

Efficiently planning Megas at the Court of Law Amsterdam

Master Industrial Engineering and Management

B. Marsman BSc. (Britt)



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Efficiently planning Megas at the Court of Law Amsterdam

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Internal supervisors

Dr. Ir. J.M.J. Schutten (Marco)

I.M.W. Schrader MSc BA (Ieke)

External supervisors

Drs. Ing. A.W.M.L de Haan-Bot (Lydia)

Mr. A.M.M Spiekerman (Anita)

By

B. Marsman BSc (Britt)

b.marsman@student.utwente.nl

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Management Summary

This research addresses critical challenges in the planning and scheduling of legal proceedings at the Court of Law Amsterdam, with a specific focus on complex cases known as Megas. These cases demand significant resources and time commitments from judges and clerks, posing complexities in resource allocation and time management. The research aims to identify how the planning and scheduling of Megas can be done efficiently, ensuring a more even distribution of cases over time and optimizing resource utilization.

The Court of Law Amsterdam holds a pivotal position in the Dutch judicial system, handling a diverse range of cases annually and playing a crucial role in upholding the rule of law in the region. However, the uneven distribution of Mega cases throughout the year, unforeseen cancellations, and security concerns present challenges in planning and scheduling.

The described problem leads to the formulation of the main research question:

'How can the Court of Law Amsterdam optimize the process of planning and scheduling Megas?'

Breaking down the main research question into several sub-questions allows for exploration of the current Mega planning situation, review of available literature on planning frameworks, analysis of the gap between current practices and ideal framework, following from literature and practice, and the development of support tools for decision-making.

The study aims to provide valuable insights and recommendations to streamline planning and scheduling processes at the Court of Law Amsterdam, enhancing resource allocation efficiency and improving the overall effectiveness of legal proceedings. By leveraging insights from the literature on planning and control frameworks in other fields, such as manufacturing, healthcare, and project scheduling, the research bridges the gap in the existing research landscape within the Court of Law Netherlands.

In the area of planning and control, various frameworks have been developed, emphasizing hierarchical decision-making structures. These frameworks integrate technological and logistical planning, capacity planning, and materials coordination across different time horizons. Strategic decisions involve long-term resource planning, including workforce capacity dimensioning and case mix planning in healthcare contexts. Tactically, decisions revolve around capacity allocation and admission planning. On the operational front, resource-constrained project scheduling, workforce scheduling, and rescheduling are common challenges addressed.

The proposed hierarchical planning framework integrates strategic, tactical, and operational levels of control, addressing deficiencies in current planning functions and processes. We identify several deficiencies, including the lack of a clear plan for accepting cases and allocating resource capacity and the absence of a dedicated Mega scheduling tool. Additionally, the current planning horizon and frequency posed challenges, particularly in aligning with the organisation's and external parties' needs.

We propose a redesign of the hierarchical planning framework to address these issues. This includes refining the planning horizon and frequency and implementing a rolling horizon approach. We recommend introducing a rolling horizon of 1.5 years with a planning frequency of every three months at the tactical high level. Next, we recommend keeping the planning horizon of ten months with a rolling planning frequency every two months at the tactical low and operational levels.

Furthermore, we recommend enhancing the interaction between control functions. The implementation plan outlines organizational changes, improved access to data during decision-making processes, and adopting dashboards to support data-driven decision-making.

Firstly, changing the planning horizon on the high tactical level to a rolling horizon of at least 1.5 years is important. This adjustment is important for enabling better forecasting and resource allocation. Additionally, recommendations are provided on managing uncertainty during the transition period until the new planning horizon is fully implemented.

Secondly, there is an emphasis on enhancing access to data during decision-making, particularly at the tactical level. The essential data required for effective decision-making, such as Mega planning status, judge and clerk availability, and other relevant information, are outlined. The report proposes designating specific employees responsible for data management and decision-making based on the available data to facilitate this.

Finally, the importance of supporting decisions with a dashboard, which visually represents key data points during meetings, is discussed.

The proposed changes aim to enhance the planning process, promote data-driven decision-making, and improve efficiency within the Court of Law Amsterdam. Implementing these recommendations is expected to lead to greater transparency, accountability, and, ultimately, better outcomes for the court.

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Translations

This chapter shows all the translations used in the thesis. This overview is intended for more accessible insight and understanding into the meaning of the terms.

Investigation judge	rechter-commissaris
Public Prosecutor's Office	openbaar ministerie
Covenant	convenant
Rebuttal	wederhoor
Summonses	dagvaardigingen
Council chamber days	raadkamer dagen
Criminal law	stafrecht
Civil law	civiel recht
Administrative law	bestuursrecht
District Prosecutor's Office	Arrondissementsparket
National Prosecutor's Office	Landelijk parket
Functional Prosecutor's Office	Functioneel parket
Multiple judge hearing	meervoudige kamer
Institutional psychiatric care	terbeschikkingstelling (TBS)
Requisition	pleidooi
Reading out of the verdict	voorleesvonnis

1 Introduction

This chapter introduces the research performed at the Court of Law Amsterdam to complete the Master of Industrial Engineering & Management. Section 1.1 gives general information about the Court of Law Amsterdam. Section 1.2 explains why this research is essential. Section 1.3 provides more context to the problem experienced by the Court of Law Amsterdam. Section 1.4 describes the research questions answered in this research.

1.1 Court of Law Amsterdam

The Dutch judicial system comprises a complex network of courts, tribunals, and other legal bodies, all of which play an essential role in upholding the rule of law in the country. Court of Law Amsterdam is one of the largest courts in the Netherlands, located in the heart of Amsterdam. The court has jurisdiction over various criminal, civil, and commercial matters. She handles a significant portion of the legal proceedings in Amsterdam and its surrounding areas. As of January 1, 2022, it includes the territory of the municipalities of Aalsmeer, Amstelveen, Amsterdam, Diemen, Ouder-Amstel and Uithoorn. The heavily secured courthouse, “De Bunker”, is also under the jurisdiction of the Court of Law Amsterdam. Court of Law Amsterdam is one of 11 courts and districts in the Netherlands. She was founded on the first of January 1838 and delivers approximately 140,000 rulings annually (De Rechtspraak, 2023).

1.2 Problem context

Court of Law Amsterdam handles various legal cases, from brief to more complex and lengthier cases. Some cases can be resolved in as little as 30 minutes, while others, known as Megas, can take longer than 15 hours, spread over multiple hearing days, to reach a verdict. These lengthier cases require a significant amount of preparation and dedication from the judges involved and extensive resources from the court. The impact of Megas extends beyond the time spent in the courtroom. The preparation and resolution of these cases can take a considerable amount of time, during which the judges involved may be less or not available at all to handle other legal matters, such as regular cases. As a result, the handling of Megas can have a ripple effect on the court's operations and the legal proceedings of other cases since they share resources and judges. Therefore, the court must carefully manage its resources and allocation of judges. Next to this, efficient time management is crucial in handling Megas. While allowing sufficient time for these complex cases to reach a verdict is essential, excessive time can lead to delays and further strain the court's resources.

1.3 Problem statement

The scheduling of Megas in the Court of Law Amsterdam is an extensive process, as these cases depend on external factors, such as the schedules of lawyers and prosecutors, and require a significant amount of time and resources from the court. To schedule a Mega, the investigation by the investigation judge (*Dutch: rechter-commissaris*) and the Public Prosecutor's Office (*Dutch: openbaar ministerie*) must be fully completed. Once the investigation is complete, the court tries to schedule the Mega. The planning takes place 10 to 12 months before the scheduled court date. It is important to evenly distribute the Megas throughout the courts schedule, which can be challenging, such that there are enough resources left for the regular cases. One of the reasons that scheduling Megas can be a challenge is the difficulty in predicting when the Megas will be finished throughout the year. Another reason for the challenge with evenly distributing the cases is the covenant (*Dutch: het covenant*), which is an agreement between the Public Prosecutor's Office and the Court of Law Amsterdam. This agreement specifies the number of Mega hours that must be met annually. To meet the requirements of the covenant, the court may need to schedule more Mega hours during specific periods, which can further impact the availability of qualified judges, clerks and other legal resources for other cases. Figure 1

shows the unevenly distributed hours of the Megas. Next to this, the dotted trend line in Figure 1 shows the increase in Mega hours over the past few years.

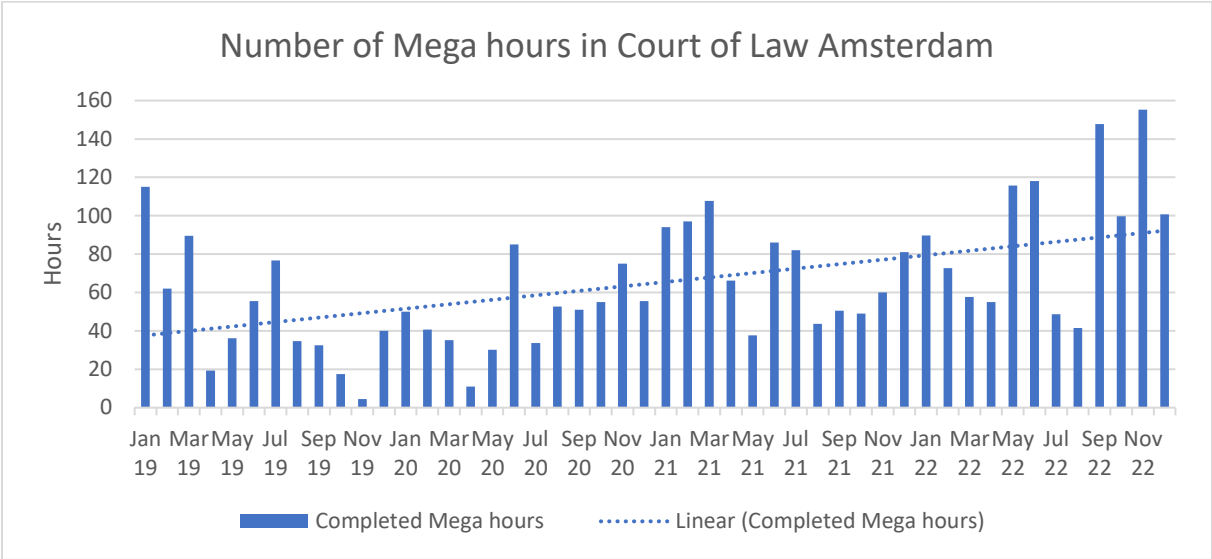


Figure 1: Number of Mega hours in court divided over the last 4 years

Additionally, already scheduled Mega cases may be cancelled due to unforeseen circumstances, such as new investigations that need to be done. In such situations, the cancelled hours can only be filled with regular cases if this is known 4 months in advance. Failure to plan other cases results in a waste of valuable time for the judges involved and for the courtrooms reserved. Figure 2 shows the cancelled Mega hours for the years 2021 and 2022.

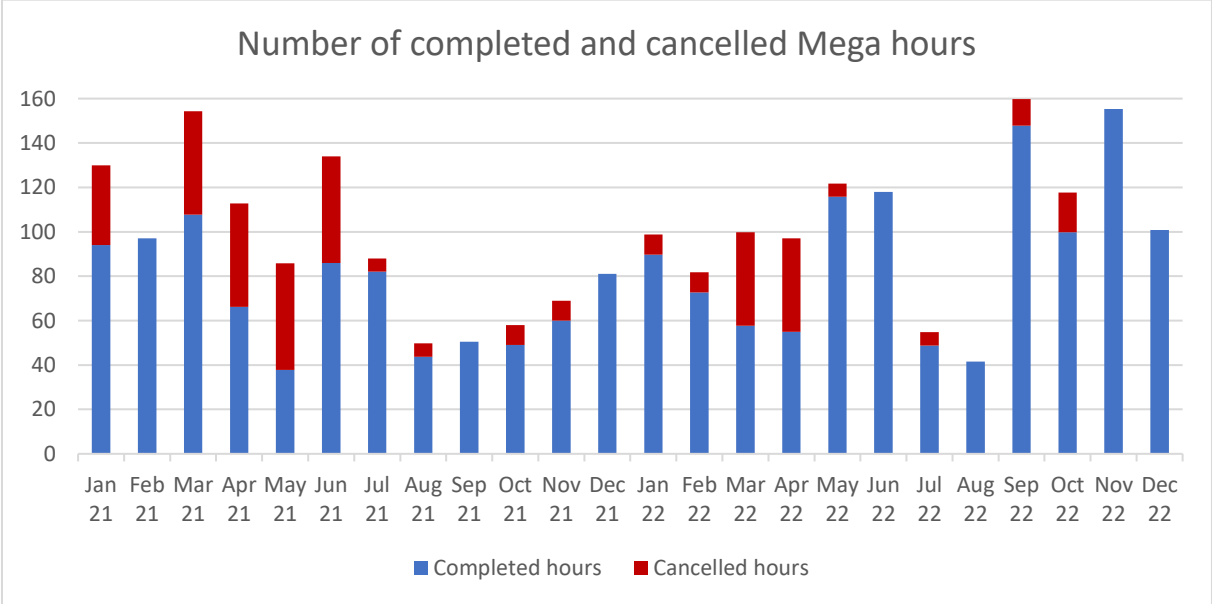


Figure 2: Number of completed and cancelled Mega hours

Furthermore, security is also a concern for the Court of Law Amsterdam. Some Megas require a higher level of security than others, for example, Megas involving multiple pre-trial detention suspects. For each pre-trial suspect, one extra security staff member is needed. Each day, a certain number of security is available, which has to be divided over multiple places, such as the underground prison, the

entrance of the building, and the courtrooms where cases are being heard. As a result, multiple high-security cases cannot take place at the same time.

Court of Law Amsterdam wants to investigate how the process of planning and scheduling Megas can be done more efficiently.

1.3 Research questions

Megas not only consume significant time and dedication from judges but also impact the availability of resources for other cases, affecting the overall efficiency of the court. The planning and scheduling of Megas is a process dependent on various external factors, such as the completion of investigations by the judiciary and prosecutors. Challenges include predicting case completion, meeting annual covenant requirements, and dealing with cancellations. Additionally, security considerations further complicate scheduling, as certain cases require heightened security measures. The Court of Law Amsterdam seeks to investigate how the process of planning and scheduling Megas can be made more efficient.

The described problem statement leads to the formulation of the main research question:

'How can the Court of Law Amsterdam optimize the process of planning and scheduling Megas?'

To obtain an answer to this question, we formulate multiple sub-questions.

We describe the current situation of planning and scheduling Megas in Chapter 2. This is necessary to determine whether the Megas are planned and scheduled efficiently and whether there are areas where the planning and scheduling of Megas is not efficient. We obtain the information by doing interviews with the employees of the Court of Law Amsterdam.

- 1) What is the current Mega planning and scheduling situation?
 - a. What are the characteristics of a Mega?
 - b. What are the different steps in the planning and scheduling process?
 - c. What different parties are involved in the planning and scheduling process?
 - d. What are the main reasons for the cancellation of Mega hours?
 - e. What is the variation in Mega hours throughout the years?

We provide an overview of existing literature regarding the planning and scheduling problem that the Court of Law Amsterdam is facing in Chapter 3. Here, we discuss the literature within the Court of Law regarding planning and scheduling. We present various planning and scheduling frameworks to categorize the decisions required during Megas planning and scheduling. After this, we investigate the decisions made from the framework in other research fields that show similarities to the Court of Law Amsterdam. Finally, we investigate what support is necessary to make the planning and scheduling decisions discussed earlier correctly.

- 2) What literature is available regarding the problem the Court of Law Amsterdam is facing?
 - a. What is already known about planning and scheduling in the field of the Court of Law?
 - b. What is known about various planning and scheduling frameworks?
 - c. What is known about decisions made in the planning and scheduling framework in other research fields?
 - d. How can the planning and scheduling decisions be supported to ensure they are made correctly?

In Chapter 4, we analyse the difference between the current planning and scheduling strategy of the Court of Law Amsterdam and the ideal planning and scheduling strategy. Here, we address the gaps

between the current situation and the literature and what the Court of Law Amsterdam can do to improve the current situation.

- 3) What should the scheduling process of Megas in the Court of Law Amsterdam look like?
 - a. What is the current planning and scheduling framework for the Court of Law Amsterdam?
 - b. What is the ideal planning and scheduling framework?
 - c. What steps should the Court of Law Amsterdam take to implement the ideal planning and scheduling framework?

Chapter 5 provides the Court of Law Amsterdam with a support tool to ensure correct decision-making.

- 4) How can the planning and scheduling framework be supported to guarantee correct decision-making?

Finally, Chapter 6 presents our conclusions and recommendations for the Court of Law Amsterdam.

2 Current situation

This chapter answers sub-question 1: “What is the current Mega planning and scheduling situation?”. Section 2.1 gives more information about Megas and some examples. Section 2.2 outlines the current planning and scheduling process of Megas. Section 2.3 provides more insight into the number of Mega hours that must be planned during the year. Section 2.4 visualizes the current situation of planning and scheduling in the Court of Law Amsterdam. Section 2.5 gives insight into how pre-trial detention affects the planning activities. Section 2.6 describes how the security is organised around Megas. Section 2.7 describes reasons why a Mega could be cancelled. Section 2.8 analyses the number of completed Megas from 2019 to 2022. Section 2.9 explains why there is uncertainty with planning in the first half of the year and what consequences this uncertainty has.

2.1 Characteristics of a (mini-)Mega

Mega cases distinguish themselves from regular cases by their prolonged duration and complex nature. The Megas require a minimum of 15 hours in the courtroom, so the time spent on the Mega is even longer, with the preparation and closing of the case included. Megas often involve multiple defendants, numerous charges, and much evidence. Every Mega consists of 4 different phases, which are the research phase, preparation phase, hearing phase, and closing phase.

Firstly, in the research phase, all necessary information for the Mega case is gathered. This step is crucial as it ensures a comprehensive understanding of the case at hand. Next, the preparation phase involves organizing and preparing the collected information for further analysis. This phase focuses on structuring the data in a way that facilitates efficient review and evaluation and on reviewing all data that is available. The hearing phase is the phase that takes place in the courtroom. During the hearing phase of a Mega, questioning and rebuttal (*Dutch: wederhoor*) take place to ensure a comprehensive discussion of all information involved in the case. Finally, in the closing phase, all discussions and conclusions drawn during the hearing phase are reviewed. This step ensures that all aspects of the case have been thoroughly considered before reaching a final decision.

The Marengo trial is an exemplary Mega case that has captured widespread attention. The Marengo trial, which began in 2019, involved a large-scale criminal organization accused of several high-profile crimes, including multiple assassinations. Another example is the "Liquidation Trial Passage", a high-profile criminal trial in the Netherlands. It is considered one of the most complex cases in Dutch legal history. The proceedings of the Passage case lasted nearly 10 years in total, commencing in 2007 and concluding on June 27, 2017, with the appeal verdict against ten defendants. The trial has left a lasting impact on the Dutch legal system, highlighting the challenges of prosecuting complex criminal cases while ensuring the safety of witnesses and upholding justice. In addition to these well-known Megas, numerous lesser-known Megas require significantly less time to reach a verdict.

Next to Megas, there are also mini-Megas. A case is classified as a mini-Mega when the case takes more than 1 day in court but less than 15 hours. It is essentially a smaller-scale version of a Mega case. While mini-Megas are not explicitly named in this research, they are still considered part of the analysis.

2.2 Scheduling process

The scheduling of Megas consists of a few steps, which we show in Figure 3.

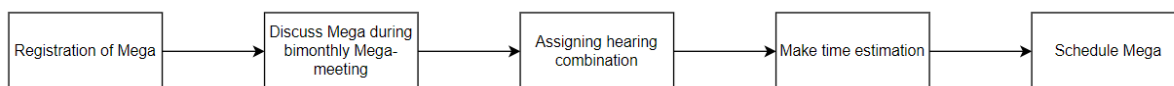


Figure 3: Scheduling process of Megas

2.2.1 Registration of Mega

The first step in the scheduling process of the Megas is a new Mega being registered by the Public Prosecutor's Office. The registration is done through an entry form, where different aspects are mentioned, such as expected press sensitivity, risk level, and duration. More information about the security involved and the press sensitivity can be found in Section 2.6. Next, the Mega is added to an Excel file containing all current Megas. As soon as the Public Prosecutor's Office registers the Mega, the investigation of the investigation judge will begin.

2.2.2 Mega-meeting

The second step in the scheduling process is the Mega-meeting. Every two months, there is a Mega-meeting with different parties present, such as the Public Prosecutor's Offices, Mega planners and other people involved, in which it is discussed which Mega can be scheduled and which Mega still requires more investigation by an investigation judge before being able to be planned. Three weeks before the Mega meeting, the progress of the Mega investigation is asked from the investigation judges. With this information, a decision can be made to schedule the Mega. A week before the Mega-meeting, a prioritization of which Megas the Public Prosecutor's Offices want to have scheduled is asked.

After a Mega is ready to be scheduled, a look is taken at the covenant to see if the Mega still fits. More information about the covenant can be found in Section 2.3. The planning horizon of the Megas is about 10 months. This means that during the Mega-meeting of March 2023, the Megas are discussed that can be scheduled in January/February 2024. The covenant is renewed every year, and in September, before the new year, the new covenant is made definite. This leads to uncertainty with planning Megas in the year's first half. Since before the covenant is known, the Megas are already scheduled for the first 6 months of the year. The problems coming from this can be found in Section 2.9.

During the Mega-meeting, there is a go/no-go moment for the already scheduled Megas. Four months before every Mega is set to happen, it is discussed if the Mega still can take place. If this is not the case, the Mega can be erased from the schedule, and the planners can try to fill the space with other cases that are not a Mega. This must be done 4 months in advance because of the 10-week service deadline for summonses (*Dutch: dagvaardingen*) and the lawyers' agenda. More information about why a Mega could be cancelled can be found in Section 2.7.

2.2.3 Assigning hearing combination

The next step in the scheduling process is assigning a combination to the Mega, which consists of a president, a youngest judge, an oldest judge, and a clerk.

Within the judiciary, there are various areas of law, such as criminal law (*Dutch: strafrecht*), civil law (*Dutch: civiel recht*), and administrative law (*Dutch: bestuursrecht*). Megas are part of criminal law. The criminal law area of the Court of Law Amsterdam consists of three teams. The three different teams have different specialization, and all have a team president, who assigns the different hearing combinations to the Megas. The hearing combinations assigned to the Megas do not always consist of the same people. However, the hearing combination of a Mega is always a multiple-judge hearing (*Dutch: meervoudige kamer*), meaning there are 3 judges involved in every Mega. The president of a

hearing combination is a judge with a lot of experience and is ultimately responsible for the verdict. The other two judges in the hearing combination are picked based on their expertise. Every team has a different number of judges who can participate in Megas.

In team 1, 18 judges can participate in Megas. If it would occur that all judges were involved in Megas, 6 different hearing combinations could be made. In teams 2 and 3, 20 and 22 judges can do Megas, respectively.

Team 1 is responsible for fraud, economy, environment, and human trafficking cases. Team 2 is responsible for institutional psychiatric care (*Dutch: terbeschikkingstelling (TBS)*), traffic cases and petitions. Team 3 is responsible for international legal assistance cases.

2.2.4 Time estimation

After the combination is known, the president of the hearing combination makes a time estimation. The time estimation consists of an estimation for the preliminary work of the clerk and the judges, the court days, the council chamber days (*Dutch: raadkamer dagen*), the final work of all members of the hearing combination, and the final verdict. The decision on the estimation takes the president of the combination around 1 day.

The preliminary work of a clerk consists of reviewing all documents related to the case, arranging all documents, and summarizing the contents. Afterwards, the judge's preliminary work involves studying the case file and determining the necessary action. After the court days, the council chamber days occur, where the judges and clerk discuss the case to determine the verdict. Afterwards, the final work starts with the clerk supporting the judges in writing the verdict. To come to the final verdict, the judges will check the clerk's work and make the verdict definitive.

The time planned for every part depends on many factors, for example, the number of documents in the case file, the newness of the case, and the number of suspects.

The time estimation of the court days of a typical case could look like this:

- Day 1 consists of discussing the facts with the suspect(s)
- Day 2 consists of the requisition (*Dutch: pleidooi*) of the Public Prosecutor's Office
- Day 3 consists of the plea of the lawyer(s)
- Day 4 consists of reactions of the Public Prosecutor's Office and the lawyer(s)
- Day 5 is an overflow day

The average final work of the judges looks like this:

- Youngest judge: 5 days
- Oldest judge: 4 days
- President: 6 days

The youngest judge needs more time than the oldest judge because he needs to check if everything discussed in the chamber days is present in the verdict. The president needs more time to make the last adjustments and to create the reading out of the verdict (*Dutch: voorleesvonnis*).

Sometimes, there is a difference between the estimation of the Public Prosecutor's Office and the estimation of the president of the hearing combination. This discrepancy arises because the president of the hearing combination conducts a more thorough inventory of involved parties. If the president of the hearing combination has a discrepancy of more than 10%, this needs to be discussed with the team president.

The preliminary work of both the judges can be done at the same time. However, the preliminary work of the clerk needs to be done before the preliminary work of the judges. Next to this, the final work of all the members of the hearing combination needs to be done consecutively to each other, starting with the clerk, then the youngest judge, the oldest judge, and finishing with the president of the hearing combination. Figure 4 shows an example.

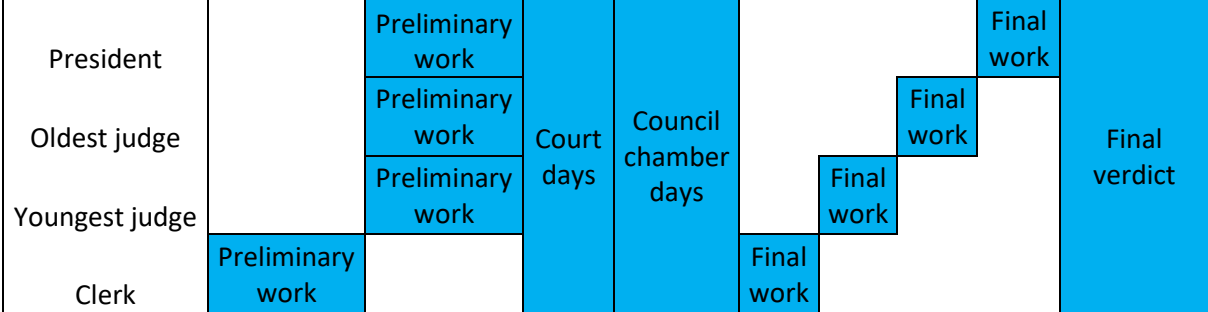


Figure 4: Example time estimation

2.2.5 Schedule Mega

After the time estimation is made, the availability of all involved parties in the Mega is asked for the 2 months in which the Mega needs to be scheduled to see if there are moments when all involved parties are available. This is done for the hearing combination, lawyers, and the Public Prosecutor. The Mega planner can start planning the Megas when all this information is known. The Mega planning is done in an Excel file by Mega planner. An example of this can be seen in Appendix A.

For every area of law, criminal law, civil law, and administrative law, a certain number of courtrooms is available daily. For criminal law, this is 9 rooms per day. This is calculated by dividing the total number of cases expected per year by the number of scheduled days. This gives the total number of rooms that must be available daily for criminal law. Appendix B shows how the total available rooms for criminal law are calculated. Within these 9 rooms per day, the Megas need to be planned and regular cases that are part of criminal law. Currently, a maximum of two Megas can have court days on the same day if the Megas are of high-level security. More Megas can run simultaneously if more security is available or if Megas do not require much capacity. For example, more security is needed if suspects are in pre-trial detention. Another example is if there are more suspects, more lawyers must be present, which requires an increase in the courtroom size, of which only a limited number is available.

Therefore, before the final plan is created, first, the number of rooms and the risk level of the Mega is assessed. When the plan is finished, it is sent to the hearing combination for review. When no comments exist, the plan is sent to all involved parties and put into the planning system. When there are comments, the plan needs to be reviewed again.

2.3 Covenant

A covenant is an agreement between the Public Prosecutor’s Office and the Court of Law Amsterdam. This agreement specifies the number of Mega hours that must be met each year and the number of regular cases that need to be met. This agreement is renewed every year, and as said in Section 2.2, every September before the new year, the new agreement is made definite.

Different meetings take place to reach the final agreement for the covenant. Before the meetings occur, a prognosis of the number of expected cases for next year and the inventory of cases that still need to be planned is asked from the Public Prosecutor’s Offices. This is called the demand of the Public Prosecutor’s Offices.

Next, the capacity of judges at the Court of Law Amsterdam is examined, and the occupancy for the following year is anticipated. This information is discussed with the judiciary board to determine a feasible production proposal, assess the required capacity, and project the expected occupancy by identifying any shortages or surpluses in capacity. The judiciary board reviews this for all legal areas to understand where there may be a shortage or surplus of judges. Regarding the allocation of judges, decisions are made by the judiciary board on where the surplus or shortage should be allocated. This information is then communicated back to the departments. Next to this, the judiciary board determines the number of judges to hire and also makes decisions on the number of courtrooms that need to be available.

If there is a shortage of judges to meet the demand of the Public Prosecutor’s Offices, this is communicated back to the Public Prosecutor’s Offices. After this, the Public Prosecutor’s Offices primarily decide on the priority of different cases, regular and Megas, and where reductions should occur, ensuring that the schedule remains feasible. The covenant is made from the numbers of the prognosis and the availability of the Court of Law Amsterdam.

After the covenant is made, the hours in the covenant are broken down into smaller periods of 2 months. With the hours divided over the smaller periods, it is easier to see if the available hours are sufficiently used. The Court of Law Amsterdam has quarterly meetings to monitor the progress of the covenant hours. If insufficient progress is made, measures are discussed to ensure improvement.

Table 1 shows the Mega hours that need to be met for 2020 until 2023. As can be seen, the hours are broken down for every different Prosecutor’s Office. These are the District Prosecutor’s Office (*Dutch: Arrondissementsparket*), the National Prosecutor’s Office (*Dutch: Landelijk parket*), and the Functional Prosecutor’s Office (*Dutch: Functioneel parket*).

The District Prosecutor’s Office is linked to a specific court and handles cases in that district. The National Prosecutor’s Office is not linked to a specific court. They are responsible for combating international organized crime that crosses the border of a district or jurisdiction. The Functional Prosecutor’s Office is also not linked to a specific court. They are responsible for combating fraud, environmental crime, and complex confiscation cases.

Table 1: Covenant 2020-2023

	Covenant Mega hours			
Prosecutor’s Office	2020	2021	2022	2023
District	260	278	475	356
National	192	342	172	108
Functional	305	255	230	96
Extra			276 Marengo	190 Marengo
Total	757	875	1.153	750
Realised	575.25	855	1102.75	682.25

2.4 Visualization current situation

In this section, we visualize the current situation of the planning and scheduling process at the Court of Law Amsterdam.

One of the first decisions are the covenant decision and capacity allocation per department decision. These decisions start in July and are finished in September. The decisions have an impact on the decisions that follow. First, the decisions impact the decision of which Megas to plan and, second,

which staff to allocate. Figure 5 shows that the planning of Megas for the year 2024 starts during the Mega meeting in March. However, in September, the covenant of 2024 is finalized. Therefore, we visualize in red boxes that the planning of Megas during the Mega meeting in March, May, and July is done without the covenant being definite. The green boxes represent Megas' planning, with the covenant being definite. Next, Figure 5 visualizes the quarterly meetings between the Public Prosecutor's Offices and the Court of Law Amsterdam, where they monitor the progress.

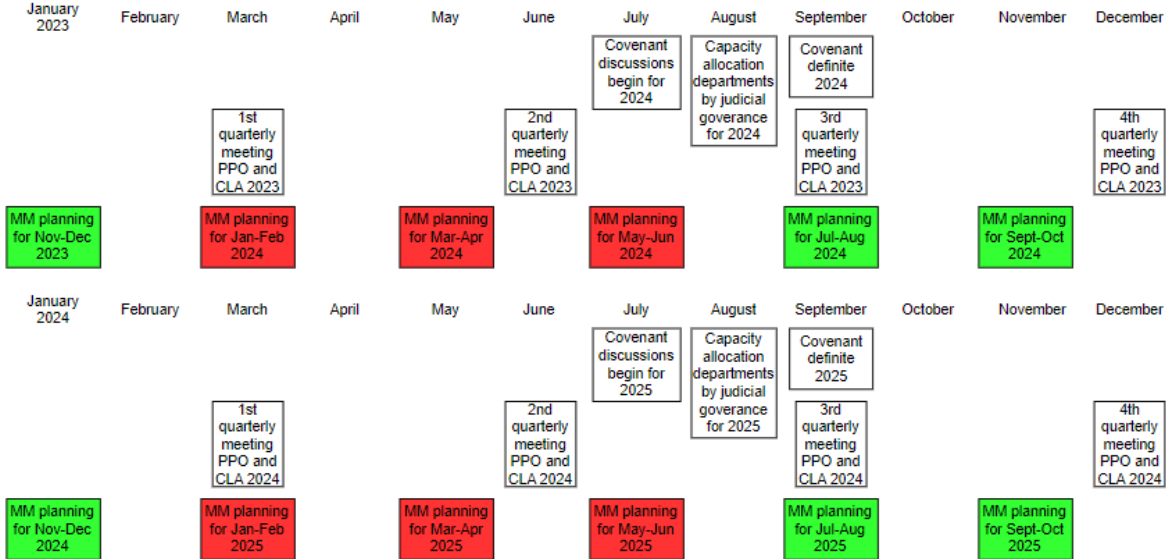


Figure 5: Current situation (1)

Next to this, after the Mega meeting, different decisions are made. We visualize these decisions in Figure 6. First, we distinguish between planning without the covenant and the covenant on the vertical axes. Next, we visualize the Mega meeting with a black dot in a yellow square. The yellow square represents the 2 months between Mega meetings in which the Mega planner plans the Megas that have been decided to be planned. The Mega planner plans the Megas 10 months in advance; therefore, the red squares represent the months in which the Mega will be planned. We use a black cross in a red square to represent a planned Mega. Additionally, green squares indicate instances where a planned Mega cannot proceed, allowing the time to be filled with a regular case. Finally, the red crosses represent the pro forma hearings, which are discussed in Section 2.5, that must occur if a Mega has suspects in pre-trial detention. On the vertical axis, we show what happens after every Mega meeting every 2 months.



Figure 6: Current situation (2)

Next, we visualize the scheduling of Megas in the bottom right corner of Figure 6. This represents the scheduling of the Mega planner of the Megas 10 months in advance since the scheduling of Megas by the Mega planner happens in the yellow boxes beforehand. The scheduling process is explained in Section 2.2. The bars shown in Figure 6 in the bottom right corner represent the number of Mega days planned per week.

After the Mega is scheduled, nothing happens anymore regarding that Mega until the preliminary work of the clerk begins, as shown in Figure 4.

2.5 Pro forma hearing

In the case of some Megas, the suspects may be held in pre-trial detention. If a suspect is being held in pre-trial detention according to Dutch law, specific time limits regulate the duration of the detention. Generally, pre-trial detention can last up to 104 days, divided into two periods: up to 14 days of detention and up to 90 days of imprisonment. Once this period has elapsed, the criminal case must be brought to court for a hearing. Failure to meet this deadline means the suspect can no longer be detained without further justification (Judex, 2018).

However, there are situations where the investigation is incomplete, or the court cannot schedule a hearing within the 104 days. In such cases, the Public Prosecutor may request a pro forma hearing to meet the pre-trial detention deadline. During a pro forma hearing, the case is presented in court, but the Public Prosecutor immediately requests a suspension of the proceedings. Essentially, the pro forma hearing is intended to ensure that the deadline for pre-trial detention is met. So, the case is not heard on its merits.

Following a pro forma hearing, another hearing must be held within 90 days. This can also be a pro forma hearing, and there is no legal limit to the number of adjournments and pro forma hearings that can take place. It is important to note that a pro forma hearing can prolong your pre-trial detention, depending on the progress of the investigation. In some cases, multiple pro forma hearings may be necessary if the investigation is extensive. In contrast, in other cases, the case may be scheduled for a

hearing shortly after a pro forma hearing. This means that with Megas' planning made 10 months in advance, at least 3 pro forma hearings must occur.

Pro forma hearings are scheduled for multiple judge hearings, which are scheduled outside of the Mega hearings. During the scheduling of pro forma hearings, attempts are made to consider whether the lawyer can be present. However, the lawyer is not always present. A part of the hearing combination must be present. Sometimes, only two of the hearing combination are present, but ideally, the president is present. Pro forma hearings are scheduled about 6 months in advance.

2.6 Security and press sensitivity

During a Mega, the amount of security that needs to be present must also be considered. The amount of security that needs to be present depends on, for example, the number of pre-trial detention suspects, the risk level, and the press sensitivity. If, for example, 4 suspects are in pre-trial detention, 5 court policemen need to be present.

Regularly, there is a meeting between the security coordinator and the Mega planners to assess which Megas have a high-risk level or a high press sensitivity. Afterwards, the Security, Surveillance & Transport coordinators will determine the required number of court policemen for each case.

2.7 Reasons for cancellation

As shown in Figure 2, which shows the number of completed and cancelled Mega hours, there are Mega hours that are cancelled. There is no information available about if the hours that are cancelled are reused again. A reason for cancelling Mega hours is the incomplete reports or investigations conducted by the investigation judge. It can be the case that witness testimonies are not finished, new investigation requests emerge, or new suspects are included.

Another reason could be a change in legal representation; when this happens, it is necessary to have an adjustment period for the newly appointed lawyer to acquaint themselves with the case, a settlement, which is where both parties reach a resolution outside of the courtroom meaning the court days are not necessary anymore, or overestimation of scheduled court days.

When an already scheduled Mega cannot proceed, the respective Public Prosecutor’s Office will try to fill this hearing capacity with regular cases or Megas from another Public Prosecutor’s Office, when this is known 4 months in advance.

Next to this, it can also happen that a judge gets sick before a court day. If this happens close to the court day, no other judge can step in since the preparation takes too long. If this happens, the court day will be cancelled and moved to another day.

Table 2 shows the total hours in 2021-2022 for different reasons.

Table 2: Number of hours per cancellation in 2021-2022

Reason for cancellation		Number of hours
Incomplete reports or investigation	New research requests	24
	Investigation not finished	108
	New suspects	18
Change in legal representation		30
Settlement		12
Overestimation of scheduled court days		6
Decision Public Prosecutors Office		126
Total		324

2.8 Data analysis number of completed Megas

Section 1.3 examines the number of completed Mega hours from 2019 to 2022. In this section, we provide a more in-depth analysis.

As can be seen from Figure 7, the variation in the number of completed Mega hours is present every year from 2019 to 2022. Especially in April and August less Mega hours are completed. The smaller number of completed Mega hours in August is because of the summer holiday, which means fewer judges are available. No particular reason is found for the decrease in April.

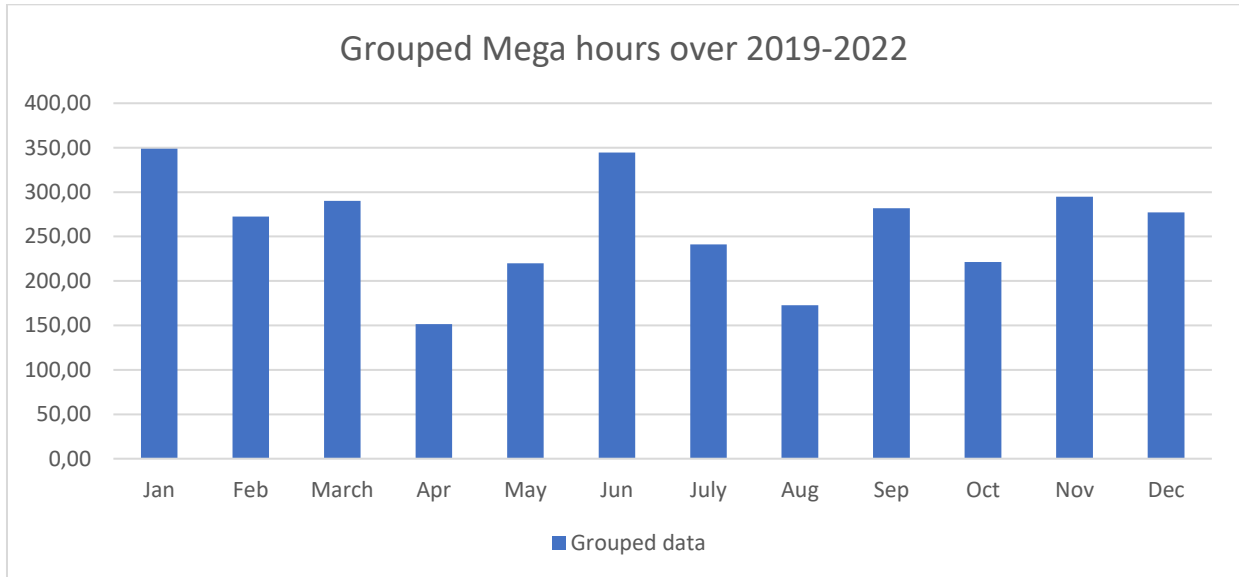


Figure 7: Grouped Mega hours over 2019-2022

Furthermore, as shown in Figure 8, the number of completed Mega hours in May and at the end of 2022 is significantly increased compared to the previous years. Next to this, the number of completed Mega hours in 2022 also significantly increases throughout the year, except for July and August because of the summer holiday. Another observation from Figure 8 is the reactive nature of the Court of Law Amsterdam. When few cases are scheduled towards the end of the year, there is a subsequent increase in scheduling at the beginning of the following year, and vice versa.

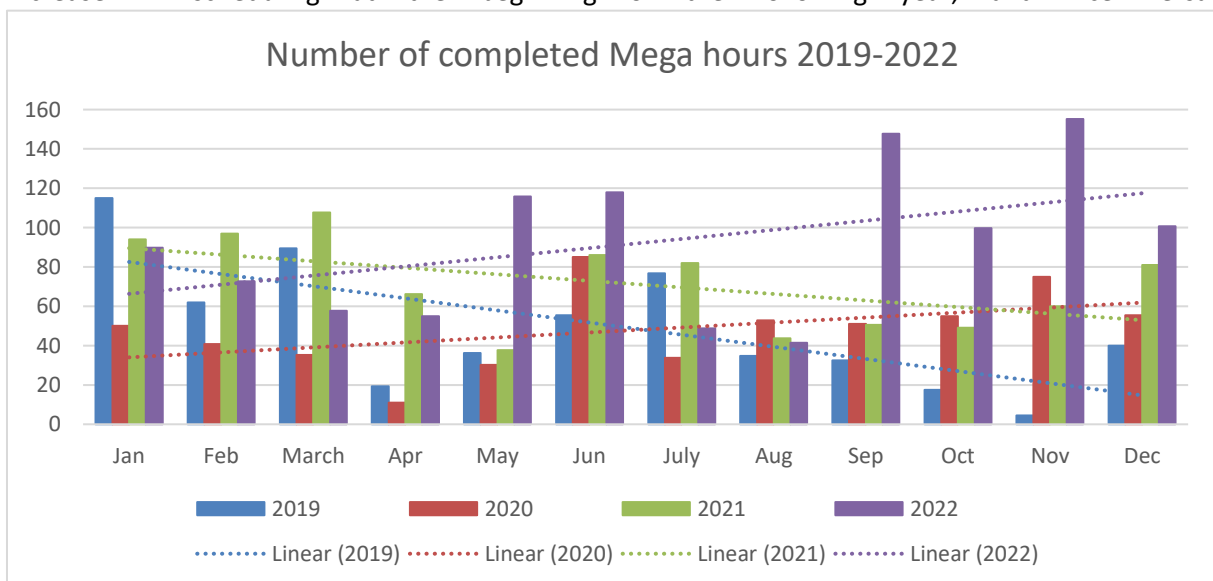


Figure 8: Number of completed Mega hours 2019-2022 per year

2.9 Uncertainty in the first half of the year

As said in Section 2.2, the planning in the first half of the year is done with some degree of uncertainty since the covenant is known in September, and Megas are planned 10 months in advance. The planning department does not know what the planning in the year's first half is based on.

Comparing the completed Mega hours of 2020 with those of 2021, it is difficult to see a pattern in the year's first half, following Figure 9. It seems that the Court of Law Amsterdam realised they had fewer hours in 2020 than was agreed on in the covenant, so they wanted to plan more hours at the beginning of 2021. In 2021, the realised hours came much closer to the agreed hours in the covenant. The reason for this could be the more realised hours at the beginning of the year.

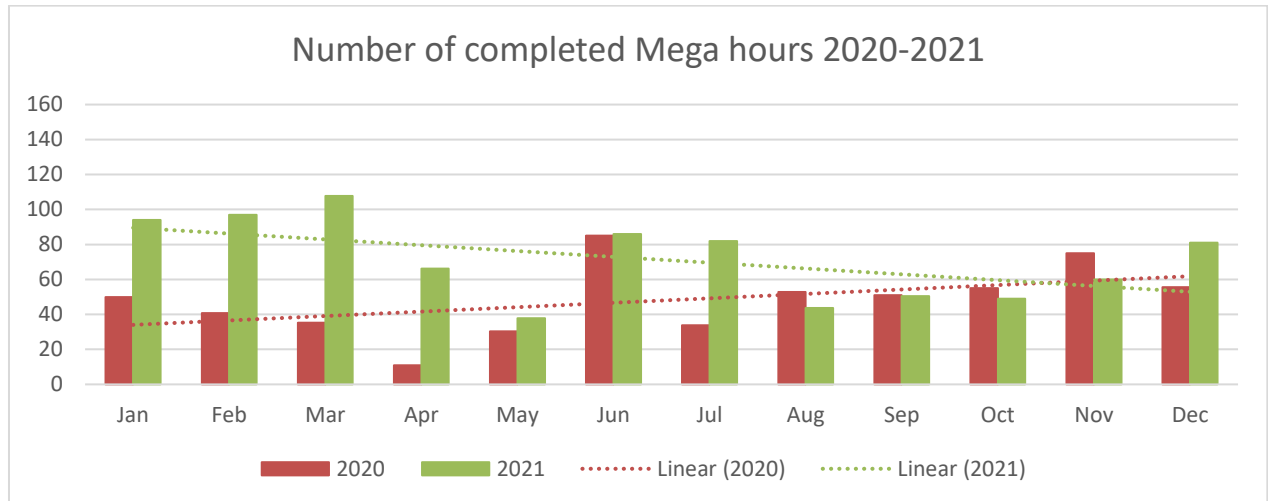


Figure 9: Number of completed Mega hours 2020-2021

Comparing the completed Mega hours of 2021 with those of 2022, a pattern can be found, following Figure 10. It seems that in the first half of the year 2022, the covenant of 2021 was used. This can be seen by looking at Figure 10 and comparing the numbers of completed Mega hours in the year's first half. This was around 489 hours in the first half of 2021 and 509 hours in the first half of 2022. The problem in 2022 is that there were many more hours in the covenant. Therefore, many hours still had to be made in the year's second half. This led to around 366 hours in the second half of 2021 and around 594 hours in the second half of 2022.

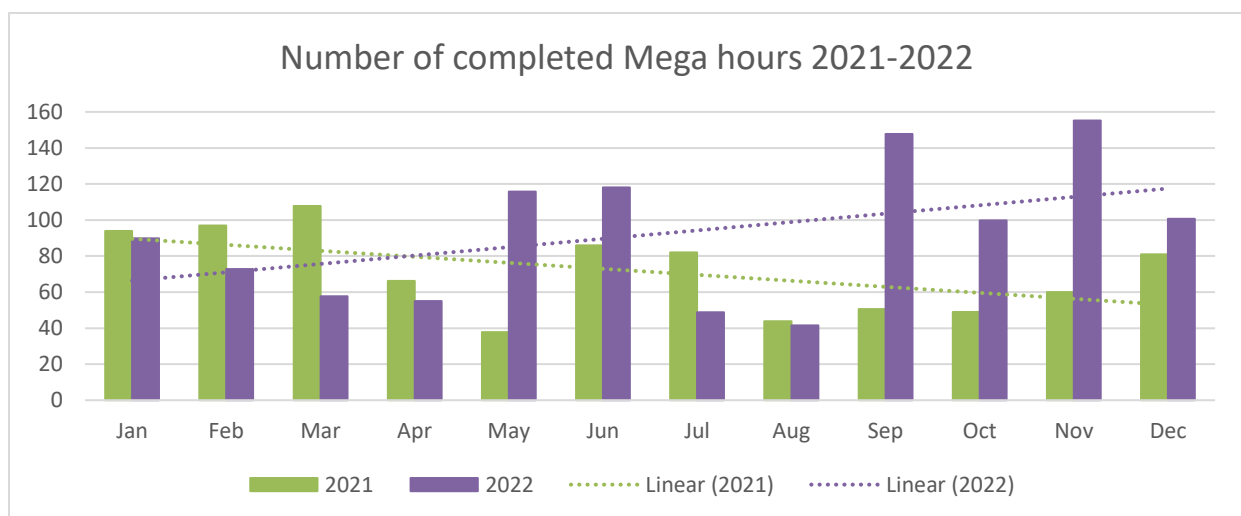


Figure 10: Number of completed Mega hours 2021-2022

Due to the uncertainty experienced in the first half of the year, there might be a tendency to schedule fewer cases during the year's first half. Because of this tendency, several challenges arise and impact the scheduling dynamics towards the end of the year.

Towards the end of the year, the Public Prosecutors Offices try to schedule more Megas to ensure the covenant is met. The increase in Megas towards the end of the year strains the available resources and scheduling capacities, leading to an uneven distribution of Megas over the year. Consequently, this can lead to trying to schedule Megas where similar skill sets are required from the judges. This leads to the increased difficulty of creating combinations for every Mega that needs to be scheduled.

Next to this, the same lawyers are often involved in different Megas. Making it hard/impossible for them to fit in new Megas because of the necessary preparation before going to court.

Finally, the limitations in the scheduling also impact the inclusion of socially impactful Megas. The already limited resources make accommodating these Megas in the packed schedule harder.

2.10 Conclusion

The current situation analysis sheds light on the planning and scheduling process of Megas at the Court of Law Amsterdam. The scheduling process involves several steps, including Mega registration, Mega meetings every two months to discuss scheduling decisions, the assignment of hearing combinations, and the time estimation. Pro forma hearings are vital for cases with suspects in pre-trial detention, ensuring that detention deadlines are met.

The covenant between the Public Prosecutor's Office and the Court of Law Amsterdam dictates the number of Mega hours to be scheduled annually, with quarterly monitoring to track progress. However, uncertainty in the first half of the year, stemming from delayed covenant finalization, leads to challenges in meeting scheduling demands. The uncertainty in the first half of the year makes scheduling more difficult. This leads to problems like not having enough resources, finding the right people for each case, and not being able to include important cases.

A closer look at how cases are completed reveals some interesting trends. For example, there's a noticeable increase in Mega hours as each year comes to a close. This shows that the Court of Law Amsterdam tends to schedule more cases towards the end of the year to meet its commitments.

Comparing completion rates from one year to the next gives us useful information about how the Court of Law is reactive. When few cases are scheduled towards the end of the year, there is a subsequent increase in scheduling at the beginning of the following year, and vice versa.

Additionally, analysing the impact of uncertainties in the first half of the year shows us how not having finalized agreements can affect scheduling. This uncertainty makes it harder to manage resources and plan ahead, leading to ups and downs in completion rates throughout the year.

3 Literature review

This chapter answers sub-question 2: 'What literature exists concerning the problem faced by the Court of Law Amsterdam?' Section 3.1 delves into the existing research about this issue within the Court of Law context. However, it becomes evident from Section 3.1 that research on this specific problem is scarce. Therefore, literature from different sectors needs to be explored. Section 3.2 establishes a foundational framework for planning and scheduling. This framework is crucial for understanding how literature from other areas can be applied and categorized within the Court of Law Amsterdam context. Section 3.2 also demonstrates how this initial framework can be adapted to suit the healthcare and project scheduling contexts, as these sectors face challenges similar to those faced by the Court of Law Amsterdam. Consequently, Section 3.3 presents literature on various decisions that need to be made following the frameworks found in Section 3.2. Section 3.2 discusses that the decisions in the framework are made on strategic (long-term), tactical (medium-term), and operational level (short-term). These terms can have different planning horizons. Therefore, Section 3.4 elaborates on the options for the different levels. Section 3.5 explains how dashboards can be used to visualize data and support decisions that need to be made, and what different types of dashboards to use for a particular problem.

3.1 Research in Court of Law

Some research is conducted within the Court of Law of the Netherlands. However, most of this research is done qualitatively or with a focus on the (decline in) number of cases handled by the different jurisdictions. Research has been done on, for example, the quality of the jurisdiction in the Netherlands compared to other countries or the motives of civilians not to go to the Court of Law (De Rechtspraak, 2023).

One paper writes about the priority queuing behaviour of the United States and Canada Supreme courts. It examines the time lapse between when a case enters a court's system and when it is disposed of (Mukherjee & Whalen, 2018).

Another paper gives insight into using advanced AI planning and scheduling technologies and the characterization and complexity of planning and scheduling problems. It mentions court scheduling as an area where the technology could be applied. However, this has not been done in the paper (Alguire & Pedro Gomes, 1997).

A final paper explores a computational approach to generate schedules. Brooks (2012) develops a tool that uses integer programming. The constraints associated with scheduling sessions for the Court of Appeals of Virginia fall into roughly two categories: scheduling and assigning judges to sessions. The number of sessions scheduled for this court is based on a forecast of the number of cases.

Other than the paper of Brooks (2012), not much attention is given to the planning and scheduling of different cases in the Court of Law in the literature. This thesis will try to fill this gap in the literature and provide a proposal such that Megas are efficiently scheduled and evenly distributed. In order to locate relevant literature to address the current problem, we incorporate literature about planning and control levels in other research fields. Given the strong similarities between scheduling Megas and scheduling surgeries in hospitals and project scheduling, this study integrates literature that covers these topics. Scheduling surgeries in hospitals shares similarities with scheduling Megas as both require coordinating multiple resources simultaneously. Moreover, hospitals have various specialities that share resources, mirroring the resource-sharing dynamic seen in Megas with regular cases. Similarly, project scheduling and scheduling Megas show resemblances in their need for efficient

resource allocation, timeline management, adaptability to change, and handling diverse tasks with differing characteristics.

3.2 Planning and control levels

All organizations make planning and control decisions to design and operate processes. Many different decisions need to be made in different areas of organizations, for long-term, medium-term, and short-term. These decisions can be shown in a framework which can be used for different work areas. Various frameworks for planning and control in manufacturing have been presented.

Most frameworks follow a hierarchical structure. This means they start by making big-picture decisions broken down into smaller details. This reflects the granularity of the information collected over time (Zijm, 2000). This method provides a structured way to manage complex problems or systems, establishing an overall framework before addressing specific details.

Figure 11 illustrates a general architecture for manufacturing planning and control. This framework emphasises the integration of technological and logistics planning, as well as the integration of capacity planning and materials coordination issues.

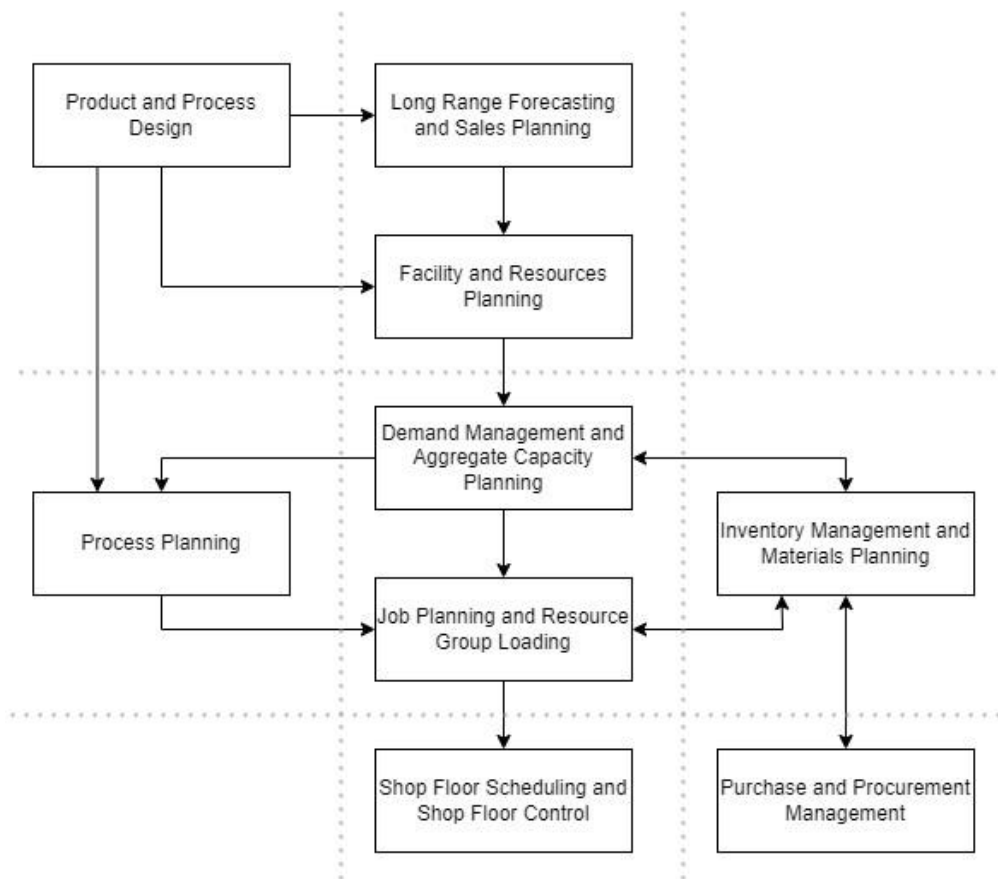


Figure 11: A manufacturing planning and control architecture (Zijm, 2000)

Following from Figure 8, it can be seen that the framework consists of 3 columns and 3 rows. The emphasis in the columns is on the integration of technological and logistics planning and the integration of capacity planning, and materials coordination.

Additionally, the rows are divided based on their level of aggregation. The first row entails high levels of aggregation, such as "long-range forecasting and sales planning," which involves long-term

estimation of market share and planning sales volumes for specific products based on that. The second row involves normal levels of aggregation, providing information at a moderate level of detail, like "demand management and aggregate capacity planning," which includes short-term demand forecasting, translating it into potential orders, and finally, order acceptance. The last row involves the most detailed decisions and information, such as "shop floor scheduling and shop floor control," which schedules jobs on all workstations in a resource group (Zijm, 2000).

Similar frameworks have also been developed in healthcare and project scheduling. Figure 12 shows a framework introduced by De Boer (1998). The emphasis of this framework is on resource capacity planning.

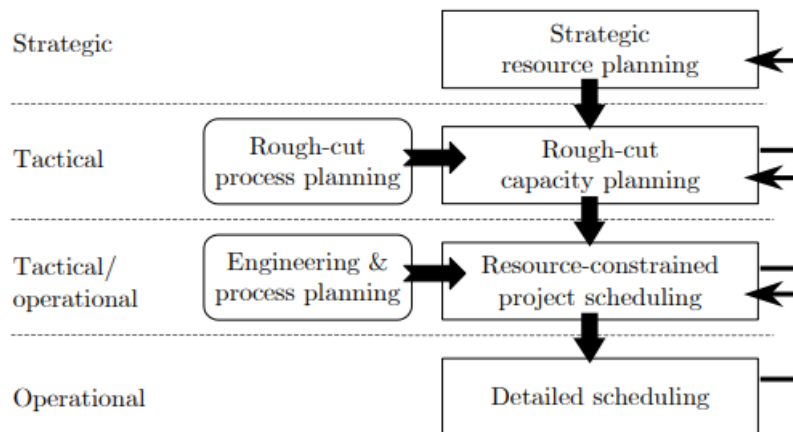


Figure 12: Hierarchical planning framework for planning in multi-project environments (De Boer, 1998)

The framework proposed by De Boer (1998) differs from that of Zijm (2000) regarding how the aggregate levels are labelled. The framework of De Boer (1998) categorises them as strategic, tactical, tactical/operational, and operational. Another notable difference is the inclusion of upward arrows in the framework of De Boer (1998), representing feedback loops. These feedback loops are also present in the framework of Zijm (2000) on the lower right-hand side.

Figure 12 illustrates feedback loops, which are crucial for maintaining upward compatibility. Whenever a significant disruption in production arises, it triggers an update of the detailed schedule. If this update leads to any breaches in project deadlines or other milestones, decisions at a higher level must be revisited. Moreover, if substantial underestimations in resource requirements for certain activities or major delays occur, adjustments at a tactical level may be necessary. These feedback loops become particularly vital when the level of activity repetition is low. For tasks that an organization has never undertaken before, accurately estimating their duration and resource needs can be challenging (De Boer, 1998).

Figure 13 shows a framework that Hans et al. (2012) introduced for healthcare planning and control in a general hospital.

	Medical planning	Resource capacity planning	Materials planning	Financial planning	
Strategic	Research, development of medical protocols	Case mix planning, capacity dimensioning, workforce planning	Supply chain and warehouse design	Investment plans, contracting with insurance companies	↑ hierarchical decomposition ↓
Tactical	Treatment selection, protocol selection	Block planning, staffing, admission planning	Supplier selection, tendering	Budget and cost allocation	
Offline operational	Diagnosis and planning of an individual treatment	Appointment scheduling, workforce scheduling	Materials purchasing, determining order sizes	DRG billing, cash flow analysis	
Online operational	Triage, diagnosing emergencies and complications	Monitoring, emergency coordination	Rush ordering, inventory replenishing	Billing complications and changes	
	← managerial areas →				

Figure 13: Example application of the framework for healthcare planning and control to a general hospital (Hans et al., 2012)

The difference between the frameworks of Zijm (2000) and De Boer (1998) and that of Hans et al. (2012) lies in the explicit naming of various managerial areas by Hans et al. (2012), a detail not specified in the previous frameworks. Additionally, Hans et al. (2012) further differentiate the operational level into offline and online components, which distinguishes between "in advance" and "reactive" decision-making processes.

In this study, the resource capacity planning area is most interesting for addressing the challenges faced by the Court of Law Amsterdam. This area includes the dimensioning, planning, scheduling, monitoring, and controlling of renewable resources, including facilities and staff (Hans et al., 2012). Therefore, Section 3.3 will elaborate on the decisions associated with resource capacity planning in healthcare and project scheduling areas. These decisions will be categorized by hierarchical levels, including the strategic, tactical, and operational levels.

3.3 Various decisions in the area of healthcare and project scheduling

The different frameworks introduced in Section 3.2 for the healthcare and the project-planning sector all include decisions that must be made on different hierarchical levels. This section discusses the decisions that must be made on the hierarchical levels.

3.3.1 Strategic level

This section discusses different decisions that need to be made on the strategic level, such as strategic resource planning, including case mix planning.

During this phase, strategic decisions are made concerning the availability of essential resources such as space, personnel, equipment, and facility layouts. A strategic resource plan should be formed by establishing corporate objectives and conducting comprehensive internal and external assessments of the organization. Input data for this process may include market research findings, contractual agreements with key clients, and management insights on strategic matters like subcontracting limits and acceptable levels of resource underutilization, all aligned with the corporate mission. The planning horizon for such a plan can range from one to several years, while the review frequency should be tailored to the organization's environmental dynamics (De Boer, 1998).

A critical decision within strategic resource planning involves long-term workforce capacity dimensioning, representing the highest level of personnel planning. This decision includes the number of employees and the composition of skill sets. Methods that are used to determine capacity

dimensioning are, among others, computer simulation and mathematical programming (Hulshof et al., 2012). Analysing workforce capacity helps assess how many staff members will be needed now and in the future while pinpointing gaps between the available workforce and the demand. In healthcare, this also involves deciding how many consultation rooms are necessary. This decision-making process ensures that capacity matches patient needs, which helps control costs and waiting times (Hulshof et al., 2012).

In healthcare, decisions regarding case mix planning are crucial. This involves determining the types and volumes of patients that a facility serves. Various methods, such as computer simulation, heuristics, and mathematical programming, are employed to establish the case mix of an organization (Hans et al., 2012).

3.3.2 Tactical level

This section discusses different decisions that need to be made on the tactical level.

3.3.2.1 Capacity allocation

The objectives of capacity allocation in the healthcare context are to trade off patient access time and the utilization of resources. Block scheduling is a frequent capacity allocation method used in hospitals. It involves dividing available operating time into blocks assigned to patient groups (Hulshof et al., 2012). With block schedules, there are instances where capacity allocation decisions may need to be re-evaluated before the scheduled block becomes operational active, allowing for potential reallocation of unused capacity. Better quality reallocations are feasible when unused capacity is released sufficiently early than when it is released the same day it becomes available (Hulshof et al., 2012).

In the project scheduling area, the papers suggest that when there are multiple projects, they should be planned together. The hospital sector papers suggest that emergency and regular patients should not be planned together. Xiao & Yoogalingam (2021) investigate two scheduling policies for emergency arrivals. The first policy is where emergency patients are inserted into the existing elective surgery schedule. The second policy in the study examines the use of reserved time slots in the OR for emergency arrivals while having patients on standby who may be available to fill the empty slot should the emergency not occur. The findings from the study demonstrate that a reserved capacity policy can effectively reduce the system's total expected costs when combined with a standby patient strategy on an operational level. The reserved capacity technique results in shorter patient waiting times, reasonable amounts of idle time, and overtime of the OR when the probability that standby patients are available is relatively high (higher than 0.5). Additionally, this policy outperforms one that has no reserved capacity. Even though idle time is higher, a reserved capacity strategy significantly reduces overtime and patient waiting times.

3.3.2.2 Admission planning

Another decision that needs to be made on the tactical level in, for example, healthcare is about admission planning. Admission planning involves priority rules for which patients are selected to be admitted from the waiting list. Factors considered are resource availability, current waiting lists and expected demand (Hulshof et al., 2012).

3.3.2.3 Rough-cut capacity planning (RCCP)

Multiple projects can be defined as a setting in which more than one project is carried out simultaneously. The projects vary in size, importance, required skills, and urgency, are in various stages of completion, and share the same pool of resources (Scott & Aaron, 2000).

When multiple projects compete for attention, the main aim is to ensure department success rather than individual projects (Scott & Aaron, 2000). Even if a project manager excels in completing their assigned project(s), the organization can still face delays due to other ongoing projects (Archibald, 1992). Ignoring how projects depend on each other can lead to localized decision-making. While there might be logical solutions to specific project problems, they may not align well with the overall departmental goals (Cyert & March, 1963). Therefore, companies should pay more attention to managing their portfolio of projects and how resources are distributed among them (Brown & Eisenhardt, 1997).

One approach to address this challenge is to employ RCCP. RCCP plays a crucial role in determining whether an order can be accepted. Since new projects often entail unique elements, detailed information such as precedence restrictions, capacity needs, and material requirements may not be readily available. Therefore, relying on aggregate data at this stage is more practical, which involves rough estimates of the required resources. As the planning process progresses, more information becomes available, allowing for the development of a more detailed activity network that serves as input for the Resource-Constrained Project Scheduling Problem (RCPS) on the operational level (De Boer, 1998).

The RCCP differentiates between two main problems: resource- and time-driven problems. In the resource-driven problem, the objective is to minimize the maximum lateness, assuming that capacity levels remain fixed and cannot be surpassed. Conversely, the time-driven problem aims to minimize the sum of non-regular capacity used, assuming that each project has a deadline that cannot be exceeded. De Boer (1998) proposes a single-pass heuristic, known as the Incremental Capacity Planning Algorithm (ICPA), for the time-driven problem, which can be adapted for the resource-driven problem with some modifications. De Boer (1998) also introduces a heuristic for the time-driven problem based on a linear programming (LP) formulation.

3.3.3 Operational level

This section discusses different decisions that need to be made on the offline and online operational level.

3.3.3.1 Resource-constrained project scheduling (RCPS)

As said in Section 3.3.2.3, multi-project management requires careful scheduling of overlapping tasks with possible competing resource requirements. The Resource-Constrained Multi-Project Scheduling Problem (RCMPSP) extends the scope of the Resource-Constrained Project Scheduling Problem (RCPS) to address this challenge (Brucker et al., 1999). Heuristics developed for the RCMPSP, utilizing priority rules, outperform those designed for the RCPS alone (Issa & Tu, 2020).

The RCMPSP requires the simultaneous planning of projects, each characterized by specific details such as the earliest release time, a series of activities, precedence relationships among these activities, and a set of local renewable resources. Moreover, a limited pool of renewable resources is available and shared among all projects. Various local and global performance metrics are established to compare different RCMPSP solutions. Among these, the Total Makespan (TMS) and the Average Project Delay (APD) stand out as widely used global criteria (Wauters et al., 2015).

For the RCMPSP, a wide range of algorithms have been created. The early work on multi-project scheduling by Pritsker et al. (1969), who offered a zero-one programming strategy, is one example of an exact approach that has been described in the literature. However, heuristics, primarily based on priority principles, have a stronger capacity for scalability compared to these exact methods, which are limited to solving small-scale problem instances.

To address the RCPSP in project-driven organizations, De Boer (1998) proposes several practical extensions to the standard RCPSP, which are commonly encountered in the literature. These extensions include various aspects, including release and due dates, multiple execution modes, variable capacity profiles, minimum time lags, and spatial resources. De Boer (1998) introduces a heuristic, based on the adaptive search method outlined by Kolisch & Drexl (1996), capable of accommodating these extensions. The study demonstrates that this heuristic can generate significantly better schedules than priority rule-based single-pass heuristics while maintaining modest computation times.

3.3.3.2 Workforce scheduling/detailed scheduling

The RCPSP determines when certain resource groups perform activities, but the schedule does not necessarily indicate which persons or machines of that group are assigned to each activity. For this purpose, detailed scheduling should be used, resulting in a schedule specifying which persons or machines will work on a specific activity at a particular time (De Boer, 1998).

The goal is to allocate available employees to projects to maximize the project's efficiency in terms of time, cost, and quality (Razavi Hajiagha et al., 2015). During the planning process, a pool of employees is considered, and the most suitable ones are chosen to join the project team based on factors such as project scope, employee skills, budget constraints, and availability within the project timeline. This constitutes a multi-criteria problem that requires finding the best solution without relying on a specific optimization method (Martinovic & Savic, 2019).

Effectively scheduling project tasks and assigning staff to these tasks is crucial, constituting a decision-making challenge known as the project scheduling and staff allocation problem (Wu & Sun, 2006). Bassett (2000) addressed this problem using a mixed integer linear programming model, considering two distinct factors: variations in employee capabilities and a fixed number of working days for each employee. A heuristic method was proposed to solve the integer program efficiently.

Additionally, Wright (1936) pioneered research on the learning effect, which suggests that employees become more productive as they spend more time on a task. Wu & Sun (2006) presented an integrated problem with a nonlinear model, incorporating the learning effect, and utilized a genetic algorithm for resolution. However, their model did not account for precedence connections or skill constraints.

In the hospital context, this problem might involve nurse rostering, also called staff-to-shift assignment, where employees are assigned to shifts for specific periods. Mathematical programming or heuristics are commonly employed to address this decision (Hulshof et al., 2012).

3.3.3.3 Workforce rescheduling

On the online, operational level, staff rescheduling is one of the decisions to be made. At the beginning of a shift, absenteeism may occur due to sickness or other reasons. Hence, a decision must be made regarding which staff member will cover the shift.

3.3.3.4 Capacity rescheduling

When using the strategy described in Section 3.3.2.1, there are reserved time slots in the OR for emergency arrivals while having patients on standby who may be available to fill the empty slot should the emergency not occur. The standby patients in this strategy must be scheduled on an operational level. In order to offset the lower utilization rates that could occur should the emergency cases not materialize, standby patients are needed to fill the appointment slots. This is feasible with some surgical procedures where some preparation can be done at home and on short notice (Persson & Persson, 2010).

3.4 Planning horizon

Section 3.2 elaborates on the necessity for making distinct decisions in different areas of organizations, for long-term, medium-term, and short-term. These terms can also be referred to as a planning horizon. A planning horizon is the length of time into the future for which plans are made (Swamidass, 2000). Consistency of short- and medium-term actions with long-term actions is necessary, and the terms must work well with each other. If actions are conducted correctly, the need to correct strategies is rare (Soloduch-Pelc, 2015). Therefore, this section elaborates on the length of the different planning horizons on long-, medium-, and short-term.

3.4.1 The importance of a planning horizon

An optimal plan should take into consideration all information relevant to future events. However, this is impossible. Instead, a finite horizon is used in planning because events far into the future usually have little impact on current decisions, and long-term forecasts are often inaccurate. If the planning horizon is too long, much data is needed, much of which is guesswork, leading to high costs. On the other hand, if the horizon is too short, important events beyond it may be overlooked, resulting in poor decisions. Therefore, finding the right balance for the planning horizon is essential for creating better plans (Swamidass, 2000).

3.4.2 Strategic

The length of the strategic horizon mainly relies on the capabilities of the employees of a company and how stable and impactful the environmental changes are, as they bring both opportunities and threats. One of the most frequent made mistakes is shortening the time horizon below 5 years. This way, an organization performs tactical actions which do not develop the company's potential (Mezger & Violani, 2001). Although forecasting the distant future might not always be practical, and strategies are always uncertain because the future cannot be perfectly predicted, focusing on planning can help spot opportunities to grow and understand risks better (Lin, 2007). Shortening a time horizon can significantly negatively affect a company's growth, development, or ability to compete (Mitchelmore & Rowely, 2013). Considering the selection of the length of the time horizon, research shows that having long-term plans is essential for making organizations work well.

Strategic objectives set out where the organization wants to be in the future, and the strategy shows how and when to get there (Getz & Lee, 2011). The time horizon is tightly related to the strategic objectives because all decisions are based on the chosen time frame. Setting the correct time frame requires both realistic thinking and creativity from those in charge of the strategy and the ability to process and understand a lot of information (Radomska, 2012). Table 3 presents determiners of the strategic time horizon selection.

Table 3: Determining of the strategic time horizon selection (Soloducho-Pelc, 2015)

KIND OF FACTORS	KEY QUESTION	FACTORS DETERMINING THE TIME HORIZON SELECTION
ORGANIZATIONAL FACTORS	Until which future moment do we need to plan?	Time necessary to fulfil strategic objectives (lead time) Product life cycle Organization life cycle Changes in technology Validity of planning premises
LEADERSHIP FACTORS	Until which future moment are we able to plan?	Cognitive limitations (reality and rationality of perception of uncertainty related to the future) Risk acceptance Time and financial limitations Information limitations

When determining the correct time horizon, knowing the specificity of a company and operation sector is essential, resulting from the knowledge and experience of strategist-leaders. The range of the time horizon is enormous, from planning 12 months ahead to focusing attention on the next 20 years (Chussil, 2007).

In 2007, companies were shortening their strategic planning timeframes from 10-15 years down to 3-5 years. This change happened because the environment became more unpredictable (Abraham & Leavy, 2007). Most companies tend to plan for about 5 years, but this is not necessarily the best approach for everyone. Planning for a more extended period, say more than 5 years, can help ensure that decisions about the strategy are implemented. Of course, this only works if the company is flexible enough to adapt to changes in the environment and within the organization (Abraham & Leavy, 2007).

A strategic plan outlines long-term goals and the pathways to achieve them. Therefore, when most of these goals have been achieved, developing a new strategic plan is necessary. Additionally, strategic planning is warranted when the organization is undergoing significant shifts in its mission or venturing into new markets. Therefore, creating a new strategic plan every three to five years is advisable, considering the growth pace of the organization (Martins, 2024).

3.4.3 Rolling horizon

A rolling horizon decision-making is common in environments where things are constantly changing and unpredictable. It means making decisions based on what we know about the future for several periods ahead. For example, at the start of a project, planning is made for the next few months or years, but as time goes on and the planning moves into the next phase, the plans are adjusted based on the new information, which can be seen in Figure 14. This process keeps repeating itself, with forecasts and plans constantly updated. The term horizon refers to how far into the future the planning is made, and this horizon rolls over each period as a new planning is made (Sethi & Sorger, 1991). The advantages of a rolling horizon include the availability of updated information along the way and the ability to incorporate unforeseen events into the planning process (Nolz, 2021).

The tactical time horizon typically ranges from one and a half to two years, encompassing not only the current year but also the entirety of the upcoming year in the forecast (Olde Bijvank, n.d.). Determining forecasting frequency depends on how often a new forecast is conducted. Forecasts are

typically updated monthly or every two months in the corporate sector on the tactical level. Conversely, updates occur once every three or four months in non-profit or not-for-profit organisations. This less frequent updating is often due to a lesser sense of urgency and aims to minimize administrative burdens (Olde Bijvank, n.d.).

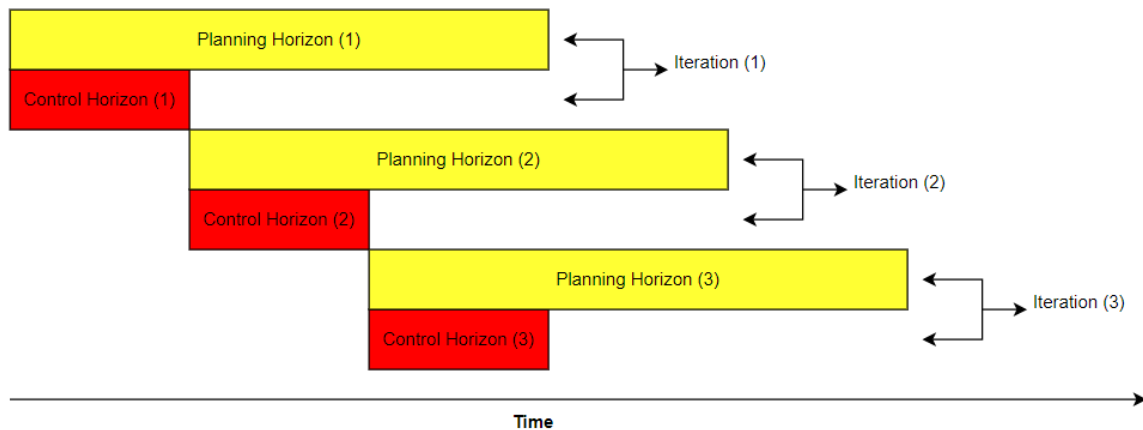


Figure 14: Explanation rolling horizon (based on (Ott et al., 2019))

Before implementing a rolling horizon, several steps and considerations must be addressed.

Communication

The first and most crucial point is to involve all stakeholders in the communication process. It is important that the value of rolling forecasts for the organization is explained, along with outlining their benefits. Projects often fail due to a lack of communication with/among stakeholders. When stakeholders do not see the value for the organization, the success of implementing rolling forecasts may be at risk (Wesselink, n.d.). Next, it is also essential to keep all stakeholders informed about the progress and developments throughout the process (Olde Bijvank, n.d.).

For example, points that can be presented to management include greater risk awareness and identifying new opportunities through more accurate planning figures. Furthermore, there is increased flexibility, such as when the planning is adjusted throughout the year based on new findings.

Replacement or enhancement of existing processes

Replacing the current process initially requires more planning than adding rolling forecasts as a supplement. A step-by-step and parallel implementation is recommended when replacing existing processes. This allows any issues to be identified and addressed early on (Wesselink, n.d.).

Furthermore, a phased implementation is beneficial when rolling forecasts are added. For example, initially involving only a few key figures and departments, then gradually expanding the use of rolling forecasts. Continuous monitoring helps keep things in check (Wesselink, n.d.).

If there is an enhancement of the existing processes or they are replaced, it is essential that the structure and functioning of the rolling forecast are documented. This ensures clarity on the purpose of the rolling forecast and its relationship with other planning and control documents. Furthermore, the document should clearly define who needs to do what and when in the successive process steps (Olde Bijvank, n.d.).

Implementing new processes

Regularly updated actual values in the database are required when forecasting throughout the year. This means that data collection processes will change. Collecting and evaluating data once a year is no longer sufficient (Wesselink, n.d.). Teams across different departments must provide data more frequently, depending on the interval selected for the rolling forecasts.

Keep performance goals and rolling forecasts separate

To ensure maximum benefit from rolling forecasts, keeping the data included and the forecasts separate from performance objectives is essential. Forecasts are most valuable when based on accurate, consistent data. When forecasts are tied to performance goals, there is an increased likelihood of presenting the numbers in a more favourable light. This compromises the data's accuracy and diminishes the forecast's meaningfulness (Wesselink, n.d.).

3.5 Dashboard

This section provides information about the fundamental aspects of what a dashboard comprises, discusses different types of dashboards, and shows how to design a dashboard effectively.

3.5.1 Characteristics of a dashboard

According to Few (2006), a dashboard visualizes crucial information needed to achieve objectives, arranged on a single screen for easy monitoring. It typically combines text and graphics to highlight key information, enabling users to identify trends and anomalies. Gröger et al. (2013) define a dashboard as a panel that gathers information from various visual resources, such as graphs or maps, to facilitate decision-making across different company levels. Caldaira (2010) further describes the dashboard as a management tool that supports decision-making processes.

Dashboards often consist of a set of Key Performance Indicators (KPIs). Most of the information displayed on dashboards is condensed into summaries of exceptions because monitoring all the necessary details at a glance is not feasible. According to Few (2006), dashboards should quickly highlight areas that need attention and may require action.

A dashboard consists of several layers: a graphical metrics view, a multidimensional view, and a detailed or operational view. These layers are structured to meet the needs of users within an organization who may not have specialized numerical expertise but rely on the tool to perform their roles effectively. The different layers allow users to navigate the dashboard using a drill-down approach. They follow a natural sequence in which users want to interact with information. First, monitoring critical metrics for exceptions, then exploring and analysing information to uncover hidden trends and issues. Finally, detailed data and reports will be examined to identify the root causes of problems and take action (Eckerson, 2012).

By visualizing critical data and using built-in features, dashboards aid organizations in enhancing corporate agility, optimizing performance, and attaining strategic objectives. However, the effectiveness of visualizing business performance depends on the quality and relevance of the information used. Hence, dashboards should be developed through data analyses and guided by Key Performance Indicators (KPIs) crucial for the company's success (Cahyadi & Prananto, 2015). These KPIs should be customized to meet the specific requirements of the company.

3.5.2 Types of dashboards

Dashboards combine three primary functions: monitoring, analysing, and managing. The emphasis on each task varies depending on the type of dashboard. Few (2006) categorizes dashboards into three types: strategic, analytical, and operational. The choice of dashboard type for an organization depends on its intended purpose.

A strategic dashboard focuses on high-level performance metrics and incorporates forecasts to anticipate future trends. An analytical dashboard delves into the root causes of problems by analysing relevant and timely information from multiple perspectives and levels of detail (Eckerson, 2012). Analytical dashboards often require additional context, such as comparisons, historical data, or nuanced performance indicators (Few, 2006). On the other hand, operational dashboards monitor ongoing situations and alert users when specific values deviate from predefined norms. Therefore, these dashboards need to be designed dynamically and immediately. Table 4 shows the different types of dashboards.

Table 4: Types of dashboards (Few, 2006)

	STRATEGIC DASHBOARD	ANALYTIC DASHBOARD	OPERATIONAL DASHBOARD
DISPLAY	Simple	Sophisticated	Simple
UPDATE FREQUENCY	Static snapshots	Static snapshots	Real-time
INTERACTIVITY	No	Yes	Yes
GOAL	Long-term strategic direction	Discover cause-effect relationship	Grab the attention when an operation fails

3.5.3 KPIs

Metrics track and provide data on the organization's standard business processes, aiding users in achieving goals by defining strategy and maintaining focus (Eckerson, 2012). Among the most common metrics used in dashboards are Key Performance Indicators (KPIs). A KPI is a quantifiable measure of performance over time for a specific objective, utilized to assess the success of an organization, employee, schedule, and so on in meeting performance objectives.

The literature states that limiting the number of KPIs by selecting only essential ones is crucial. Determining KPIs' feasibility is evaluated by assessing whether they can be measured with the available data (Lempinen, 2012). If the necessary data is unavailable, the KPIs should be adjusted accordingly.

3.5.4 Design of dashboard

To effectively communicate the goal of a dashboard and enable users to identify trends, patterns, and anomalies visually, it is crucial to design the dashboard thoughtfully.

One way to achieve this is by displaying all KPIs on a single screen. This allows users to observe the relationships between different KPIs (Cahyadi & Prananto, 2015).

Second, arranging the most essential data in the upper left corner and the least in the lower right corner can enhance usability. It is also beneficial to position graphs that complement each other next to one another (Few, 2006). This approach is supported by Andrade (2013), who refers to the Gutenberg Diagram (Figure 15), illustrating the reading behaviour of Western users from left to right and top to bottom. As per this diagram, the primary information should be placed in the top left area of the layout, as this is where users tend to focus first. Moreover, Nielsen (2017) suggests that the lower right area is the least attention-grabbing for users.

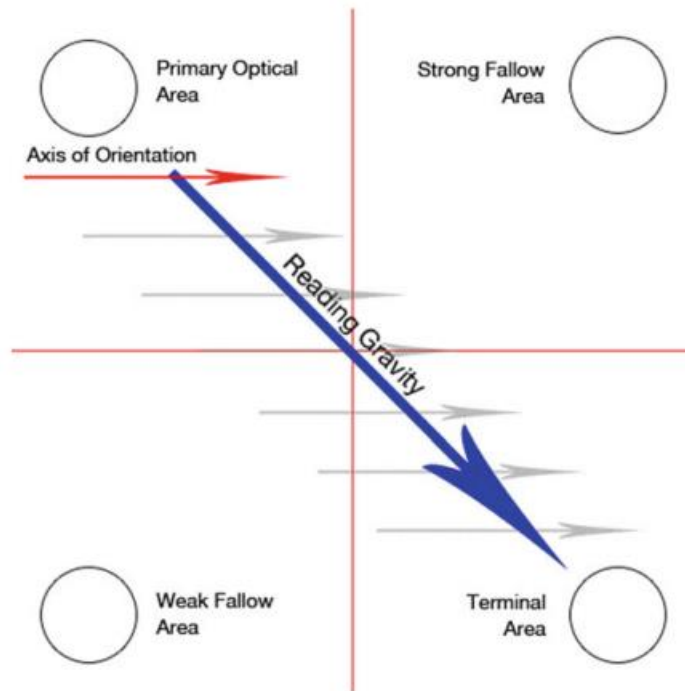


Figure 15: Gutenberg diagram (Bradley, 2011)

Third, it is essential to select the correct media display to showcase the various KPIs effectively. The chosen display should serve its purpose and communicate clearly and efficiently. There are six media display categories: graphs, images, icons, drawing objects, text, and organizers. Few (2006) elaborates on each category, which can be found in Table 5.

Table 5: Media display categories (Few, 2006)

Category	Display Media	Comments
Graphs	Bullet graph	Display key measures in comparison to a target
	Bar graph	Great for displaying measures associated with a category
	Stacked bar graph	Use only when there are multiple instances of a whole displayed, with a focus on the whole
	Combination bar and line graphs	When combining data that fits best with a bar chart and a line, consider using a combination of these two visualization types
	Line graphs	When aiming to reveal patterns or trends in data, consider utilizing this approach
	Sparklines	Simple graph meant to provide a quick sense of historical context
	Box plots	This method is effective for conveying a rich picture of data distribution

	Scatterplots	Shows if two paired sets of measures are correlated
	Tree maps	This method is effective for displaying large sets of hierarchically or categorically structured data
Icons	Alert	Use to draw attention to particular information on the dashboard
	Up/down	To indicate if measures go up or down
	On/off	Use to identify some items different from others
Text		Use to report a single measure without comparing it to anything
Images		It is unnecessary for most typical business uses
Drawing objects		Useful to connect pieces of information
Organizers	Tables	Arrange data into columns and rows
	Spatial maps	Useful when data is tied to a physical space
	Small multiples	Displays a single row or column of related graphs

The fourth point is the number of media displays used in the dashboard. Treude & Storey (2010) discovered that 77% of dashboards typically contain between 5 and 10 media displays. This finding aligns with Eckerson (2012), who suggests that having around 7 media displays is optimal depending on the intended use of the dashboard.

The fifth point is the use of colour, which can significantly impact the clarity of the dashboard. Colour should be employed to (de)emphasize various elements such as comparisons, KPIs, or performance indicators. It is essential to avoid excessive use of colour and instead opt for one or two colours, utilizing darker and lighter shades to (de)emphasize elements as needed (Few, 2006). Furthermore, it is recommended to use soft colours that facilitate easy and straightforward data reading (Matheus et al., 2020). As stated by Juice Analytics (2015), dashboards often suffer from unnecessary and impulsive use of colour. Thus, dashboards should initially be designed in shades of grey, gradually adding colour to convey meaningful information. When incorporating colour, precautions, such as defining shades to connect related data or increasing saturation to highlight important information, should be taken. These considerations ensure that colour enhances the dashboard's effectiveness rather than detracting from it.

The final point is to minimize non-data pixels, which do not represent data, such as gridlines in Excel. Removing these non-data pixels helps direct focus to the essential aspects of the dashboard (Few, 2006). Additionally, creating blank spaces is crucial for comfortable interaction with the platform. Whitespace enables the definition of hierarchies to distinguish information effectively. A layout with a high information density, lacking whitespace at the outer edges or between elements, can make it challenging for users to read and concentrate on the information (N. Martins et al., 2022). Therefore,

incorporating whitespace strategically enhances the user experience and facilitates a more transparent comprehension of the dashboard content.

3.5.5 The dashboard platform

A dashboard platform is a software tool tailored to meet the visualization requirements of businesses. It should offer intuitive interfaces and standard functionalities to enable users to address common business scenarios with minimal technical assistance (Chiang, 2010). Ideally, this platform should be highly customizable and adaptable to complex requirements.

The primary function of a dashboard platform is to develop and deploy dashboards efficiently. It should facilitate accelerated development and deployment timelines, support collaborative workflows, and offer an open application programming interface (API) (Chiang, 2010).

Defining the business metrics and KPIs is essential when developing and deploying dashboards. By concurrently discovering the data behind these KPIs while designing dashboards, the overall time needed for dashboard creation can be significant (Chiang, 2010).

A comprehensive dashboard solution should involve all stakeholders participating in the initiative. This can be achieved by providing specific interfaces and functionalities tailored to each audience. Business users should have easy access to dashboards, while business analysts require tools to define KPIs and design dashboards. Database administrators need functionalities to connect to data sources and manipulate data to meet KPI definitions. Additionally, IT personnel should have interfaces for managing dashboard access and system administration (Chiang, 2009).

Although dashboard platforms may not initially possess all required features, they should offer customization capabilities to meet future needs. Thus, having an API for adding new features is crucial for ensuring the platform's adaptability and scalability (Chiang, 2010).

3.6 Conclusion

In conclusion, the literature review provides valuable insights into the planning and scheduling challenges faced by the Court of Law Amsterdam. While existing research within the Court of Law context is limited, studies from other sectors such as healthcare and project scheduling offer relevant frameworks and methodologies that can be adapted to address the specific needs of the Court of Law Amsterdam.

The hierarchical planning and control frameworks presented offer a structured approach to decision-making at strategic, tactical, and operational levels. These frameworks highlight the importance of integrating technological and logistics planning, capacity planning, and materials coordination to effectively manage complex systems.

In healthcare and project scheduling, strategic decisions involve long-term resource planning and case mix planning, ensuring alignment with organizational objectives and market dynamics. Tactical decisions, on the other hand, focus on capacity allocation, admission planning, and rough-cut capacity planning, balancing patient access time with resource utilization.

Operational decisions include resource-constrained project scheduling, workforce scheduling, and rescheduling, aiming to optimize resource utilization and minimize delays in task completion.

Overall, by drawing on insights from various industries, this study aims to fill the gap in the literature regarding the planning and scheduling of cases in the Court of Law Amsterdam. By applying relevant frameworks and methodologies, the goal is to propose efficient scheduling strategies that ensure the

timely and equitable distribution of cases, ultimately enhancing the efficiency and effectiveness of the Court's operations.

Next, the literature states that understanding the planning horizon, whether long-term, medium-term, or short-term, is crucial for making informed decisions. Balancing the length of the planning horizon ensures that organizations can anticipate future events. Incorporating rolling horizons in decision-making is a strategy for adapting to dynamic environments and enhancing organizational agility.

Meanwhile, dashboards serve as essential tools for monitoring and analysing key performance indicators (KPIs) to support decision-making processes. Effective dashboard design involves thoughtful arrangement of information, selection of appropriate visualizations, and consideration of user needs and preferences.

In essence, by integrating these insights and approaches, the Court of Law Amsterdam can enhance their planning and scheduling processes, ultimately facilitating smoother operations and better outcomes.

4 Gap analysis and implementation of the planning framework

This chapter applies the hierarchical framework, as discussed in Chapter 3, to the observed situation at the Court of Law Amsterdam. Section 4.1 provides a recap of the current situation. Section 4.2 maps the current situation at the Court of Law Amsterdam within a planning framework and offers further insight into the decision-making process behind selecting this framework. Additionally, we identify any lacking planning functions and explain the current interaction between the control functions. With the current design mapped out, Section 4.3 delves into redesigning the planning and control functions. Subsequently, Section 4.4 outlines how the Court of Law Amsterdam can implement these changes. Finally, Section 4.5 gives a conclusion.

4.1 Current situation recap

First, we recap the current planning and scheduling process of Megas on the hierarchical levels based on the information in Chapter 2.

On the strategic level, decisions are made by the judicial board to determine how many courtrooms should be built and how many judges should be hired and educated to deal with the demand. Next, the management team determines how many clerks to hire and educate to handle the demand.

Figure 16 and Figure 17 show figures introduced in Chapter 2. These figures represent the tactical and operational level of the planning process. Here, we visualize the different decisions made on the tactical and operational level per month.

There are 3 takeaway points from Figure 16. The first one is that the covenant and capacity allocation decisions have an impact on which Megas to plan and which staff to allocate. Next, there is uncertainty in the first 6 months of planning due to the covenant not being ready, as we show in the red boxes. Finally, there are quarterly meetings between the Public Prosecutor’s Offices and the Court of Law Amsterdam where the progress is discussed; however, no more changes can be made at that point in time.

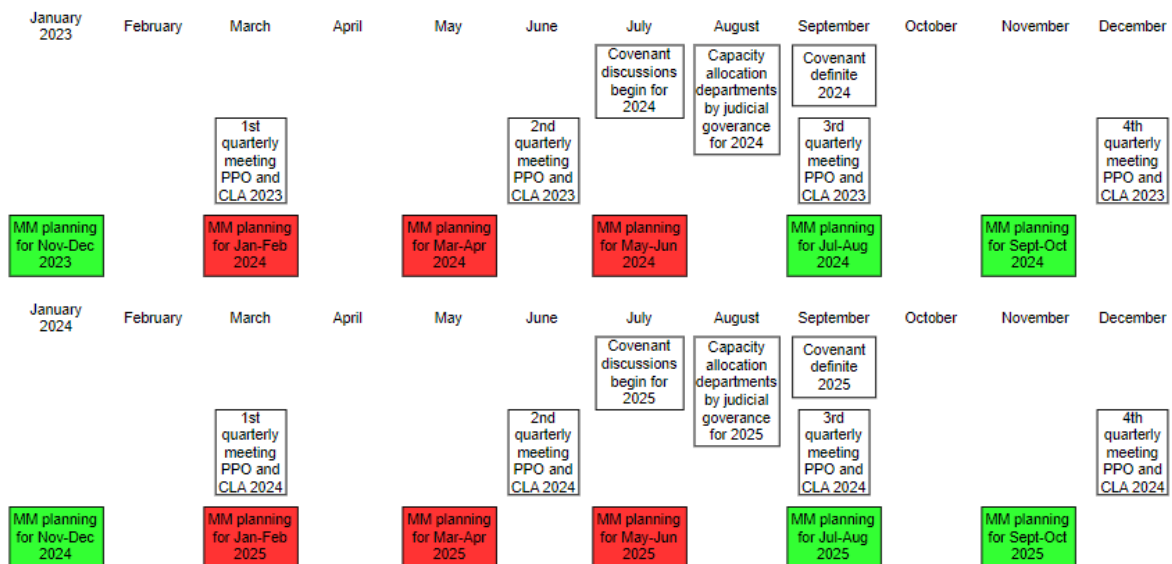


Figure 16: Current situation tactical level

There are two takeaway points from Figure 17. The first one is that a rolling horizon is present, shown on the vertical axis. Here, we visualize that a new decision is made every 2 months. Next to this, in the first 4 months after planning a Mega, the Mega can still be replaced by a regular case if the Mega cannot take place. Once a Mega is scheduled 10 months in advance, it cannot be changed anymore.

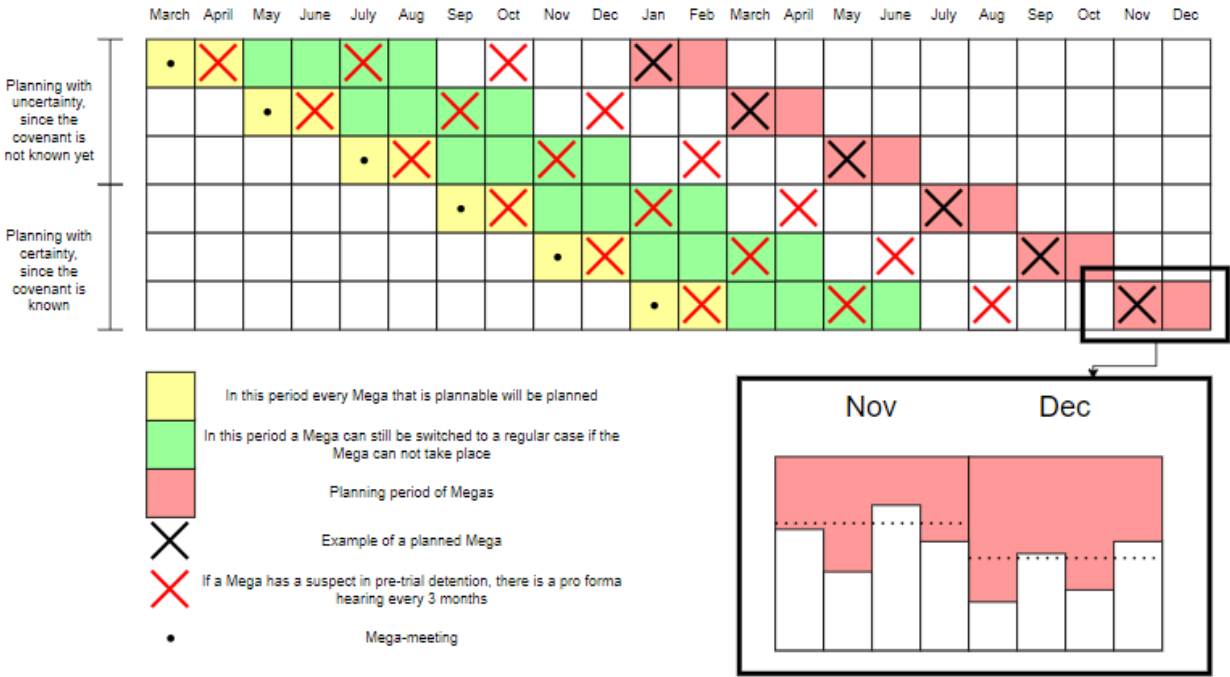


Figure 17: Current situation tactical-operational level

4.2 Mapping the current situation in the planning framework

The planning framework can help identify missing planning functions and planning problems. We collaborate with employees of the Amsterdam Court of Law and review relevant literature to identify missing planning functions and planning problems. We identify the missing planning functions upon establishing the current hierarchical framework for the Court of Law Amsterdam. Next, we focus on the lack of coherence between the planning functions by explaining the current interaction between different hierarchical levels of control at the Court of Law Amsterdam.

4.2.1 Overview of the current hierarchical planning framework

As said in Section 3.2, this study focuses on the resource capacity planning area since it is the most interesting problem faced by the Court of Law Amsterdam. First of all, we show all the decisions that are made in the planning process in Table 6. The table columns and the allocation of decisions to hierarchical control levels are both based on the literature. Next, the sequence of decision-making follows the sequence of the rows in Table 6. Next, the content of Table 6 determines the placement of the planning functions in Figure 18.

Table 6: Content hierarchical framework - current situation

Hierarchical level of control	Based on estimation or actual demand	Horizon of level of control	Plannings frequency	Decision maker	Decision
Strategic	Based on estimation	4-6 year	4-6 year	Judicial governance, council for the judiciary	Capacity dimensioning (Number of courtrooms)
				Judicial governance	Workforce planning (number of judges to hire)
				Management team	Workforce planning (number of clerks to hire)
Tactical	Based on estimation	1 year	1 year	Judicial governance	Capacity allocation (number of employees for every department)
				Head of planning department, team presidents, management team	Capacity allocation (separation of hours over different Public Prosecutor's Offices)
	Based on actual demand	10 months	2 months	Team president, head of legal support	Staff allocation (judge and clerk)
				Mega meeting	Multi-Mega planning (which Megas to plan)
				Public Prosecutor's Offices	Prioritization of Megas
Operational	Based on actual demand	10 months	2 months	Mega planner	Mega scheduling (when will the Megas take place)
		Flexible		Mega planner	Mega rescheduling

Figure 18 projects the planning functions of the Mega planning process of the Court of Law Amsterdam on a combination of the hierarchical framework of Hans et al. (2012), De Boer (1998) and Zijm (2000)

with a focus on resource capacity planning. We decide to base the structure of the framework on the framework of Hans et al. (2012) and De Boer (1998), since both frameworks are well-structured and easy to read in comparison to the framework of Zijm (2000). Next, we decide to include feedback loops, such as in the framework of De Boer (1998) and Zijm (2000), since Section 3.2 states that these are important to ensure the hierarchical levels work well together. The arrows between the control levels represent the feedback loops.

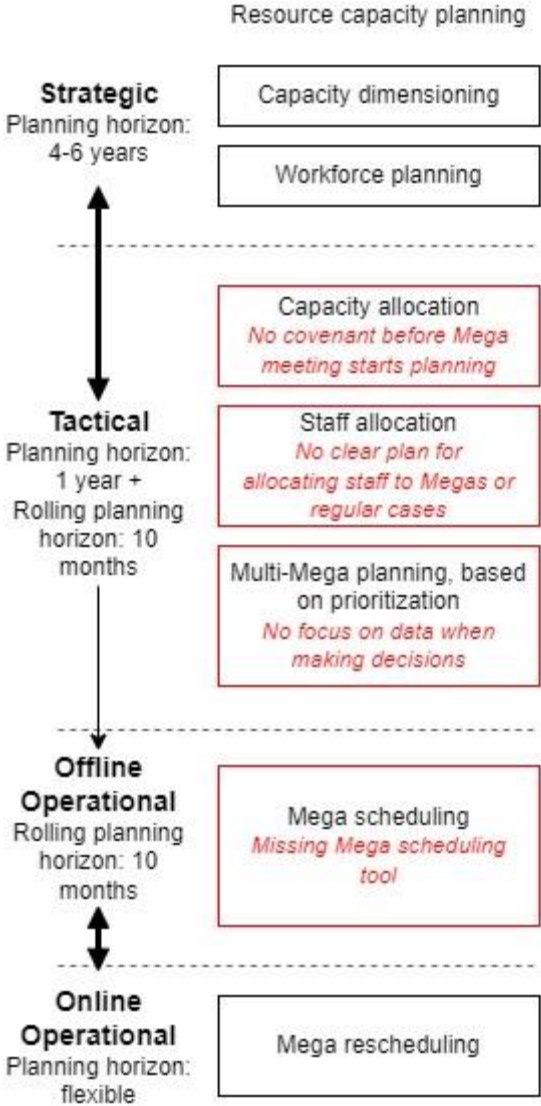


Figure 18: Hierarchical framework Court of Law Amsterdam current situation

4.2.2 Current interaction between the control functions

In this section, we explain the current interaction between planning functions. The different levels of control must communicate with each other. Section 3.2 states that if decisions are made on a hierarchical level, they should be communicated with the higher and/or lower level.

Strategic – tactical

At the strategic level, decisions are taken about workforce planning and capacity dimensioning. Once every quarter, new judges are introduced. This is downward interaction. Next to this, there is a progress meeting between the department management and the judicial board every quarter, in which

the finances, number of hours spent on cases, personnel, sick leave, and performance reviews of employees are discussed. This is upward interaction.

Tactical – operational

At the tactical level, meetings are held about the covenant and the decision about how the employees are divided over the departments. After the employee decision is made, the results are shared with the different departments. At least the head of the planning department and the team presidents are present during the meetings about the covenant. The head of the planning department and one of the team presidents are also present at the Mega meeting. Next to this, there are quarterly meetings in which the progress of the covenant is discussed.

At the tactical level, the Mega meeting takes place, attended by the Mega planner along with other employees. The Mega planner takes care of the operational level of the process. Therefore, the decisions made on the tactical level are communicated with the operational level, which means there is a downward interaction. The communicated information is which Megas to plan and the combinations for the Megas.

At the operational level, no meetings are held since there is only one person at this level, the Mega planner. Next, there is no upward interaction with the tactical level since the progress of the planning or the encounter of issues by the Mega planner is not shared with the tactical level even though the Mega planner is present at the Mega meeting. It is unclear why this progress is not shared with the tactical level.

4.2.3 Identification of missing planning functions and support of planning functions

In Chapter 2, we analysed the current situation. After applying the hierarchical planning and control frameworks introduced in Chapter 3, we can identify lacking planning functions from Figure 18. Next, we also identify the lack of support for planning functions. Below, we discuss the findings for the different hierarchical levels of control.

Strategic

At the strategic level, the decisions made are comparable to those made on the strategic level in literature. Therefore, we identify no missing planning functions or support of planning functions.

Tactical level

No covenant before Mega meeting starts planning

As said in Section 2.3, the covenant is made definite in September of the year before and consists of the number of hours for the Megas and the regular cases. Figure 16 and Figure 17 also show this process. The covenant is known exactly in time for the regular cases since the regular cases are planned 4 months in advance. However, for the Megas, which are planned 10 months in advance, the covenant is known to be 6 months too late.

No clear plan for accepting cases and allocating resource capacity to Megas or regular cases

After analysing the tactical planning process, it becomes clear that the decision regarding which Mega to plan in the next cycle depends on whether the hours align with the covenant and if the investigation is completed. Notably, the decision is not based on the availability of judges/clerks, potentially resulting in a shortage of personnel for regular cases.

No focus on data when making decisions

The tactical decisions made during the Mega meeting are not based on available data. The data consists of how many hours should be planned during a planning period of 2 months and how many of those hours are already planned. Because of this, it is too late to know whether too little or too many Megas are planned.

Operational level

Missing Mega scheduling tool

At the moment, there is one employee who schedules the Megas. The Mega planner uses Excel to schedule the Megas; an example schedule can be seen in Appendix A. To make the schedule, the Mega planner has to know the schedule of all parties involved. The schedule of the judges and clerks can be found in the planning system the Court of Law Amsterdam is using, and the schedule of the lawyers and the public prosecutor is gathered through email. After this, the schedules are manually put in Excel, and the Mega planner tries to find fitting dates for all the parties involved. No tool is available to assist the Mega planner in making or creating a standardized detailed schedule. This way of working takes up a lot of time because it is all done manually.

4.3 Redesign of the hierarchical planning framework for the Court of Law Amsterdam
This section proposes redesigning the hierarchical planning framework for the Court of Law Amsterdam. The redesign is made because of lacking planning functions, support of planning functions, and missing interaction between the control functions. First of all, we show the redesign of the framework on the right side of Figure 19. Next, we explain how we got to the redesign. Afterwards, we discuss the planning horizon and planning frequency of the different control levels and the interaction between the control functions.

We start the redesign with a greenfield, meaning we start the design from scratch. We adopt this approach because the current structure of the Mega planning process is centred on addressing individual issues with ad-hoc solutions rather than looking at the whole picture to resolve the challenges faced by the Court of Law Amsterdam. By starting from scratch, we ensure that every step in the planning process fits together. Some specific parts of the current planning process cannot be changed since, in practice, it cannot be done otherwise. We also explain the parts that cannot be changed in this section.

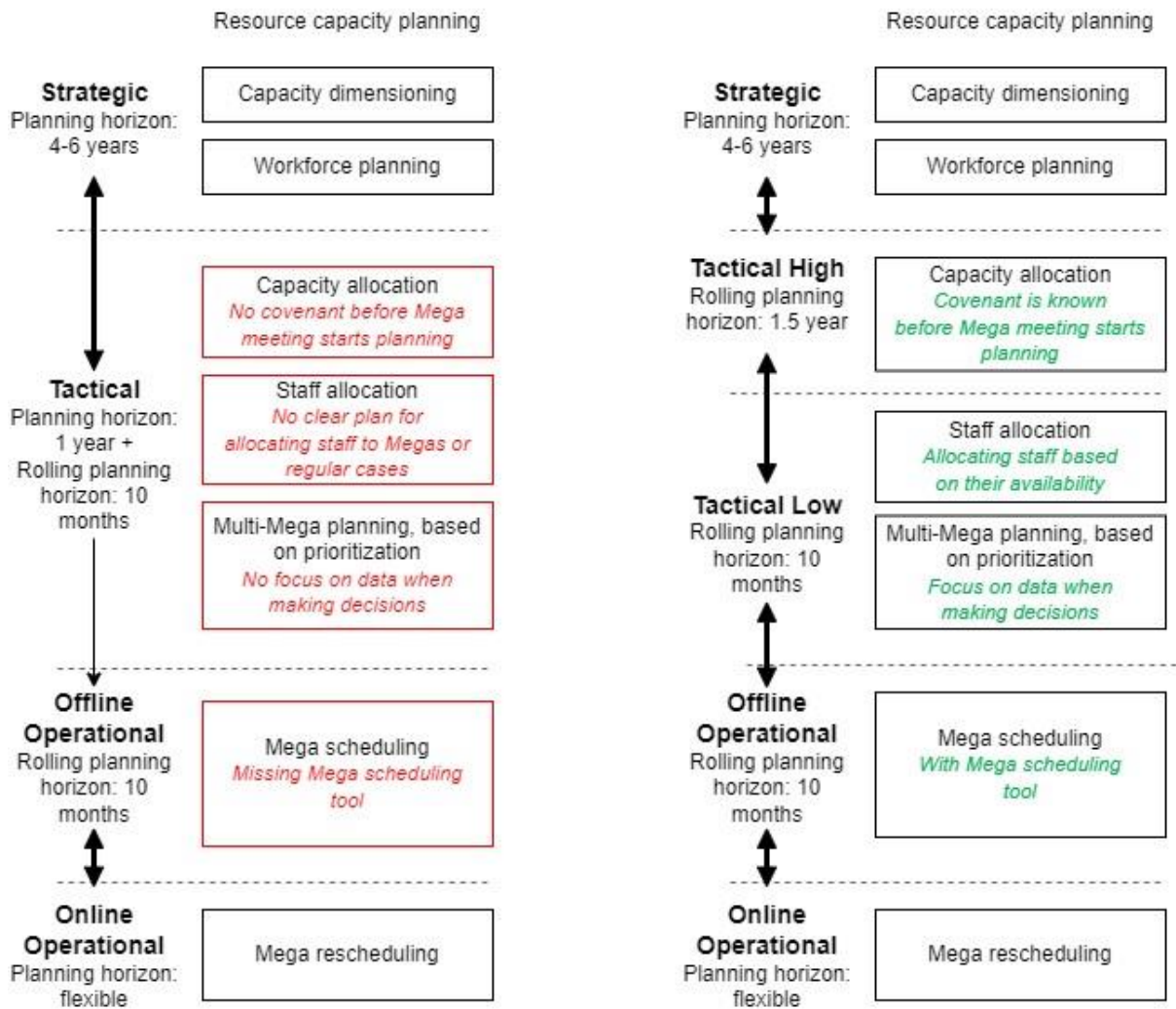


Figure 19: Current situation and redesign hierarchical framework Court of Law Amsterdam

4.3.1 Explanation change in framework

One visible change is that the tactical control level is divided into high and low level. This change is based on the framework of De Boer (1998), where the tactical level is split up into 'tactical' and 'tactical/operational'. We observe that the decisions can be divided into different levels of aggregation for the tactical level. The capacity allocation decision is made based on estimates, while the decisions on the low tactical level are based on actual demand. Because of this, we decide to put the capacity allocation decision on the high tactical level.

Strategic

Section 4.2.3 shows that no missing planning functions or support of planning functions have been detected at the strategic level since the decisions being made on this level cover the decisions made in the literature on this level. Therefore, we keep the decisions and how they are currently executed the same.

Tactical high

Capacity allocation

We observe that the allocation of capacity is managed effectively. The determination of the covenant is based on the inventory of Megas, forecasts of Megas, and the capacity of judges assigned to criminal law. Therefore, we recommend no changes to the capacity allocation process. However, as mentioned in Section 4.2.3, no covenant is in place before the Megas meeting begins planning. We recommend a solution to this issue in Section 4.3.2.

Tactical low

Multi-Mega planning

With multi-Mega planning, it is essential to manage all the cases simultaneously instead of planning individual Megas to achieve departmental success. During the Mega meeting, every Mega is considered, and the parties present look at which Megas can be planned and if they can be planned together. Therefore, we recommend making no changes to this part.

However, it is essential to make sure that the covenant is efficiently divided over the months, such as fewer Megas during July because of the summer holiday, and to make sure that during the planning of the Megas, the target is met.

Staff allocation

We decide to keep the staff allocation on the tactical level. The literature in Section 3.3.3.2 states that the RCPSP determines when certain resource groups perform activities. However, the schedule does not necessarily indicate which persons or machines of that group are assigned to each activity. That is determined during the detailed scheduling and done on the operational level. In the Court of Law Amsterdam context, this staff allocation decision should be made before the Mega is planned. This is because some Megas have pro forma cases, which occur every 90 days until the actual Mega can occur. These cases should be done by at least 2 persons of the combination. Different judges and clerks can also do the pro forma cases and Mega. However, this will double the preparation time since all judges and clerks must be prepared for the pro forma and the Mega. Therefore, we recommend keeping the staff allocation decision on the tactical level. The pro forma cases are only considered for this particular decision, for the remainder of this thesis, they are out of scope.

On the tactical level, it is possible to still influence the capacity, for example, the number of employees. For the Court of Law Amsterdam, this is not the case. Judges come from 3 different places, first from employees who join the Court of Law Amsterdam through training to become a judge or from different judges from other courts. Getting judges to the Court of Law Amsterdam on shorter notice is difficult for all these options.

No focus on data when making decisions

The decisions made on this level are not based on available data. This is the first control level where decisions can be made on the actual demand. However, the data on how many hours should be planned and how many are already planned are not used. The focus on data will, for example, help the decision based on the order acceptance. We recommend finding a way to make use of the data that is available. We elaborate on this in Section 4.4.2 and Chapter 5.

Operational

Mega scheduling tool

As said in Section 4.2.3, no tool is available to assist the Mega planner in making a schedule for the Megas. Therefore, the scheduling of the Megas and the communication with the other parties is done

manually. The manual scheduling of the Megas includes much repetitive work. At first, the schedule of all parties involved is requested. After that, the schedules are put in an Excel file, and finally, the schedule is made by manually looking for available dates. A tool can assist the Mega planner in doing repetitive tasks, and the Mega planner only has to check the work of the tool. This tool could also include a function where the parties involved can put their schedule so no human mistakes can be made by communicating the schedule through email and putting the schedule in Excel.

Next to this, the tool can be used to create a better overview of when the court days of the Megas take place. Only a limited number of Megas court days can take place at the same time. Therefore, it is essential to see when they occur and when court days of new Megas can be scheduled. When there is a better overview, this can also be shared with the security to see when more security is needed or to assess if the current schedule is not feasible.

4.3.2 Explanation change in planning horizon

We must determine the planning horizon within which the control functions operate in the redesign. It is essential that the planning horizon supports the process and is chosen well.

Strategic

We discuss the options for the planning horizon on the strategic level, which are 3, 5, and 10 years. We decide on these options because decisions are made for approximately 5 years. Therefore, we want to investigate whether the planning horizon should be shorter, every 3 years, or longer, every 10 years, or if maintaining the current planning horizon is preferable.

Planning horizon of 3 years

One of the most frequent made mistakes is shortening the time horizon below 5 years. Section 3.4.1 discusses that a planning horizon of below 5 years significantly negatively impacts an organisation's growth, development or competitiveness. In this way, an organization performs tactical actions that do not increase the company's development.

However, Section 3.4.1 discusses that the time horizon is tightly related to the strategic objectives because all decisions concerning the strategic objectives refer to the given time horizon. Therefore, shortening the time horizon is meaningful regarding tactical or implementation actions.

Planning horizon of 5 years

Section 3.4.1 discusses that currently shortening the time horizon of strategies can be observed from 10-15 years to 3-5 years, which is a response to the unpredictability of changes occurring in the environment. The most popular time horizon reaches 5 years ahead. However, such a horizon length does not constitute a standard for planning. We discuss that a downside of a planning horizon of 10 years is that it might be harder to adjust quickly to the fast-paced changes in society. With a planning horizon of 5 years, the Court of Law Amsterdam is more flexible and responsive to unexpected shifts.

As mentioned earlier, a planning horizon of 3 years and a horizon of below 5 years significantly negatively impact an organisation's growth, development or competitiveness. Opting for a 5-year planning horizon can function well. However, extending it beyond 5 years allows for more impactful changes and adaptations.

Planning horizon of 10 years

Section 3.4.1 discusses that opting for a time horizon exceeding 5 years enforces the execution of strategic decisions. A longer planning horizon allows for a new perspective on the organization,

providing the opportunity to generate and test innovative ideas. The chosen time horizon aligns with research emphasizing the importance of crafting long-term plans for optimal organizational efficiency.

A downside of planning too far ahead is that adjusting quickly to the fast-paced changes in society might be more challenging. While having a clear plan for the future is good, the Court of Law Amsterdam needs to stay flexible and responsive to unexpected shifts to ensure its goals align with the evolving needs of the legal landscape.

Conclusion

We discuss that a strategic planning horizon of 10 years is the best for crafting long-term plans to attain optimal organization efficiency and test innovative ideas. However, the long-term planning horizon is not well suited for the Court of Law Amsterdam to quickly adjust to the fast-paced changes in society. Therefore, we recommend to keep the strategic planning horizon of 5 years. As stated in Section 3.4.1, a new strategic plan should be created when the majority of the goals of the old strategic plan have been achieved. Therefore, we also recommend keeping the planning frequency of 4-6 years the same.

Tactical high

We discuss the options for the planning horizon on the high tactical level, which are 1 and 2 years. We decide on these options because decisions are currently made for a year. Therefore, we want to investigate whether the planning horizon should be longer, every 2 years, or if maintaining the current planning horizon is preferable. Next, we discuss if a rolling horizon is suitable for the high tactical level since the rolling horizon is already implemented at the low tactical and operational level.

Planning horizon of 1 year

The advantage of a planning horizon of 1 year is that it is easier to forecast the demand since the horizon is small, and most Megas that are to take place in that year are already known since the demand of the Public Prosecutor's Offices is known.

The disadvantage of a planning horizon of 1 year is that the Court of Law Amsterdam is experiencing a higher peak of hours at the end of the year and a lower number of hours at the beginning of the following year. This is happening because the Public Prosecutor's Offices are trying to fill the hours still left in the covenant at the end of the year. The reason is that the Court of Law Amsterdam is bound to the calendar year with a planning horizon of 1 year.

Planning horizon of 2 years

The advantage of a planning horizon of 2 years is that the Court of Law Amsterdam is no longer bound to one calendar year. However, with a planning horizon of 2 years, there is still a time when the period ends and when the Public Prosecutor's Offices will try to fill the hours still left. Therefore, a planning horizon of 2 years is an improvement to the planning horizon of 1 year since the end of the plan only occurs once every 2 years instead of once every year.

Rolling horizon

Section 3.4.2 discusses that the advantage of a rolling horizon is that once a decision is made, this is only definite for the control horizon. After this, the decisions can be revised or updated. Next to this, new decisions are made after a control horizon that requires more information in the future. This is important for the Court of Law since, with this practice, there is no endpoint. Therefore, we recommend using the practice of a rolling horizon on the high tactical level. We visualize this in Section 4.4.1.

In order to use this practice, first, we need to decide the length of the rolling horizon. To do this, we first see if there are any constraints with the planning horizon of the low tactical level since all levels should work well together. We discuss the recommendation in the conclusion of the low tactical level.

Tactical low

We discuss the options for the planning horizon on the low tactical level, which are 4 or 10 months. We decide on these options because the planning horizon currently is 10 months with a rolling planning horizon. Therefore, we want to investigate whether the planning horizon should be shorter, every 4 months, or if maintaining the current planning horizon is preferable. We include the choice of 4 months to see if Megas and regular cases can be planned together.

Planning horizon of 4 months

The advantage of a planning horizon of 4 months is that the Megas can be planned together with the regular cases. The result is that the capacity does not have to be divided and can be used for the cases that have to be planned at that moment. Next to this, the Court of Law Amsterdam will have greater certainty on the feasibility of the Mega since the planning is closer to the exact date.

The disadvantage of a planning horizon of 4 months is that the Megas take up much time in a schedule. Suppose the planning takes place closer to the exact date. In that case, there is a possibility that the external persons, such as the public prosecutor or the lawyers, will not be available anymore.

Planning horizon of 10 months

The advantage of a planning horizon of 10 months is that there is a greater possibility that external persons are available.

The disadvantage of a planning horizon of 10 months is that the capacity needs to be divided beforehand. Dividing the capacity means the capacity cannot be optimally used.

Conclusion

We recommend to keep a planning horizon of 10 months. In practice, the closer the planning gets to the date, the less available the lawyers become. Next to this, preparing the lawyers before a case takes much time. Therefore, they need to know when the Mega takes place to schedule the preparation time.

Next, we determine the planning horizon for the high tactical level. With a rolling horizon of 1 year, there will still be the issue that in the first 6 months of planning Megas, the plan is not known yet, as shown in Figure 16 and Figure 17. Next, Section 3.4.3 states that the planning horizon typically ranges from 1.5 to 2 years, so the current year and the upcoming year are included in the forecast. Therefore, we recommend a planning horizon of 1.5 or 2 years. We discuss the planning frequency in Section 4.3.3.

Operational

Currently, the planning horizon of the operational level is 10 months with a rolling planning horizon. Currently, the planning horizon at the operational level is the same as the planning horizon at the low tactical level. We investigate if this planning horizon should be changed.

When looking at the pros and cons of the low tactical level options, we see that we choose to keep the planning horizon of 10 months because of the availability of the external persons. We find the same problem at the operational level.

The Court of Law Amsterdam's influence over the assignment of lawyers to specific cases is limited, as defendants select or are assigned their lawyer. Consequently, the lawyer's availability aligns with the scheduled court dates. Thus, it ensures that once a Mega session is planned on the low tactical level, it is also scheduled on the operational level, guaranteeing the lawyer's presence at the Mega. Therefore, we recommend keeping the planning horizon of 10 months with a rolling planning horizon on the operational level.

4.3.3 Planning frequency of rolling horizon

With a rolling planning horizon, the planning horizon should be determined, which we determine in Section 4.3.2, and the planning frequency should be determined.

Tactical high

Section 3.4.3 states that in the corporate sector, the planning frequency is typically monthly or every 2 months. In non-profit organisations, the frequency is once every 3 or 4 months. Section 3.4.3 states that the less frequent updating is often due to a lesser sense of urgency and aims to minimize administrative burdens.

For the Court of Law Amsterdam, it is not necessary to have a planning frequency of every month since the updating is not that urgent. Next, input from the Public Prosecutor's Offices is required to update the forecast. Therefore, we recommend to update the planning horizon every 3 months.

Tactical low/operational

From the previous section, we conclude that once a Mega is planned on the tactical level, it should also be scheduled on the operational level. Therefore, the planning frequency of the rolling horizon should be the same. The planning frequency currently is 2 months. Therefore, we want to investigate whether the planning frequency should be more frequent, every 2 weeks, or less frequent, every 4 months, or if maintaining the current planning frequency is preferable.

2 weeks

We observe that deciding which Mega to schedule every 2 weeks is too frequent. Often, it takes time to see progression in an investigation of a Mega. Therefore, we believe that in 2 weeks, not many new Megas will become available for scheduling, which could lead to non-optimal planning since the focus will be more on scheduling single Megas instead of scheduling multiple Megas.

2 months

The advantage of scheduling every 2 months is that the Court of Law can act quickly if new Megas become available for scheduling. Next, there is a higher chance that more Megas are ready to be scheduled. This positively impacts the schedule since the focus can be on the multi-scheduling of Megas instead of focusing on only one Mega.

4 months

We observe that deciding which Mega to schedule every 4 months is too late. Sometimes, Megas need to be scheduled soon, for example, the socially impactful Megas. For these Megas, and if Megas become ready to be scheduled during the 4 months, they have to wait a long before they can be scheduled.

Conclusion

Concluding from the options, we recommend keeping the planning frequency the same, which is every 2 months.

4.3.4 Explanation change in the interaction between the control functions

To ensure the optimal functioning of all planning functions, the Court of Law Amsterdam must ensure seamless interaction among all control functions. All information influencing the decision on another level must be shared during the interaction, as stated in Section 3.2. We discuss which pieces of information must be shared and how often they must be shared.

Strategic – Tactical

At the strategic level, the downward interaction with the tactical level introduces new judges. The tactical level is not informed about what the decisions are based on. Therefore, we recommend that the strategic level informs the tactical level more about introducing new judges. We recommend keeping the tactical level up-to-date on these decisions every quarter.

Next to this, there is a progress meeting between the department management and the judicial board every quarter, in which the finances, number of hours spent on cases, personnel, sick leave, and performance reviews of employees are discussed, which makes sure that there is downward and upward interaction.

Tactical – Operational

At the moment, there are quarterly meetings in which the progress of the covenant is discussed, and if insufficient progress is made, measures are discussed to ensure improvement. This meeting is an interaction between the high tactical level and the low tactical level. However, we observe in Figure 16 that in January 2023, the planning of Megas for November and December of 2023 are made. Therefore, during the quarterly meetings of 2023, which take place in March, May, September, and December, only progress can be observed, and no changes can be made anymore to try to increase the number of Mega hours. Therefore, we recommend having quarterly meetings to discuss the year ahead, so the quarterly meetings in 2023 discuss the progress made in the number of scheduled Megas in 2024.

The operational level should communicate with the tactical level about how the scheduling of the Mega is going and if there are any bottlenecks.

4.4 Implementation in the process of the Court of Law Amsterdam

This section explains the steps the Court of Law should take to improve the current situation to the ideal one, as shown in Figure 19 and discussed in Section 4.3. The first step is divided into the required organizational changes, which is the focus of Section 4.4.1, and the improvement of access to the available data, which is the focus of Section 4.4.2. Section 4.4.3 describes the last step, which is software to support the showing of data and in the making of decisions.

4.4.1 Organizational changes

This section explains the required organizational changes to implement the ideal situation into the Court of Law Amsterdam process. First, we discuss the planning horizon and, afterwards, the interaction between the different control levels.

Planning horizon

We recommend changing the planning horizon on the high tactical level from 1 year to a rolling horizon of at least more than 1 year. We recommend a planning horizon of 1.5 years for the rolling horizon since it is easier to forecast for a less distant future than 2 years.

Changing the planning horizon affects how the covenant is determined. The planning horizon needs to be changed for Megas. However, this is not the case for the regular cases. Since the covenant consists of Megas and regular cases, two options exist to change the planning horizon.

The first is having two separate covenants, one for the Megas and one for the regular cases. However, the disadvantage of separating the covenant is that the employees must be allocated for the regular cases and the Megas. The downside is that the utilization of the employees is not optimal anymore since empty spots in their schedule can no longer be filled up with shorter cases.

The other option is keeping one covenant and changing the planning horizon for the covenant of the regular cases. This way, the employees do not have to be allocated to regular cases and Megas and can be used for both. This way, the utilization of the employees is higher. Therefore, we recommend keeping one covenant and also changing the planning horizon and planning frequency of the regular cases. Later in this section, we discuss when the covenant discussion should be in the interaction between control levels. We show the new rolling horizon and planning frequency on the high tactical level in Figure 20.



Figure 20: New rolling planning horizon high tactical level

To implement the rolling horizon, Section 3.4.3 discusses some steps and considerations that need to be considered. The first one is communication. The Court of Law Amsterdam needs to ensure that all stakeholders are involved in implementing the rolling horizon and that the stakeholders see the organisation's value.

Next, the Court of Law Amsterdam must decide if the rolling horizon will replace or enhance the current processes. Section 3.4.3 states that replacing the current process will initially require more planning than adding the rolling forecast as an enhancement. We recommend the Court of Law to add the rolling horizon as an enhancement, by slowly taking steps to implement the rolling horizon. When the processes are changed, it is important to document the changes and to make sure that it is clear what needs to happen and who needs to do what. For example, the data collection process will change since collecting and evaluating data once a year is no longer sufficient. Therefore, the process must be well designed to ensure everyone knows when to deliver what.

For the time being, until the planning horizon can be changed, the Court of Law Amsterdam can deal with the uncertainty experienced in the first 6 months from the covenant not being done in time in other ways. When comparing the multiple covenants of previous years, there is a lot of resemblance

between them. Next, since the covenant is based on the inventory of Megas and the capacity of resources, a rough estimate of what to expect can be made. Therefore, given the anticipated resemblance of the new covenant to its predecessor and the created rough estimate of what to expect, the uncertainty experienced can be managed.

Different strategies deal with the uncertainty of how many Mega hours to plan in the year's first half. The first strategy is to follow the covenant of the previous year. This strategy will work well if the new covenant is approximately the same or includes fewer Mega hours, given that a substantial portion has been arranged in the year's first half, balancing out in the subsequent half. However, a negative of this strategy is that if the new covenant includes more Mega hours, more Mega hours should be planned to compensate in the year's second half, which may strain the available resources. However, this strategy will strain the available resources less than how the process is currently structured.

Another strategy is to follow the covenant of the previous year while incorporating an additional buffer. This means planning more in the first half of the year compared to the covenant of the previous year. Compared to the previous year's covenant, this strategy will work well in every scenario, whether maintaining the same hours or reducing or increasing hours. If the new covenant has the same hours as the previous year's covenant and more hours are done in the first half of the year, fewer hours need to be done in the second half of the year, leading to more time in the schedule to do regular cases. Next, if the new covenant has fewer hours than the previous year's covenant and more hours are already done in the year's first half, even fewer hours must be done in the year's second half. In the case of increasing hours compared to the previous year's covenant and having done more hours in the first half of the year, the hours that still have to be done should be manageable in the year's second half. The challenge with this strategy is to determine the size of the buffer.

Determining the size of the buffer involves considering various factors. The total available hours for judges within a year should be calculated. After the total hours spent on handling regular cases in a year, including both preparation and completion and, the total hours spent on handling Megas in a year, including both preparation and completion should be analysed. Furthermore, we examine the proportion of Mega cases relative to the overall workload to gauge their significance. The significance also determines the size of the buffer; if the significance is considerable, the buffer should be more significant, and the same applies in reverse. After that, the Court of Law can determine if the remaining capacity can accommodate a buffer and the size of the buffer.

We recommend aligning the planning efforts with the previous year's covenant. Including a buffer in the year's first half will yield improvements. However, it is crucial for the Court of Law Amsterdam first to ensure that sufficient Megas are planned in the first half of the year before considering the need or size of a buffer. The buffer strategy holds value, but only when it is executed right. However, the buffer strategy is a way to make a suboptimal situation as optimal as possible rather than addressing the root cause of the problem. Therefore, we recommend prioritizing the solution to the problem described at the beginning of this section.

Interaction between control levels

Operational → tactical

As said in Section 4.3.3, the operational level should communicate with the tactical level about how the scheduling of Megas is going and if there are any bottlenecks since this is not being done at the moment. This change can be easily implemented in the Court of Law Amsterdam organisation. We recommend adding an extra element to the already existing Mega meeting. In this extra element, the

struggles that the Mega planner is experiencing can be discussed, and solutions to the struggles can be found.

Tactical high ↔ *tactical low*

As said in Section 4.3.3, the quarterly meetings can only be used to observe the progress made, and no changes can be made anymore to try to increase the number of Mega hours. We recommend having quarterly meetings to discuss the year ahead, so the quarterly meetings in 2023 discuss the progress made in the number of planned Megas in 2024. Next to this, during the discussion of the progress, the new covenant discussions for the new rolling horizon can also be made. The progress of the previous rolling horizon is an excellent measure to see if the number of Megas in the new rolling horizon should be higher or lower.

This change can be easily implemented in the Court of Law Amsterdam organisation. We recommend adding an extra element to the already existing quarterly meeting. Therefore, in the quarterly meeting in 2023, the progress of the Megas that have been executed in 2023 is monitored, and next to this, the progress of the Megas that have been planned in 2024 is monitored, and the new rolling horizon is made.

4.4.2 Improve access to data during decision-making

As said in Section 4.2.3 and Section 4.3.1, the low tactical level decisions are made without looking at the available data.

For the decision-making on the tactical level, the Court of Law Amsterdam needs the following data:

- Is the Court of Law Amsterdam on track to meet the covenant?
 - o The number of Mega days that have been planned already
 - o The number of Mega days that need to be planned
- Which Megas are ready to be scheduled?
 - o The status of the investigation of every Mega
- Which judges and clerks are available?
 - o The availability of judges
 - o The availability of clerks
- Extra information:
 - o The estimation of the president of the combination of the court days

We recommend using this data during the Mega meeting. Therefore, the data should be updated before every Mega meeting. The data should be used to decide which Mega to plan and which combination to choose. We recommend that the Court of Law Amsterdam have one employee responsible for keeping the data up-to-date. Keeping the data up-to-date on the dashboard can be done next to the regular tasks of the employees since updating the dashboard does not take much time. Next to this, we also recommend having one employee responsible for making sure that during the Mega meeting, the decisions are based on the data on the dashboard. The same or two different employees can do these two responsibilities. We recommend assigning one employee to this role, as shared responsibility often leads to ambiguity and a lack of accountability. A designated employee overseeing this aspect ensures clarity, ownership, and effective decision-making.

4.4.3 Supporting data and decisions with dashboard

There should be an easy way to show the available data and to work with the available data to recognize potential threats and strengths. To show the data discussed in Section 4.4.2, there should be a way to show the data during the Mega meeting.

Chiang (2010) states that an ideal dashboard platform should provide an accelerated development and deployment timeline, a collaborative workflow, and an open application programming interface. For the Court of Law Amsterdam, the most essential part of this is the open application programming interface since the platform should be accustomed to meeting future needs. Next to this, there must be a collaborative workflow during the making of the dashboard, but also for working with the dashboard since most likely multiple employees will work with the dashboard. Next to this, it is essential that employees can easily manage the dashboard and that the data can be easily interpreted. These requirements can be found in a dashboard platform, but Excel can also provide this. With the use of Excel one employee must know the basic functionalities of Excel so the dashboard can be kept up-to-date and with the possibility of further expansion in the future.

For now, we recommend showing the data on a dashboard in Excel. We choose Excel because it is easy and quick to set up and can be used by every employee without extensive training. Next to this, Excel is already in use by the Court of Law Amsterdam, which makes it easy to transfer the data to the dashboard. What the dashboard should include and look like is discussed in Chapter 5. The data on the dashboard in Excel must be kept up-to-date.

4.5 Conclusion

In this Chapter, we showed a practical application of different hierarchical planning frameworks for the Court of Law Amsterdam.

Firstly, we provided an overview of the current state of the Court of Law Amsterdam. Next, we adapted and integrated hierarchical planning frameworks proposed by Hans et al. (2012), De Boer (1998), and Zijm (2000), focusing particularly on resource capacity planning within the context of the Court of Law Amsterdam.

During this analysis, we pinpoint several deficiencies in interaction and planning functions, such as the lack of upward interaction between operational and tactical levels, the absence of a covenant prior to Mega meeting starts planning, and inadequate attention to data-driven decision-making.

Consequently, we redesigned the hierarchical framework for the Court of Law Amsterdam, introducing modifications to enhance planning efficiency and effectiveness. This included redefining the tactical level into high and low tactical levels, emphasizing the importance of data-driven decision-making, and extending the planning horizon to 1.5 years with a rolling planning horizon and a planning frequency of three months.

Furthermore, we proposed practical steps for implementing these changes, emphasizing the need for organizational adjustments to accommodate the revised planning horizon. This involved recommendations for stakeholder involvement, process enhancement rather than replacement, and interim measures to bridge the transition period.

Additionally, we highlighted the crucial role of data and supporting infrastructure in facilitating informed decision-making. Recommendations were made to ensure the availability and accuracy of necessary data during planning meetings, along with assigning responsibility for data management.

5 Dashboard in Excel

This chapter explains what the dashboard should look like and what should be presented on it. Section 5.1 explains the KPIs that should be visible on the dashboard and why they are essential. Next to this, Section 5.2 explains what type of dashboard is suitable for the Court of Law Amsterdam and what the design should be. Section 5.3 explains where the KPIs and relevant information should be placed on the dashboard. Section 5.4 explains how the KPIs should be visualized on the dashboard.

5.1 KPI and relevant information selection

KPIs must be selected to help the Court of Law Amsterdam reach their goal and give them a clear focus. The Court of Law Amsterdam seeks insight into the following questions: Is the Court of Law Amsterdam on track to meet the covenant? Which Megas are ready to be scheduled? Which judges and clerks are available? These KPIs also improve the information sharing between different hierarchical levels. We discuss this in Table 7.

Some questions are asked to keep track of the progress, and others are asked to get all the relevant information needed to plan a Mega. For the questions that keep track of the progress, we select KPIs that keep track of the progress. We select the relevant information for the other questions to plan Megas. These KPIs and relevant information are based on the data necessary to plan Megas, as stated in Section 4.4.2. From the data, we, together with the Court of Law Amsterdam input, select the relevant KPIs and information.

Table 7: Different KPIs for the dashboard

Factors	KPI/relevant information	Explanation	Relation to information sharing between hierarchical levels
Is the Court of Law Amsterdam on track to meet the covenant?	KPI: Total planned Mega days per bi-monthly period	This KPI measures the cumulative number of planned Mega days scheduled within every two-month timeframe, providing insight into the workload distribution and distribution of Mega days over specific periods. We select this KPI to provide the Court of Law Amsterdam with insights into how many Mega days already have been planned.	These KPIs improve the information sharing between the high and low tactical levels. It helps the Court of Law Amsterdam in the discussions to create a new covenant and to evaluate the progress of the current covenant.
	KPI: Total planned Mega days per Public Prosecutor's Office per bi-monthly period	This KPI measures the aggregated number of planned Mega days scheduled every two months for each Public Prosecutor's Office. It provides insight into the workload distribution of the specific offices.	

		<p>We select this KPI to provide the Court of Law Amsterdam with insights into how many Mega days are planned for every specific office. This KPI is a detailed version of the previous KPI, as it is also crucial to track whether each office meets its target.</p>	
	<p>KPI: Remaining covenant days to be planned per Public Prosecutor's Office</p>	<p>This KPI measures the days remaining within the covenant period that are yet to be planned for each Public Prosecutor's Office. It helps track the unallocated time within the covenant, indicating the planning progress and potential workload distribution for each office.</p> <p>The previous two KPIs show if the target is met bi-monthly. However, it is also essential to see how the progress of each office is compared to the total number of days that should be met following the covenant.</p>	
<p>Which Megas are ready to be scheduled?</p>	<p>Relevant information: Which Megas are ready for scheduling</p>	<p>The data shows the Megas that have completed all necessary prerequisites and are prepared and available for planning within a given timeframe.</p> <p>This data gives the Court of Law Amsterdam more insights into which Megas are ready to be scheduled.</p> <p>For this information, different statuses are needed to see in which phase the investigation is. Section 5.4 explains the different statuses.</p>	<p>This information improves the information sharing between the low tactical level and the operational level. The different statuses help the low tactical level to share which Megas are ready to be scheduled on the operational level. Next, this information is also necessary to plan Megas on the low tactical level.</p>
	<p>Relevant information: What is the status of scheduling the Megas</p>	<p>This data provides an overview of the current status of Megas that are prepared for scheduling within the Court of Law</p>	<p>This information improves the information sharing between the operational level and</p>

		Amsterdam. It offers insights into the operational aspects of Mega scheduling, making it convenient to observe the progress and status of the scheduling process.	the low tactical level. It helps the operational level to show the progress and to show if there are any bottlenecks in the scheduling.
Which judges are available?	Relevant information: Monthly judge/clerk availability	The data shows the number of judges/clerks available for Mega cases each month, indicating the pool of judicial resources accessible for scheduling Megas every month. We select this data to provide the Court of Law Amsterdam with insights into which judges/clerks are available every month.	These pieces of information are necessary to plan Megas on the low tactical level. These pieces of information are therefore not needed for information sharing. However, the information is important for the low tactical level and therefore present on the dashboard.
	Relevant information: Allocation of Megas per judge/clerk	The data shows the Megas assigned or allocated to each judge/clerk, indicating the workload distribution or responsibility among judges/clerks within the Mega planning process. We select this data to provide the Court of Law Amsterdam with insights into how the Megas are allocated over the different judges and clerks, seeing if a specific judge/clerk is doing more Megas than others.	

5.2 Type and design of dashboard

As stated in Section 3.4.2, there are 3 different types of dashboards: the strategic, the analytic, and the operational dashboard. In this context, the operational dashboard suits the best. It is essential for the dashboard that the update frequency allows for real-time updates and that the dashboard grabs the attention of the user when the goals are not being met. This is because the dashboard will be used during and in preparation for the Mega meeting and, therefore, needs interactivity.

Section 3.4.4 mentioned multiple design guidelines that help convey the dashboard's message well and effectively. The guidelines recommend having the dashboard on one screen with around 7 media displays, reducing non-data pixels and using colour to emphasize the relationships between data, such as graphs.

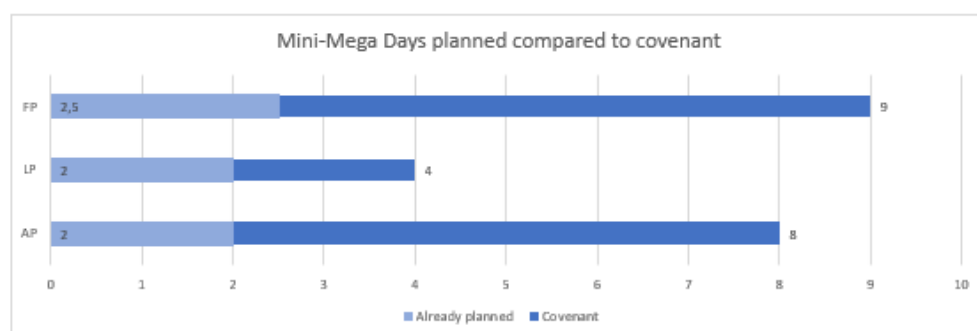
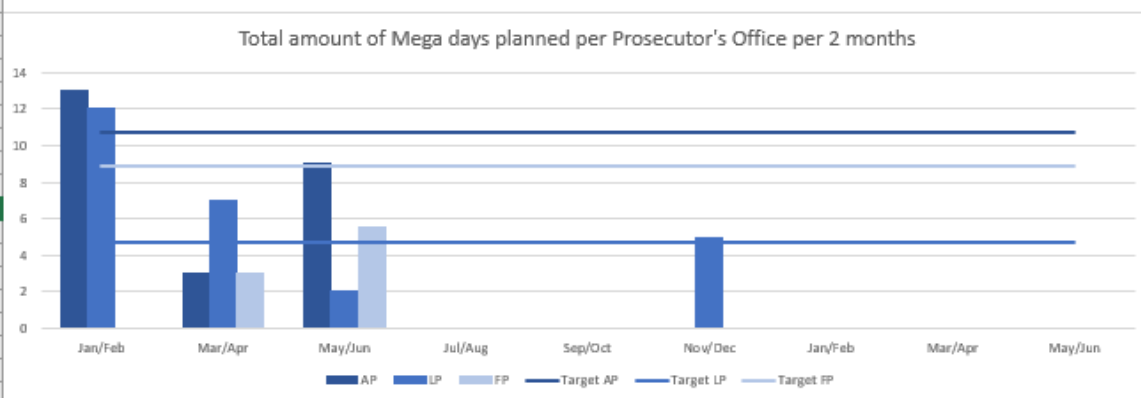
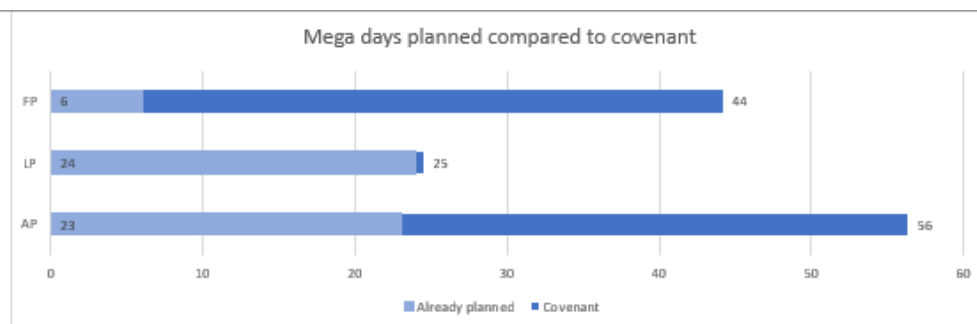
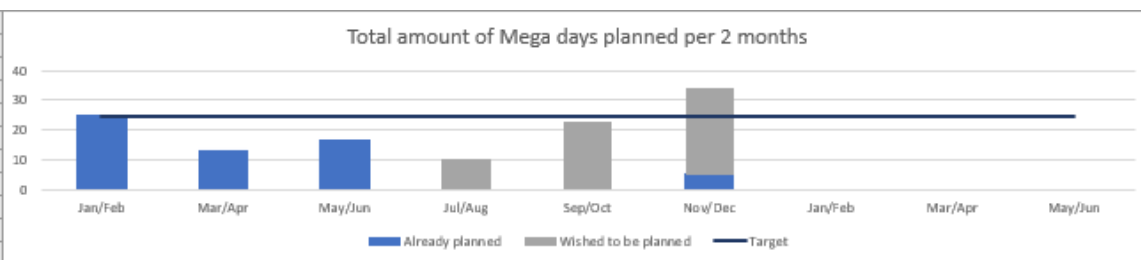
However, we do not recommend showing the dashboard on one screen for the Court of Law Amsterdam. This is because the data about the monthly availability of the judges/clerks and the allocation of the judges/clerks is not necessary to show during the Mega meeting. This data is

essential for the team president and the head of legal to decide which judge or clerk is selected for the Mega. Therefore, we decide that 1 dashboard and 2 separate sheets in Excel are more suitable for the Court of Law Amsterdam. We have one dashboard for the Mega meeting (Figure 21), one sheet for the team president (Figure 22), and one sheet for the head of legal (Figure 23).

The dashboard for the Mega meeting consists of 5 media displays, which is around the recommended number. The other two sheets only consist of 1 media display each since the team president and the head of legal only need to decide which judge or clerk to select.

Next, we minimize the non-data pixels by removing the gridlines and leaving out unnecessary information. Moreover, we include whitespace to increase the ease of reading the information.

Finally, we discuss the colours used in the dashboard. Section 3.5.4 discusses that dashboards should initially be designed in shades of grey, and colour should only be added to convey helpful information. Next to this, soft colours should be used. Moreover, one or two colours should be chosen, and lighter and darker shades should be used to (de)emphasize. Therefore, we use a blue colour and lighter and darker shades of this blue colour. Next, we decide to add a colour scale of green-orange-red to indicate the statuses of the Megas and the scheduling of the Megas. The colour scale emphasises which Megas is not ready yet and which Mega is.



(mini-)Mega	Name Mega	Priority	Prosecutor's	President	Oldest judge	Younger	Clerk	Time e	Status investig	Status pla	Period Planning	GO/NO-GO	Date registration
mega	9	2	AP					Ow: 5	Investigation Public Prd	Registered			31-8-2022
mega	8	2	AP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 3	Investigation delegated	Combination			7-3-2022
mega	7	3	FP				Clerk	Ow: 6/7	Investigation Public Prd	Registered			25-1-2024
mega	6	2	AP	Judge 1	Judge 2	Judge 3	Clerk	RB: 4	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	4-1-2022
mega	52	1	AP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 5	Ready to be scheduled	Scheduled	Mar/Apr 2024	Nov/Dec 2023	14-2-2022
mini	51	1	LP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 2	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	22-11-2021
mini	50	2	AP					Ow: 2	Ready to be scheduled	Registered			29-8-2022
mini	5	2	FP	Judge 1	Judge 2	Judge 3		Ow: 2	Ready to be scheduled	Combination			26-7-2023
mega	49	1	LP	Judge 1	Judge 2	Judge 3	Clerk	RB: 5	Ready to be scheduled	Scheduled	Nov/Dec 2024	Jul/Aug 2024	24-10-2022
mini	48	3	AP				Clerk	Ow: 2	Registered	Registered			5-1-2022
mini	47	3	FP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	24-5-2021
mini	46	1	FP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 4	Ready to be scheduled	Scheduled	Jul/Aug 2024	Mar/Apr 2024	8-1-2022
mini	45	2	FP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	3-4-2021
mini	44	2	LP	Judge 1	Judge 2	Judge 3	Clerk	Ow: 2	Investigation Public Prd	Combination			26-5-2022

Figure 21: Dashboard 1 (Mega meeting)

Judge	Team	(mini-)mega	Months available
Judge 1	2		3,4,5,9,10,11
Judge 2	1		
Judge 3	2	Mega 2	5,6,7
Judge 4	1	Mega 4, mini-Mega 6	4
Judge 5	2	Mega 32	2,3,4,5,6
Judge 6	2		10,11,12
Judge 7	3		3,7,9
Judge 8	2	Mega 25, mini-Mega 11	
Judge 9	1	mini-Mega 13	
Judge 10	2		

Figure 22: Sheet 1 (judges)

Clerk	Team	(mini-)mega	Months available
Clerk 1	2		3,4,5,9,10,11
Clerk 2	1		
Clerk 3	2	Mega 2	5,6,7
Clerk 4	1	Mega 4, mini-Mega 6	4
Clerk 5	2	Mega 32	2,3,4,5,6
Clerk 6	2		10,11,12
Clerk 7	3		3,7,9
Clerk 8	2	Mega 25, mini-Mega 11	
Clerk 9	1	mini-Mega 13	
Clerk 10	2		

Figure 23: Sheet 2 (clerks)

5.3 Placement of KPIs and relevant information on dashboard

As mentioned in Section 3.4.4, the placement of KPIs on a dashboard is critical. The most important KPIs should be placed in the left upper corner, and the least essential KPIs should be placed in the right lower corner (Few, 2006). Also, we place KPIs related to each other next to or below each other for easy comparison.

In the upper left corner of Figure 21, we visualize the total planned Mega days per bi-monthly period. Below, we visualize the total planned Mega days per Public Prosecutor's Office per bi-monthly period. These two KPIs show the target of the covenant that must be met and the bi-monthly progress. Next, these graphs show if the number of days are evenly distributed over the year. These are the two most essential objectives for planning the Megas in the Court of Law Amsterdam and, therefore, are placed in the upper left corner.

In the upper right corner of Figure 21, we visualize the remaining covenant days to be planned per Public Prosecutor's Office. These graphs are added to see how many days per Prosecutor's Office must be planned. These graphs are not the most important when planning a Mega; however, they are an excellent addition to quickly see the total progression of the different Public Prosecutor's Offices. Therefore, the KPIs are placed in the upper right corner.

Below all the graphs in Figure 21, we visualize all the Megas that have been registered. This table gives insight into the relevant information on which Megas are ready for scheduling. This table visualizes the combination added to the Mega, the time estimation, the investigation status, and the go/no-go moment. This table is convenient during the Mega meeting since all Megas are discussed. However, it is not the most important feature on the dashboard; therefore, it is placed below the graphs.

5.4 Visualisation and explanation of KPIs and relevant information

As mentioned in Section 3.4.4, choosing the correct media display is essential. Therefore, we discuss per KPI and relevant information on visualising this.

Total planned Megas per bi-monthly period

Media display: Combination stacked bar and line graph

This KPI shows the total Mega days planned on a bi-monthly basis. For this KPI, the media display would be a bar and line graph combination, which we select based on literature from Section 3.5.4. The bar graph represents the progress so far per bi-monthly period, and the line graph represents the target per bi-monthly period.

However, the Court of Law Amsterdam wants to add an extra feature to the graph to show the Megas that are wished to be planned per bi-monthly period. This allows the Court of Law Amsterdam to ‘plan in advance’ and to see how much should still be planned. This functionality enables the Court of Law Amsterdam to experiment with scheduling different Mega meetings across various months. It provides the flexibility to assess whether the established targets will be achieved and determines whether adjustments, such as scheduling more or fewer Mega meetings, are necessary.

Therefore, we change the bar graph to a stacked bar graph. This change is made because a stacked bar graph is more suitable for displaying multiple instances of a whole, including already planned and wished to be planned Megas, emphasising the total days planned.

In Figure 24: Total number of Mega days planned per 2 monthsFigure 24 and Figure 25, the target is determined by dividing the covenant over the respective months. In practice, this will not work, since in some months less Megas can take place, due to less availability of judges. Therefore, we recommend looking into how the Mega hours should be divided over the year to get a more accurate target. Next, since we recommend a rolling horizon of 1.5 years with a planning frequency of 3 months, the covenant can be different every 3 months. Therefore, we recommend updating the target line of all figures in this section every time the covenant is changed.

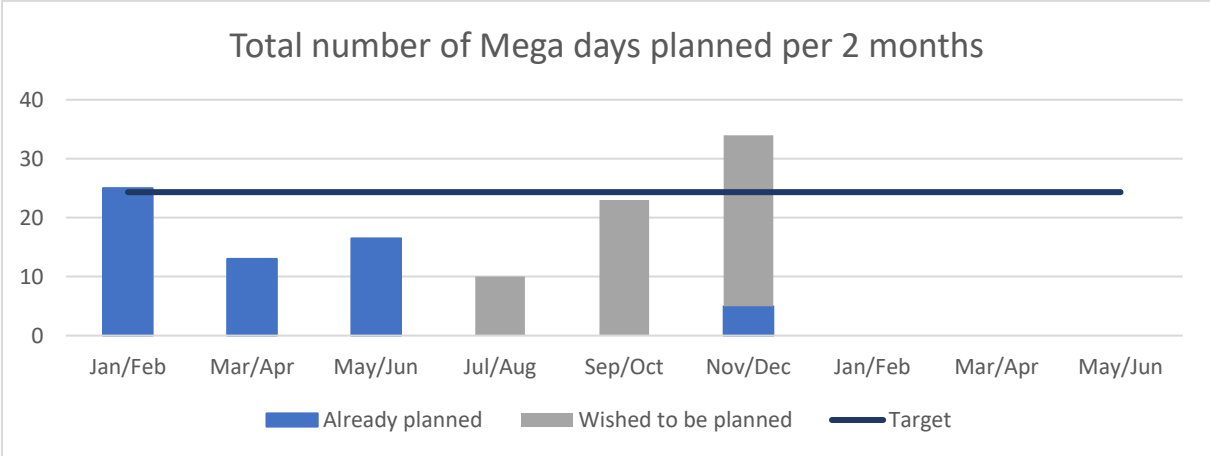


Figure 24: Total number of Mega days planned per 2 months

Figure 24 shows the number of Mega days scheduled every 2 months using blue stacked bar charts. Because of the added target line, it is easy to see if enough days are being planned. The grey stacked bar charts represent Mega days that are wished to be planned but not yet. Next to this, 1.5 years of data is shown in the graph. This is done to show the rolling planning horizon of 1.5 years.

Total planned Mega days per Public Prosecutor’s Office per bi-monthly period

Media display: Combination bar and line graph

A bar graph is used for displaying measures associated with a category. With this KPI, there are 3 categories: the District Prosecutor’s Office (AP), the National Prosecutor’s Office (LP), and the Functional Prosecutor’s Office (FP). Next, the progress should be compared to the target for every category. Therefore, we add a line graph.

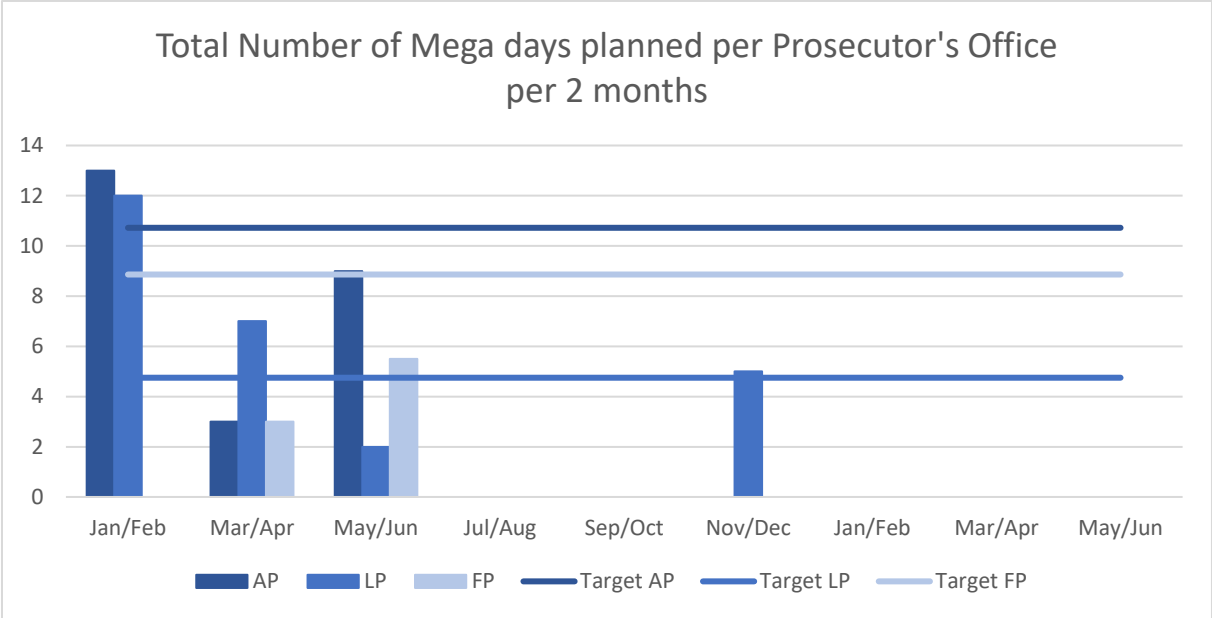


Figure 25: Total number of Mega days planned per Prosecutor's Office per 2 months

Figure 25 shows the number of Mega days planned per Prosecutor’s Office per 2 months. This graph is a more detailed version of the graph seen in Figure 24. The graph allows the Court of Law Amsterdam to see which Public Prosecutor’s Office meets the target every 2 months and which Public Prosecutor’s Office does not.

Remaining covenant days to be planned per Public Prosecutor’s Office

Media display: Bar graph with indicator

Visualizing this KPI involves creating two overlapping bar graphs: one illustrating the progress of Mega days completed and the other depicting the target goal set by the covenant. This visual representation allows for a clear visualization of progress relative to the covenant's objectives.

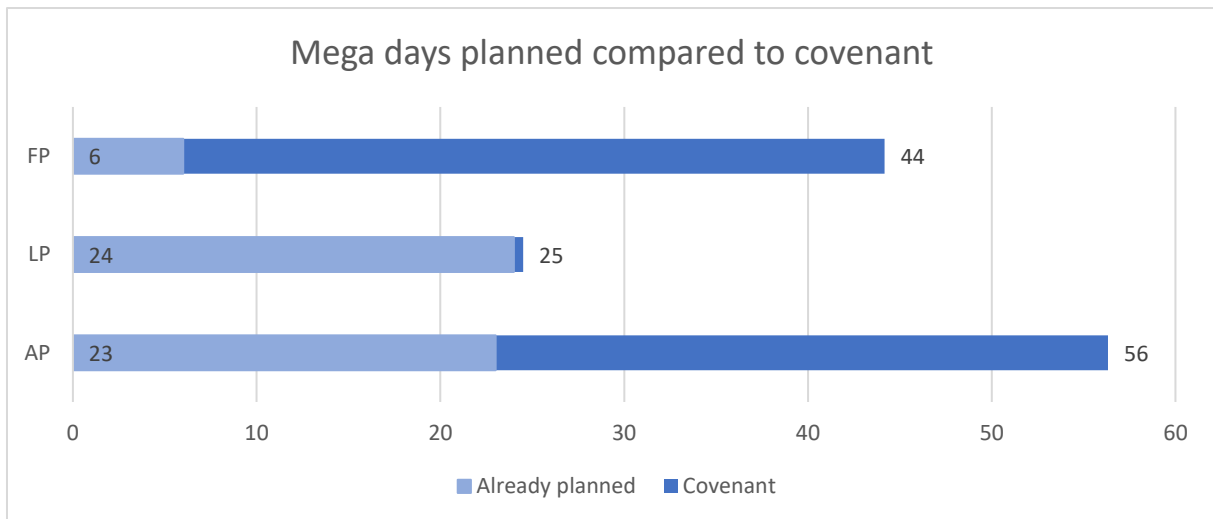


Figure 26: Mega days planned compared to covenant

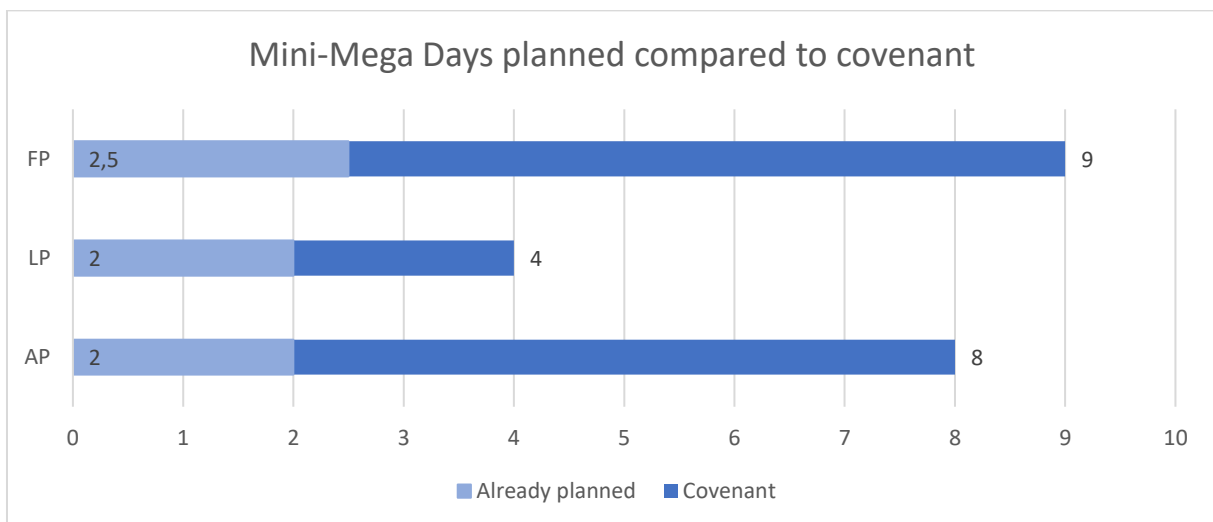


Figure 27: Mini-Mega days planned compared to covenant

Figure 26 shows how many Mega days must be planned per Public Prosecutor’s Office. Figure 27 shows the same only for the mini-Mega days, which are also discussed during the Mega meeting, which is why they are added on the dashboard.

Which Megas are ready for scheduling

Media display: Table

For this KPI, different information is needed first to see if a Mega is ready to be scheduled. First, statuses are necessary to determine the investigation phase and if the Mega is ready to be scheduled. Therefore, for every Mega, the state the investigation is should be indicated. Next to this, it should be clear which combination is assigned to the Mega and also what the time estimation of the Mega is.

A way to visualize this is with the use of a table. A table is used to organize data. Since a lot of information is needed for every Mega, a table is added to the dashboard to organize the data.

(mini-)Mega	Name Mega	Prioritization	Prosecutor's Office	President	Oldest judge	Youngest Judge	Clerk	Time estimation	Status investigation	Status planning	Period Planning	GO/NO-GO	Date registration
mega	9		2 AP					QwJ: 5	Investigation Public Prosecutor's Office	Registered			31-8-2022
mega	8		2 AP					QwJ: 3	Investigation delegated judge	Combination			1-3-2023
mega	7		3 FP	Judge 1	Judge 2	Judge 3		QwJ: 6/7	Investigation Public Prosecutor's Office	Registered			25-1-2024
mega	6		2 AP	Judge 1	Judge 2	Judge 3		RB: 4	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	4-1-2022
mega	52		1 AP	Judge 1	Judge 2	Judge 3		QwJ: 5	Ready to be scheduled	Scheduled	Mar/Apr 2024	Nov/Dec 2023	19-2-2022
mini	51		1 LP	Judge 1	Judge 2	Judge 3		QwJ: 2	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	22-11-2021
mini	50		2 AP					QwJ: 2	Registered	Registered			29-8-2022
mini	5		2 FP	Judge 1	Judge 2	Judge 3		QwJ: 2	Ready to be scheduled	Combination			26-7-2023
mega	49		1 LP	Judge 1	Judge 2	Judge 3		RB: 5	Ready to be scheduled	Scheduled	Nov/Dec 2024	Jul/Aug 2024	24-10-2022
mini	48		3 AP					QwJ: 2	Registered	Registered			5-1-2022
mini	47		3 FP	Judge 1	Judge 2	Judge 3		QwJ: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	24-5-2021
mini	46		1 FP	Judge 1	Judge 2	Judge 3		QwJ: 4	Ready to be scheduled	Scheduled	Jul/Aug 2024	Mar/Apr 2024	8-1-2023
mini	45		2 FP	Judge 1	Judge 2	Judge 3		QwJ: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	3-4-2021
mini	44		2 LP	Judge 1	Judge 2	Judge 3		QwJ: 2	Investigation Public Prosecutor's Office	Combination			26-5-2022

Figure 28: Table with registered Megas

(mini-)Mega	Name Mega	Prioritization	Prosecutor's Office	President	Oldest judge	Youngest Judge	Clerk
mega	9		2 AP				
mega	8		2 AP	Judge 1	Judge 2	Judge 3	Clerk
mega	7		3 FP				Clerk
mega	6		2 AP	Judge 1	Judge 2	Judge 3	Clerk
mega	52		1 AP	Judge 1	Judge 2	Judge 3	Clerk
mini	51		1 LP	Judge 1	Judge 2	Judge 3	Clerk
mini	50		2 AP				
mini	5		2 FP	Judge 1	Judge 2	Judge 3	
mega	49		1 LP	Judge 1	Judge 2	Judge 3	Clerk
mini	48		3 AP				Clerk
mini	47		3 FP	Judge 1	Judge 2	Judge 3	Clerk
mini	46		1 FP	Judge 1	Judge 2	Judge 3	Clerk
mini	45		2 FP	Judge 1	Judge 2	Judge 3	Clerk
mini	44		2 LP	Judge 1	Judge 2	Judge 3	Clerk

Figure 29: Table with registered Megas (zoomed part 1)

Time estimation	Status investigation	Status planning	Period Planning	GO/NO-GO	Date registration
QwJ: 5	Investigation Public Prosecutor's Office	Registered			31-8-2022
QwJ: 3	Investigation delegated judge	Combination			7-3-2022
QwJ: 6/7	Investigation Public Prosecutor's Office	Registered			25-1-2024
RB: 4	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	4-1-2022
QwJ: 5	Ready to be scheduled	Scheduled	Mar/Apr 2024	Nov/Dec 2023	14-2-2022
QwJ: 2	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	22-11-2021
QwJ: 2	Ready to be scheduled	Registered			29-8-2022
QwJ: 2	Ready to be scheduled	Combination			26-7-2023
RB: 5	Ready to be scheduled	Scheduled	Nov/Dec 2024	Jul/Aug 2024	24-10-2022
QwJ: 2	Registered	Registered			5-1-2022
QwJ: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	24-5-2021
QwJ: 4	Ready to be scheduled	Scheduled	Jul/Aug 2024	Mar/Apr 2024	8-1-2023
QwJ: 1,5	Ready to be scheduled	Scheduled	Nov/Dec 2023	Jul/Aug 2023	3-4-2021
QwJ: 2	Investigation Public Prosecutor's Office	Combination			26-5-2022

Figure 30: Table with registered Megas (zoomed part 2)

Figure 27 shows a table with all the (mini-)Megs that the Public Prosecutor Offices register.

The table contains the following elements:

- Prioritization of the Public Prosecutor's Office: we add this information to see which Mega should be planned first
- Combination of the Mega: we add this information to see if the Mega that needs to be planned has a combination
- Time estimation of the court days: we add this information to see if the Mega that needs to be planned still fits in the covenant. This is shown in the column 'Stand van Zaken'.
- Status of the investigation: we add this information to see if the Mega is ready to be planned
- Status of the planning: we add this information to see the status of the planning of the Mega. The different statuses are discussed below.
- Planning period: we add this information to see in which month the Mega is planned
- Go/No-Go moment: we add this information to see when the go/no-go moment needs to take place
- Date of registration: we add this information to see how long the Mega is already on the list

These elements are all important in planning Megs and after the Megs have been planned.

There are different statuses in which the investigation can be. These are:

- Registered

- Investigation procedures Public Prosecutor's Office
- Investigation procedures delegated judge
- Ready to be scheduled

Since the investigation of every Mega is different, it is difficult to make detailed statuses that can be applied to every Mega. Therefore, the statuses are kept simple. Due to the added colours, it is easy to see how far along the Mega is and if it is ready to be planned.

Next to this, statuses are added in which the planning of a Mega can be. These are:

- Registered
- Determining combination
- Determining unavailable dates
- Scheduling
- Scheduled

Monthly judge/clerk availability

Media display: Table

For the team president, it is essential to see on the judge level which judge is available from which month. Therefore, this relevant information can best be visualized in a table since this way, it is easy to filter and to see which judge is available. The same goes for clerks.

Figure 22 shows which judge is doing which Mega, the team of judges, and when the judge is available again.

Allocation of Megas per judge/clerk

Media display: Table

The same as for the previous relevant information goes for this relevant information. It is essential to see the number of Megas a judge is involved in on the judge level. Therefore, the best way to visualize this is in a table.

Figure 23 shows which clerk is doing which Mega, the team of clerks, and when the clerk is available again.

5.5 Conclusion

In this chapter, we outlined the design and implementation of a dashboard tailored to the needs of the Court of Law Amsterdam. We identified KPIs essential for monitoring progress and facilitating decision-making. These KPIs include the number of Mega days planned, remaining covenant days, Mega investigation status, and judge/clerk availability.

To ensure effective communication and decision-making, we chose an operational dashboard format. This dashboard provides real-time updates and highlights deviations from targets, crucial for the Mega meetings and information sharing between the different hierarchical levels.

The design of the dashboard prioritizes clarity and ease of use. We arranged KPIs logically, with the most critical metrics placed prominently for quick reference. Moreover, we tailored the dashboard's layout to suit the specific needs of different stakeholders. Separate sheets for the team presidents and head of legal ensure that each user receives relevant information without clutter.

In conclusion, the dashboard serves as a tool for the Court of Law Amsterdam, enabling informed decision-making, improving information sharing across hierarchical levels, and ultimately enhancing the efficiency of Mega scheduling processes.

6 Conclusions and Recommendations

This chapter concludes this thesis. Section 6.1 provides a conclusion to the central research question. Section 6.2 gives recommendations to the Court of Law for further research. Section 6.3 discusses the limitations of this research and Section 6.4 the contribution to science.

6.1 Conclusion

The current planning process at the Court of Law Amsterdam causes much variation in the monthly Mega hours. However, it is important to distribute the Megas evenly throughout the court's schedule so there are enough resources left for the regular cases.

This problem resulted in the following research question:

'How can the Court of Law Amsterdam optimize the process of planning and scheduling Megas?'

The research question can be answered by answering multiple sub-questions.

Firstly, the examination of the current situation highlighted significant variability in monthly Mega hours, posing challenges for resource allocation. The discrepancy between the finalization of the covenant and the planning of Megas introduced uncertainties, especially in the initial half of the year, leading to difficulties in meeting targets and creating bottlenecks towards the end of the year.

Next, we find that the existing literature on the challenges faced by the Court of Law Amsterdam are limited, insights from other fields such as healthcare and project management provide valuable frameworks for addressing planning and scheduling issues. By adopting hierarchical decision-making frameworks and considering strategies like capacity planning and admission management, the literature showed that resource allocation can optimize and enhance operational efficiency. Additionally, embracing a rolling horizon approach allows for adaptability to changing circumstances. Integrating these principles offers promising results for improving decision-making processes and resource management.

After finding the different planning frameworks in the literature, we looked at what the scheduling process of Megas at the Court of Law Amsterdam should look like. In evaluating the planning framework, it became evident that the existing hierarchical structure revealed shortcomings in planning functions and communication between control levels.

To improve the current situation, we redesigned the hierarchical framework to the ideal situation for the Court of Law Amsterdam shown in Figure 31. Next, we recommended a new planning horizon on the high tactical level and to focus more on data when planning Megas. We recommend introducing a rolling horizon of 1.5 years with a planning frequency of every 3 months at the tactical high level. Next, we recommend keeping the planning horizon of 10 months with a rolling planning frequency every 2 months at the tactical low and operational levels. Furthermore, we recommend enhancing the interaction between control functions.

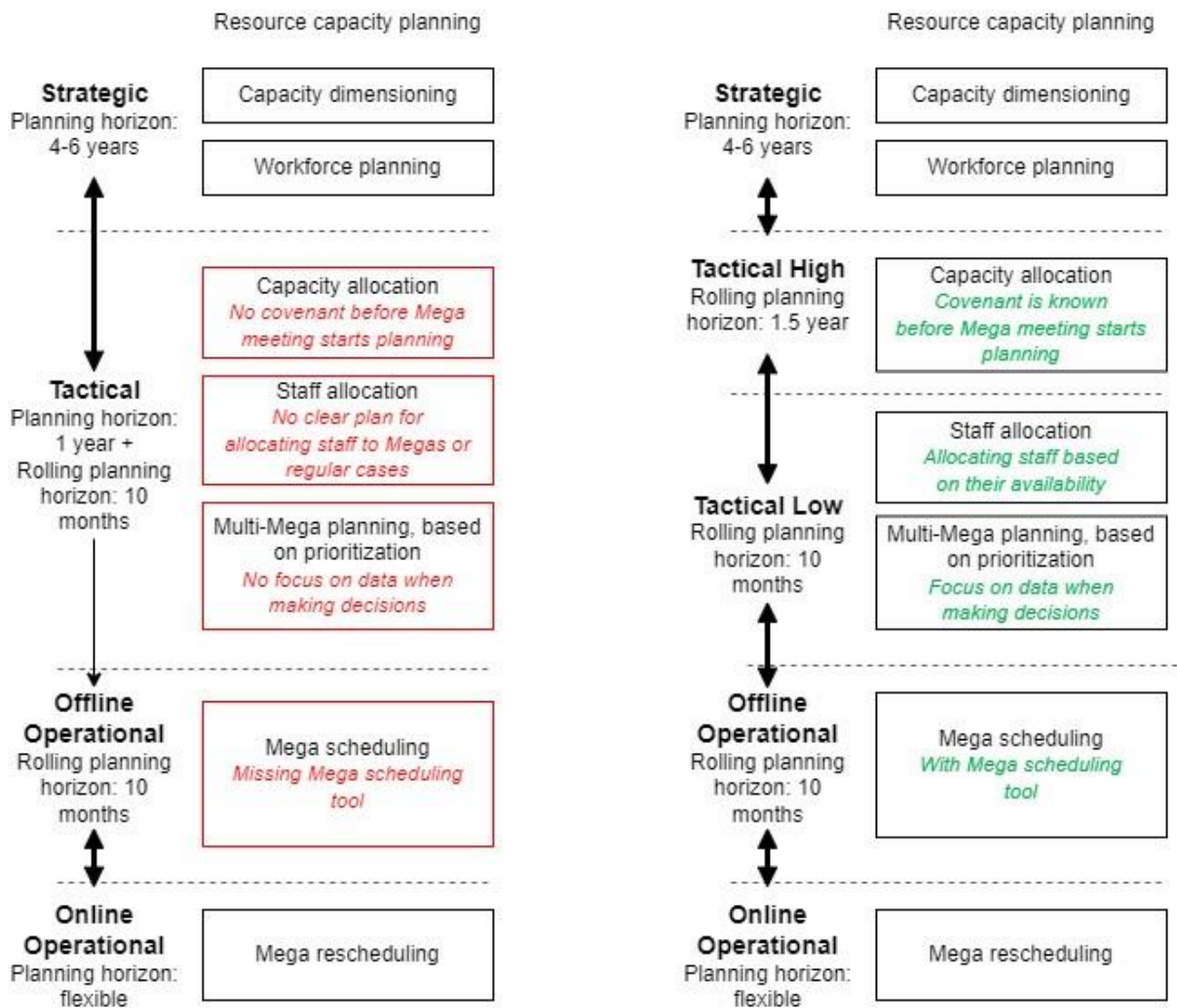


Figure 31: Recap current situation and redesign hierarchical framework Court of Law Amsterdam

Afterwards, we look at the steps that need to be taken to implement the ideal planning and scheduling framework. The implementation plan outlines organizational changes, improved access to data during decision-making processes, and adopting dashboards to support data-driven decision-making. Some steps and considerations need to be made to implement the rolling horizon. Communication with all stakeholders is important to ensure they are involved in changing the process. Next, we recommend enhancing the current process instead of replacing it so the Court of Law Amsterdam can take small steps to improve this process.

Furthermore, the interaction between the different control levels needs to change. The operational level should communicate with the tactical level about how Megas are scheduled and if there are any bottlenecks. This can be discussed during the Mega meeting. Since the tactical level is divided into a high and low level, they need interaction. We recommend adding an extra element to the already existing quarterly meeting.

The last step in the implementation is that we recommend the Court of Law Amsterdam focus more on data when planning Megas. Therefore, we collected the most important questions that needed to be answered before a Mega can be planned.

At last, we looked at how the planning and scheduling framework should be supported to ensure correct decision-making. For this, we recommend showing the data on a dashboard such that the

Court of Law Amsterdam can easily show the data and recognize potential threats and strengths. We recommend choosing Excel to make the dashboard since it is easy and quick to set up and can be used by every employee without extensive training.

We selected the relevant KPIs and information for the dashboard with the Court of Law Amsterdam's input. The KPIs are put on an operational dashboard since it is essential for the dashboard that the update frequency allows for real-time updates and that the dashboard grabs the attention of the user when the goals are not being met. Next, we recommend the dashboard design, where each KPI should be, and how each KPI should be visualized.

In conclusion, by implementing the recommended strategies and improvements, the Court of Law Amsterdam can streamline the Mega planning and scheduling processes, mitigate uncertainties, and enhance resource allocation, ultimately improving operational efficiency and achieving organizational objectives effectively.

6.2 Recommendations

This section provides the Court of Law Amsterdam with recommendations for further research.

Simultaneously or separately scheduling

One of the recommendations in this report was to keep scheduling the Megas and regular cases separate and to keep scheduling the Megas 10 months in advance. However, by shortening the time between scheduling and execution, greater flexibility can be introduced into the scheduling process. This flexibility is crucial, especially in a dynamic environment like the legal system, where unforeseen circumstances and last-minute changes are expected.

We recommend exploring the feasibility of negotiating agreements with lawyers to achieve this. These agreements could involve discussions about the timing of Mega scheduling. Specifically, we suggest reserving slots for Megas but finalizing the scheduling details closer to the actual date. This approach fosters a more collaborative relationship between the court and lawyers. By involving lawyers in the scheduling process and considering their preferences and constraints, they can get a sense of ownership and cooperation. This collaborative approach may lead to smoother proceedings.

Create more feasible targets for the dashboard

When designing the dashboard we chose to divide the covenant over the number of months. However, we recommend exploring how the hours can be better distributed across the months, considering vacations and absences, to create a more accurate target.

Enhance data collection

Another recommendation is to enhance data collection efforts within the Court of Law Amsterdam, particularly regarding the preparation time, court days, and council chamber days for each Mega. By compiling and analysing this data, the Court of Law Amsterdam can discover potential correlations and patterns to inform future decision-making and resource allocation strategies better.

By aggregating and analysing data on Mega cases alongside regular cases, the Court of Law Amsterdam can gain insights into the overall impact of Mega cases on the workload and efficiency of the entire court system. This comparative analysis allows them to assess the proportion of time and resources dedicated to Mega cases versus regular cases, seeing if more time should be spent on Megas or regular cases.

Furthermore, by quantifying the total hours spent on Mega cases and comparing them to the anticipated duration, the Court of Law Amsterdam can see their performance in meeting targets. This analysis provides valuable feedback on the feasibility of current scheduling practices and helps identify areas for improvement or optimization.

Loss of capacity due to cancellation or planning too much

The loss of capacity due to various reasons is a concern within the Court of Law Amsterdam. Despite the documentation of the reasons for cancellations, there is no tracking system to monitor whether regular cases fill the cancelled Mega hours. This lack of oversight has a negative effect on the court's ability to optimize its resource allocation and mitigate the impact of cancellations on overall efficiency.

To address this issue, it is important to implement a monitoring mechanism that tracks the utilization of hours following cancellations. By recording whether the cancelled Mega hours are subsequently allocated to regular cases, the court can better assess its capacity utilization and identify opportunities to minimize downtime and maximize productivity.

Another way the Court of Law Amsterdam is losing capacity is due to Mega being planned for too long. However, there is a lack of monitoring to determine the frequency of these occurrences. Consequently, the extent of the problem remains unclear. To address this issue, it is essential to establish a system to monitor instances where Mega is planned for too long. This data will provide insights into the time lost due to such occurrences and help assess their impact on efficiency. By analysing these records, the court can identify patterns and underlying reasons for the excessive planning, enabling them to implement strategies to mitigate the issue.

Algorithm for planning Megs

To optimize the scheduling of Mega cases at the Court of Law Amsterdam, we recommend that the Court of Law Amsterdam research different algorithms as discussed in Section 3.3.2.3 and Section 3.3.3.1. Currently, scheduling is done manually, which can be time-consuming and prone to inefficiencies. Implementing an algorithm can automate the scheduling process, saving time and ensuring a more systematic approach.

Furthermore, we recommend that the algorithm consider which combinations of judges to make for each Mega. Currently, team presidents can choose which judges to assign to a Mega, which may not always result in the most efficient combinations. By incorporating this aspect into the algorithm, optimal combinations of judges can be determined.

Tool for Mega scheduling on operational level

An operational scheduling tool is recommended to enhance operational efficiency in scheduling Mega cases. Currently, scheduling is primarily managed manually, which can be labour-intensive and prone to errors. Introducing a dedicated scheduling tool would streamline the process, allowing for better organization and coordination of resources.

This operational scheduling tool could facilitate the assignment of a lawyer, Public Prosecutor, and all other staff involved. It could also incorporate features such as calendar integration, real-time updates, and notifications to ensure smooth communication with, for example, security and coordination among all persons involved.

By providing a centralized platform for scheduling, the operational tool would enable efficient resource allocation, minimize scheduling conflicts, and improve overall productivity in handling Mega cases at the Court of Law Amsterdam.

6.3 Limitations

Firstly, one notable limitation is the exclusive focus on Megas without considering the planning and scheduling of regular cases. While Megas give challenges due to their complexity and resource-intensive nature, it is essential to recognize that the scheduling dynamics for regular cases may differ. Incorporating regular cases into the analysis could provide a more comprehensive understanding of the overall scheduling landscape within the court and facilitate a total approach to planning and resource allocation in the Court of Law Amsterdam.

Secondly, the research concentrates on optimizing the scheduling process within the Court of Law Amsterdam. However, there may be potential benefits in exploring whether Megas could be centralized, with a designated registration system separate from individual courts. Centralizing Megas could streamline the scheduling process, improve coordination among stakeholders, and enhance efficiency in resource allocation. Moreover, it could provide a standardized approach to handling Mega cases across different jurisdictions, potentially reducing administrative burdens and improving overall transparency.

6.4 Contribution to Science

Considerable attention in research has been directed towards hierarchical frameworks and their application in contexts such as hospitals or project planning. However, there has been a notable absence of research exploring hierarchical frameworks and decision-making within the context of the Court of Law. Therefore, this study, conducted for the Court of Law, aims to fill this gap by focusing on the legal system's specific context of planning and scheduling.

By looking at the planning and scheduling of court proceedings, particularly those involving Megas, insights are found to enhance the efficiency of the Court of Law Amsterdam. Moreover, the findings of this research may have broader implications for other courts, offering potential solutions to common challenges in the planning and scheduling of cases.

This framework can be applied to different types of cases within the legal system, such as civil cases, criminal cases, or administrative cases. Each type of case may have its unique characteristics and scheduling requirements, but the principles of efficient decision-making and resource allocation remain relevant. By adapting the hierarchical framework to different case types, the Court of Law can streamline their processes and improve overall efficiency.

Examining the planning and scheduling processes of the entire court system, such as been done in this thesis, can provide insights into improving the overall performance. This includes not only scheduling court proceedings but also managing administrative tasks, allocating resources (such as staff and courtrooms), and optimizing case flow. A comprehensive hierarchical framework can help identify bottlenecks, streamline workflows, and enhance coordination across different departments within the court system.

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Appendix A – Example schedule

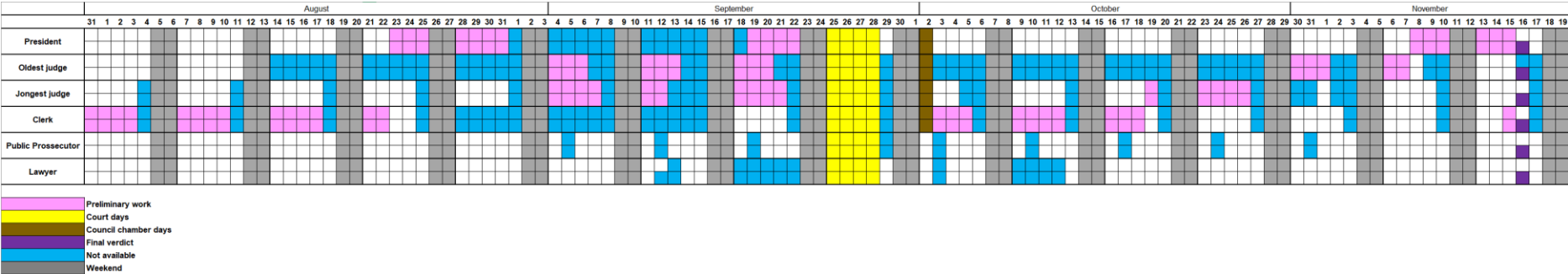


Figure 32: Example schedule Mega

Appendix B – Example calculation division rooms

Different kinds of cases belong to criminal law, with one of them being the Megas. Next to the Megas, there are also a lot of different regular cases. The available rooms in the Court of Law are divided over all cases. The calculation is made by first writing down the expected cases per different kinds of cases per year expressed in rooms needed per year. After, this number is divided by the total number of available days per year per room, which is in the Court of Law equal to 250. To find the final number, the total rooms needed per day per different kind of case is added up. Table 8 shows an example of this calculation.

Table 8: Example calculation division rooms

Case type	Expected cases per year (rooms needed per year)	Total number of available days per year	Total rooms needed per day
1	450	250	1.80
2	36	250	0.14
3	260	250	1.04
4	54	250	0.22
		Total	3.20