# Smart after-sales services through the use of service control towers

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# Introduction

Over the last years after-sales services have taken flight in industry. Companies have become more aware of the service contribution to a firm's profitability. Yet, many firms struggle how to reap the profit potential of these services, since its decision making is highly complex.

Service decisions are typically classified in strategic (long term), tactical (medium term) and operational (short term) decisions. Most firms consciously deliberate strategic and tactical decisions in order to come to the right decision. Operational decisions, on the other hand, are made more ad-hoc. This is remarkable given the fact that the operational decisions are pivotal in delivering good after-sales service. As a result, there exists a large potential to impact the after-sales service delivery by making better operational decisions. An effective mechanism to establish these smart after-sales decisions is a service control tower.

A service control tower is a central after-sales service support system for physical assets that uses (semi) real-time information from multiple sources in order to (i) monitor relevant aspects of after-sales service, (ii) anticipate on after-sales service issues, and (iii) support operational service decisions.

A service control tower is primarily concerned with organizing the operational after-sales logistic activities that support the availability of physical assets. This includes for instance spare parts fulfillment and service engineer dispatching.

The concept of a service control tower has received attention in academic literature over the last years, see for instance Boshle et al. (2011), Rustenburg (2016), and Topan et al. (2019). However, it is unclear to what degree this concept has disseminated to industry. Therefore, this paper sheds light on the awareness and implementation of service control towers at Dutch firms. It is based on in-depth interviews held with 21 firms that have major operations in The Netherlands. Each of the firms either operates in a business-to-business or in a business-to-government market. Moreover, the firms are active in a wide range of sectors including software solutions, third-party logistics, high-tech, agriculture, automotive, aviation, rail, food & beverages, healthcare, defense and industrial lease.

The remainder of this paper is organized as follows. First, the role and positioning of a service control tower in service decision making is discussed. Secondly, the current status of service control towers in academic literature is briefly discussed and it is contrasted to the practical challenges that firms encounter. Subsequently, the process of developing a service control tower is presented. This process starts with the need that a firm has for a service control tower. Two main drivers for this need are discussed. Given the need, a model is presented that describes the continuous development of a service control tower. This model is based on a maturity grid that can be used to assess a firm's current and desired service control tower maturity level. Also, the grid provides concrete development directions for increasing the maturity of a service control tower. Next, the added value that a developed service control tower brings to smart after-sales service is discussed. This paper concludes by presenting the general maturity of service control towers at Dutch firms.

# The role of a service control tower in service decisions

A service control tower requires data to operate. This data comes in various forms, but all originate from asset data. Asset data is information that can describe the current configuration of the asset or its current operating state. This asset data can be used directly in a service control tower. For instance, the asset configuration can determine which service engineer has the required skills for performing maintenance. Asset data is also used in analysis systems. These systems mainly address strategic or tactical service decisions, such as determining the spare parts assortment, the required skills of service engineers, and deciding on maintenance strategies for the assets. Examples of analysis systems are included in Figure 1 and more can be found in Driessen et al. (2015). The outcome of analysis systems is used as input for the operational management of after-sales services within a service control tower. The relationship between asset data, analysis systems and a service control tower is illustrated in Figure 1.

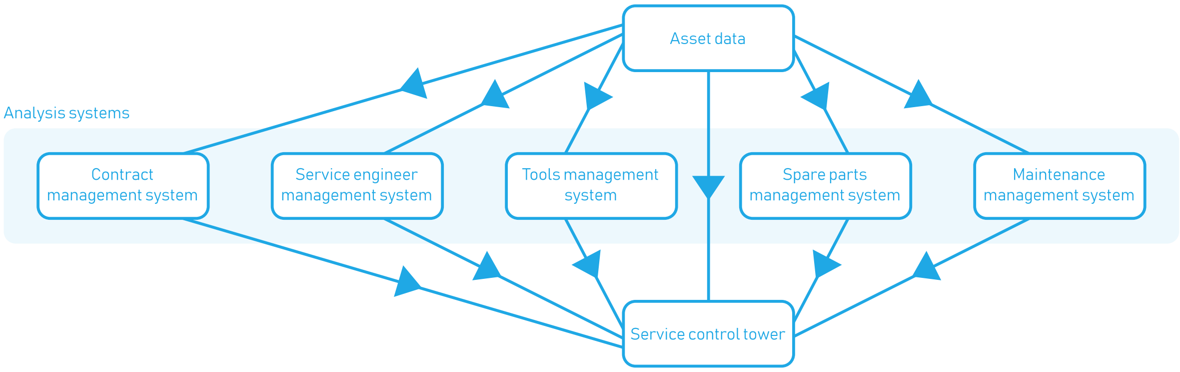


*Figure 1: The position of a service control tower relative to analysis systems*

The decomposition in Figure 1 points to the fact that intelligence used to make smart after-sales service decisions need not be centralized in a single system like a service control tower. In particular, the interviews revealed that service intelligence is commonly found in the analysis systems, rather than in an operational system like a service control tower. As a consequence, many operational decisions are made ad-hoc. This is the very point where a service control tower can help by contributing to more deliberated and smarter service decisions that ultimately increase the customer's service experience.

# Service control towers in academic literature

The academic literature on service control towers makes a clear distinction between the three levels on which decisions are made, and it focuses mainly on tactical and strategic decisions for after-sales decisions. Review papers (Kennedy et al., 2002; Basten & van Houtum, 2014), frameworks (Cavalieri et al., 2008; Driessen et al., 2015) and books (Sherbrooke, 2004; Muckstadt, 2005; van Houtum & Kranenburg, 2015) all focus on tactical and strategic decisions regarding spare parts management. Other research that is geared towards strategic and tactical decisions studies the control of tool kits for after-sales (Vliegen, 2009), the use of service engineers (Haque & Armstrong, 2007), and the combination of service engineer planning and spare parts planning (Sleptchenko, 2018).

Research on operational decisions in after-sales services is scarcer. In recent work (Topan et al., 2019) multiple operational actions are studied and the authors provide a brief literature overview regarding service control towers. Their work is the result of a cooperation with five Dutch firms who report the interventions or actions they make to operationally organize their after-sales services. The most common intervention categories are: *spare parts allocation* (for instance, use reserved parts to repair failed assets or customer differentiation by stock allocation); *expediting* (accelerate the lead time by sourcing parts from a different warehouse, working overtime or prioritize jobs in a repair shop); *cannibalization* (using a part from a non-functioning asset); and *capacity allocation and lot sizing.* Figure 2 presents an overview of the current state in academic research regarding the operational aspects of service control towers, where only spare parts aspects are considered. It is a graphical representation of the literature overview by (Topan et al., 2019) and the numbers represent the quantity of papers found on a topic.

One can observe that the vast majority of research studies at most two operational interventions. This, however, strongly contrasts with the practice found in industry as firms use operational interventions from all categories and even combine these in order to realize their desired after-sales service levels.

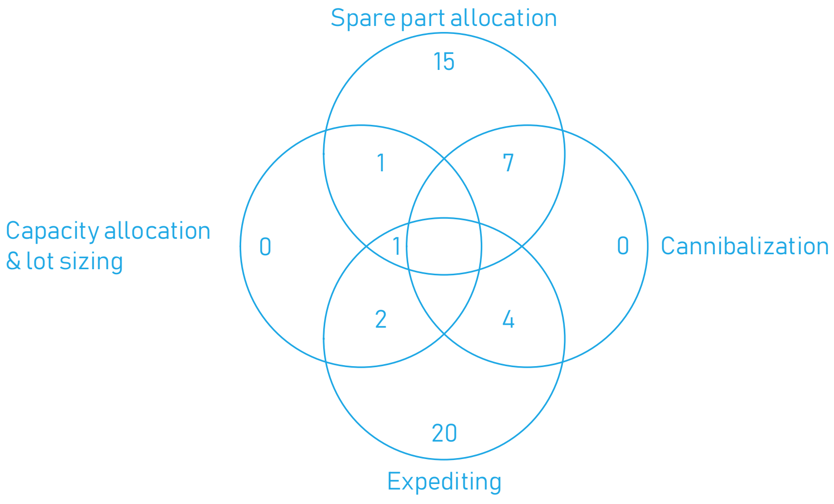


*Figure 2: Graphical literature overview of studied operational interventions (Topan et al., 2019)*

# The process of developing a service control tower

The initial development of a service control tower starts with identifying the need for a service control tower and its scope and depth. Based on this need, a firm should assess the current maturity of its service control tower. Naturally, a firm without a service control tower in place starts at the lowest maturity level. Subsequently, the firm derives the desired maturity of the service control tower it wants to develop. This desired maturity level is affected by the need of a service control tower, and it is compared to the current maturity level. Next, the firm can derive improvement directions to increase its current maturity. In the meanwhile, this maturity is continuously compared to the desired maturity level and subsequently the developments directions are changed or updated. This continuous improvement process is depicted in Figure 3.

The desired maturity of a service control tower may evolve over time, possibly due to the use of a service control tower. It may also evolve due to a change in the need for a service control tower. If the need for a service control tower increases, the desired maturity will also be elevated. Consequently, the continuous improvement process is initiated again. Eventually, the objective is to obtain a service control tower that complies with the desired maturity level.

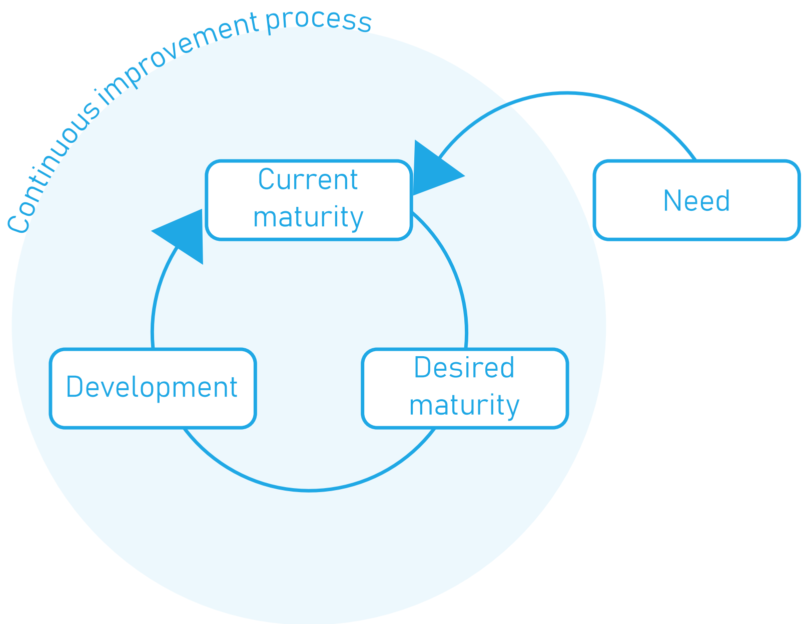


*Figure 3: A continuous improvement process towards a mature service control tower*

In the remainder, each of the components from Figure 3 is elaborated upon. First, the factors that determine the need for a service control tower are discussed. Second, a single maturity grid is presented that can be used for the continuous improvement process – consisting of current maturity, desired maturity, and development. Finally, some attention is given to the benefits that a firm obtains when the continuous improvement process has resulted in a service control tower that satisfies the desired maturity.

# The need for a service control tower

The need for a service control tower differs between various firms, which is also one of the outcomes of the interviews. Combining academic literature, domain knowledge, and the results from the interviews insight has been obtained in the process that drives the need for a service control tower. In this process two main drivers are identified that push the need for a service control tower: the degree of a firm's servitization and the complexity of organizing the after-sales services, see Figure 4.


*Figure 4: Drivers for the need of a service control tower*

## Servitization

Servitization is the process wherein a firm's focus shifts towards the integration of service in its business model (Baines & Lightfoot, 2013). The degree of a firm's servitization determines what a firm sells to its customers. This process can be broken down into six steps, based on Oliva & Kallenberg (2003) and Jovanovic et al. (2016).

1. Product sales (P): a firm only sells its product.
2. Spares sales (S): a firm sells its product and supporting spare parts.
3. Spares & labor sales (SL): a firm sells spare parts and maintenance activities next to its product. The service – spare parts and maintenance - is transaction based and the customer decides whether, when, and what is maintained. The service provider performs the maintenance and is therefore required to have an after-sales service organization in place.
4. Service contracts (SC): a firm sells its product and after-sales service contracts. A customer purchases the product and pays a periodic fee to the firm for the service contract. Such a contract typically includes Service Level Agreements (SLAs), for instance on asset availability or service response times. The firm is subsequently responsible for the after-sales service management to satisfy the SLAs. These contracts are characterized by the incentive to meet the SLA, but a firm is not incentivized to exceed it.
5. Service performance contract (SP): a firm sells its product to the customer and charges a periodic fee for a service performance contract. A service performance contract, also called performance-based contract, is very comparable to a service contract. The difference between both is that the firm is paid based on the realized service performance under a service performance, and thus is incentivized to realize higher performance.
6. Service sales (SS): a firm only sells service, meaning that sales are no longer centered on the product, but the product is simply a means to deliver the service. The customer pays only for the use of the service. A common example of service sales is "power by the hour" (Rolls Royce, 2012).

## The complexity of managing after-sales service

The complexity of managing after-sales service is a result of

- the number of aspects used in after-sales decision making,
- a firm's business setting.

*Number of aspects*

It is essential that various aspects of after-sales services are monitored and potentially controlled, when a firm desires to deliver good after-sales service. The interviews have reported the following relevant aspects to monitor:

(i) Maintenance activities: data with respect to maintenance activities contains information such as what maintenance is performed, by what engineer, on what location and how long it took.

(ii) Spare parts: spare part data informs the firm on various elements. For instance, the location of the parts, the spare parts on order, the consumption of spare parts, or the backorder quantity. Spare parts may be kept in service vans that are mobile, which complicates planning.

(iii) Service engineers: typical service engineer data contains information on the tasks performed by an engineer on a particular day, the engineer's location and the skills of an engineer.

(iv) Tools: the data for tools commonly includes the location of tooling, the quantity of available tools and for which maintenance tasks it is used.

(v) Service contracts: most of the firms monitor the realized service performance that is delivered to each of the customers. This enables the firm to monitor whether the service contract requirements are met and to see which customers require extra attention to avoid potential penalty fees.

(vi) Configuration: the assets for which after-sales services are in place are typically sold in various configurations. These configurations are saved in an information system. As parts in the assets are replaced by others during the asset's life, the configuration of the asset also changes. Therefore, it is essential to monitor the assets' current configuration in order to deliver the best possible after-sales service.

(vii) Operating status: many assets are nowadays connected to a central database of the service provider. As a result, the service provider has information on the operating status of each of the assets, such as location, speed, vibrations, oil pressure etc. This logging information is used for multiple purposes, such as determining what assets require maintenance on the short term or remotely diagnosing problems or repairing failures.

A second type of status information relates to environmental factors that describe the setting in which the asset operates. These include the temperature, air humidity, salinity, dust levels or the composition of the soil. These factors may affect the required tools, spare parts or engineer skills to resolve a problem.

For some firms it suffices to monitor a selection of the above aspects, while others monitor all aspects. For example, tools play a large role in the high-tech industry that requires custom tools and calibration equipment, while other industries do not need to monitor tools as they work with standard tooling.
Some of the seven aforementioned aspects are not only monitored, but are also actively controlled; in particular (i) maintenance activities, (ii) spare parts, (iii) service engineers, and (iv) tools. Examples of control on each aspect are widespread. During the planning of maintenance activities, the firm determines *where, by whom, and when* maintenance is done. For spare parts, it determines the location from where the spare part is consumed. Regarding tools, the firm decides what tools are used for the maintenance action. Finally, service engineers are assigned to maintenance activities depending on the available capacity and individual skills of each engineer.
The degree of monitoring and possibly present degree of control can be represented in a spider web chart, see the example below.

### Example

A firm monitors its maintenance activities as its service engineers log the start and finish times of each maintenance activity. Spare parts are monitored less accurately, because it is contaminated. This data is contaminated because service engineers report spare part usage based on their own initiative. As an example, the system records five parts that are used on a single day, while in practice these parts have been used over the course of multiple days. Tools are not relevant for this firm, because it uses standard tooling. Furthermore, the location of the service engineers can be easily determined on a high level, because each engineer has its own service region. The company closes service contracts containing SLAs with its customers. However, the SLAs are not being monitored accurately. Monitoring the assets' configuration is on the firm's radar, but due to the data contamination this is hard to monitor accurately. Finally, the firm's assets are connected to a central server and the firm monitors not only the operational status of the assets but also the error codes if errors occur. Thus, operating data of the assets is carefully monitored.

For control, the firm has a fair grip on the maintenance activities because it uses a manual planning method for maintenance. Service engineers make the order decisions for spare parts. This lowers the level of control, since spare parts control is decentralized and based on the judgement of individual engineers. The service engineers are manually planned, but as each engineer has its own region this control not highly required.

The particular firm is faced with a relatively high complexity of the management of after-sales services, because it is responsible for six of the seven aspects.

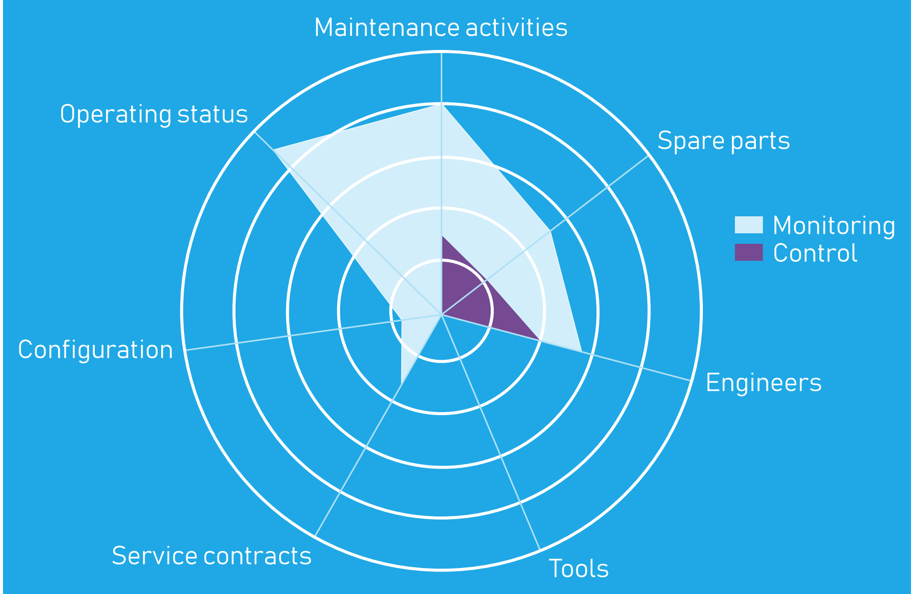


*Figure 5: Illustration of the degree of monitoring and control for the various service aspects*

*Business setting*

The second element affecting the complexity of the after-sales management is the business setting which a firm finds itself in. This setting is foremost characterized by the required asset availability, as this puts an extra strain on the service delivery. Firms that service capital intensive assets are typically faced with a high pressure on availability, while firms servicing assets that are far less capital intensive commonly face lower pressure on availability.

In addition to asset availability, the geographical scale on which the firm operates also plays a major role. A number of interviewed companies operates on a global scale and is confronted with more challenges, such as language barriers, duties and import taxes, different time zones and cultural differences.

Confidentiality and national security also play a role in various business settings. For these instances, a firm may be forced to perform service on specific locations by certain service engineers. These settings can affect the complexity of the after-sales services.

## Need for a service control tower

The degree of servitization and the complexity of managing the after-sales services together drive the need for a service control tower. This need is roughly broken down into three regions: no need, a need, and a necessity. For a high degree of servitization, delivering excellent service is elementary for a firm's profitability. Thus, the need for a service control tower is a necessity in this regime rather than a need. Similarly, after-sales services that are highly complex require a centralized system that aids smart service decisions such as a service control tower. This relation is depicted in Figure 6.

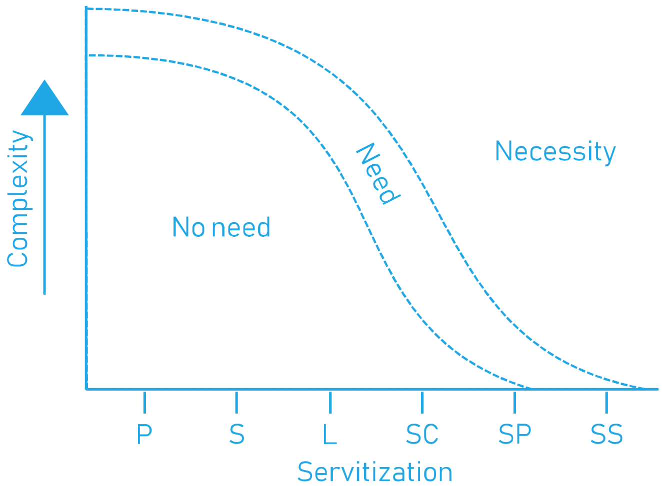


*Figure 6: The relation between servitization, complexity, and the need for a service control tower*

# Continuously improving a service control tower

The insights from the previous chapter enable a firm to assess its need for a service control tower. Using this need, a firm can (re-)enter the continuous improvement process of Figure 3. Thus, it can start to continuously improve its service control tower by assessing the current and desired maturity level, and by deriving development directions to increase the maturity.

## Current & desired maturity

First, the firm assesses the current maturity level of its service control tower. In Figure 7, a maturity grid is presented that aids the firm in performing this task. The maturity of a service control tower is decomposed into the maturity per functionality. The functionalities are formulated based on our definition of a service control tower (monitoring, anticipating and supporting decisions) and have been supplemented by other functionalities resulting from the in-depth interviews.
The maturity level of each functionality has been materialized by concrete examples, see Figure 7. These examples are the result of combining the outcome from the in-depth interviews, academic literature and the domain knowledge. The maturity grid from Figure 7 is not exhaustive, and more examples and best practices can be found in industry as well.

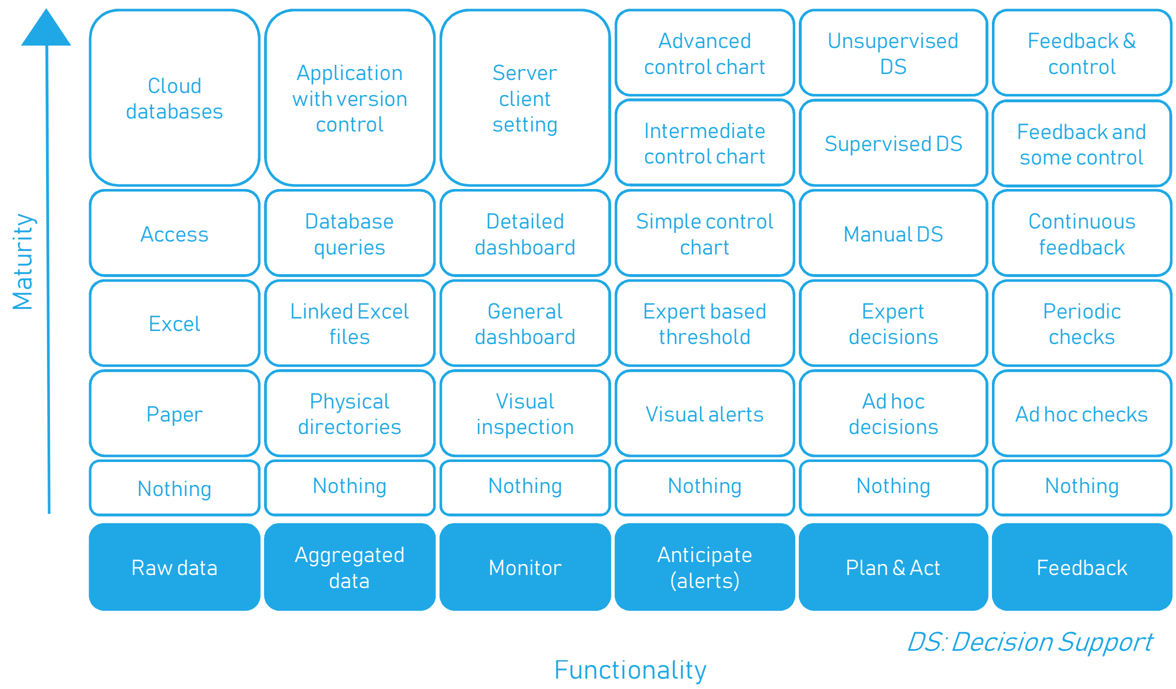


*Figure 7: A maturity grid for a service control tower*

A firm is able to highlight cells in Figure 7, when it wants to assess its current maturity level. However, the maturity grid from Figure 7 can also be used to visualize the desired maturity level of a service control tower. The same principle of highlighting cells from the maturity grid can be used for this purpose.

## Developing a service control tower

With the current maturity and the desired maturity assessed, a firm can start to develop its service control tower. This can be done on two levels: (i) the operational and technical level, and (ii) the organizational and social level. This paper is focused primarily on the operational and technical level, but the organizational and social level is also touched upon briefly.

### *Operational and technical level*

For the operational and technical development of a service control tower, the maturity grid from Figure 7 provides concrete directions for developing a service control tower. By design, the maturity developments of the functionalities are interdependent; some functional developments are hard to realize when other functionalities have not been sufficiently developed.

**Example**

A firm currently monitors its after-sales service aspects by performing visual inspections and generates alerts based on visual judgements. The firm uses the maturity grid from Figure 7 to determine how to develop their service control tower. The firms has decided to upgrade the alarm functionality to automatic alarm generation based on expert thresholds. To do so, it must first upgrade its monitoring functionality by moving from visual inspections to a digital dashboard that enables data-based monitoring (for which the right maturity level of data aggregation is required).

The above example illustrates how a firm can use the maturity grid to direct the developments for a service control tower. Each cell in the maturity grid is a direction in which a firm can develop its service control tower. Therefore, it still leaves room for a firm-specific interpretation, and it requires careful consideration on how such a direction takes concrete shape for a firm.

### *Organizational and social level*

The maturity grid is mainly an operational and technical oriented framework. To further facilitate the development of a service control tower, a firm should also consider developments on the organizational and social level. Although this paper focuses on the operational and technical level, the interviews also revealed some best practices regarding the organizational and social level:

- A service control tower should be an independent organizational entity. This ensures an objective decision making process that results in a uniform service delivery to its customers.
- Delivering good service consists largely of customer experience. The interviews have shown that human intervention can lead to suboptimal decisions from a cost or efficiency perspective, but result in improved customer satisfaction. Thus, a service control tower needs experts to achieve the best customer experience.
- Necessary data has to be available and accessible for a service control tower to operate, and all departments or supply chain parties have to be willing to contribute to this objective.

# The added value of continuously improving a service control tower

A mature service control tower offers more insight in the after-sales service delivery. It starts by increasing the transparency of the service decisions, which supports smart after-sales decision making for a firm's employees. Suppliers of service control tower software are focused on this increased transparency and the resulting potential for smart service decisions. In general, the benefits of smart after-sales services are diverse.

## Increased service efficiency

Since all information is centrally available in a service control tower, all aspects can be taken into account during the decision making process. This prevents an employee from searching various information systems to find, for instance, the availability of service engineers, the available spare parts, the lead time of a part, and the closest location to perform maintenance. A central information system, which is present in a service control tower, increases both the transparency and the efficiency of the decision process.
Moreover, a mature service control tower contributes to a further efficiency increase, when it can recommend operational interventions, or even make autonomous decisions. This way, the workload of the employees is lowered and the efficiency increased.
Considering multiple aspects in decision making is highly complex, especially when uncertainties play a role. A mature service control tower can aid this complex decision making since it is capable of handling uncertain and highly dimensional information. This results in smarter after-sales service decisions and service that is delivered the first time right, thereby yielding an efficiency increase.
As a service control tower results in better operational control of the after-sales services, fewer resources (such as spare parts and tools) are required and to deliver the service. Moreover, fewer engineers are required to be on standby to deliver quick response service.
Ultimately, an increase in the efficiency of the after-sales service delivery positively impacts a firm's profitability, as the operational costs are reduced.

## Increased service effectiveness

A service control tower also contributes to delivering higher customer service. As more after-sales services are delivered the first time right, fewer service visits occur. This strongly impacts customer satisfaction which in turn contributes to a firm's profitability.
Customer satisfaction is also elevated because a service control tower offers transparent information about the service delivery. This way, a service engineer can better inform a customer on the service to be delivered.
Additionally, a firm can offer more service differentiation when smart after-sales service decisions are taken. If a firm has a better grip on the efficient delivery of after-sales services, it can differentiate between the customers and offer each customer tailor-made service solutions. This differentiation step does not only create the possibility to elevate customer satisfaction, but also to increase a firm's profitability. Furthermore, a better grip on service decisions enables a firm to develop its level of servitization and thus to develop new business models, such as service as a business.

## Other benefits

The benefits of using a service control tower reach beyond the direct effects on the service delivery. A service control tower results in more sustainable operations, thereby reducing the ecological footprint. Fewer resources – such as spare parts and transportation – are required to deliver the service. Moreover, a service control tower enables a firm to reuse or recycle systems that are used to deliver service. This particularly holds for firms that have a high degree of servitization.

Better operational control through using a service control tower also affects the scheduling of service engineers. Service is typically delivered around the clock, and consequently engineers have to be available at all times to deliver this service. Better operational control requires fewer engineers to be available during non-desirable times (such as the night or weekend), and thus implies an increased satisfaction of service engineers.

# Service control tower maturity in The Netherlands

The interviews revealed that many companies in the Netherlands are actively working towards smart after-sales service solutions. The average maturity level of a service control tower at a Dutch company is depicted in Figure 8.

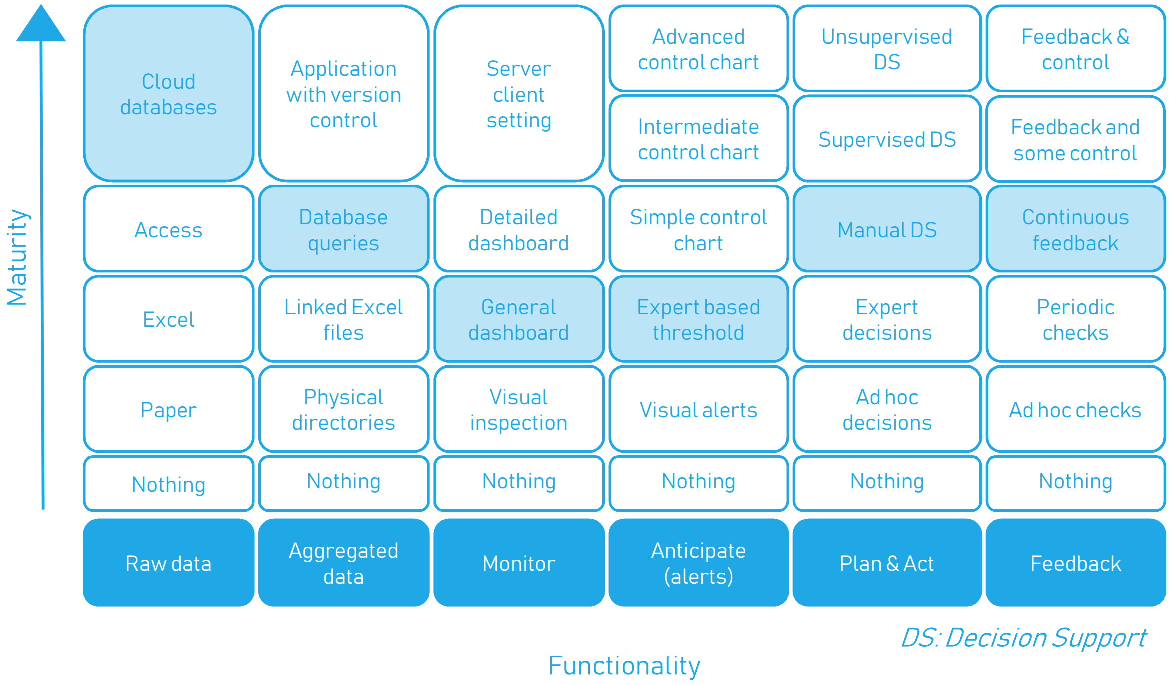


*Figure 8: Service control tower maturity of Dutch firms*

Most companies have already achieved a high level of maturity regarding their raw and aggregated data. Often, external factors (such as regulations) play a role in these developments, forcing companies to set up a solid database. This enables companies to develop a higher maturity on the other control tower functionalities (monitor, anticipate, plan & act, and feedback). Nevertheless, this research revealed that, for most companies, the current maturity level of the remaining functionalities is lower compared to the raw and aggregated data. Yet, the variation in the maturity level between companies is high for the monitoring, anticipating, plan & act, and feedback functionalities. This is partly due to differences in needs and desired maturity, and partly due to differences in complexity between companies.

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# Contact

Would you like to know more about service control towers or smart after-sales service? Please contact Joni Driessen (driessen@cqm.nl) or Minou Olde Keizer (oldekeizer@cqm.nl).

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