6 to 9 months. In addition to these inpatient treatment programs, they can also receive ambulatory treatments at the same time or after the inpatient treatment.

Ambulatory clients can receive care at home, their school or at the office. The location differs per client. Factors that are involved are: the client's place of residence, the treatment program and the condition of the client. The mild intellectual disability target group is known for not always complying with agreements. They forget appointments or do not show up for other reasons. This can be a reason to treat the client at home.

2.1.2 Care pathway

Every client receives an appropriate care pathway based on their demand for care. The care pathway at Ambiq starts at the intake if the situation is not urgent. If there is a crisis, the client is helped as quickly as possible and follows a different care pathway. On average, 85% to 90% of the clients have a non-urgent question and 10% to 15% are emergency clients. This study focuses on non-urgent clients and therefore we do not provide further details about the emergency care pathway.

In the intake the demand for care is determined. After the intake the treatment plan will be drawn, and the treatment starts. As soon as the treatment goals are reached, the care pathway will come to an end. Figure 2 (left) shows the general care pathway. This section describes the three stages a client usually passes.



Figure 2 General care pathway (left) and the decision tree about which treatment program will be followed (right, source: "Kwaliteitshandboek")

Intake

Children with mild intellectual disabilities that have additional (behavior) problems will be noticed by a general practitioner, a district coach of a certain municipality or a certified institution. This notifier will contact an intaker of Ambiq by telephone or via the website. The intaker checks if Ambiq can answer the demand for care. If so, the intaker ensures that the notifier sends the application form and starts building the dossier. These steps will be executed within 24 hours. Consecutively, the intaker assigns one ambulatory caregiver and one screening behavioral scientist to the client. This assignment process differs between the two regions. In Noord/Midden, each day one ambulatory caregiver and one behavioral scientist are responsible to treat the client. In Twente/Achterhoek, one ambulatory caregiver and three behavioral scientists are responsible. The screening behavioral scientist gives the definitive treatment advice. If the question is more complex or if it is an inpatient request, the ambulatory caregiver plans a front door/intake consult, eventually with the behavioral scientist. This consult usually takes place at the office of Ambiq. The demand for care must become clear in this consultation. If the behavioral scientist to discuss the consult. Afterwards, the behavioral scientist gives the definitive treatment advice. The behavioral scientist gives the definitive treatment advice as the behavioral scientist gives the definitive treatment advice. Afterwards, the ambulatory caregiver contacts the behavioral scientist to discuss the consult. Afterwards, the behavioral scientist gives the definitive treatment advice. The behavioral scientist gives the definitive treatment advice. This will be communicated with the notifier and intaker by the ambulatory caregiver. As soon as the

allocation of the municipality is received, the client is put on the waiting list for treatment. The intaker controls this process. The placement on the waiting list is the end of the intake phase.

There is no maximal duration for this intake procedure, because Ambiq is quite dependent on external parties in this process. First, Ambiq must wait until the notifier has completed the application form. Second, scheduling the front door consult can take a long time because it requires various external parties, such as the district coach and the parents. Third, Ambiq must wait until the allocation of the municipality is received. Ambiq only receives money if there is a valid regulation.

In January 2019 the front door process is changed by the steering committee process optimization and the involved employees. A step has been added between sending the application form and building the dossier. After the application form has been sent, the intaker waits until the notifier has sent a complete dossier. The intaker therefore no longer tries to get all the information, but now leaves this to the notifier. Furthermore, the secretary becomes more involved. After the information is received, the secretary fills the dossier in User and they perform several other administrative actions. The intaker is therefore less concerned with administrative tasks. Another change is that a front door consult will be conducted less often. In the new process, this consult will only be conducted if there is more than one ambulatory demand for care. With the change in this process, a maximum duration has also been assigned to each step. The maximum duration is 28 working days with the remark that the process can sometimes take longer because external parties do not provide their information. This is already included in these 28 days.

Treatment

To give clients a personal, appropriate care pathway Ambiq has developed five health care programs. Figure 2 (right) gives the decision tree about which treatment program will be followed. The five health care programs are:

- 1. Diagnostics ("Diagnostiek")
- 2. Safety ("Veiligheid")
- 3. Educate and grow ("Opvoeden en opgroeien")
- 4. Development towards independence ("Ontwikkeling naar zelfstandigheid")
- 5. Maintaining independence ("Behoud van zelfstandigheid")

The health care programs mentioned above consist of various treatment programs. Working with these health care programs aims to give clients a perspective and rough timescale on beforehand. In this way Ambiq aims to work efficient and effective towards the goals of the treatment.

The personal care pathway of a client consists of one or more treatment programs. There are 44 treatment programs in total. Appendix IV shows the most common ambulatory and inpatient treatment programs together with their average duration and the involved employees. For each client individually, they look which care he or she needs. There are many different routes for each health care program that a client can follow. In addition, there are optional treatments that can be used. Moreover, a client can transfer to another health care program

when the current health care program is completed. Having these many different care pathways is unique for health care. Comparable organizations, such as mental health care organizations, have more standardized care pathways and therefore less variation in the number of treatment programs that a client receives.

In Figure 3, the number of clients per treatment program and per region in 2018 can be found. Almost all clients will be screened (= intake), therefore this treatment program contains many clients. More than 30% of the clients will have the Intensive Orthopedagogic Family Treatment (IOG) treatment, almost 18% light guidance, 16% Psycho Diagnostic Assessment (PMT) and 13% diagnostics.

The ambulatory caregiver provides the ambulatory care. In addition, a behavioral scientist is involved who oversees the process and possibly provides treatment/therapy. Furthermore, a professional therapist can be involved. The ambulatory caregiver and behavioral scientist are not the same people as the employees in the intake. The inpatient care is provided by group leaders or professional foster parents and behavioral scientists. The demand of care determines if other employees, like a professional therapist, are needed.

Clients who receive ambulatory treatment are divided into four regions, both in Twente/Achterhoek and Noord/Midden. Twente/Achterhoek has teams in Almelo, Hengelo and two in Enschede. Noord/Midden is divided into Zuid/West, Zuid/Oost, Noord/Midden and Groningen/Friesland. Every team consists of one or more behavioral scientists, ambulatory caregivers and some behavioral scientists. The client's place of residence determines the team that will treat the client.



Figure 3 Number of clients per treatment program and per region in 2018 (source: User BI)

Termination of care

As soon as the client has reached the treatment goals the care is terminated. This process is controlled by the behavioral scientist. The care pathway ends with a final meeting with all stakeholders.

Context analysis

2.1.3 Scheduling process

Each client is individually scheduled. This scheduling process depends on the phase of care in which the client is involved. Most appointments are scheduled by the caregivers. They decide on the duration of the appointment and the duration of the treatment. The throughput time of the treatment is recorded in the care pathways. Caregivers must try to comply with these guidelines, but these guidelines are not monitored very tightly.

In general, when scheduling the appointments, much attention is paid to the wishes of the client and other external parties who must be present. This results in appointments that are scheduled at a time that suits the client or external best. In doing so, there is sometimes a lot of time between successive appointments causing a long throughput time. Besides, the appointments are mostly scheduled one at a time at the end of each session. This makes it even more likely that the process takes longer. An agenda is often fuller in the coming week than further in the future.

All appointments are scheduled via Outlook, no separate application is used. People often call or email with the people involved to make the first appointment. Successive appointments are made face-to-face. The remainder of this section describes the scheduling process per phase.

Intake

In the intake all appointments are scheduled by the ambulatory caregiver. The ambulatory caregiver contacts all those involved and schedules the appointment(s). This happens as soon as it is known whether the client can be treated by Ambiq. The number of appointments depends on the situation. In some cases, separate appointments have to be planned, for example when parents are divorced. In addition, one appointment may not provide sufficient information, which means that several appointments are needed. These follow-up appointments will then be scheduled later.

Ambulatory treatment

The ambulatory caregivers, behavioral scientists and professional therapists schedule the appointments with the clients by themselves, usually at the end of the current appointment. Sometimes, the treatment secretary schedules the first appointment. In addition, the treatment secretary schedules the external MDO's and internal consults.

Inpatient treatment

For the inpatient treatment some appointments are scheduled by the treatment secretary. They usually schedule the first appointment, discussions about the treatment plan, evaluation sessions etcetera. For some treatment programs, like the very intensive trauma treatment (ZIT), a treatment secretary schedules all appointments. The schedulers ensure that the inpatient employees are scheduled.

2.2 Planning and control

To determine the planning and control decisions regarding the described process we will use the framework for health care planning and control (Hans, Houdenhoven, & Hulshof, 2011).

Figure 4 shows an example application of this framework to a general hospital. This framework integrates four managerial areas and three hierarchical levels of control. The four managerial areas are: medical, resource capacity, materials and financial planning. The medical planning is the core business of a health care organization. These planning decisions are made by the caregivers. The other three managerial areas facilitate this medical planning. The resource capacity planning is about the planning and control of the renewable resources, like personnel and equipment. The non-renewable resources are covered in the materials planning. The financial planning is about financial management.

The managerial areas can be decomposed into three different hierarchal levels of control: strategic, tactical and operational. The remainder of this section elaborates on the decisions on every level. Since the problems that Ambiq encounters are mainly related to the resource capacity planning the focus will be mainly on this managerial area.



Figure 4 Example application of the framework for health care planning and control to a general hospital (Hans et al., 2011)

2.2.1 Strategic level

The strategic level consists of setting and enabling long-term company goals and is called the long-term planning (year and longer, dependent on the specific characteristics of an organization). This long-term planning is made based on the predictions of the demand. The mission, vision and strategy of an organisation are being translated into the dimensioning of the resources and the design and organisation of the processes (Hans et al., 2011).

There are several examples of decisions that Ambiq makes on a strategic level. At the medical planning Ambiq is developing new care pathways like the development of the very intensive trauma treatment pathway. At the financial planning, Ambiq is investing in physical facilities, like opening a parent-children center. At the resource capacity planning Ambiq makes a workforce planning and teaches its personnel.

These decisions are made by the members of the management team (MT). In terms of determining the dimension of the resources there are some hard facts on which to act, like financial numbers such as the turnover. There are, however, no predictions made based on historical and current data. Furthermore, Ambiq does not refuse any clients, so there is no maximum number of clients. Also, they do not have to meet a minimum number of treatments performed for the municipalities. The expectation is that there are going to be standards for this in the future.

Context analysis

2.2.2 Tactical level

The tactical level is the midterm planning where demand is partly known, and capacity is still flexible (Hans et al., 2011).

One component of the tactical level is staffing. Table 1 shows the FTE division among the different employee types that are delivering primary care in March 2019. For inpatient care, staffing can be determined easier than for ambulatory care. The inpatient staffing is determined in advance, based on the turnover. On average, 0.5 to 0.7 FTE civilian employees and 7 to 8 FTE pedagogical employees are required for one treatment location. With a lower inpatient occupation, the same number of employees is often still needed. The inpatient staffing of Ambiq is flexible. If an employee is absent, this can be replaced by another employee within Ambiq. If no internal employees are available, an external temporary worker is requested. Recently, ambulatory caregivers have also been deployed inpatient, which increases the flexibility. The reverse is not possible. The schedulers and cluster managers are responsible for a correct schedule.

The ambulatory staffing is inflexible. A session with a behavioral scientist or ambulatory caregiver is cancelled if this employee is absent. Often the process is then slightly postponed. Only for the "Families First" treatment immediate care is needed, so in case of an absent employee another employee or temporary worker is requested. To accommodate variation in demand, caregivers are sometimes exchanged within a profit center. However, the exchange between the two profit centers is very low. The ambulatory staffing should depend on the number and type of registrations and the current workload. Since this is not fully known, it is hard to determine the number of employees in advance. So, the supply does not increase if the demand increases.

	Twente/Achterhoek	Noord/Midden	Total
Cluster managers	8.5	7.3	15.9
Behavioral scientists	17.1	16.0	33.1
Professional therapists	9.6	13.5	23.1
Ambulatory caregiver	29.0	27.1	56.0
Group leaders / pedagogical employees	140.6	105.3	245.8
Psycho diagnostic workers	2.2	4.5	6.6
Professional foster parent / social worker	41.0	61.1	102.1
Intaker	1.8	3.3	5.1
Treatment secretary	6.4	7.9	14.3

Table 1 Number of FTE per function group delivering primary care in March 2019 (source: MIS)

Chapter 1 describes the problem of the fragmentation of tasks. Many caregivers perform many tasks. It is unclear to the caregivers how much time they can spend on each task. A caregiver, for example, can have a contract of 8 hours intake, 8 hours diagnostics and 8 hours EMDR/CGT. Often the number of hours they receive for a function is not enough. Besides, the employees have insufficient insight into their hours. At this moment, they do not

know which choices they can make on how to dedicate their time. Treating a new client is dependent on the workload experienced by the caregiver. There is no control on the number of clients that a caregiver can treat if he/she has x number of hours for a specific specialty. Employees have indicated that they would like to have some frameworks within which they can make decisions.

Other components of the tactical level are block planning and admission planning. Block planning is currently not used within Ambiq. This is, however, often used within hospitals and mental health care institutions. Also, admission planning, deciding on the number of clients and mix of clients admitted for a specialty each day, is not used within Ambiq.

2.2.3 Operational level

The short-term planning is made on the offline operational level (coming week/days) and on the online operational level (current day(s)). On these levels the demand is known, and the capacity is given. On the online operational level adjustments can be made for unexpected events (Hans et al., 2011).

To understand the planning and control on the operational level it is important to know how Ambiq manages its employees. Ambiq uses the concept of working in a result-responsible manner. This results in a lot of freedom and responsibility for the employees, which becomes clear in various ways. First, employees may determine their working hours by themselves. These working hours may (slightly) differ per week. Most employees work between 9:00 and 17:00, but some treatments require an appointment in the evening or early in the morning. Second, caregivers can decide for themselves whether the number of sessions that is determined for a treatment is too many or too little. If it turns out to be too little, caregivers can independently extent the client's treatment by increasing the number of sessions. Third, the employees themselves are responsible for ensuring that their caseload is enough. If the caseload is insufficient, the caregivers can decide to treat a new client who is on the waiting list. However, they often discover this when the employee has finished treating one of their clients. If they only look at the waiting list at that time, time will pass when the first appointment with the new client can be scheduled. This may result in a temporarily lower caseload and a longer access time for clients.

Even though the caregivers at Ambiq work in a result-responsible manner, the final responsibility remains with the cluster managers and regional directors. The conducted interviews show that they do not, however, manage the caseload of their staff and that they do not have sufficient insight into the various characteristics mentioned. The only control they have is the productivity/billable ratio, but this is still insufficiently clear and not reliable. For example, when Ambiq receives no money for a treatment the employees are not billable, but their productivity may be high.

The distribution of the clients among the employees differs per region. In Twente/Achterhoek, a weekly multidisciplinary meeting shows which client will be treated by which employee. In Noord/Midden, employees check the waiting list when their caseload is insufficient. The client who is on the waiting list first, is usually treated first. Sometimes, however, a client can be treated better by another employee. In that case the next on the waiting list client will be treated.

If there are unexpected events, for example, if a client needs care as soon as possible, this client gets the highest priority. In Noord/Midden, each day one caregiver is responsible for the urgent cases.

2.3 Current performance

Ambiq is increasingly concerned with keeping track of its performance. Monitoring performance is important to examine if internal goals are reached. Besides, one can benchmark the results with similar health care organizations to check whether the quality is (still) good. Slack et al. (2013) state: "Without performance measurement, it would be impossible to exert any control over an operation on an ongoing basis" (Slack, Alistair, & Johnston, 2013).

To develop the key performance indicators (KPIs) that are of interest for this research (2.3.2), first the current KPIs of Ambiq (2.3.1) are mapped.

2.3.1 External and internal performance indicators of Ambiq

To reach the required level of quality Ambiq must abide by external standards. In addition to these external standards, Ambiq has its own KPIs.

The external standards that Ambiq must meet is the Treeknormen. Ambiq must adhere to the Treeknormen for mental health care that includes meeting four different standards. First, the access time for acute crisis reception must be within 24 hours. Second, the access time for subacute crisis reception must be within 7 days. Third, the norm for access time for ambulatory care is that 80% of the clients can start with their treatment within 4 weeks, with a maximum of 6 weeks. Fourth, the access time for inpatient care must be, for at least 80% of the clients within 8 weeks, with a maximum of 13 weeks. Municipalities can change these norms. The intakers are responsible for keeping track of the access times of the clients on the waiting lists. Cluster managers are responsible for the earliest possible start within the Treeknormen.

The internal KPIs are evolving within Ambiq. They are currently developing KPIs for the external waiting times, throughput times per treatment program, reason of termination, turnover, goal achievement, bed occupation and existence of the allocation and outflow.

2.3.2 Key performance indicators of interest

The KPIs of interest for this research are: registrations, current number of clients on the waiting list, access times, throughput times, utilization and no-shows. In the remainder of this section we first explain the relevance and definitions of each of these KPIs. After this explanation, we will calculate each KPI.

The registrations can be defined as the total number of clients which are newly registered by Ambiq. The number of clients that are registered is important for Ambiq to generate the turnover. In addition, mapping this KPI ensures the discovery of trends in the data, so that Ambiq can respond to demand.

The number of waiting clients is a KPI maintained by Ambiq. We define a waiting client as a client who is put on the waiting list. The placement on the waiting list is an activity that happens at the end of the intake phase, as soon as it is known which treatment(s) a client need(s). In addition, a client can be put on the waiting list if it appears during a treatment that another treatment is needed. The reason why a client is (still) on a waiting list can be external or internal. An external reason for not starting the treatment can for example be that the financing is not arranged yet. An internal reason means that although the financing for the treatment program is arranged, Ambiq is unable to start treatment. For example, because there is no caregiver available. This KPI is important for forecasting the workload. In this way, Ambiq can determine how many caregivers per treatment program are required.

The access time is the time that a client spends on the waiting list before being served (Yeung, Leung, McGhee, & Johnston, 2004). This KPI is important for two reasons. First, controlled access times ensure quality of care for the client and prevents clients from seeking treatment elsewhere. Second, Ambiq needs to ensure that it meets the Treeknormen.

The total access time of a client can be split into two parts: the access time for intake and the access time for treatment, see Figure 5. The access time for intake is the time between the registration date and the actual intake of the client. This access time largely depends on external parties, since the notifier needs to provide information, which may take a while. Also, there are many people who must be present in the intake consult, so finding a date on which everyone is available can take a while. Furthermore, the actual date of intake is difficult to get out of the system. Therefore, the access time for intake will not be calculated. The access time for treatment is the time between the moment of placement on the waiting list for the treatment, this is the moment when the demand for care is clear and the allocation of the municipality is arranged, and the actual starting date of the treatment.



Figure 5 Determination of the access and throughput times of a client

Just like the access times, the throughput times are an important KPI to ensure quality of care and to prevent clients from seeking treatment elsewhere. The total throughput time of a client is the time between the start and the end of one treatment. The start of the treatment is the first appointment of the client and the caregiver, and the end of the treatment is the final appointment.

Chapter 1 described two problems related to the tasks of caregivers. Caregivers spend a lot of time on scheduling, checking and other administrative activities. This leads to their productivity appearing relatively low. Therefore, we will measure the KPI 'utilization'. The utilization is the proportion that a system is operating of the available time. We will measure this by showing the allocation of the total time of a behavioral scientist. We chose to analyze the time of the behavioral scientist, because these caregivers are the most valuable resources.

Context analysis

Chapter 1 described also another problem. The interviewees have indicated that the no-show percentage is high in this specific mental care sector. The no-show can be defined as the number of clients that do no turn up for their scheduled appointment (Bowers, Lyons, Mould, & Symonds, 2005). This can be clients that did not appear without notification, or clients that signed out too late (within 24 hours of the appointment). No shows lower the quality of care, lower the utilization of capacity and increase variability in workload. In addition, no shows are expensive for health care organizations, as caregivers are not or only partially allowed to declare this time. If and how the no shows are reimbursed differs per municipality. Finally, no shows put pressure on planning as they typically require twice the capacity, once in the initial planning and once for the replacement appointment.

Since Ambig tries to be as client friendly as possible, it is also important to measure the quality of care and the satisfaction of the clients. Although there are some questionnaires that clients fill out after they have undergone treatment, they are not asked about their satisfaction regarding health care logistics. Two KPIs that are related to client friendliness are the waiting time and the extent to which clients are treated at their preferred appointment date. The waiting time is defined as the time that a client waits in the office before being seen by a caregiver (Tran, Nguyen, Minh Nong, & Tran, 2017). Both the client's arrival time and the actual appointment time are not registered. By registering these dates in the future, this KPI can be measured by subtracting the maximum of the client's arrival time and client's appointment time from the actual appointment time. The extent to which the preferred appointment date is achieved, can be measured by subtracting the actual appointment date from the preferred appointment date for all clients, summing these differences, and dividing this by the number of clients. At the moment both KPIs can currently not be measured due to absence of data.

Two other KPIs that are important to measure, but also lack data, are the service time (actual appointment end time – actual appointment start time) and the overtime (actual appointment end time – scheduled appointment end time) (Cayirli & Veral, 2009). By registering these appointment times in the future, better predictions can be made on the duration of an appointment and the occupancy of the caregivers. In this way the appointments can be scheduled more accurately.

Registrations

Figure 6 shows the number of youth registrations in 2018 per region and per month. The total number of registrations in 2018 was 979, of which 463 in Twente/Achterhoek and 516 in Noord/Midden. There is a downward peak in the number of registrations in August and September in both regions. Figure 7 presents a graph showing the total number of youth registrations in 2016, 2017 and 2018. The total number of registrations increases every year. The negative peak in August and September occurs every year. There is a positive peak in March, July and October. The number of youth registrations varies between 49 and 99 clients, so the supply of Ambig should be flexible to meet demand in periods with high demand and low demand.

Not every registered person becomes a client who will be treated by Ambiq. In 2018, of the 516 registrations in Noord/Midden, a total of 126 clients did not receive treatment of Ambiq. These clients, however, did have multiple intake consults. This results in very expensive care, because Ambiq does not receive any money for the front door process if a client does not receive treatment.

Context analysis

The main reason that a client does not continue in a treatment after intake is that the care of Ambiq is not needed, for example because another organization can provide a better treatment for the problem at hand. Another reason is that clients have been on the waiting list for too long, for example for EMDR, and after a while it appears that care is no longer needed because they are already treated by another organization or because the mental health problems are not present anymore.



Figure 6 Youth registrations per month and per region in 2018 (source: User BI)



Figure 7 Total number of youth registrations in 2016, 2017 and 2018 (source: User BI)

Current number of waiting clients

Table 2 shows the ten treatment programs with the most clients, along with the current number of clients on the waiting list at a certain date, by example March 8. In addition, the reason why a client is on the waiting list is given. The next KPI will show clearly the course over time through the trend of the waiting lists.

Especially for the treatment programs "Diagnostiek", "EMDR/CGT" and "Gezinshuisopname" the number of clients that are on the waiting list is high. These are the same treatment programs that had a relatively high access time in 2017 and 2018. For diagnostics, the reason for waiting is in 85% of the cases external and 15% internal. For EMDR/CGT 78% of the clients are waiting due to external reasons and 22% due to internal reasons.

Treatment program	Total number of waiting clients (n=243)			External reason (n=173)			Internal reason (n=43)		
	NM	ТА	Total	NM	ТА	Total	NM	ТА	Total
Begeleiding licht	1	1	2	1	1	2			
Diagnostiek	40	26	66	35	21	56	5	5	10
EMDR/CGT	31	18	49	24	14	38	7	4	11
Gezinshuisopname	24	11	35	21	8	29	3	3	6
IOG	16	12	28	14	8	22	2	4	6
РМТ	12	10	22	10	8	18	2	2	4
Speltherapie	14	10	24	12	8	20	2	2	4
Systeemtherapie	12	13	25	9	8	17	3	5	8
Verblijf	2	4	6		4	4	2		2
Zeer intensieve behandeling	7	14	21	7	11	18		3	3
Zelfstandigheidstraining	19	9	28	17	5	22	2	4	6

 Table 2 Current number of clients waiting per region at March 8, 2019 (NM= Noord/Midden, TA= Twente/Achterhoek) (source:

 MIS)

In Chapter 1 we state that diagnostics is sometimes performed at a later stage in the care pathway of a client. A reason for this may be long access times for diagnostics, which may require interim care. Unfortunately, the number of clients that receive interim care and the duration of this cannot be determined, because the required treatments are not registered in User.

Table 3 represents the number of clients and the treatment number of the treatment program diagnostics. 69% of the clients has diagnostics as the third or even further treatment program, which means that diagnostics is indeed often performed at a later stage in the care pathway.

Treatment number	Number of clients	Percentage	Treatment number	Number of clients	Percentage
1	111	13%	10	21	2%
2	151	18%	11	12	1%
3	132	15%	12	8	1%
4	132	15%	13	3	0%
5	99	12%	14	5	1%
6	67	8%	15	3	0%
7	48	6%	16	2	0%
8	35	4%	17	1	0%
9	26	3%	18	1	0%

Table 3 Treatment number of "diagnostics" with the number of clients (source: "Kubus Excel Cube User")

Access times

The average access time of the clients per treatment program is calculated by the starting date of the treatment minus the registration date (= moment of placement on the waiting list). Only the first treatments of that client's treatment program are included. In formula, the average access time per treatment program p is:

$$AT_p = \frac{\sum_{c=1}^n S_{c,p} - R_{c,p}}{n},$$

where $S_{c,p}$ = Starting date of client *c* for treatment program *p* and $R_{c,p}$ = Registration date of client *c* for treatment program *p*.

Table 4 shows the average access times in 2017 and 2018 of the inpatient and ambulatory treatment programs that are most common. The access times of crisis reception and Families First are almost equal to zero. These treatment programs are used for clients that need care as soon as possible, so they must apply to the Treeknormen for subacute crisis reception. The access times for "Gezinshuisopname", "Zelfstandigheidstraining", "Diagnostiek" and "EMDR/CGT" in particular are relatively high, both in 2017 and 2018.

	2017		2018				2017		2018	
Treatment program (inpatient)	Access time (days)	N	Access time (days)	N		Treatment program (ambulatory)	Access time (days)	N	Access time (days)	N
Crisisopname	0.29	114	0.21	96		Begeleiding licht	3.03	266	2.53	256
Gezinshuisopname	99.66	53	55.18	54	-	Diagnostiek	68.04	207	67.84	247
Intensieve behandeling	12.94	93	22.33	47		EMDR/CGT	78.17	63	43.92	124
Zeer intensieve behandeling	28.10	76	19.37	87		Families First	0.30	119	0.28	107
Zelfstandigheidstra ining	43.18	78	44.73	56		IOG	9.25	471	14.59	478
						PMT	34.16	227	24.69	263
						Speltherapie	33.60	116	21.94	138
						Systeemtherapie	22.46	119	13.67	205
						Vaktherapie Beeldend	38.71	84	17.15	78

Table 4 Average access times per treatment program (inpatient and ambulatory) in 2017 and 2018 (source: "Kubus Excel Cube User")

Table 5-7 show the comparison of the access times for subacute, ambulatory and inpatient treatment programs that are most common with the Treeknormen. The access time of the subacute treatment programs must be within 7 days and Table 5 shows that in 2018 100% of the clients are treated within 7 days. So, the subacute treatment programs are in line with the Treeknormen. The access times of the ambulatory treatment programs "Diagnostiek", "EMDR/CGT", "IOG", "PMT" and "Speltherapie" are not in line with the Treeknormen. The treatment programs "Diagnostiek", "EMDR/CGT", "EMDR/CGT" and "PMT" do not even meet access times of 80% within the
maximum of 6 weeks while this should all be a 100%. Of the inpatient treatment programs are "Gezinshuisopname" and "Zelfstandigheidstraining" not in line with the Treeknormen.

	P(AT = 0 days)	P(AT ≤ 7 days)	P(AT ≤ 14 days)
Crisisopname	100%	100%	100%
Families First	99%	100%	100%

Table 5 Access times of the subacute treatment programs in line with "Treeknormen" in 2018

	P(AT = 0 days)	P(AT ≤ 14 days)	P(AT ≤ 28 days)	P(AT ≤ 42 days)
Begeleiding licht	92%	95%	98%	98%
Diagnostiek	38%	46%	51%	58%
EMDR/CGT	53%	57%	65%	69%
IOG	63%	71%	77%	87%
РМТ	62%	65%	72%	76%
Speltherapie	71%	72%	79%	84%
Systeemtherapie	71%	80%	84%	89%
Vaktherapie				
Beeldend	77%	79%	83%	83%

Table 6 Access times of the ambulatory treatment programs in line with "Treeknormen" in 2018

	P(AT = 0 days)	P(AT ≤ 14 days)	P(AT ≤ 28 days)	P(AT ≤ 42 days)	P(AT ≤ 56 days)	P(AT ≤ 91 days)
Gezinshuisopname	69%	69%	70%	72%	72%	72%
Intensieve behandeling	60%	66%	70%	77%	81%	94%
Zeer intensieve						
behandeling	59%	63%	77%	84%	87%	95%
Zelfstandigheidstraining	52%	52%	55%	63%	68%	80%

Table 7 Access times of the inpatient treatment programs in line with "Treeknormen" in 2018

Throughput times

The average throughput times of the clients per treatment program is calculated by the final date of the treatment minus the starting date. In formula, the average throughput time per treatment program p is:

$$TT_p = \frac{\sum_{c=1}^n F_{c,p} - S_{c,p}}{n}$$

where $F_{c,p}$ = End date of client *c* for treatment program *p* and $S_{c,p}$ = Starting date of client *c* for treatment program *p*.

Figure 8 shows the actual and target throughput times of the most common treatment programs of clients with a treatment end date in 2018. Most throughput times are actually higher than targeted. Especially, the treatment programs "intensieve behandeling", "PMT", "speltherapie" and "Vaktherapie Beeldend" have a high throughput time. The throughput times of "Begeleiding licht" and "STA! Ambulant" are within the target throughput times.



Figure 8 Actual and target throughput times of the treatment programs of clients with a treatment end date in 2018 (source: "Kubus Excel Cube User")

Utilization

Figure 9 shows the allocation of the total time of a behavioral scientist. The time distribution per task cannot be given, because this differs greatly per behavioral scientist since they all have different tasks.

The caregivers of Ambiq spend a relatively large amount of time on non-client related activities. This means that they spend a lot of time on things outside their skills. The problem is that they are not billable in this time. Behavioral scientists have a lot of administrative tasks, like keeping track of their mail, arranging indications, registrations etcetera. They are also involved in many working groups. These working groups aim to improve care. Another non-client related task that takes a lot of time is the lack of planning. Behavioral scientists spend a lot of time on determining where they should be and when, booking rooms and scheduling appointments. For this, they need a lot of internal coordination with the intakers and the treatment office. Furthermore, there is a lack of clarity regarding responsibilities. As a result, behavioral scientists perform a lot of tasks that could also be performed by lower skilled staff. So non-client related tasks take a lot of time of the highly skilled caregivers, which is expensive, and which does not belong by their specialism. These tasks can be performed by lower skilled staff.

Also, the indirect care time is relatively high, especially for those caregivers who travel a lot. Furthermore, there are many internal consultations which take a lot of time but ensure a high quality of care. It is, however, advised to reduce the number of internal consultations of the caregivers and to discuss only relevant cases in a consult.



Table 8 shows the travel time per treatment program in 2018. In general, the travel time in Noord/Midden is higher than Twente/Achterhoek. This can be explained by the size of the service area of Noord/Midden. The travel time is relatively high for the guidance treatment programs, IOG, LOG, STA! Ambulant and system therapy.

	Twente/Achterhoek		Noord/Midden			
Treatment program	Travel time (hours)	N	Travel time / client (minutes)	Travel time (hours)	N	Travel time / client (minutes)
Begeleiding licht	1663.4	213	468.6	2511.3	154	978.4
Begeleiding middel	568.8	51	669.2	37.2	9	248.2
Begeleiding zwaar	n.a.	n.a.	n.a.	397.1	43	554.1
Diagnostiek	32.8	128	15.4	261.2	128	122.4
EMDR/ CGT	78.9	56	84.6	58.8	96	36.8
Families First	416.0	118	211.5	n.a.	n.a.	n.a.
IOG	3085.5	251	737.6	6990.1	397	1056.4
LOG	590.3	84	421.6	18.2	7	156.0
Muziek/dansther apie	2.3	6	23.0	70.2	77	54.7
PMT	155.5	131	71.2	351.8	193	109.4
Speltherapie	122.3	105	69.9	228.4	65	210.8
STA! Ambulant	1264.7	54	1405.2	n.a.	n.a.	n.a.
Systeemtherapie	484.1	138	210.5	12197.8	94	7785.9
Thuis Werkt!/ VPT	0	29	0	67.6	92	44.1
Training	53.5	50	64.2	45.2	9	301.1
Vaktherapie Beeldend	34.6	20	103.8	222.3	107	124.6

Table 8 Travel time in 2018 per treatment program per region (source: "Kubus Excel Cube User")

No-show

Table 9 shows the no-show percentage per treatment program of all appointments in 2017 and 2018 and confirms this statement. Only no-show percentages for ambulatory treatments can be calculated, because no data is available for inpatient treatment programs. No targets are known about the average no-show percentage

for this specific target group. Therefore, we cannot compare the actual percentages with the targeted percentages. The no-show percentage is calculated by the number of appointments where the client did not appear or signed out too late (within 24 hours of the appointment) divided by the number of appointments the client appeared. So, the no-show percentage is a comparison to the appointments where the client appeared. In formula, the no-show per (ambulatory) treatment program *p* is:

No show_p =
$$\frac{\sum_{c=1}^{n} appointments \text{ not appeared or signed out too late}}{\sum_{c=1}^{n} appointments appeared} * 100\%$$

These high no-show percentages greatly affect the productivity of the caregivers. Furthermore, this necessitates rethinking the appointment scheduling approach (Cayirli & Veral, 2009).

Treatment programs	2017	2018
Begeleiding licht	18%	19%
Begeleiding middel	25%	22%
Begeleiding zwaar	18%	23%
Behandeling	15%	14%
Diagnostiek	6%	13%
EMDR/ CGT	6%	19%
Families First	2%	0%
IOG	18%	25%
LOG	14%	20%
Muziek/danstherapie	23%	5%
Naschoolse Dagbehandeling	75%	55%
РМТ	48%	47%
Speltherapie	28%	41%
STA! Ambulant	36%	36%
Systeemtherapie	8%	19%
Training	52%	35%
Vaktherapie Beeldend	25%	21%

Table 9 No-show percentages per treatment program of all appointments in 2017 and 2018 (source: "Kubus Excel Cube User")

2.4 Challenges for Ambiq

Chapters 1 and 2 describe the current and desired situation, which results in various challenges for Ambiq. This section elaborates on the challenges that Ambiq faces. These challenges follow from both the problem cluster and the context analysis of Chapter 2. Therefore, these challenges are added to the problems following from the problem cluster. The challenges are related to Operations Research and Management Sciences (OR/MS), an interdisciplinary branch that uses various scientific research-based principles and analytical models to improve an organization's ability to enact rational and meaningful management decisions (Hulshof, Kortbeek, Boucherie, Hans, & Bakker, 2012). OR/MS has been applied widely to resource capacity planning and control, which is argued in Chapter 1 as the focus of this thesis.

Context analysis

These challenges give a dot on the horizon for Ambiq. By solving these challenges, the processes of Ambiq can become more efficient. Each bullet represents a challenge and describes a method or model that can be used to face this challenge. Knowledge from the study program and literature was used to determine the methods/models.

- Matching client demand with supply of care
 - The number of caregivers is currently not aligned with the demand. As a result, supply and demand do not match. For example, there is currently no waiting list for diagnostics in Twente/Achterhoek and the caseload of the caregivers is low, but there is a waiting list in Noord/Midden and the caseload of these caregivers is high. A first step in matching demand and supply is forecasting the demand and understanding the demand patterns (Braaksma et al., 2014).
- Forecasting client volumes
 - At this moment, Ambiq does not predict the number of clients per treatment program. Good forecasts of demand are, however, essential for effective capacity planning. Forecasting client volumes can be done by performing a time series analysis, using queuing networks or moving averages (Archer, 1980; Armstrong, 2010; Soyiri & Reidpath, 2012).
- Mapping client flows
 - Ambiq does not know how many clients are moving from one particular specialism to another specialism. This can be mapped by using Markov models or a convolution model (Kucukyazici, Verter, & Mayo, 2011; Vanberkel et al., 2011). Furthermore, machine learning, simulation and queuing models can be used (Kovalchuk, Funkner, Metsker, & Yakovlev, 2018).
- Minimizing the travel times of the ambulatory caregivers to the clients
 - This problem is a vehicle routing problem (VRP)/travelling salesman problem (TSP), since the goal is to minimize the travelling distance. This problem can be optimized by using heuristics or exact solution methods (Du, Liang, & Sun, 2017; Nakari, 2016). Reducing the travel times will result in a higher productivity of the caregivers.
- Minimizing the access times
 - To minimize the access times of some treatment programs queuing theories, integer linear programming or discrete event simulation can be used (Bikker, Kortbeek, van Os, & Boucherie, 2015; Rais & Viana, 2011; Vanberkel & Blake, 2007). For the latter a lot of data is required.
- Minimizing the throughput times
 - To minimize the throughput times steady state equations or a discrete event simulation can be used.
- Pooling of demand and supply between the various regions
 - At this moment, the exchange of clients and caregivers within and between the various regions is minimal. By pooling demand and supply, it is easier to meet demand. This can be represented by a Monte Carlo simulation, where all decisions are fixed in advance or a discrete event

simulation, where the decisions are not fixed in advance, but which requires a lot of data (Izadi & Kimiagari, 2014; Rau et al., 2013).

- Care must become more plannable
 - By having appointments scheduled by secretaries and planners instead of caregivers and scheduling appointments further in advance, there will be more clarity for caregivers and clients. This requires investigating what is useful for (central) planning. By setting up patient categories with a similar length of stay and that require the same number of caregivers the schedule can be made.
- Maximizing the utilization of the behavioral scientists
 - The utilization of the behavioral scientists must be higher. By minimizing the indirect and nonclient related activities and maximizing the direct client contact, the utilization will increase.
- Optimizing the inpatient bed occupation
 - The inpatient occupation is not optimized, since there are empty beds. The number of caregivers, however, is the same if the beds are fully occupied or not. To optimize the inpatient occupation first the average bed occupancy, refusals and average number of group leaders/pedagogical employees per inpatient location must be mapped. Afterwards, Markov models or simulation models can be used to optimize the bed occupation (Andersen, Nielsen, & Reinhardt, 2017).

2.5 Conclusions

In this chapter we have analyzed the general care pathway of an ambulatory and inpatient client of Ambiq. A notifier refers the client to Ambiq. In the intake phase, it is determined whether Ambiq can deliver care and which care it will deliver. After the intake phase, the treatment plan is drawn. The care is terminated as soon as the treatment goals are reached.

For a few treatment programs the access times are high. Diagnostics is one of the largest treatment programs and has the largest number of clients on the waiting list. The treatment programs "EMDR/CGT" and "Gezinshuisopname" also have many clients on the waiting lists. These facts also emerged from the interviews. These interviews showed that there has always been a waiting list for diagnostics. During this study there is, however, no longer a waiting list for diagnostics in Twente/Achterhoek. This waiting list has been eliminated by hiring additional employees. Now the problem arises that there is not enough work to do for these employees. Besides, Noord/Midden still has a waiting list with a length of six months. At a glance, it appears that supply and demand do not match. This is caused by the core problem that the required capacity is not known early and results in cost-intensive/inefficient care.

In the remainder of this report we develop a framework for Ambiq to control the demand and supply on the resource capacity planning area. This framework consists of multiple hierarchical levels at which demand and supply must be coordinated to be able to organize the logistics of the primary processes well. Furthermore, we

give some recommendations for a model to obtain insight into demand and supply of care by forecasting the client volume per treatment program and constructing care pathways. These are the first steps in improving a health care organization (Braaksma et al., 2014). Accurate demand forecasts are essential in health care planning, since the forecasts provide input that is needed to be able to solve optimization problems (Rais & Viana, 2011). A clear perception of the demand can be acquired by constructing care pathways (Braaksma et al., 2014). Constructing care pathways also ensures that the client's process can be planned instead of just planning the next step (one-step planning).

By doing so, the required capacity (core problem 7) can be mapped to match the demand and supply. This can also give more insight into the relatively high access and throughput times of some treatment programs. We will also investigate how the planning can be changed (core problem 1) such that the access times and throughput times can be reduced.

We have chosen to not optimize planning, access times and throughput times for one treatment program, because this will result in a higher number of clients at the next treatment programs, since clients flow from one treatment program to another. So, optimization of one subprocess may result in suboptimal utilization of capacity. By describing the integral care process together with its capacities and processes logistic problems can be addressed the best. This is another reason why we first develop a framework to control the demand and supply.

To develop a resource capacity planning and control framework, it is first necessary to describe comparable frameworks in the literature. In Chapter 3, existing work on comparable frameworks and on operational research in the mental home health care sector is discussed. Chapter 4 describes the framework that we propose to solve the core problems based on the results of Chapter 3.

Literature review

3 Literature review

This chapter provides an overview of previous work on planning and control frameworks to match demand and supply. It reviews two topics within the relevant literature: planning and control frameworks to match demand and supply (Section 3.1) and prior operational research in the mental home health care sector (Section 3.2). Section 3.3 concludes this chapter. Appendix V provides the literature search strategy that is used.

3.1 Planning and control frameworks to match demand and supply

The need to match highly fluctuating demand with current and available capacity is one of the major challenges that managers face in any service industry (Jack, Bedics, & McCary, 2006; Klassen & Rohleder, 2001). To match demand and supply, planning and control is required. According to Slack et al., planning and control concerns *"the activities that attempt to reconcile the demands of the market and the ability of the operation's resources to deliver"* (Slack et al., 2013). It comprises integrated coordination of resources and product flows such that the organization's objectives are realized (Anthony, 1965). Planning and control decides in advance what to do, how to do it, when to do it and who should do it (Hulshof et al., 2012).

Two management activities of planning and control are demand and capacity management (Slack et al., 2013). In the health care context, demand management is the *process of identifying where, how and why patients or clients demand health care and developing the best methods of curtailing, coping with or creating demand* (Jack & Powers, 2009). Capacity management is concerned with the *capability to effectively and efficiently respond to the level of demand experienced by the allocation of key resources such as facilities, equipment and workforce* (Jack & Powers, 2009; Ridge, Jones, Nielsen, & Shahani, 1998; Smith-Daniels, Schweikhart, & Smith-Daniels, 1988).

Jack and Powers (2009) state that research on health care capacity management mostly only focus on specific subjects, such as workforce management. They signal the need for research on capacity management that addresses all capacity management activities (Jack & Powers, 2009). Zijm (2000) has found the same research gap and argues for further research on an integral planning and control framework (Zijm, 2000).

De Vries et al. (1999) and Vissers et al. (2001) presented a hierarchical framework for production control of hospitals, assuming that hospitals are organized in relatively independent business units. The framework is limited to resource capacity planning and considers all levels of planning and control (De Vries, Bertrand, & Vissers, 1999; Vissers, Bertrand, & De, 2001). The hierarchical levels are first identified by (Anthony, 1965): strategic, tactical and operational planning. Strategic planning has a long-term scope and is made by the top management. Tactical planning has a mid-term scope and is made by the middle and top management. Lastly, operational planning has a short-term scope and is executed by the lower levels of management and non-managerial staff that executes the daily activities. These three hierarchical levels are translated by Vissers et al. (2001) into 'strategic', 'patient volumes', 'resources', 'patient group' and 'individual patient' planning and control. The hierarchical levels indicate the period when decisions must be taken. A higher hierarchical level demarcates the scope of the lower hierarchical levels (Vissers et al., 2001).

Hans et al. (2011) refined the classical hierarchy of Zijm by splitting the operational planning level into the offline and online operational level. The offline operational level concerns the short-term decision making and the online operational level concerns the real-time reactive decision making in direct response to unexpected events (Hans et al., 2011; Hulshof et al., 2012). Hans et al. developed a framework presenting these hierarchical levels and including the orientation of more than one managerial area as argued by Zijm and Jack and Powers. Section 2.2 described and explained these managerial areas: medical, resource capacity, materials and financial planning. Finally, Hans et al. (2011) and Hans (2015) emphasized that to attain exceptional operational performance, integrated management of care processes is needed. All capacity dimensions must be integrated along the hierarchical and managerial levels (Hans, 2015; Hans et al., 2011).

Hulshof et al. (2012) introduced a taxonomy to identify, break down and classify decisions to be made in the resource capacity planning area. This area is defined as *"Resource capacity planning and control addresses the dimensioning, planning, scheduling, monitoring, and control of renewable resources"* (Hans et al., 2011). The taxonomy is a refinement of the framework developed by Hans et al. The vertical axis represents the same hierarchical levels as presented by Hans et al., but the horizontal axis positions different services in health care: ambulatory, emergency, surgical, inpatient, home and residential care services (Hulshof et al., 2012).

Hans et al. argued that the frameworks for planning and control that exist in the literature mostly only focus on hospitals (Hans et al., 2011). Matta et al. are one of the researchers that presented a framework for the care sector. This framework presents the hierarchy of the decisions that have to be made in the resource capacity planning area in home care (HC) organizations. Figure 10 presents this framework (Matta, Chahed, Sahin, & Dallery, 2014).



Figure 10 Hierarchy of operations management decisions in home care organizations (Matta et al., 2014)

From the frameworks emerge that decisions in capacity management can be positioned in hierarchical and managerial levels within health care organizations. The hierarchical levels indicate when decisions have to be

made. The decision making disaggregates as time progresses and more information becomes available. Aggregate decisions are made in an early stage where little information is available, while detailed decisions are made in later stages. The managerial levels demarcate the scope of the decisions, where the medical planning comprise decision making by clinicians and the other managerial areas facilitate this decision-making. An integral view across those hierarchical and managerial levels is needed.

In the remainder of this section we will elaborate on the decisions that have to be made at each hierarchical level in the resource capacity area.

3.1.1 Strategic level

Vissers et al. (2001) describe two decisions on strategic level. First, it must be decided what the range of services offered is. This involves decision making on the catchment area, target groups and specialties, investment of resources, collaboration and outsourcing. Second, a decision about the volume and capacity requirements must be made. This is dependent from the development of the activities of a health care organization.

Hans et al. (2011) and Hulshof et al. (2012) identified three strategic decisions: case mix planning, capacity dimensioning and workforce planning. These decisions involve defining the mission of the organization. The decisions can be made based on highly aggregated forecasts.

According to Matta et al. (2014) HC organizations should make five decisions on the strategic level: defining the market strategy, identifying strategic objectives, partnership selection, capacity planning and districting (Matta et al., 2014). Defining the market strategy, i.e. the types of delivered service, client profile and catchment area, and identifying the strategic objectives is more difficult in this sector than in other health care sectors. This is due to the unstable environment since the sector still undergoes relevant changes. The capacity planning is about determining the number of resources/employees. These decisions are very important to be able to meet the demand. Therefore, these decisions should be made based on accurate predictions of the demand. These predictions are, however, hard to make on this level, and health care providers do not have tools for this.

3.1.2 Tactical level

Vissers et al. (2001) argues that there are two types of decisions on the tactical level. First, a decision about the time-phased allocation is needed. This concerns the allocation of resources to specialties and patient groups. The second decision is about how the specialist-time is scheduled at patient group level. This involves decisions about the availability of the capacity of the specialist and the number of patients per period (Vissers et al., 2001).

Hans et al. (2011) describe three decisions on tactical level: block planning, staffing and admission planning. The block planning results in an allocation of resource capacity over specialties. They emphasize the flexibility on the tactical level which enables temporary capacity expansions like overtime or hiring staff (Hans et al., 2011).

Hulshof et al. (2012) describe the following steps in tactical planning: the characterization of patient groups based on diagnose, urgency and resource requirements, division of the resources among the patient groups, and the creation of aggregated blueprints.

Matta et al. (2014) describe one tactical decision in HC organizations that differs from other healthcare organizations. This concerns resource dimensioning. Resource dimensioning in HC organizations can be done per district, e.g. determining the number of behavioral scientists required in a district. Since health care providers generally lack knowledge about operations management, this sector often faces unbalanced resources among the districts. This is solved by requesting a temporary worker or by redistributing the resources resulting in increased travel times and costs. Resource dimensioning can be formulated as a multi-resource allocation problem. This can be hard to solve due to the uncertain (prediction of the) demand (Matta et al., 2014).

3.1.3 Operational level

Vissers et al. (2001) describe that on operational level it must be decided which patient is treated when. This involves scheduling the patients and allocating the caregivers to the patients.

As mentioned above, Hans et al. (2011) identified an offline and an online operational planning level. Also, Hulshof et al. (2012) describes those two planning levels. Decisions on offline operational level are the patientto-appointment assignment and staff-to-shift assignment. The online operational level involves monitoring the process, coordinating emergencies and rescheduling of elective patients.

Matta et al. (2014) identified six important operations management decisions that home care organizations should make at offline operational level: staff rostering, therapeutic project planning, operator assignment, and at online operational level: scheduling, routing and management of unplanned activities. The operator assignment and scheduling in HC organizations differ from other health care organizations, like hospitals.

The operator assignment is the assignment of clients to the caregivers. Various issues must be considered in HC organizations. First, continuity of care is specific for HHC organizations. A good relationship between the client and the caregiver is very important to successfully deliver care. Second, there must be a workload balance between the caregivers. Third, the travel times must be considered. Forth, the availability of the caregivers is important. Lastly, the districts must be considered. Some HHC organizations do have many districts to simplify the assignment problem, but in fact this reduces the optimality, since the possible number of solutions reduces. There are no studies performed on the relationship between districting and assignment problems (Matta et al., 2014).

Scheduling is quite complex in HHC organizations, due to great uncertainty inherent to the process, the service that is provided at the client's home, many clients per districts, multiple caregivers that are assigned to a client, preferences of clients for time schedules, the clients' condition, precedence relations between activities and the effect of the skills of the caregiver on the activity duration. The existent models try to minimize the travel time, overtime costs, number of uncovered visits and the maximization of client satisfaction (Matta et al., 2014).

3.2 Prior operational research in the mental home health care sector

Benzarti et al. (2013) and Sahin et al. (2015) argue that most studies on health care logistics are performed in the cure sector. This sector consists of 'cure' institutions, like hospitals, and is focused on healing and recovery. The care sector, however, consists of 'care' institutions, like disabled care and home care, and is aimed at minimizing the disadvantages of diseases, disorders and limitations (Keet, 2008).

The care sector is quite different from the cure sector in terms of the way operations are managed. The first difference is the strong preference for continuity of care in the care sector. The sequence of the care activities must be consistent with the needs of the client and these activities must be performed by the same caregivers as much as possible (Benzarti, Sahin, & Dallery, 2013). A second difference is that the clients' home must be integrated into the supply chain. As a consequence, clients need to be treated individually since they are not hospitalized, and all resources need to be synchronized. Also, the care program for a client needs to be customized, because the care pathway is dependent from the condition and social status of the client (Chahed, Marcon, Sahin, Feillet, & Dallery, 2009). To deliver good quality care, tight coordination is required between all different caregivers with different competencies. The resources are, however, not organized in the same health unit, which makes a tight coordination more difficult. The last difference is the strategic decision about the composition of the team. An organization in the care sector may choose for a single team of caregivers or multiple districts. The latter can have the advantage that caregivers have more motivation, because they can find a close collaboration inside the team, the manager can better manage the (smaller) team, and clients can be satisfied more efficiently (Benzarti et al., 2013).

To our knowledge, there are no publications that address operational research, scheduling or planning in youth (mental) health care. Studies performed in youth (mental) health care are often about the medical aspects of care and concern, for example, clinical staging, a method for a better and faster diagnosis in psychiatry (McGorry et al., 2007).

The youth mental health care is shifted from institutional care towards family-based care in the community (Burrell & Trip, 2011; Cantwell, Davidson, Elsley, Milligan, & Quinn, 2012). As a result of this shift, most clients receive 'in-home' care unless out-of-home placement is necessary (Runswick-Cole, Curran, & Liddiard, 2018).

In home care (HC) and home health care (HHC) organizations some studies are performed on operational research (Benzarti et al., 2013; Fikar & Hirsch, 2017; Sahin & Matta, 2015). Although these organizations sound the same, the services they offer differ from one another (Eveborn et al., 2009). HC services consist of providing care to clients in their homes and involves helping clients with everyday activities, like bathing and housekeeping tasks, and monitoring the daily medication regime (Eveborn et al., 2009; Matta et al., 2014). HHC services are more medically oriented and usually involves helping clients recover from an illness or injury in their homes (Eveborn et al., 2009; Fikar & Hirsch, 2017). Thus, the caregivers who provide HHC services are often registered nurses or therapists (Eveborn et al., 2009).

Literature review

Operational research in HHC and HC operations is a quite recent, but quickly evolving research area (Cappanera & Scutell, 2015). Furthermore, it appears to be a highly heterogeneous research area since studies have a different focus, study different objectives and consider different regulative settings. Nevertheless, numerous research questions are still to be investigated (Fikar & Hirsch, 2017). The interest in this research area is accelerated by an increase in the demand for HHC services. The ageing of the population, technological developments, increase of people with chronic diseases and the urge to reduce the costs contributed to this increase. The demand will continue to grow in the next decades (Chahed et al., 2009).

The operations management investigations in HHC operations can be split based on the hierarchical levels of control. At the strategic and tactical planning level, studies have been conducted on the districting and the funding problem (Benzarti et al., 2013; Blais, Lapierre, & Laporte, 2003; Busby & Carter, 2006; De Angelis, 1998; Lahrichi, Lapierre, Hertz, Talib, & Bouvier, 2006). At these levels, the coordination among the various resources is an important issue at the tactical level. Since it is difficult to forecast patient demand in HHC operations, tight coordination is extra hard. At the operational planning level, studies are performed on scheduling-routing and allocation problems (Bertels & Fahle, 2006; Eveborn, Flisberg, & Rönnqvist, 2006; Fikar & Hirsch, 2017; Redjem & Marcon, 2016). Time constraints, like precedence relations, need to be considered, because of the customized care pathway of a client (Chahed et al., 2009). Most research is done on the districting problem and the scheduling-routing problem and therefore we will elaborate on those two problems (Benzarti et al., 2013).

Districting problem

The districting decision can be modelled as a mixed integer problem. In this model, the workload can be balanced or the travel distance can be minimized. This can yield an improved service quality, because caregivers can respond faster to their clients, they have more time for direct care and they can be more satisfied, and thus more motivated, because of balanced workloads (Benzarti et al., 2013).

Scheduling-routing problem

The scheduling-routing problem of an HHC operation consists of two components: a staff rostering problem and a routing problem. On the one hand a feasible working plan for the operators must be created and on the other hand clients must be visited by the operator in a given roster using a car or public transport (Bertels & Fahle, 2006). This requires the assignment of operators to clients (on a geographical basis), working times that have been set, arrival times that have been agreed upon and designed travel routes (Cappanera & Scutell, 2015; Fikar & Hirsch, 2017). Since the scheduling and routing is often done manually, which results in sub-optimal solutions and high organizational efforts, there is a strong urge for optimization and the more efficient organization of these operations (Fikar & Hirsch, 2017; Trautsamwieser & Hirsch, 2011).

Both the staff rostering, and the routing problem are well known combinatorial optimization problems that are quite complex due to the high inter-dependencies of these two problems (Bertels & Fahle, 2006). When optimizing these problems, specially designed algorithms are needed to consider certain requirements and constraints. Figure 11 gives an overview of these constraints. In addition to the hard constraints that must certainly be met, soft constraints can be used, for example, to include preferences of clients and operators.

Rostering constraints include qualification requirements, regulations, work time limitations, workload balance measurements, continuity of care and staff and client satisfaction. The qualification requirements are quite complicated, because the operators as well as the clients are heterogeneous and spread over the operational area. The vehicle routing constraints include time windows and travel times and distances (Bertels & Fahle, 2006; Fikar & Hirsch, 2017).



Figure 11 An overview of constraints relevant to the scheduling-routing problems in HHC operations (Bertels & Fahle, 2006)

Multiple objectives are used in the literature for the scheduling-routing problem. The minimization of the travel time, travel costs and staff costs and maximization of clients and staff satisfaction are of most interest for companies (Bertels & Fahle, 2006; Fikar & Hirsch, 2017). Hence, it is important to assign higher qualified staff only to clients that need that high qualification. Furthermore, client satisfaction must be reached to ensure that clients do no switch to another health care provider and staff satisfaction is important because it increases motivation, which has impact on the clients (Bertels & Fahle, 2006). Other objectives are the minimization of overtime, waiting time, number of operators and maximation of fairness and continuity of care (Fikar & Hirsch, 2017).

Solution methods that are used in these problems include metaheuristic solution procedures, local search-based procedures, set-partitioning models, branch & pricing, and exact solutions (Fikar & Hirsch, 2017). Also, column generation, tabu search, simulated annealing and constraint programming are used (Bertels & Fahle, 2006).

In the literature, scheduling problems can be found that focus on single-period or multi-period problems. The first problem focuses on the planning horizon of one single working day. Most of the studies were conducted in this research area. The latter focuses on a longer planning period, in which continuity of care, a more complex assignment of operators to clients and working time regulations must be included in the analysis. Nevertheless, much research needs to be done on this increasing health care sector to decrease the costs and to guarantee a good quality of care (Fikar & Hirsch, 2017).

3.3 Conclusions

This chapter presented various planning and control frameworks that exist in the literature. These frameworks can be positioned in hierarchical and managerial levels. The most common used hierarchical levels are the strategic, tactical and operational level (Anthony, 1965; Hans et al., 2011). These levels indicate when decisions

Literature review

have to be made. The managerial areas in hospitals are: medical, resource capacity, materials and financial planning. The decisions on the medical planning area are made by clinicians. The other managerial areas are facilitative (Hans, 2015; Hans et al., 2011). To ensure integral management, the decisions along the three dimensions and the four managerial areas must be well-aligned.

Benzarti et al. and Sahin et al. argue that most studies on health care logistics are performed in the cure sector (Benzarti et al., 2013; Sahin & Matta, 2015). Yet, more research is needed on health care logistics in the care sector. This sector, especially the mental care sector, is in great need of more efficient solutions and to our knowledge no publications address operational research, scheduling or planning in (mental) youth health care. In HC and HHC organizations, however, some studies are performed on operational research. These organizations are quite similar to Ambiq. An important difference, however, is that Ambiq treats clients at home as well as at the office. Furthermore, Ambiq tries to treat a client in six months to two years instead of providing care until the patient dies. Also, the diversity in the competencies of caregivers is relatively large due to the diverse supply of Ambiq. Finally, the care pathway of a client at Ambiq is much more unpredictable than in most HHC organizations, partly to the disabled target group of Ambiq.

The operational research in HC and HHC organization is mainly focused on the strategic and operational level (Chahed et al., 2009). On the strategic planning level, studies have been conducted on the districting and funding problem. On the operational planning level studies are performed on scheduling-routing and allocations problems. Research on tactical planning level is largely missing. The coordination among the various resources at tactical level appears to be an important issue.

In this literature research another research gap is identified. No publications are found regarding planning and control frameworks for (youth) mental health care organizations. In Chapter 1 and 2 it is argued that the planning and control decisions on the resource capacity planning area are not well identified and classified at Ambiq. Furthermore, some decisions are made incorrectly due to absence of data and mathematical models. Therefore, we will propose a framework for mental health care organizations on this managerial area in Chapter 4. We will focus specifically on the tactical level, since the coordination among the various resources is an important issue. This framework will be based on the aforementioned frameworks and the operational research found in HC and HHC organizations.

4 General mental (home) health care framework & roadmap for Ambiq

This chapter presents a general mental (home) health care resource capacity planning and control framework. Home is put between brackets since mental health care organizations provide care at a client's home and at the office. Besides, this chapter presents a roadmap to enable Ambiq to better plan and control their processes. First, we will explain **why** we believe that mental (home) health care organizations should apply integral resource capacity planning (Section 4.1), followed by **how** the resource capacity planning at mental (home) health care organizations should look like (Section 4.2) and **what** components Ambiq should use (Section 4.3). Section 4.4 concludes this chapter.

4.1 Why should mental (home) health care organizations, like Ambiq, apply integral resource capacity planning?

From August 2019, the consultancy firm together with the employees of Ambiq have started on process optimization of all processes within Ambiq. They aim to improve the processes on operational level by means of the lean methodology. This methodology is widely used in health care organizations. It tries to achieve the three basic principles of operations management: maximization of value adding activities for clients (= minimization of waste), minimization of variability and minimization of complexity. While variability is always bad for the performance of an organization, complexity is not necessarily bad. Complexity is related to the capability of an organization and therefore these two must match. If the organization's capability is low, it is advised to reduce complexity to keep the processes manageable. If the organization's capability and minimizing complexity are contradictory. The variability can be reduced by making use of planning, but this increases the complexity. Therefore, we have to search for the optimal balance between reduction of variability and reduction of complexity, taking into account the capability of the organization, to obtain optimal reduction of waste (Hans, 2015). The tactical planning level tries to balance these three principles.

Chapter 3 showed that HHC organizations are planning mainly on operational level and partly on strategic level. On strategic level the top of the management decides upon the number and type of employees. On operational level clients and caregivers are planned for only a small part of the care process of a client (e.g. appointment(s) between a client and a caregiver). The tactical level, planning of the entire care chain, is mostly overlooked and lacks in most organizations. Even hospitals devote too little attention to the tactical level (Hans, 2015). Therefore, integral resource capacity planning is needed that connects all hierarchical levels. To be successful, the levels must be closely related to each other, which integral resource capacity planning can provide. We identified three consequences of an overlooked tactical level and a lack of integral resource capacity planning:

 Insufficient tactical planning and control results in operational challenges, such as long access, waiting and throughput times (Larsson & Fredriksson, 2018). These operational challenges have been identified in the context analysis. Tactical planning is needed to stabilize operational performance and to decrease the risk that insufficient resources and long waiting times for clients are addressed with costly shortterm fire-fighting adjustments (Hans et al., 2011).

- 2. In the problem and context analyses it has become clear that employees from different regions work alongside each other and hereby missing cooperation and coordination between specialisms and different regions and teams. Also hospitals and other health care organizations have a silo-ed organization of (hospital) departments. This results in a non-collaborating care delivery in the care pathway. By implementing integral resource capacity planning and implementing the tactical planning and control level, chain cooperation can be ensured. Coordinated decision making is needed within a care chain by all caregivers that are involved with a client's treatment to deliver effective and efficient care (Hulshof et al., 2012).
- 3. The ad hoc, operational planning creates a lot of variability which causes strong fluctuations in workload. These fluctuations can largely be reduced by planning on tactical level, because on tactical level the demand is already partly known and there is flexibility to divide the employees among the different teams and specialisms on a temporary basis in order to address anticipated problems such as a spike in demand. This is not possible on the operational planning level (Hans, 2015). An integral planning and chain cooperation on tactical level ensures planning the required capacity across departments, specialisms and entire client pathways instead of planning within a specific department, resulting in less variability on operational level.

In this thesis an integral resource capacity planning and control model is designed for mental HHC organizations. This integral approach, which considers all hierarchical levels of control, will ensure that demand and supply can be balanced and controlled and that integration and coordination among specialisms and teams, operation strategy and operational planning in the care chain can be enforced. In this way, efficiency, effectivity and steerability are created. Both the organization and the caregivers at Ambiq (and likely at other mental HHC organizations) are in great need of these three points.

4.2 How should the resource capacity planning at mental (home) health care organizations look like?

In the previous section it is made clear why mental HHC organizations should apply a framework regarding integral resource capacity planning. In this section we will explain how this framework at these organizations should look like.

Figure 12 shows the proposed planning and control framework for mental HHC organizations. This framework is based on a review of the literature (Benzarti et al., 2013; Chahed et al., 2009; Eveborn et al., 2009; Hans, 2015; Hans et al., 2011; Hulshof et al., 2012; Larsson & Fredriksson, 2018; Matta et al., 2014; van Merode, Groothuis, & Hasman, 2004; Vissers et al., 2001). It shows the time span when decisions have to be made. This depends on the information that will gradually become available. Furthermore, it shows the relation between the decisions.

General mental (home) health care framework & roadmap for Ambiq

Some decisions need the information from other decision making. In this way, the higher-level decisions demarcate the scope of the decisions on the lower levels. In other words, the strategic planning has a long-term horizon and sets the boundaries for the tactical planning that has a mid-term horizon. The tactical planning sets the boundaries for operational planning that has a short-term horizon (Jonsson & Mattsson, 2009). If this feedback loop lacks, the demand for care is unknown and therefore the resources cannot be allocated well. In addition, the framework shows the information needed to be able to make the decisions. Lastly, it shows the actors that are responsible for the decisions on that hierarchical level. The feedback loops are not visible in this framework, however, the decisions on the lower hierarchical levels give feedback about the health care delivery realization to the higher levels.



Figure 12 Integral resource capacity planning and control framework for mental (home) health care organizations

We continue this section by clarifying the decisions per hierarchical level. This will be done by following the same format as in this chapter. First, we will explain *why* planning at that level is required. Second, we will explain *how*

that planning should be approach. Finally, we will identify **what** steps need to be taken in the corresponding level and we will go through all steps in detail.

4.2.1 Strategic level

Why planning on strategic level?

To be a successful (health care) organization, an organization must have a clear understanding of the organization-wide strategy for the coming years. This strategy determines what type of clients they want to treat, the range of services they want to offer and their specific service area. These kinds of decisions need to be made 1 to 5 years in advance to ensure that enough facilities and caregivers are available to provide care to the target group. In this planning horizon a capacity expansion is (still) possible. Following from the strategy the logistic and financial objectives make the focus and direction of the organization clear to both clients, employees and other stakeholders. In this way, the strategic level provides a high-level overview on the overall balance of customer demand with available resource capacity (Voudouris, 2008).

How should the strategic planning be approached?

The strategic level should decide upon the direction in which an organization is heading for the next one to five years and translates this direction into the design, dimensioning and development of the health care delivery process (Hans et al., 2011; Vissers et al., 2001). These decisions are influenced by planning and financial restrictions which are imposed by health insurance companies and national and regional governments (Vissers et al., 2001). Since these decisions affect and shape the direction of the whole organization, the decisions should be made by the management team. They have a broad view of the organization.

The first decision that has to be made is the range of services that an organization will offer in terms of catchment area and target groups specialties. This decision must be made 2 to 5 years in advance (Vissers et al., 2001). Based on this strategy, it is determined how many physical facilities are needed and how they are distributed over the catchment area. In this context, consideration can be given to cooperation with similar health care organizations and to outsourcing. In addition, the annual number of clients per client group, the needs per client group and the service level per client group must be determined. KPIs must be drawn up to be able to measure the performance. These decisions regarding the client volumes will indicate the required capacity per client group, such that the number of FTEs per employee type can be determined. Learning paths can be developed for missing knowledge and/or specialties. All these decisions should be made 1 to 5 years in advance.

The strategic level has a high planning uncertainty. The demand is unknown and the capacity is flexible at the time the decisions needs to be made. To be able to make these decisions, mental HHC organizations should create highly aggregated, accurate (annual) forecasts of the long-term demand for services including expected trends in the demand. With these forecasts they can identify the resource requirements needed to deliver those services (Voudouris, 2008). The input data of these forecasts consists of three elements (van Merode et al., 2004; Vissers et al., 2001):

1. Demographic characteristics of the population surrounding the facilities;

- 2. Historical data regarding the number of clients and the type of care they need;
- Client volumes agreed upon with municipalities and eventually health insurance companies (municipalities are now developing some minimum number of treatments that must be performed).

Since the planning uncertainty is high, it is sufficient to predict the number of clients per client group and to produce an estimate of the resources needed per specialty.

A number of things must be taken into account to have a successful strategic planning. First, the strategy and goals of the organization must be clear and concrete. In addition, it must be clear why these goals should be achieved. Furthermore, extensive and reliable data is required to generate forecasts. Finally, it is necessary that the decisions concerning the client volumes and the required resources are consistent with each other and with the other decisions taken at the strategic planning level.

What are the steps in the strategic planning process?

The steps to be taken at strategic level are described in detail below.

Step 1: Define market strategy and strategic objectives

As a first step in strategic planning, mental HHC organizations should define a clear market strategy and strategic objectives. Deciding on the types of care that will be delivered, the client profile and the catchment area is of great importance. Typically, the care that mental HHC organizations offer is very broad. It provides many different types of care and it is possible to make an exception for a client who does not fall within the catchment area. Due to the broad supply, it is difficult for behavioral scientists to properly organize the care for the client. Moreover, due to the wide range of treatments, there can be some treatments that receive few registrations which means no production and no specialization. Therefore, mental HHC organizations must think carefully about what kind of organization they want to be, what their target group is and what type of care they want to deliver. By having a broad and vague market strategy, both the variability and complexity will increase. However, mental HHC organizations should strive for reducing fluctuations and variations in the demand, because variability results in high access times for the clients and imbalance in the workload of the caregivers. Reduction of the variability ensures a higher productivity of the caregivers and a faster access and flow for clients. We advise mental HHC organizations to eliminate treatment programs that receive few registrations and to have focus on treatment programs that contain many clients.

Michael Porter has drawn up three distinctive strategies that companies and organizations can define: cost leadership (minimizing the costs of the offered services), differentiation (maximization of the value of the offered services) and focus strategy (offer optimal service to a limited customer group) (Porter, 1985). Related to this, the three types of customer values have been distinguished by Treacy and Wiersema: operational excellence, product leadership and customer intimacy (Treacy & Wiersema, 1997). To be successful, an organization should focus on a maximum of two of the three customer values, because otherwise the organization gets 'stuck in the middle' (Oldenkamp & Boersma, 2004).

After deciding upon the market strategy and strategic objectives, mental HHC organizations have to determine the number, types and locations of physical facilities (step 2), the case mix planning (step 3) and the definition of the KPIs (step 4). These decisions can be taken at the same time and they do affect each other.

Step 2: Determine the number, types and locations of physical facilities

Typically, mental HHC organizations consist of several types of physical facilities which may be subdivided into inpatient facilities, outpatient facilities and offices. The inpatient facilities are specified for certain treatment programs, like a very intensive trauma treatment location. Based on the expected number of clients per client group and the type of care they require, the mental HHC organizations have to decide upon the number and type of physical facilities. One option is to collaborate with similar health care organizations. They can decide to share resources or to outsource some treatments/activities. It is important that this is based on the adopted strategy.

Besides the number and types of locations, a choice must be made about the location of the physical facilities. For the inpatient and outpatient facilities it is important to locate these facilities such that the maximum number of clients is covered within a maximum acceptable distance based on the catchment area. Clients base their decision for the health care provider on, among others, the distance to the provider. Also, the travel distance, and so the transportation costs, of the employees should be minimized. An efficient facility location can save costs and improve the facility utilization (Peng & Afshari, 2014).

Step 3: Determine type and number of clients treated

After deciding upon a minimum and maximum number of clients a mental HHC organization wants to treat in a year, a case mix planning could be interesting. Case mix planning concerns choosing the ideal composition and volume of clients and grouping these clients by their characteristics (Hof, Fügener, Schoenfelder, & Brunner, 2017). This is especially interesting for mental HHC organizations, because the variety of the required care in type, frequency and time is substantial. The case mix has a high impact on the other planning decisions, since the case mix will be included in these decisions. Another important point to keep in mind is the risk pooling effect. A higher volume of the same type of clients ensures less variability and a higher quality of care.

The optimal case mix is dependent from the characteristics of the client categories and the way resources are made available to one specific specialty. Therefore, the frequency of the treatment programs and the length of stay of the clients that need these treatments need to be analyzed.

Besides the type and number of clients, mental HHC organizations should also consider the placement policy. To provide clients with the right treatment at the right time in the most cost-effective manner, they should decide per type of clients whether they should receive inpatient care, outpatient care at home or outpatient care at a treatment facility (Xie, Chaussalet, Thompson, & Millard, 2007).

Step 4: Define key performance indicators

To be able to measure and evaluate the performance, mental HHC organizations have to define KPIs following from the adopted strategy. The KPIs can involve different levels of aggregation (Slack et al., 2013). Roughly they

can be classified into two categories: strategic KPIs and operational KPIs. Strategic KPIs measure the performance of the organization-wide goals and are aimed to evaluate whether the organization as a whole is heading in the direction of the market strategy and strategic objectives. Operational KPIs are specific for one specialty/department/treatment and are aimed at directing the operational goals. They provide insight into the performance of processes, departments and employees.

The KPIs mean relatively little until they are compared against some kind of target (Slack et al., 2013). Therefore, the management team should translate the defined goals into service-level standards, like maximum length of the waiting list and access times per client group and specialty (Vissers et al., 2001). These service-level standards may vary per specialty/department/treatment, as long as the overall standard is met. In other words, the service-level standards of the operational KPIs may differ slightly from each other as long as the service-level standard of the strategic KPI is met.

The following decisions that need to be made are: workforce planning (step 5), education planning (step 6) and (re)considering the districts (step 7). These decisions can also be made simultaneously.

Step 5: Determine number of FTEs

Mental HHC organizations should determine the number of FTEs of the caregivers that is required to meet future demand. At strategic level, the level of detail is: number of FTEs of behavioral scientists, professional therapists, ambulatory caregivers A and B, group leaders/pedagogical workers A and B, psycho diagnostic workers, professional foster parents/social workers, intakers and treatment secretary. In addition to the accurate predictions, the required ratio of caregivers to clients is also an important input. Both for outpatient and for inpatient care, it should be determined in general how many of each type of caregivers per time unit (e.g. week) are required for a client's treatment program.

Step 6: Develop learning paths

To improve the skills of the caregivers learning paths can be used. These learning paths can be made horizontal or vertical (Matta et al., 2014). Horizontal learning paths can be used to enhance and sharpen the skills of specialized caregivers. Vertical learning paths can be used to increase the specialization of caregivers to make them able to work more widely within the organization. These vertical learning paths can also ensure that missing specialties are filled.

Step 7: (Re)consider the districts

By determining the catchment area, mental HHC organizations should also (re)consider the districts. We propose to model this problem as a mixed integer problem and minimizing the travel distance and maximizing the workload balance, as explained in Chapter 3.

4.2.2 Tactical level

Why planning on tactical level?

Besides an organization-wide view of the planning, also a department-wide view of the planning is required. The importance of the tactical planning has already been explained above. Summarized, tactical planning is needed to ensure chain cooperation, to reallocate capacity where needed, to reduce the variability and to predict the remaining variability. Although this level is often overlooked, it is very important to consider. The planning horizon is equal to 1 to 12 months, meaning that demand is partly known, and the capacity is still flexible. Hence, it is beneficial to allocate capacities at this planning level.

How should the tactical planning be approached?

The tactical level translates the strategic planning decisions to facilitate operational planning decisions. In other words, the tactical level determines the 'what, where, how, when and who' of the primary processes (Hans et al., 2011). Since decisions are made across departments and there still is a little planning uncertainty due to the planning horizon, the middle management should make these decisions. The middle management consists of the directors of the profit centers and the cluster managers. They have a broad view of the departments, since they are responsible for multiple departments.

One of the main decisions on tactical level is the allocation of the resources to specialties, districts and client groups. In order to do so, the clients have to be characterized. This characterization can be done based on the diagnosis, urgency and resource requirements and should be performed 6 to 12 months in advance. Since the demand is partly known, the expected number of clients per client group can be estimated more precisely. Based on the characteristics of the client group, detailed capacity requirements can be set per client group. With this knowledge, available caregivers, settled at the strategic level, can be allocated to these client groups (Hans et al., 2011; Hulshof et al., 2012; Matta et al., 2014; Vissers et al., 2001). This decision should also be made 6 to 12 months in advance.

Another main decision that has to be made on this planning level is how the time of the caregivers is scheduled at client group level. The planning horizon is 1 to 6 months. Consequently, the demand for care is pretty known. An underlying choice is the expected number of clients per period and the availability of the caregiver capacity per client group that can be properly estimated due to the relatively short planning horizon. The output of the main decision is a basic roster. If it appears that there is not enough staff, temporary capacity expansions like overtime or hiring staff is optional (Hulshof et al., 2012; Matta et al., 2014; Vissers et al., 2001).

The decisions at midterm planning should be made based on the given and expected workload. The expected workload can be determined by dynamically forecasting the demand based on (seasonal) demand, waiting list information and the "downstream" demand in care pathways of clients currently under treatment. It is not needed to know the name of the clients yet, but you need to know the volume per type of client to allocate the flexible capacity.

What are the steps in the tactical planning process?

The steps to be taken at tactical level are described in detail below.

Step 1: Characterize the client groups

The first step in tactical planning should be the characterization of the client groups. This characterization should be based on the diagnosis, medical urgency and resource requirements. Medical urgency distinguishes clients into emergent, urgent and elective cases. The first class should receive care immediately, the second class requires urgent care, but can wait for a short time, the latter class can be planned in advance and can wait for a longer time. Resource requirements distinguishes clients into inpatients, clients who need low skilled staff and clients who need high skilled staff (Hulshof et al., 2012).

The client demand can be organized by compiling client flows/care pathways. Based on homogeneous process characteristics, it can be investigated where standardization is possible. This will result in uniform and efficient processes for both the clients and for the caregivers.

Step 2: Allocate the caregivers to the specialties and districts

The decision of resource allocation should be made 6 months to 1 year in advance. By considering the given and expected workload (and thereby the planned absence of staff) and the current and expected waiting lists of treatments, the staff can be allocated to the different specialties/treatments and districts. Coordination between the different specialties and districts is required to ensure continuity of care and to prevent overlap of care (Benzarti, 2012). Furthermore, the caregivers should be flexible and should be able to work in multiple districts. In this way, mental HHC organizations can respond to fluctuating demand. It is also important to consider the care pathways. If the capacity at diagnostics will be increased due to a high waiting list, for example, it can be expected that there will also be an increase in the demand in the subsequent care processes. So, in this case, a higher capacity will not solve the waiting list problem, but actually will shift the problem to another step in the care pathway. Since there is a problem with the fragmentation of tasks and staff that does not know what their tasks exactly are and have no insight into their hour distribution, it is advised to classify the caregivers in such a way that the task division is clear, they spend at least 16 hours per specialty and they have insight into their workload that they spend per specialty.

Step 3: Create a basic roster

The basic roster can be made 1 to 6 months in advance. Table 10 illustrates an example basic roster. In this basic roster, shifts of the personnel can be planned based on the current and expected demand per period and the care pathways that indicate how many sessions are needed per client group. These shifts indicate the activities that will be performed and the number of caregivers that are needed per shift. In addition, shifts will be planned for interdisciplinary team meetings and administrative tasks. The management will decide on the working times per caregiver and will decide upon the amount of time dedicated to direct care, indirect care and non-client activities. Since mental HHC organizations typically deal with high no show levels, it is also important to declare how employees should deal with these no shows. By creating these rosters on time, it becomes clear which

resources are still missing. In the tactical level, where the capacity is flexible, the middle management can decide to expand the capacity temporarily, like overtime or hiring staff.

	Monday	Monday	Tuesday	Tuesday	Wednesday	Wednesday
	morning	afternoon	morning	afternoon	morning	afternoon
Behavorial scientist	Consultation	Project and	Interdisciplinary	Examination	Examination	Examination
	hour	administration	team meeting			
Professional therapist	Therapy	Therapy and	Interdisciplinary	Therapy	Therapy	Therapy
		administration	team meeting			
Ambulatory caregiver A	Home visit	Home visit	Interdisciplinary	Intake	Consultation	Home visit
			team meeting		hour	
Ambulatory caregiver B	Intake	Project and	Interdisciplinary	Consultation	Home visit	Home visit
		administration	team meeting	hour		
Group	Group	Group	Group	Group	Interdisciplinar	Administration
leader/Pedagogical					y team meeting	
worker A						
Group	Group	Group	Group	Group	Interdisciplinar	Administration
leader/Pedagogical					y team meeting	
worker B						
Psycho diagnostic	Diagnostics	Consultation	Administration	Diagnostics	Interdisciplinar	Diagnostics
worker		hour			y team meeting	

Table 10 Example of a basic roster

4.2.3 Operational level

Why planning on operational level?

Operational planning is needed to predetermine the day to day activities of the organization. This is required to enable the organization to manage the flows and to coordinate the activities (Matta et al., 2014). Decisions regarding the execution of the health care delivery processes have to be made to deliver uniform and efficient care. Clients have to receive a project planning and must be treated by a caregiver that fits to the needs of the clients. Furthermore, the appointments and the workforce need to be scheduled to ensure that the demand of the client fits with the supply of the organization. Caregivers need a route that enables them to perform the activities in a cost-efficient way. Finally, the emergency and urgency clients need to be coordinated and in unexpected situations the activities must be rescheduled to ensure that every client receive the right treatment at the right time. Overall, the operational planning should support the strategic planning by linking the strategic objectives to the tactical objectives.

How should the operational planning be approached?

The operational planning addresses the execution of the processes. The main decision to be made is which client will be treated when. This decision concerns the scheduling of the clients for intake, admission and outpatient visits. In addition, it concerns the allocation of capacity to individual clients (Vissers et al., 2001). These execution plans can be designed at individual client level and individual resource level and should be in line with the tactical basic roster. Since the caregivers execute the day to day activities, they are responsible for the decisions on operational level. They can be supported by the cluster managers and directors of the profit centers.

General mental (home) health care framework & roadmap for Ambig

The offline operational level, the short-term advance planning, has a planning horizon of 1 to 31 days. There is little or no opportunity to plan extra staff capacity in this time horizon which is an important factor that needs to be considered in the decisions on this level. The first decision that has to be made is whether a client will receive care from the mental HHC organization. If yes, a detailed plan is made with the client regarding the place of treatment and the care requirements. This project planning should be made 7 to 31 days in advance. After the establishment of the plan together with the client, the mental HHC organization, municipalities and the notifier, a suitable caregiver should be assigned to the client. This caregiver is responsible for the individual care process of the client and should arrange that the appointments are scheduled. The caregivers should have a detailed schedule in order to be able to meet the productivity/billable ratio. Finally, the activities of an individual caregiver should be route in a cost-efficient way. The latter decision can be made 1 to 7 days in advance, when the schedule is fixed for both the clients and for the caregivers.

The online operational level manages the processes during the course of one day (Hans et al., 2011). It enables the organization to make adjustments to accommodate unexpected events. An example of an unexpected event is the arrival of an emergency or urgency client or the unplanned absenteeism of caregivers.

The decisions at this level should be made based on the given workload (= actual clients) (offline) and must react to unforeseen events (online). The demand is known in this stage, except for the emergency demand, and therefore the staffing roster can be adjusted to the tasks at hand. Since the emergency demand is not known, this type of care must be forecasted. The planning uncertainty is minimal since this type of planning is almost done real time (van Merode et al., 2004). The flexibility of the capacity is limited, because the decisions on the higher hierarchical levels have demarcated the scope for the operational level. The available capacity is leading in making decisions, the schedule of the caregivers must be filled to the maximum.

A few things are important to be able to manage the processes well. First, the level of detail is high. For the operational planning it is imperative that details such as scheduled hours are identified. Second, activities should be performed as decided. Caregivers cannot simply extend the care process of a client. They must adhere to the guidelines given at strategic and tactical level. Finally, the performance has to be measured to check whether strategic and tactical objectives are being achieved.

What are the steps in the operational planning process?

The steps to be taken at operational level are described in detail below.

Step 1: Create a project planning per client

The caregiver that is responsible for the front door process should first assess whether the client is eligible for inpatient care, outpatient care at home or outpatient care at a treatment facility or that the client is not eligible for the mental HHC organization at all. For this decision, the caregiver could rely on the strategic placement policy and should consider the social and psychological state of the client. Second, if the client is eligible, the responsible caregiver creates a project planning with the client based on the care requirements. This planning must include all treatments that are required and should indicate the hours per care type per week (Eveborn et al., 2009). This

can be estimated by using the drafted care pathways and assessing the possible variation herein. If the required treatments are not known in advance, a client should be diagnosed, after which the treatments can be determined. When the diagnosis and the required treatments are known before the treatment starts, the total throughput time of the client will be shortened, which will improve the quality of care. In addition, planning becomes easier when the treatments are known in advance. Furthermore, to ensure a high quality of care, uniformity and efficiency this project planning must be standardized as much as possible. One caregiver should be the case manager for the client. This case manager is responsible for the coordination of the entire multidisciplinary treatment. The directors of the profit centers must keep control of the access times and throughput times of the treatments.

Step 2: Assign clients to caregivers

After the project planning, the clients need to be assigned to the caregivers. We recommend assigning the clients based on the weekly demand and waiting lists and to consider continuity of care, workload balance between the caregivers, travel times and availability of the caregivers and the districts (Rais & Viana, 2011). Furthermore, it must become clear how many clients a caregiver can treat based on their contract. This provides clarity to employees and (cluster) managers. An optimized assignment can lead to considerable cost reduction and an increase in service quality (Rais & Viana, 2011). Yalcindag et al. (2016) propose a method for HHC organizations based on the Kernel regression technique to estimate the travel times of caregivers when their routes are not known yet (Yalcindag, Matta, Sahin, & Shanthikumar, 2016).

Step 3: Schedule the appointments of the clients

After the caregiver is assigned to the clients, appointments need to be scheduled in advance as much as possible. It is important to take precedence relations between appointments into account. It is recommended to schedule similar appointments at the same time every week such that structure is created in both the caregiver and the client's agenda. If the care process of a client is very uncertain, it is advised to build a robust schedule.

The extent to which appointments can be scheduled in advance depends on the variability within and between appointments in the individual care process of a client. By considering the short-term and long-term variability of an appointment and between appointments a scheduling method can be chosen. If a certain care pathway has a low variability, a centralized planning should be used whereby managers should plan the appointments. However, if a care pathway is highly variable, a decentralized planning should be used whereby the caregivers should plan by themselves. In the latter case, the caregivers could be supported by the secretary. Generally, the more variability, the more caregivers should determine the (subsequent) activities and the more robust the planning should be.

Step 4: Schedule the workforce

At the operational level, it is important to fill the roster of the caregivers to the maximum. Therefore, the basic roster should be translated into a detailed schedule for the caregivers. Table 11 illustrates an example of a

detailed schedule. By comparing this schedule with the actual activities, the caseload can be managed and the productivity/billable ratio can be controlled.

Caregiver	Monday	Tuesday	Wednesday
9.00	Consultation hour	Interdisciplinary team	Intake
9.30	Consultation hour	meeting	
10.00	Travel time		
11.00	Home visit		
12.00	Break	Break	Break
12.30	Home visit	Home visit	Home visit
14.30	Consultation hour	Home visit	Home visit
15.00	Project	Home visit	Consultation hour
16.00	Administration	Home visit	Consultation hour

Table 11 Example of a detailed schedule of caregivers

Step 5: Route the activities in a cost-efficient way

For each caregiver who visit clients at home cost-efficient routes should be constructed that determine the sequence of the activities per day. These routes should depend on the assignment of caregivers to clients and the project planning of a client. However, these two decisions should also depend on the routes. It is, for example, beneficial to assign a caregiver to a client who lives in the same area. Section 3.2 provided some theory about this decision.

Step 6: Coordinate the emergency clients

Since the emergency coordination is out of scope, we will not go into further details about this part. It is, however, an important part of the online operational planning level, which is why it is stated here.

Step 7: Reschedule at unexpected situations

In unexpected situations, such as unplanned staff absenteeism, changed visit requirements due to changed client health conditions, bad weather conditions, and incoming emergent or urgent care requests, rescheduling and rerouting is sometimes necessary (Hulshof et al., 2012). For this, rules must be made whether to request a temporary worker, replace the caregiver or postpone the appointment.

4.2.4 Evaluating and early adjustment

To guarantee that decisions at a lower planning level are taken and executed within the boundaries set at a higher planning level, a control function needs to be implemented (Vissers et al., 2001). This function measures the KPIs, controls the goods flow and controls the individual client processes. By analyzing these functions periodically, the processes can be improved. In addition, adjustments can be made as early as possible. As previously stated in the beginning of this section, these controls can be used in a feed forward way and in a feedback way.

Measure the key performance indicators

By measuring the KPIs on operational level developed in Section 2.3, setting standards and comparing these with the desired and agreed goals, the planning on the higher hierarchical levels can be adjusted. The KPIs must be constructed in such a way that decisions can be evaluated and deviations from targets can be explained (Vissers et al., 2001). Moreover, it is necessary to evaluate whether Ambiq is heading in the direction of the market strategy and strategic objectives set in the strategic planning level.

Control the goods flow

Another way to control the processes is the goods flow control which focuses on the coordination between client flows and capacities across departments. Starting from the goals about production volume and desired level of service, the goods flow control should manage the departments about at what time what needs to be produced. On operational level, monthly forecasts should be made for caregivers based on the demand.

Control the individual client processes

Another important evaluation is the control of the individual client processes. For example, checking whether the care pathway of a client does not take too long. The caregivers should be responsible for controlling the individual client processes, eventually supported by the cluster managers and directors of the profit centers. The caregiver sees clients in different stages of the care chain in the primary processes every day and therefore receives daily signals of where things go right or wrong in the processes. With relatively small effort, the caregiver is therefore able to fill the role as process manager for the client level.

Integral consultation sessions to control and adjust the processes

Integral consultations sessions at ICM consist of periodic consultations with the actors involved at strategic, tactical and operational level. These consults are needed in order to:

- Monitor and evaluate processes and logistical objectives;
- Look ahead and make decisions about the deployment of capacity in the future;
- Make agreements about how decisions are communicated to other planning levels and relevant stakeholders

Strategic planning consultations

In these consultations the final volume agreements are translated into a resource planning. In the current year, the volume agreements and the resource planning are monitored and adjusted where necessary. This leads to real volume agreements for the coming year. In addition, it ensures that the organization is financially under control. Another result of this consult is the definition of the KPIs and their standards and the establishment of the policy and rules regarding resource allocation.

Tactical planning consultations

In these consultations, decisions are taken in the midterm about the (re)allocation of shared resources to client groups and specialisms. The annual planning will be translated into period planning that are in line with the plan

horizon of the organization. Moreover, the KPIs are monitored and bottlenecks are identified and possibly passed on to the strategic planning consultations. Finally, the demand for care is being translated into the volume agreements and resource planning which is submitted to the strategic planning consultation.

Operational planning consultations

In these consultations, the day to day activities are evaluated with the aim of making optimum use of the released capacities. Bottlenecks can be passed on to the tactical planning consultations to prevent similar things from happening in the future.

4.3 What should Ambiq use of the proposed integral resource capacity planning and how should they start with this approach?

In the previous sections it is made clear why mental HHC organizations should apply integral resource capacity planning and how this approach should look like at these organizations. In this section we will use Ambiq as a case to show them which steps they should use of the proposed integral resource capacity planning (Section 4.3.1). Furthermore, we will describe how they can best start applying integral resource capacity planning (Section 4.3.2).

4.3.1 What should Ambiq use of the proposed integral resource capacity planning?

Strategic level

The first step, the defining of the market strategy and the strategic objectives is an important step for Ambiq. Like many organizations, Ambiq has created mission and vision statements. However, the current market strategy which defines the type of care that will be delivered, the client profile and the catchment area is currently too broad. Ambiq provides many different types of care and therefore requires many different resources. This results in treatment programs with a demand of only three clients per year. Therefore, we recommend narrowing down the scope and clarifying these three decisions.

The second step, determining the number, types and locations of the physical facilities, is not relevant at this time. Ambig already has several physical facilities. When a new physical facility is needed, Ambig can use mathematical models such that the maximum number of clients is covered within a maximum acceptable distance based on the catchment area and such that the travel distance of the employees is minimized. An example of a model is the center of gravity. This method is useful when the geographical position of a location is important in terms of distribution of the services. It works with coordinates on a map and shows existing facilities with respect to the proposed new facility.

The third step, determining the type and number of clients treated, is done by the planning and control department.

The fourth step is to define the KPIs. The internal KPIs are evolving within Ambiq. Currently, few KPIs measure the performance on operations management. Section 2.3 proposed several KPIs. These KPIs may be used in the future. For some KPIs, more data is needed before they can be measured. Finally, it is important to add targets to the KPIs. There are hardly any of these at the moment.

The fifth and sixth step concern the determination of the number of FTEs and the development of the learning paths. These steps are already performed at Ambiq.

The seventh step, the (re)consideration of the districts, can be improved at Ambiq. The districting decision at Ambiq is currently based on geographical characteristics and is not modelled in a mathematical way. By modelling this problem as a mixed integer problem, the travel distance can be minimized and workload balance can be maximized (see Chapter 3).

Tactical level

The first step on the tactical planning concerns the characterization of the client groups. Ambiq should base this characterization on the diagnosis, medical urgency and resource requirements. To forecast the demand, Ambiq should compile client flows.

The second step concerns the allocation of caregivers to specialties and districts. This decision is currently not made based on current and expected waiting lists and given and expected workload. Therefore, Ambiq should forecast the demand and map the current and expected workload to better allocate their resources among the regions.

The final step is to create a basic roster. This basic roster will provide clarity to employees and clients. Section 2.2 gives an example of this roster.

Operational level

The first step on the operational level is to create a project planning per client. At the end of the intake phase, mostly not all treatments that the client requires are known. Sometimes this is also difficult to indicate. Diagnostics can help to determine the required treatments. To indicate the required hours per care type per week, care pathways can be used.

The second step is the assignment of caregivers to clients. At this moment, the assignment of caregivers to clients differs at the two regions, but in both regions the caregivers decide by themselves if they will treat a client and if it fits in their caseload. We recommend assigning the caregivers based on the weekly demand. Furthermore, caregivers need to know their caseload.

The third step, the appointment scheduling, can be done more efficiently. Care pathways with a low variability can be planned by a secretary or planning department. However, if the care pathway is highly variable, caregivers should plan the appointments by themselves. The very intensive treatment program, for example, can be

scheduled centrally. It has been established for this treatment program that clients receive treatment four days a week of two weeks. The very intensive treatment, however, should be scheduled decentral. During this treatment, underlying traumas are often revealed, making it difficult to determine the type and the amount of care at the start of the care process.

The fourth step concerns the workforce scheduling. At this moment, the directors of the profit centers have no control over the actual activities of a caregiver. The directors and cluster managers should, however, realize the expected planning and production agreements per employee. Therefore, the basic roster should be translated into a detailed schedule for the caregivers. Section 4.2 showed an example of a detailed schedule.

The fifth step is the routing of the activities in a cost-efficient way. Section 3.2 discussed multiple solution methods to optimize this routing, like metaheuristic solution procedures, local search-based procedures, set-partitioning models, branch & pricing, and exact solutions. Also, column generation, tabu search, simulated annealing and constraint programming are used.

Since the emergency coordination, step 6, is going well and is out of scope, we will not go into further details about this part. It is, however, an important part of the online operational planning level, which is why it is stated here.

For the final step, reschedule at unexpected situations, rules must be made whether temporary workers may be requested, caregivers may be replaced and appointments may be postponed.

4.3.2 How should Ambiq start with integral resource capacity planning?

This section will describe the first steps that Ambiq should take regarding implementing the integral resource capacity planning.

Step 1: Decide whether to implement integral resource capacity planning

Implementing integral resource capacity planning is a strategic, permanent choice. It is important to realize that it is not a temporary decision, but an inherently complete change of the current planning and control. It is therefore essential that first an agreement is reached regarding implementing integral resource capacity planning.

As soon as it has been decided to apply integral resource capacity planning, the principles, and thereby the KPIs, can be determined. The following things must be considered:

- What performances does Ambiq want to achieve with integral resource capacity planning?
 - We believe that the end goal of using integral resource capacity planning must be that Ambiq strives for chain optimization for the client.
- What bottlenecks/problems does Ambiq want to solve with integral resource capacity planning?
- Which resources does Ambiq want to manage integrally?

- What systems, equipment and other things are required to implement integral resource capacity planning successfully?
 - To implement integral resource capacity planning successfully, there must broad support within the organization first. Secondly, there must be power to change, and employees must be motivated. This can only be achieved when all employees understand why integral resource capacity planning must be implemented. The final requirement is that Ambiq has enough and correct data to analyze the current processes.
- What are possible challenges?
 - One of the challenges of implementing integral resource capacity planning is to ensure the accuracy of the demand forecasts. Correct data is underlying to this. Inaccurate forecasts will lead to sub non-optimal plans (Voudouris, 2008).

Step 2: Decide at what level to start

When the decision regarding the implementation of integral resource capacity planning is made, the decision has to be made on what hierarchical level to start. When the organization starts at strategic level, the regional layout and strategic workforce planning are taken into consideration. Since assumptions have to be made about how the processes run at tactical level, and this level is currently overlooked, it is not possible to start on this level. When the organization starts at tactical level, the chains are first aligned. The last option is to start on operational level, whereby planning systems are first developed. This will only result in short-term gains.

We advise to start on the tactical level. This level is now overlooked but is very important. At tactical level, there is no need to know the entire strategic plan, but there is a need for a global idea of the operational processes. Moreover, aggregated demand forecasts are required on tactical level to be able to reallocate the resources. It is therefore necessary to start developing better demand forecasts. In order to do so, first clinical pathways/client flows need to be developed.

Step 3: Develop clinical pathways/client flows

The third step that Ambiq should take is to develop clinical pathways/client flows based on the historical data. This is explained in the detailed explanation of the strategic level.

Step 4: Make aggregated forecasts

The fourth step consists of making aggregated forecasts. Appendix VI describes some models for forecasting.

Step 5: Reduce the variability in demand and supply as much as possible and predict the remaining variability

In the aggregated forecasts, patterns can be recognized. Natural and unnatural variability are included in these forecasts. If there were no variability, all clients could be scheduled at one time. If there is a lot of variability, however, we can manage this variability by simply scheduling all similar appointments at the same day. So, the variability in demand and supply, the unnatural variability, can be reduced by making use of block schedules or making use of fixed capacity allocation between the regions to level the demand or to better match capacity with demand. The next step is to forecast the remaining variability, the natural variability, as good as possible. Hereby

it has to be investigated how the capacity can be deployed flexible, in order to follow the demand patterns. Through cooperation in the care chain, capacity can be allocated as much as possible and peaks in the workload can be leveled. This results in flow, better quality of care and more productivity.

Step 6: Embed the tactical planning into the organization

To embed the tactical planning in the organization, autonomy must be assigned to a person or department. This person or department is responsible for making the decisions regarding the tactical planning level. An example of such a decision is how the forecasts will be automated. In addition, this person or department must examine which dashboards are needed to be able to make these decisions.

Step 7: Measure the key performance indicators on operational level

To check and control the influence of the tactical planning, the performance must be measured at operational level. In addition, it must be investigated whether it is compatible with the information systems and whether the information systems receive the right information automatically.

4.4 Conclusions

This chapter presented a integral resource capacity planning framework for mental (home) health care organizations to enable these organizations to better plan and control their primary processes. Figure 13 presents the conclusion of this chapter.



Figure 13 The why, how and what of integral resource capacity planning (IRCP)

integral resource capacity planning should be implemented at Ambiq and other (mental) (home) health care organizations to balance and control the demand and supply at every hierarchical level. Typical for integral resource capacity planning is that it uses integration and coordination between the different hierarchical levels.

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The integral planning and control model defined all steps that are needed to implement integral resource capacity planning. By periodically analyzing the processes and having consultations on every hierarchical level, bottlenecks can be identified, and it can be controlled if an organization is heading towards the strategic planning. If there are deviations from the defined standards, early adjustment is possible.

After agreement on starting with integral resource capacity planning, Ambiq should first implement the tactical level. This level is currently overlooked. To be able to implement tactical planning, aggregated forecasts are needed. These forecasts can be made based on clinical pathways. Although Ambiq developed clinical pathways a few years ago, these are not concrete, and they are hardly used in practice. Therefore, first clinical pathways have to be developed based on the daily experience of the caregivers and data analyses.

5 Conclusions and recommendations

This chapter presents the conclusions of our research (Section 5.1) followed by the recommendations to Ambiq that have direct and indirect influence on solving the core problem (Section 5.2). Finally, an outlook is given (Section 5.3).

5.1 Conclusions

The main purpose of this research was to obtain uniformity and efficiency within Ambiq. We defined several research questions in order to realize this objective. This section will give a short answer on every research question.

The first question "What are the current processes of Ambiq, how are these processes organized and what is the performance?" is answered in Chapter 2. To answer these questions, two rounds of interviews were held with employees from both regions. The first round of interviews aimed to identify the current issues, processes and planning and control system. The second round of interviews aimed to determine a more concrete, ultimate objective of process optimization. These interviews have created awareness of employees towards health care logistics. Furthermore, strategic goals for process optimization are defined and relations between the problems have become clear. Another result of the interviews is the development of a general care pathway of the ambulatory and inpatient clients of Ambiq to visualize the current processes. In addition, the current planning and control system of Ambiq has been screened. Especially, the tactical planning and control level is overlooked. This results in logistical problems at operational level, such as long access times and long throughput times for some treatments. These operational problems have been found because of the developed KPIs. These KPIs can be used in the future to measure the performance.

The second question "According to the literature, how can the care sector be planned and controlled?" is answered in Chapter 3. This chapter presented various planning and control frameworks that exist in the literature. These frameworks can be positioned in hierarchical and managerial levels. In this literature research, a research gap is identified. There does not exist a planning and control model for mental and/or youth health care organizations. Therefore, multiple planning and control frameworks are described. Moreover, to our knowledge no publications address operational research, scheduling or planning in (mental) youth care. In HC and HHC operations, some publications have been found. These operations are similar to Ambiq, except that Ambiq has to deal with a very specific target group that needs customized care. One of the greatest issues in HC and HHC operations is the coordination among the various resources in the tactical level. This coordination is also missing at Ambiq. The various planning and control models and the prior operation research in HC and HHC organizations are used to propose a general integral resource capacity planning and control framework in Chapter 4.

The third question "How can Ambiq plan and control their processes?" is answered in Chapter 4. First, we advise mental (home) health care organizations to implement integral resource capacity planning, which connects all hierarchical levels of planning and control. This approach will create efficiency, effectivity and steerability.
Furthermore, it includes the tactical planning level. This level is currently overlooked by many health care organizations but is very important to ensure chain cooperation. Also, this level uses flexibility in demand and supply to create a more stable level of activity within the operational process. Second, we have proposed the integral resource capacity planning and control framework for mental (home) health care organizations to visualize what this approach should look like. All the decisions following from this framework are described in detail. The time span when a decision needs to be made, the information that is needed to be able to make the decision and the actors that are responsible for the decision are given. Third, we identified and described which steps Ambiq should take regarding resource capacity planning and control and we have presented a roadmap to implement the tactical planning level. The steps are: Deciding whether to implement ICM, decide at what level to start, develop clinical pathways/client flows, make aggregated forecasts, reduce the variability in demand and supply as much as possible and predict the remaining variability, embed the tactical planning into the organization and measure the key performance indicators on operational level.

Finally, the fourth question "What is the conclusion of this research and what are the recommendations for process optimization?" can be answered. We advise mental (home) health care organizations and Ambiq to apply integral capacity management and to implement the tactical planning and control level in this approach, such that demand and supply can be balanced and integration and coordination among departments, operation strategy and operational planning in the care chain can be enforced. In this approach, the required capacity is known on an highly aggregated level 1 to 5 years in advance, on a aggregated level 6 to 12 months in advance and on a detailed level 7 to 31 days in advance. This solves the main core problem, number 6 "Required capacity is not known early". Core problem, employees can schedule their appointments by themselves and do not have fixed time slots for specific treatments, is solved by implementing the proposed block schedule and by using a central planning for care pathways with a low variability. Care pathways with a high variability should be planned by the caregivers. Core problems 3 "Highly skilled staff deployed in other places" and 4 "Fragmentation of tasks" can be solved by the distribution of the caregivers among the districts and by a better coordination among the caregivers, proposed in the framework.

5.2 Recommendations

This section presents recommendations to Ambiq for the process optimization of the primary youth care processes for the benefit of their clients. The first two recommendations relate to core problem 6 (not much reliable data is being collected).

Correct data

In order to be able to measure the defined KPIs, Ambiq must register more data and the correct data. The following data is currently missing:

- Client's arrival time at an appointment (needed to measure the waiting time)
- Actual appointment starting time (needed to measure the waiting and service time)
- Actual appointment end time (needed to measure the service time and overtime)

- Scheduled appointment end time (needed to measure the overtime)
- Preferred appointment date (needed to measure the extent to which clients are treated at their preferred appointment date)

The following data is not properly registered in the system:

- Moment of placement on the waiting list
- First appointment date of a treatment program
- Last appointment date of a treatment program
- Throughput times (throughput times of 0, 1, 2 or 3 days are common in the data)

It is also difficult to get the correct data from the information systems. In this research, therefore, data from User BI and User Kubus are linked to each other using Excel and VBA.

Central data

Currently, all teams have their own Excel overviews, like the current waiting lists, throughput times of the current clients in treatment, the number of hours an employee has per task/function and so on. Ambig should try to set up the information systems in such a way that this data becomes centrally available. This will solve core problem 5 "Waiting list management is done manually through various lists".

The following points were not of direct influence on solving the core problem but are worth mentioning.

Data analysis

In this research, a difference is found in the values that User Kubus displays and the values that User BI displays. These are two other ways to analyze the data from User. We have discovered that the values about direct, indirect and travel times in User BI are incorrect. This data was obtained from the focus area "JW Zorgdata detail". The software supplier has also indicated that this focus area is still developing. From now on, analyzes about direct, indirect and travel times from User BI must therefore use the focus area "Verantwoording". In that case, the values for User Kubus and User BI tool match. Both analyses, for example, represent 7.5 minutes for an MDO of 30 minutes in which 4 clients have been discussed (30/4 = 7.5 min.) and represent 17.75 minutes for a general report of 75 minutes about 4 clients (75/4 = 17.75 min.). The data is therefore well represented.

Uniformity in the execution of the tasks

At present, many tasks are performed by different employees. An example is filling in the stop mutation. This is sometimes done by a secretary, a pedagogical employee, an ambulatory caregiver or an employee of the client administration. Uniformity is also needed here. The client administration is currently spending a lot of time checking the mutations and communicating with the person who delivered it. Uniformity can be achieved through clear task descriptions and standardized forms.

Inpatient facilities in order to enable flow for young adults

The long throughput times of some treatment programs are partly due to the fact that young adults cannot move on to the next inpatient facility. Although this is not due to Ambiq, Ambiq may provide inpatient facilities in order to enable the flow for young adults.

5.3 Outlook

Following from this thesis, Ambiq has to get started to implement the tactical level. The first step is to map the clinical pathways/client flows. This can be done by simultaneously analyzing the data and having caregivers outline the current processes. The second step is to forecast the demand based on these clinical pathways/flows. By analyzing these forecasts, natural and unnatural variability in the data can be recognized. A third step should be reducing the unnatural variability and predicting the remaining natural variability. We recommend conducting further research in suitable forecasting techniques and techniques to map the clinical pathways/client flows.

Finally, we recommend that further research is conducted on operational research, scheduling or planning in (mental) youth care.

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Appendix I: Organogram of Ambiq

Ambiq (2017)

This section gives some background information about the staff that is involved in delivering primary care.

Intaker

The intaker has the first contact with the notifier and the client. The tasks of the intaker are giving information, providing intake and placement and coordinating crisis requests. In Noord/Midden the intaker is also responsible for keeping an overview of the waiting list.

Ambulatory caregiver

The ambulatory caregiver gives direct care to the client and is mainly active in the ambulatory care. They are responsible for the preparation and implementation of the treatment plan. Some ambulatory caregivers have received more education than others and are therefore more suitable for performing complex treatments.

Behavioral scientist

The behavioral scientist has the ultimate responsibility for the treatment process of the client. They must coordinate care and perform treatment and/or therapy. In addition, they contribute to the development of treatment policy. In the intake there is a screening behavioral scientist. The screening behavioral scientist is responsible for giving appropriate treatment advice. Most behavioral scientist are responsible for multiple treatments.

Professional therapists

A professional therapist is responsible for preparing and implementing a work plan. There are vision therapists, music therapists, psychomotor therapists, play therapists and family therapists

Pedagogical employees

Pedagogical employees act as personal counselors for clients that are inpatient. In addition, they also perform a part of the treatment plan.

Schedulers

The schedulers have to realize the schedule for the inpatient employees: pedagogical employees and civilian employees.

Treatment secretary

The treatment secretary performs administrative tasks regarding client administration. Furthermore, they schedule some appointments. In Twente/Achterhoek they also keep track of the waiting lists.

Cluster managers

The cluster managers lead the inpatient employees, professional therapists, pedagogical employees and ambulatory caregivers. In addition, they are responsible for developing, implementing and controlling tactical policy.

Profit center director

The profit center director manages the behavioral scientists and cluster managers. There is one director for each profit center.

Appendix II: Results of the interviews about the strategic goals and KPIs

This appendix shows the general interview scheme, followed by the summary of the findings, of the interviews about the strategic goals and KPIs. The questions and summary are written in Dutch because otherwise possible translation errors may occur which leads to a bad interpretation of the results.

Interview scheme

Doelen interviews:

- Erachter komen wat de strategische doelen m.b.t. procesoptimalisatie zijn
- Erachter komen wat de KPIs zouden moeten zijn en hoe je de prestatie van bijvoorbeeld een diagnostiek proces dus het beste kunt meten

Hoofdonderwerp	(Mogelijke) vragen
Eindbeeld van	Wat zou het eindbeeld van procesoptimalisatie (bijvoorbeeld over 3 jaar) moeten zijn?
procesoptimalisatie	Wat moet er feitelijk opgelost worden? Wanneer is het een succes?
Doelen afdeling	Welke doelen wil jullie afdeling/medewerkersgroep bereiken?
	Zijn er externe doelen/KPIs van jullie afdeling waar Ambiq zich aan moet houden?
Торѕ	Welke onderdelen moeten binnen de huidige processen onveranderd blijven? Waarom?
Voldoende verbeterd	Wanneer zijn de processen voldoende verbeterd?
Verantwoordelijkheid	Wie zou er verantwoordelijk voor de processen moeten zijn?
Prestatie/KPIs	Hoe zou de prestatie van bijvoorbeeld het diagnostiek proces gemeten moeten worden?

Summary of the findings

Eindbeeld van procesoptimalisatie

- Zoveel mogelijk streven naar eenheid van de processen en hiervan een duidelijke procesbeschrijving hebben
 - Ondanks dat gemeenten veel verschillende eisen kunnen hebben moet Ambiq proberen zoveel mogelijk één te zijn
 - Ook verschillen in arbeidsovereenkomsten/contracten moeten zoveel mogelijk geëlimineerd worden
 - Er zijn op dit moment teveel keuzes, de variatie moet uit de processen gehaald worden
 - Door eenheid in de processen weten medewerkers wat ze moeten doen en heb je overal dezelfde dienstverlening
- Duidelijke taakomschrijvingen, zodat het duidelijk is wie wat wanneer doet
- Meer sturing op en meer inzicht in doorlooptijden, wachttijden etc.
 - Processtappen moeten sneller, er moet eerder begonnen worden (ook ondanks dat gemeenten niet snel reageren) en er moet eerder afgerond worden (trajecten lijken langer te duren dan nodig is)

- Wanneer er x aantal sessies van tevoren afgesproken zijn, moeten er ook maximaal x aantal sessies uitgevoerd zijn aan het eind van het traject
- Zo snel mogelijke afhandeling van het dossier, zodat de behandeldoelen zo snel mogelijk behaald zijn
- Zorg op maat leveren
- Processen moeten in elkaar overvloeien
- Softwaresystemen moeten goed op elkaar aansluiten en aansluiten op de praktijk en het aantal softwaresystemen moet zoveel mogelijk gereduceerd worden
- Planbare zorg en inzet
- Continuïteit van zorg: niet te veel verschillende zorgverleners die één cliënt behandelen

Onderdelen die onveranderd moeten blijven

- Cliëntgerichtheid
- Zorg op maat
- Hoge expertise van de zorgverleners

Processen voldoende verbeterd als:

- Efficiëntie
- Meer houden aan afspraken/zorgpaden

Prestatie/KPIs:

- Cliënttevredenheid
- Lage doorlooptijd, waardoor je bij bijvoorbeeld diagnostiek z.s.m. weet wat er aan de hand is
- Doorlooptijd conform zorgprogrammering
- Lage toegangstijd, vooral bij diagnostiek
- Instroom snel, cliënten snel in zorg

Appendix III: Results of the interviews about the problems employees face regarding process optimization

This appendix shows the general interview scheme, followed by the summary of the findings, of the interviews about the problem's employees face regarding process optimization. The questions and summary are written in Dutch because otherwise possible translation errors may occur which leads to a bad interpretation of the results.

Interview scheme

Inleiding:

- Voorstellen
- Afstudeeronderzoek Technische Bedrijfskunde, vraag van Ambiq: *Hoe krijgt Ambiq het zorglogistieke* proces ten behoeve van de cliënt geoptimaliseerd?
- Toestemming opnemen interview (alleen voor mezelf)

Doelen interviews:

- Meer te weten komen over de organisatie & functies binnen Ambiq
- Erachter komen waar jullie als medewerkers tegen aan lopen bij de dagelijkse werkzaamheden en wat jullie visie is op het huidige zorg logistieke proces

Hoofdonderwerp	Sub onderwerp	(Mogelijke) vragen		
Algemene	Functie	Wat houdt uw functie precies in? Hoeveel uur werkt u in de		
vragen		week?		
		Hoe lang werkt u nu bij Ambiq en hoe lang deze functie?		
		Ook nog bij andere (soortgelijke) organisaties gewerkt?		
		Zo ja, later vragen naar overeenkomsten en verschillen hiermee.		
	Dagelijkse bezigheden	Wat zijn uw dagelijkse bezigheden? Hoe ziet een dag eruit?		
		Welke directe zorg levert u? En welke indirecte zorg levert u?		
		Wat is de verhouding hiertussen? Hoeveel directe zorg, hoeveel		
		indirecte zorg?		
		In hoeveel gevallen komen jullie bij de cliënt en in hoeveel		
		gevallen komt de cliënt bij jullie?		
	Andere functies	Met welke collega's (andere functies) werken jullie samen?		
		Hoe is de communicatie?		
		Hoe komt de takenverdeling tot stand?		
	Werkdruk	Hebben jullie genoeg tijd voor het uitvoeren van jullie taken? (E-		
		learning, reistijd, aandacht cliënt, rapporteren, inlezen)		
	Knelpunten &	Waar loopt u in uw dagelijkse werkzaamheden (regelmatig)		
	verbeterpunten	tegenaan?		
		Waardoor komt dit?		
		Wat zou volgens u beter kunnen bij de ambulante zorg?		
		Wat zou volgens u beter kunnen t.a.v. het zorg logistieke proces?		
		Cliëntperspectief		
		Personeelsperspectief		
		Organisatieperspectief		
1				

Zorglogistiek	Planning	Hoe plannen jullie op dit moment?
		Wat plannen jullie zelf? Wat wordt door anderen gepland?
		Walke eliäntengraan nlannan jullis in?
		weike clientengroep plannen julie in?
		Wanneer plannen jullie dit? Gedurende de behandeling of al van
		tevoren?
		Wat zijn hjerin de normen?
		Via walk programma plannan jullia dit?
		via weik programma plannen julie dit?
		Verschilt het kritieke pad (volgorde zorgactiviteiten) erg per
		cliënt?
	Capaciteit	Wat is de capaciteit van het aantal cliënten? Wie doet de
		canacitoitanlanning?
		capaciteitspianning:
		Wat is de capaciteit van het aantal cliënten per medewerker?
	Toegangs-/wachttijd	Is er op dit moment een wachttijd voor cliënten?
		Wat is de maximale wachttijd voor cliënten? Wanneer gaat de
		wachttijd in?
		Zeggen clienten of hun ouders wel eens iets over de wachttijd?
	Doorlooptijd	Hoe is de doorlooptijd voor cliënten op dit moment?
	No show	Wat is het percentage no show cliënten (cliënten die zich niet
		afmelden voor de richtlijn van 24 uur van tevoren?
		Waarom zoggon cliënton af2
		Valt dit te voorkomen?
		Wat zijn de gevolgen hiervan voor jullie?
	Spoed	Behandelt u ook spoedcliënten?
		Hoe worden deze ertussen gepland?
	Verschillen tussen regio's	Wat zijn de verschillen tussen de uitvoering van processen in de
	verschnien tussen regio s	vvat zijn de verschmen tussen de uitvoering van processen in de
		regio Twente en Noora-Wildden?
		Is het een probleem dat deze verschillen er zijn?
	Knelpunten &	Wat vindt u van de logistiek en planning van de cliënten binnen
	verbeterpunten	Ambia?
	· · · · · · · · · · · · · · · · · · ·	Wat is er positief/negatief?
		7 ¹ / ₂ and the standard st
		Zijn er verbeteringen mogelijk?
		Wat vindt u van de logistiek en planning van de medewerkers
		binnen Ambiq?
		Wat is er positief/negatief?
		7iin er verheteringen mogeliik?
		Llee zien jullie de glegging het liefste, zeuglusen de gliënt ele
		Hoe zien julie de planning net liefste, zowei voor de client als
		voor de medewerkers?
Onderzoek van	Centrale planning	Hoe zou dat er idealiter uitzien?
adviesbureau		
	Vooruitplannen	Afspraken/trainingen worden vooruit gepland met de cliënt.
		heschikhaar via cliëntnortaal
		is dat realistisch?
		Is dat wenselijk?
	Contactmomenten via	Contactmomenten alleen fysiek indien noodzakeliik voor
	videoconferencing	behandeling anders gebruik van videoconferencing
	hacocontenenting	benandeling, anders gebraik van videocomereneing
	Cradaring	la hat magaliik am hii da inteka asa madatia asa ta husuna. '
	Gradering	is net mogelijk om bij de intake een gradatie aan te brengen in
		de complexiteit van casussen en daarmee te komen tot één of
		meerdere varianten van de screening die geen of minder inzet
		vergt van bepaalde functiegroepen die nu betrokken zijn?
Clat		Ale u con situatio in do porglaciatiol, readers all'estar marche
JOI		Als u een situatie in de zorgiogistiek rondom clienten mocht
		veranderen, wat zou u dan het liefst willen veranderen?

Summary of the findings

Toegangs-/wachttijd

- Lange wachtlijsten komen onder andere doordat zorgverleners een hoge caseload hebben of doordat zij zeer zware casussen hebben. Ook kan dit komen door pieken in de aanmeldingen (bijv. voor de zomervakantie) of doordat er een medewerker ziek is.
- De toegangstijd van diagnostiek was lange tijd heel lang. In Twente/Achterhoek is deze inmiddels aanzienlijk korter aangezien er meer personeel is aangenomen.
- Een aanmelder vindt het vooral lastig als een intakefunctionaris niet kan vertellen hoe lang de wachtlijst is.
- De toegangstijd van diagnostiek en traumabehandeling (EMDR, CGT) in Noord/Midden zijn rampzalig. Dit kan komen door onvoldoende capaciteit (personeel wordt op andere plekken ingezet, bijvoorbeeld ZIT), schaarste op de arbeidsmarkt en de kosten om nieuw personeel aan te nemen.
- Door een lange toegangstijd bij diagnostiek vindt diagnostiek te laat in het zorgproces plaats. Een cliënt kan al behandeld zijn, waarna later nog diagnostiek wordt uitgevoerd.
- In Noord/Midden houden de intakefunctionarissen een in- en uitstroomlijst van cliënten bij. Daardoor zouden hulpverleners kunnen zien welke soort cliënten eraan zitten te komen.
- De toegangstijden zijn in Twente/Achterhoek verdeeld per stad.
- Medewerkers denken soms dat er nog hoge toegangstijden zijn, doordat deze er vroeger waren. Er is hierdoor geen algemeen goed inzicht in de huidige toegangstijden.

Doorlooptijd

- Doorlooptijden zijn soms lang, omdat medewerkers langer met een behandeling doorgaan dan nodig is. Medewerkers hebben moeite om een traject met een cliënt af te sluiten. Hier ligt een grote rol voor de gedragswetenschappers om de ambulant hulpverleners hierop aan te sturen. Er moet hier meer controle op komen en ze moeten er strakker op zijn. Het moet niet meer kunnen dat er te makkelijk een maand bij een traject aangeplakt wordt.
- Intramuraal is de doorlooptijd lang. Cliënten kunnen niet doorstromen naar een woonplek met begeleiding, omdat er bij externe organisaties geen plek is. Cliënten blijven hierdoor bij Ambiq terwijl de behandeling al klaar is.
- Een nulmeting hoe lang de doorlooptijden zijn en vooral waarom doorlooptijden langer duren is onbekend.
- De intakefunctionaris en gedragswetenschappers zijn hier momenteel verantwoordelijk voor. De intakefunctionaris houdt doorlooptijden handmatig bij door in te vullen wanneer de cliënt vertrekt.
- De doorlooptijden zijn uitgeschreven in de zorgpaden. Het is alleen de vraag of deze reëel zijn. Deze zouden geëvalueerd moeten worden.
- Binnen Ambiq wordt er zorgvuldig gekeken naar wat een cliënt nodig heeft. Iedereen doet heel er zijn best om zorg op maat te maken. Zorgverleners hebben de intentie om de doorlooptijd zo kort mogelijk te laten zijn.

No show

- Het hoge no show percentage komt mede door de vrijblijvendheid, als er geld voor gevraagd zou kunnen worden zou het no show percentage naar verwachting lager zijn. Gemeenten zien al wel iets strakker toe op no shows. Het is maar de vraag of een herinnering via een SMS-code zal werken voor de doelgroep van Ambiq.
- De cliënten van Ambiq gaan niet bellen dat ze niet kunnen komen, ze komen gewoon niet opdagen.
- Vooral in de eerste afspraken met een cliënt is er vaak sprake van no show.

Appendix III: Results of the interviews about the problems employees face regarding process optimization

- De no show kan mogelijk verlaagd worden door met cliënten elke week op hetzelfde tijdstip af te spreken.
- Wanneer cliënten naar het kantoor van Ambiq moeten komen is de no show stukken hoger dan wanneer medewerkers bij de cliënt op school/thuis komen. Daarom worden veel afspraken op school/thuis gepland.
- No show komt doordat cliënten een afspraak spannend vinden, omdat zij geen klik met de zorgverlener hebben of doordat zij het belang van een afspraak niet in zien. Intramurale cliënten worden herinnerd aan een afspraak door de groepsleiders.
- Ambiq mag hier zakelijker in zijn, cliënten hebben niet door wat het kost.

Knelpunten en verbeterpunten zorglogistiek

- Het duurt soms lang voordat cliënten worden doorgezet naar een behandeling, dit komt door de wijkcoach (toewijzing niet geregeld), financiering die nog niet binnen is of drukte bij de medewerkers.
- Bezettingen (aantal cliënten en aantal personeel) zouden eerder bekend moeten zijn, zodat medewerkers beter gepland kunnen worden op de verschillende locaties en behandeltrajecten en de kosten verlaagd worden.
- De logistiek in de voordeur moet verbeterd worden. Er moet hier meer capaciteit worden ingezet, omdat er nu te veel gevraagd wordt van de intakefunctionarissen die te maken hebben met veel verschillende eisen van gemeenten.
- Er missen nulmetingen over hoe de zorglogistiek er op dit moment voor staat.
- In de voordeur moet al duidelijk worden wat een cliënt heeft, zodat het zorgproces zo goed mogelijk voorspeld kan worden.
- Medewerkers plannen per keer en plannen niet vooruit. Door dit wel vooruit te plannen is het voor zowel cliënten als medewerkers duidelijker wat ze kunnen verwachten.
- Er is veel aanbod binnen Ambiq, waardoor het als gedragswetenschappers lastig is om alle verschillende zorg voor de cliënt te organiseren en hier één plan voor de cliënt van te maken.
- Intramuraal zijn er lege plekken. Wanneer er onverwachts iemand intramuraal uitvalt moet er snel gehandeld worden om een nieuwe cliënt te plaatsen. Medewerkers doen er dan soms lang over om te reageren om een cliënt te plaatsen. Daarnaast moet het idee van een perfecte plaatsing eraf. Als je echt de juiste cliënt op een locatie wilt hebben duurt het te lang voordat een lege plek gevuld is.
- De communicatie tussen groepsleiders, intakefunctionarissen en behandelaren gaat niet altijd goed.

Knelpunten en verbeterpunten buiten zorglogistiek

- Mutaties in roosters van medewerkers worden vaak laat aangevoerd/aangegeven.
- Veel verschillende personen bemoeien zich nu met de beschikkingen. Door hier een afdeling voor toe te wijzen wordt het efficiënter en tevens duidelijker voor externen.
- De cliëntadministratie moet er als laag tussen uit bij het aanmaken van bijvoorbeeld een start mutatie. Dit kan beter door de secretaresse gebeuren, aangezien er anders allemaal communicatie over en weer is om dingen duidelijker te maken.
- Op dit moment moeten secretaresses veel verschillende zaken controleren of dit gebeurd is, bijvoorbeeld of zorgovereenkomsten zijn ondertekend en of verslagen zijn gemaakt). Dit kan meer geautomatiseerd worden.
- Doordat er steeds meer mensen aanwezig moeten zijn bij een afspraak is het plannen van afspraken steeds lastiger, waardoor er een langere tijd overheen gaat. Daarnaast zijn er communicatie problemen, waarbij bijvoorbeeld een secretaresse nog een afspraak probeert te plannen waarbij achteraf blijkt dat dit niet meer nodig is.

Appendix III: Results of the interviews about the problems employees face regarding process optimization

• De agenda's in User en Outlook lopen niet synchroon, waardoor er in twee verschillende agenda's moet worden geregistreerd.

Appendix IV: Treatment programs

Treatment program	Туре	Duration Norm	Employee
Families first	Ambulatory	4 weeks	Ambulatory caregiver
			Behavioral scientist
Basic diagnostics	Ambulatory	1 week	Psycho diagnostic worker
			Behavioral scientist
Specialistic diagnostics	Ambulatory	? weeks	Psycho diagnostic worker
			Behavioral scientist
IOG basic	Ambulatory	6 months	Ambulatory caregiver
			Behavioral scientist
IOG	Ambulatory	9 months	Ambulatory caregiver
			Behavioral scientist
LOG	Ambulatory	12 months	Ambulatory caregiver
			Behavioral scientist
System therapy	Ambulatory	20 weeks	System therapist
Other therapy	Ambulatory	20 weeks	Therapist
STA! Ambulatory	Ambulatory	12 months	Ambulatory caregiver
,	,		Behavioral scientist
STA! Part-time	Ambulatory	12 months	Ambulatory caregiver
	,		Behavioral scientist
			System therapist
			Therapist
			Psychiatrist
After-school child care	Ambulatory	9 months	Ambulatory caregiver
Independence training	Ambulatory	6 months	Ambulatory caregiver
	,		Behavioral scientist
Training group	Inpatient	?? weeks	Group leader
			Behavioral scientist
Crisis	Inpatient	6 weeks	Civilian employee
			Group leader
			Behavioral scientist
Parent Child Treatment	Inpatient	6 months	Civilian employee
center (OKB)			Group leader
			Behavioral scientist
Intensive treatment	Inpatient	9 months	Civilian employee
			Group leader
			Behavioral scientist
Verv intensive treatment	Inpatient	9 months	Civilian employee
(ZIB)			Group leader
			Behavioral scientist
Very intensive trauma	Inpatient	4 days per	Group leader
treatment (ZIT)		week for 2	Behavioral scientist
		weeks	
Independence training	Inpatient	9	Civilian employee
		months??	Group leader
			Behavioral scientist
J-SGLVB	Inpatient	3 years	Civilian employee
		,	Group leader
			Behavioral scientist
Family home	Inpatient	1,5 years	??
Adult care	Inpatient	>12	Civilian employee
		months	Group leader
			Behavioral scientist

Appendix V: Literature search strategy

Table 12 shows the overview of search strings used in Scopus, Web of Science and Google Scholar. Exclusion criteria that we used were papers focused on medical or financial aspects (not focused on resource capacity planning), ERP-databases (too narrow for the chosen scope) and papers with a sole focus on health care (too broad for the chosen scope).

Search string	Scope	Date of search	Data range
"operation* research" OR	Title, keywords and	May-15	2005 (peak in the number
"Problem" OR	abstract		of documents)
"optimization" AND			
"home health care"			
"capacity management"	Title, keywords and	May-15	2000
AND "Planning and	abstract		
control" AND "hospital*"			
OR "health care"			
"resource capacity	Title, keywords and	May-20	2000
planning" AND "Planning	abstract		
and control" AND			
"hospital*" OR "health			
care"			
"resource capacity	Title, keywords and	May-20	2000
planning" AND "Planning	abstract		
and control" AND			
"hospital*" OR "health			
care"			
"operation* research" OR	Title, keywords and	May-20	2000
"Problem" OR	abstract		
"optimization" AND			
"mental health care"			

Table 12 Overview of search string in Scopus, Web of Science and Google Scholar

Appendix VI: Models for forecasting

Health forecasting is the process of predicting future health situations based on historical data such that health organizations can better allocate resources and manage demand (Soyiri & Reidpath, 2012). In addition, the information can be used to support decision making, like deciding how many clients can be admitted at a time and deciding how many resources are needed at what time (Matta et al., 2014). So, forecasting serves as a basis for planning (Ozcan, 2009).

Figure 14 presents one way to classify the different methods of demand forecasting. To forecast demand, qualitative and quantitative methods can be used. Most studies are focused on quantitative methods, because of better accuracy (Rais & Viana, 2011). The qualitative methods depend upon the experience of people, and hence are intuitive and judgmental (Archer, 1980; Armstrong, 2010; Soyiri & Reidpath, 2012). This is an appropriate method if there is insufficient data. A widely used, effective method to reach consensus of a group experts is the Delphi method (Archer, 1980). The quantitative methods are statistical approaches and can be split into time series and causal models (Archer, 1980; Armstrong, 2010; Soyiri & Reidpath, 2012). Time series models extrapolate the historical data and analysis linear, exponential trend and/or cyclical changes (Archer, 1980). It assumes that the future will follow the same patterns as the past (Ozcan, 2009). This analysis requires sufficient data for the dependent and independent variables (Soyiri & Reidpath, 2012). Causal models explore cause-and-effect relationships by using leading indicators to predict the future. The models can be linear or nonlinear and relate demand to explanatory variables (Archer, 1980; Armstrong, 2010; Soyiri & Reidpath, 2012). Linear models include regression analysis and index. Non-linear models, also called classification models, include segmentation (Armstrong, 2010).



Figure 14 Classification of the methods of demand forecasting

The forecasting process can be split into 6 steps (Ozcan, 2009):

- 1. Identify the goal of the forecast
- 2. Establish a time horizon
- 3. Select a forecasting technique
- 4. Conduct the forecast

- 5. Determine the accuracy of the forecast
- 6. Monitor the forecast