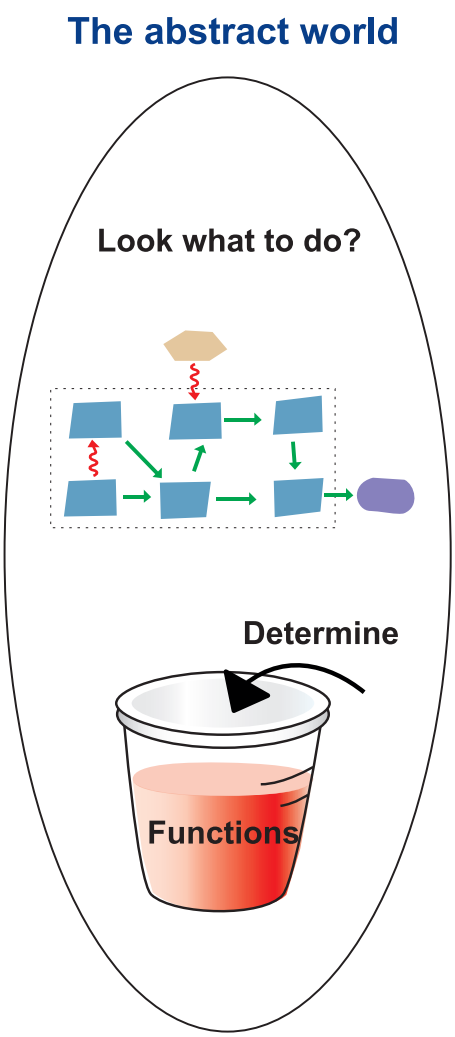
6. Determine Functions – The functions Domain of Information

The final determination of the functions is always the result of an iterative process in which the initial outline is first created and then gradually refined to perfection. Refining the initial outline requires access to more detailed information from the information domains of Customers, Needs, Solutions, and Processes. Therefore, you need to revisit the other information domains several times during the determination of the functions. This iterative approach to filling the domains with value-critical information increases your chances of creating a WoW product.



Customers are motivated to buy a product because of its ability to satisfy needs, and needs can only be satisfied by performing functions. They pay for the functions to be performed. When the product can no longer perform its functions satisfactorily, it is repaired, changed, or discarded. Your bin contains all the things that are no longer of any value to you. The functions provided by the products in the bin are not worth the expenditure for you to keep them.

There is a growing trend among customers to prioritize access to functions over ownership of products. People are increasingly interested in only paying for the functionality and benefits of a product or service rather than owning it. A desire for convenience, flexibility, and sustainability drives this shift. Examples of this trend include:

- Shared mobility: city bike, carpooling, and timesharing services
- Pay-per-use models: pay-per-laundry for white goods, cloud computing, and cloud storage
- Collaborative consumption: vintage clothing rentals and sharing platforms
- Product-as-a-Service (PaaS): companies offering products as a service rather than selling them.

The transition from a linear to a circular economy further accelerates this trend of only paying for the functionality if and when it is used. In a circular economy, products are designed to be shared, reused, and upcycled, reducing waste and minimizing environmental effects. This shift from ownership to access transforms how businesses design, produce, and deliver products and services. New business models are needed. Companies adapting to this trend will be better positioned to meet their customers' changing needs and preferences while contributing to a more sustainable and circular economy.

This chapter contains the following:

6.1 The Importance of the Information Domain Functions

The Functions domain serves as a bridge between the customer's world and the company's world. In a development project, information must flow seamlessly between these two worlds. For example, to translate and convert subjective customer needs into detailed technical specifications. A type of information that is neither technical nor subjective is required to facilitate this flow.

Algebra in mathematics enables handling complex tasks and general relationships. Functions have the same role in product development. Functions provide an abstract framework for understanding and comparing different technical solutions. This abstract information allows you to measure and evaluate an approximation of customer value across various technical options, making it possible to benchmark your product against competitive solutions or compare an existing product with one under development.

The abstract nature of the functions also enables the creation of models that can help solve complex technical problems. By operating at a higher level of abstraction without getting bogged down in details, these models create an understanding of where value is created and where value is lost in your present product. Creating a focus on where you need to direct your development efforts to create a WoW product.

The functional language is solution-neutral and describes what the product should and should not do. The functional language describes the interaction that takes place between the product, the customer, and the surrounding environment. The functional language has a defined syntax and rigorous rules. Attention to all these details is essential for harvesting all the benefits of using this domain of information.

Navigating the Needs and Solution domains can be challenging, as they are subject to constant change. Customer needs evolve, products become obsolete, and new technologies emerge. However, amidst this turbulence, the Functional domain remains relatively calm and stable.

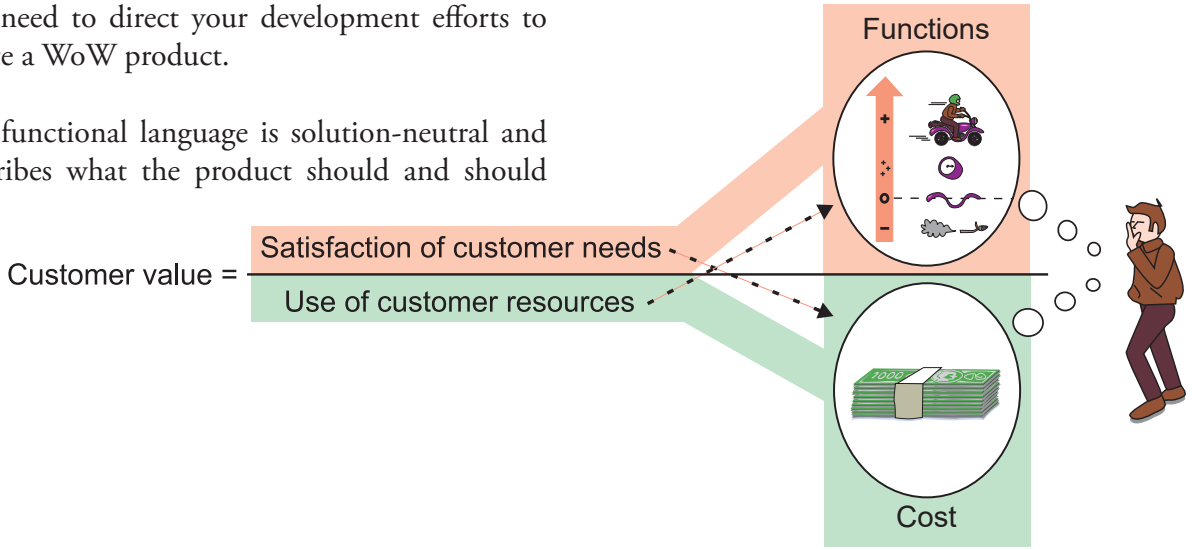
Functions represent a product's or service's underlying purposes or benefits. Some functions have remained remarkably consistent for centuries. For example:

Products will expire but the functions will endure.

- ***The watch tells the time***

The function of telling time has remained the same, but the solutions have evolved from sundials to mechanical clocks to digital watches. The function has also moved to higher hierarchal levels, such as the computer and mobile phone.

Over the years, numerous solutions have come and gone, but the underlying customer need for the functions usually remains constant. What changes, however, is how well, how fast, how reliably, and at what cost the functions will be



performed. Performance increases with every new product generation. Most WoW products are excellent examples of quantum leaps in performance or radical reductions in the use of customer resources. An excellent example was the quartz movement watches, replacing mechanical watches.

The stability of the Functional domain provides a foundation for innovation and improvement. By understanding the underlying functions, businesses can focus on developing new solutions that perform these functions better, faster, and more efficiently. A company with the business model of helping customers "tell the time" will be more open to innovations than a company whose business model is to manufacture mechanical watches.

Every little thing in your product and every little line of code in your computer program has to have a function. Functions motivate their existence; otherwise, you should have them removed! However, that is not always the case. In complicated hardware, around 1% of all the components don't perform any desired function. Dead code is a far bigger problem in software products.

Mastering the functional domain will take your professional skills to the next level. You will better understand how your product creates and destroys customer value. You will have access to new, powerful tools that make complex problems easy to solve at an innovative level.

6.2 The syntax for formulating functions

Our definition of function is the interaction between the product, the customer and its environment. This interaction can produce both favorable and desired effects as well as adverse and undesired effects. From a customer perspective, functions are best formulated based on how the product, customer, or surrounding environment does what. The syntax for formulating functions consists of three or four parts:

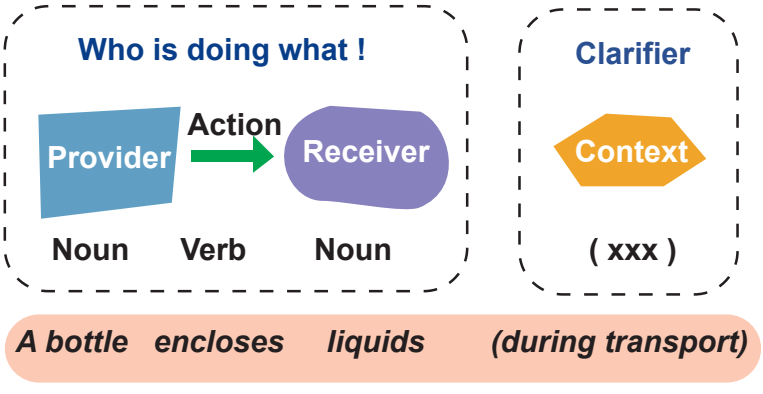
- The provider of the function is always a noun.
- The function is always a verb.
- The receiver of the function is always a noun.
- The Clarifier is optional to provide context, limitations, or clarifications.

Clarity improves by stripping away the unnecessary and leaving only the bare essentials. This involves eliminating adjectives and adverbs, which often only clutter the thought process. Instead, adopting a simple three-word syntax, noun-verb-noun, helps distill the idea into its purest form.

If clarification is needed, a clarification can be added to provide context, usually in brackets. By doing so, the mind is sharpened and forced to focus on the heart of the matter, resulting in clarity that cuts through the noise.

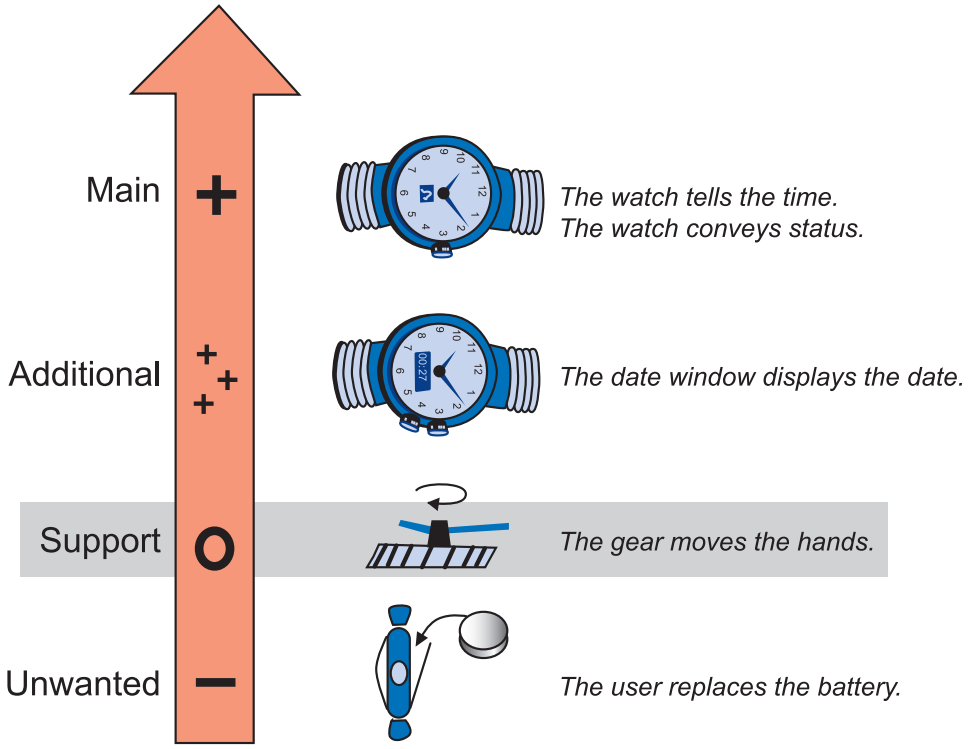
A Swedish proverb formulates this idea of the minimalistic approach to strip down the formulation to its bare essentials: *"The sharpness of thought lies at the tip of the pen."*

By strictly adhering to these guidelines, you cultivate the habit of concise expression and lay the groundwork for creating functional models. In a functional model, functional providers and receivers are typically represented as squares or blocks, while the functions are drawn as arrows connecting these blocks. This visual representation allows for a clear and organized illustration of how different components interact, making it easier to analyze, design, and optimize complex systems.



6.3 The Classification of Functions

I recommend using functions holistically. There are positive functions that increase customer value and negative ones that decrease value. There are hard technical functions as well as soft human functions. I have developed a structure for classifying and dividing functions



into different groups depending on how they impact customer value. Let's go back to our example with the watch to exemplify this:

The watch tells the time (in the dark)

Functions that are a must and, if removed, would change the customer's perception of the product are called Main functions. There can be several Main functions, but often only a few, usually only one or two. An easy way to decide whether a function is a Main function is to imagine eliminating it from the product. For example, can you sell an expensive watch that can't tell the time or cannot provide the buyer with status, a source of beauty, or a feeling of well-being?

Performance is defined as the product's capacity to perform the function. One performance metric of the function to "tell the time" is the watch's ability to tell the correct time, not to go too fast or too slow. This metric is for a modern quartz watch less than plus/minus 10-15 seconds per month. Today's accuracy is better than most of us manage to set the time when moving to and from daylight-saving time. Increased accuracy of a modern quartz watch can hardly lead to increased benefits for the everyday user. So, improvement in performance does not automatically result in higher customer value. An increase in performance must always be seen in relation to the customer's capacity to use and willingness to pay for better performance.

As you know, watches are available in many different designs. This is because a watch contains many more functions than just telling the time. Some watches also contain additional functions, for example:

- *The watch measures the body temperature.*
- *The watch monitors your heartbeat.*
- *The watch sends out emergency signals.*

These types of functions are called Additional functions. They are not an absolute must for the customer, but they can increase customer value if provided at a low cost.

All Main or Additional functions aim to increase customer value by contributing to the product's benefits. The impact of these functions on customer value depends on individual customer needs and the cost of supplying the function. Main and Additional functions differ depending on how your market segments are defined. What is Main in one market segment may be an Additional in another.

Unfortunately, products or services also perform Unwanted or non-beneficial functions that can harm or be inconvenient for the customer or the environment. Inherent weaknesses or shortcomings in the chosen technology or design can cause these Unwanted functions. They can be regarded as functions that provide negative benefits, ultimately reducing value from the customers' perspective. These unwanted functions cause frustration, inconvenience, and dissatisfaction, eroding the overall customer experience. Eliminating or minimizing these Unwanted functions can be a powerful way to increase customer value.

Batteries power a quartz movement watch. As a consequence, it has the unwanted function of "the user replaces the battery."

A way of increasing customer value in the product is to change it so that the change of batteries function can be eliminated. In recent years, the leading manufacturers of quartz watches have launched products that do not require any battery changes. They are powered by the movements of the hand or by solar cells.

Finally, all products and services also contain Support functions. These functions must be carried out if the product is to work. Support functions don't influence customer value as they do not cause or have any benefits or drawbacks for the customer.

Every Support function in a product or service typically increases costs and complexity. These functions should, therefore, be eliminated in the long run to create room for higher margins or lower prices. The watch example illustrates this concept, where the Support function of rotating hands has been targeted for elimination. One example is digital display watches.

Hopefully, the above example has helped illustrate the vital significance value-based thinking, or funtion- and cost-based, has in defining customer value in a product.

To WoW your customers, strike the right chord with the 4-string instrument of functions.

6.4 Strategies to Increase Customer Value

Based on the classification above, your four only options to increase customer value in your product are as follows:

1. Increase the performance of the Main functions

Provided customers need it and are willing to pay for it. Of course, the price they are willing to pay must be higher than the costs you incur in providing higher performance. Performance can be increased in soft human functions (providing status) and hard technical functions (telling the time).

2. Increase the number or the performance of Additional functions

Provided customers require them and are willing to pay for them. Again, the price they are willing to pay must be higher than the costs you incur in providing it.

3. Reduce and/or eliminate Unwanted functions

Provided customers require it and are willing to pay for it. Again, the price they are willing to pay must be higher than the costs you incur in providing it.

4. Identify support functions and change the product to eliminate or simplify these

Doing this can reduce the cost and complexity of the product.

The first three strategies directly impact customer satisfaction by increasing customer needs or reducing the use of customer resources. The fourth strategy impacts customers indirectly by a less complex or cheaper product.

Development engineers typically prefer to stay within the Solution domain of information. It's comfortable and familiar territory for them. They find it easy to develop numerous technical tweaks to a product and push it forward, believing it's in the customer's best interest.

However, the "Start anywhere but go everywhere" philosophy forces engineers out of their comfort

zone and into the functional domain. Suddenly, all the suggestions for technical changes must be justified from a functional and value perspective.

They must prove which function is being improved and which metric is enhanced. In the end, very few of these tweaks survive when tested in the functional domain. Giving the development engineers a tool to evaluate their technical ideas and killing them in time before testing live on customers clears up space for focusing on creating WoW products.

6.5 Value charts – A way to measure an approximation of customer value

Some functions are relatively easy to measure. Others are significantly more difficult. Common to all functions is that several metrics must be used to create satisfactory measurability. We can take the photocopier's Main function as an example. The Main function is to "make copies of documents."

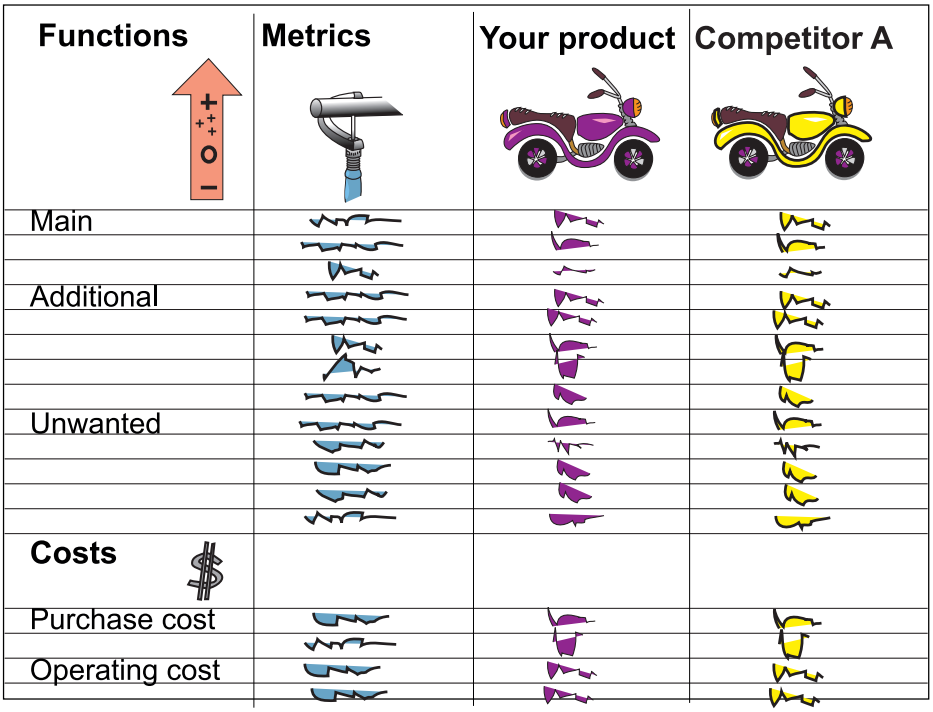
How well the photocopier carries out its Main function depends, for example, on:

- Printing speed – copies per minute
- Resolution – number of dpi
- Start-up-time – seconds
- Paper sizes, A4, Letter, Executive, B5
- Storage Capacity – 250 sheets 80 g/m2
- Special papers – transparency films, envelops, postcards

Combining several different metrics or measurable characteristics is necessary to measure a function.

A Value chart is a table consisting of a selection of metrics used to measure the Main, Additional, and Unwanted functions, and cost. The aim is to capture customer value, not to describe the product or service. It may, therefore, include additional metrics typically not found in a technical specification. These metrics serve the purpose of guiding product development or performing benchmarking against the competition. The Value chart is a valuable tool in product development, serving multiple purposes beyond traditional technical specifications. Typical advantages of using Value charts are:

- Improves measurability of customer value.
- Stable structure for long-term plans and benchmarking.
- Clarifies strong and weak areas in your product.
- Good overview for target-setting.
- Foundation for value-based selling.



A Value Chart is a comprehensive tool containing many performance metrics, typically in the range of 50 to 150 metrics.

However, not all metrics are equally crucial for customer value. Only about 10% are value-critical, meaning they significantly impact the product's overall value proposition. Furthermore, only a tiny fraction, around 2%, of all metrics are suitable for demonstrating value to customers, often called "Money Bags." Money bags are key metrics that truly resonate with customers and drive purchasing decisions. Concentrated efforts to improve those metrics in the next-generation products are essential if your company intends to implement value-based selling.

Technical specifications in brochures and marketing materials typically lack clarity and structure. I advocate for a clear and organized approach, directly linking technical specifications to product functions and customer benefits. This is particularly crucial for customer-facing technical specifications, which should provide a transparent and accurate representation of the product's benefits.

By adopting a structured and customer-centric approach to technical specifications, companies can present their products clearly and compellingly, highlighting the benefits that matter most to customers. The Value chart is an excellent starting point for this.

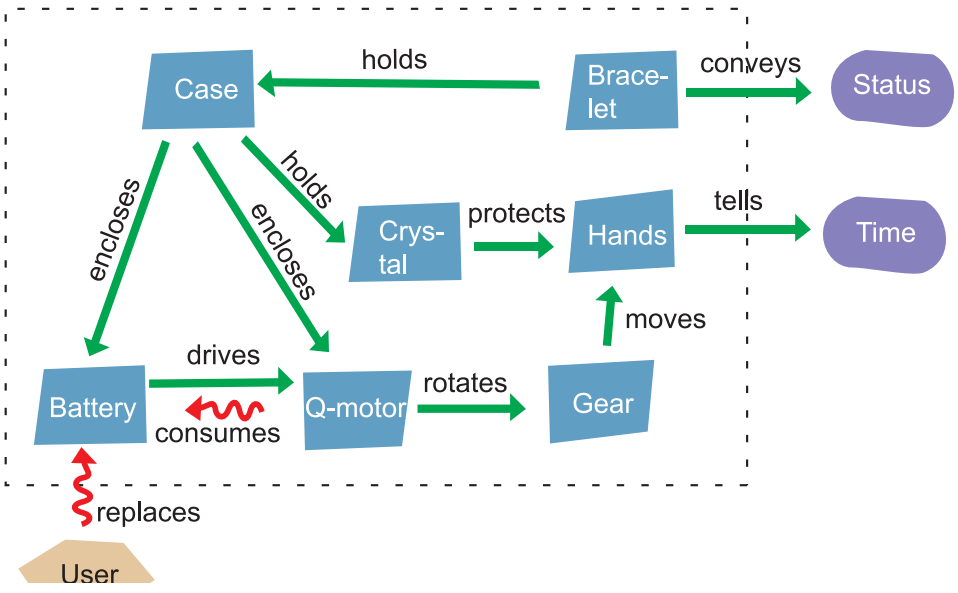
6.6 Making Functional Models

Making a functional model is probably the hardest to learn in the functional domain. A functional model is a logical model entirely different from other models familiar to most engineers like:

- A drawing or a 3D model describing the physical world.
- A flow sheet describing the sequence of activities.
- A system hierarchy describing the structure of a product.

For beginners, it is tough to free themselves from these known models. It is essential to be incredibly observant when creating a functional model, as it must not simply mimic the physical world or describe a sequence of functions or the hierarchy of your product. For those who have never constructed a functional model before, this distinction is crucial. The model should serve as a representation of how various functional providers interact and relate to one another rather than merely replicating the physical attributes of the product. By focusing on functionality, you can gain deeper insights into how your product operates and how its subsystems or components work together to achieve the desired outcomes.

A functional model is a logical model describing how Value is created and lost.



To create clear and consistent functional models, I recommend that the following notations are used:

- The system border is a larger rectangle drawn using a dotted line.

- All functional receivers that affect customer value are located outside the system border. These include the receivers for Main, Additional, and Unwanted functions. They are represented as rectangles with soft edges. They contain the name of the receiver, formulated using a noun. For example, "time" or "status."

- All functions that affect customer value pass through the system border. These are represented as arrows. Besides, the arrow is the action formulated using a verb. For example, "tells" or "conveys".

- Inside the system border are all subsystems represented as rectangles, and functions performed by subsystems are represented as arrows. For example, "hands." Hands are the most important subsystem in the watch for "tells time."

- The following color scheme is used to distinguish between functions that create value and those that decrease value. Value-creating functions are green arrows, and value-decreasing functions are red arrows.

To clarify, the subsystem "Hands" is a rectangle inside the system border, a green arrow goes through the system border with the text "tells," and outside the system border is "time" inside a rectangle with soft borders. It sounds complicated, but getting familiar with these rules simplifies the making of functional models. At the product level, the Main function was "The watch tells time." Broken down in the functional model, it will be " The hands tells time." The "hands" is one subsystem that may contain several hands.

I have made many functional models together with product development teams from all over the world. What has always surprised me is that the team members never agree on how to name the functions, how subsystems are named, and what functions subsystems provide. They don't have a common understanding of how the product works logically. How many problems, arguments, discussions, and mistakes have not been made over the years due to this lack of understanding? Fixing this problem is the foundation for innovation and effective product development. A functional model is, to my knowledge, the best tool to fix this problem.

Strive to produce simple models that focus on the most critical functional elements involved in the problem you are working with. This task is more difficult than you may realize, and practice is required before the art can be mastered. One of the most common problems is finding the right level to formulate the functions and making the functional model. A functional model can be created on three levels, each focusing on a specific product or service aspect. The levels are like magnifying glasses. You can create an overview or drill down to the physical level.

At the customer level, the model describes what the customer wants and how the product or service drives value by performing Main, Additional, and Unwanted functions from a customer perspective. This level is all about understanding how and where customer value is created and how and where customer value is lost in your product or service. For example, *The hair dryer dries hair.*

At the technical level, the model explains how the product or service works. This level is focused on driving product improvements and optimizing performance. For example, T*he hair dryer blows hot air.*

Finally, at the physical level, the model describes what we want to happen on a physical level. This level is mainly used if you are trying to develop an innovative solution. For example, *The hair dryer moves water molecules (away from hair)*

The functional providers and receivers and the system's functions will differ depending on your selected level. The right level is selected depending on your understanding of your product and your challenge.

There is a method for evaluating and grading each subsystem's contribution to value, which allows you to prioritize and optimize your product's performance. This method provides a systematic approach to assessing the value contribution by each subsystem. With this method, you can create a comprehensive ranking of all subsystems in your product, from the highest value contributors to the lowest. This ranking enables you to identify which subsystems are the weakest and need to be improved. My somewhat humorous way of describing this to those responsible for such subsystems is – "Shape up, or we will design you out."

I recommend you visit the slide presentation and look at the examples to learn more about creating functional models and rate the value contribution of different subsystems.

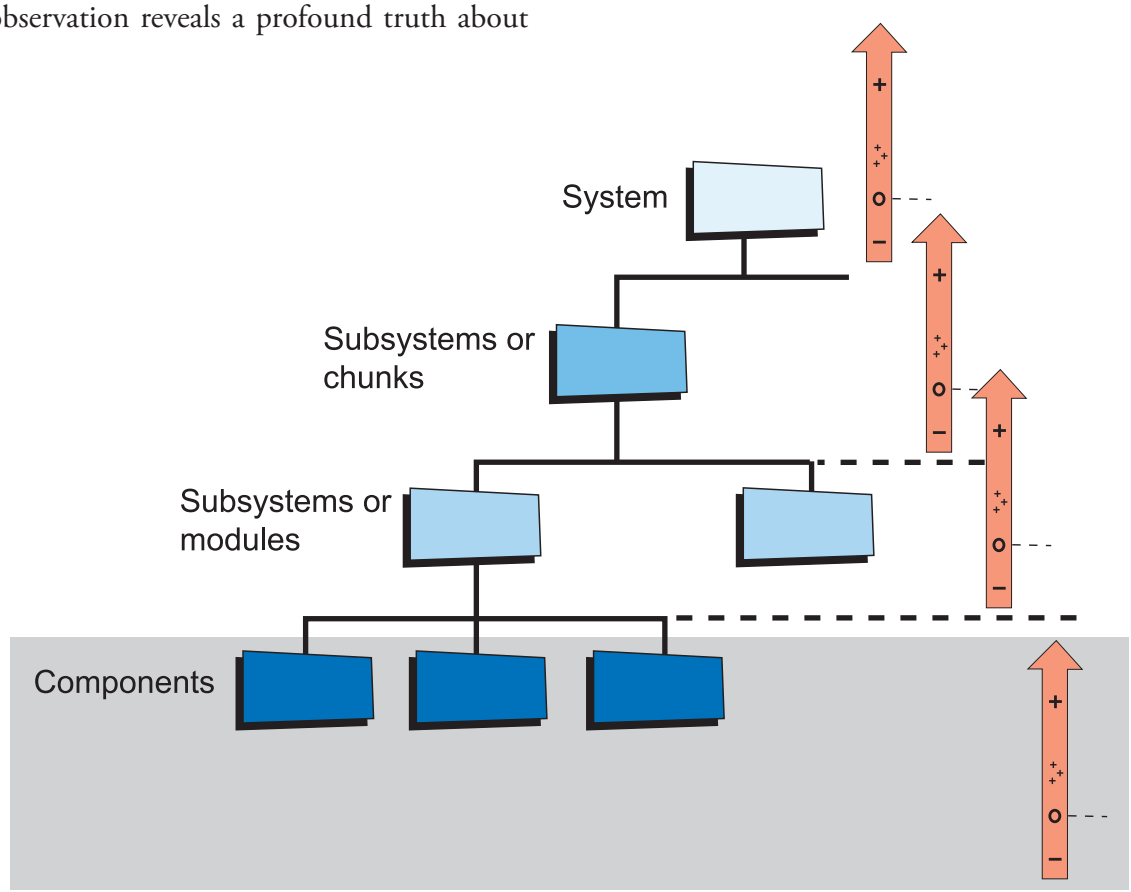
6.7 Functional models at different hierarchical levels

Something that I find difficult to explain is that the functional mindset I have described in this chapter operates similarly across all system levels within a complex product. You will discover a fundamentally similar structure regardless of which level you analyze in a complex product. This observation reveals a profound truth about how complexity is managed and understood in product design and systems engineering.

This fact holds immense significance when analyzing a complex product. You can begin by creating a comprehensive functional model of the entire product to identify weak subsystems. These subsystems can then be broken down using the same methodology to better understand the underlying issues. This breakdown can occur in multiple steps or layers, much like peeling an onion. By doing so, you can reach and identify the fundamental problem or root cause that is best addressed at the lowest possible level.

In the context of product analysis, recognizing the importance of a thorough assessment cannot be overstated. A functional model serves as a roadmap, guiding you through the intricate components and interactions within the product. By systematically identifying weak points, you can better prioritize areas for improvement and innovation.

As we delve into the hierarchy of functions, the distinction becomes evident. We encounter a limited number of Main functions at the product



level, typically no more than a few. These Main functions represent the product's core purpose, which is the primary reason customers buy and use it. Alongside these, a handful of Additional functions enhance the product's capabilities and appeal, providing extra value to the user. However, based on shortcomings of the technology, every product may also have several Unwanted functions. These are the aspects that are harmful or have a negative impact on the customer or the environment.

When we shift our focus to the subsystem level, we see the same principal structure but fewer functions. You will find fewer Main, Additional, and Unwanted functions.

At the component level, the hierarchy simplifies even further. Here, we typically find only one Main function that defines the component's role within the subsystem, and there are no Additional functions. Nonetheless, even at this level, you may still find Unwanted functions.

An intriguing pattern emerges as we analyze this functional structure. Many components' main function is to address an Unwanted function present at higher hierarchical levels. This cascading effect demonstrates how layers of design decisions impact one another within a complex system architecture.

In reality, numerous functional providers, whether subsystems or components, are often remnants of quick fixes to solve previous challenges. For instance, consider a scenario where the oil within a machine is heated up excessively. The immediate solution was to introduce a cooling flange to mitigate this heat. While this adjustment improved the situation, it proved insufficient, leading to adding a fan to enhance cooling further. The introduction of the fan, however, brought its own challenges as it generated significant noise, causing customer complaints. A noise hood was added to address this new issue. I am sure you get the picture. This example describes how many products evolve over time. Not through thoughtful innovation but rather through a series of reactive measures that increase complexity rather than reduce it.

As we analyze this evolutionary path, we must recognize that the accumulation of quick fixes can lead to unwieldy and inefficient products, ultimately diminishing customer satisfaction. In the Solution Domain, I will delve deeper into this phenomenon and propose a strategy for trimming a product, essentially, how to enhance customer value by eliminating outdated quick fixes.
In conclusion, understanding the functional mindset across various system levels reveals the interconnectedness of design choices within complex products.

The important conclusion is that it doesn't matter on which hierarchical level you are working, product, subsystem, or component. You can use the methodology described in the chapter.

6.8 Listen to all the remaining Voices

The advantages of the functional model is increased if other perspectives are added to the model. The difficulty here is that a specific aspect may be crucial for the success of one project and of no importance whatsoever in another. At the outset, it is impossible to know whether a specific aspect is essential. Here are some aspects you may need to complement your functional model with:

- Add or replace existing subsystem or components with competitors superior subsystems or components (if not protected).
- Add or replace existing subsystems or components with new verified subsystems or components with higher value from research or sub-suppliers.
- The cost of each subsystem or component.
- Manufacturing or supply chain aspects.
- Safety, regulatory, legal, or certification aspects.
- Environmental aspects.
- Position on the S-curve and trends of evolution.
- Patent situation.
- Situation-specific, such as weight on wearables.

Systematically analyzing the critical aspect of your product indicates the direction in which to move or which subsystems need the most attention. I call this the Gold Digger's Dilemma: **It's mostly gravel, but you'll never discover the gold nuggets without panning.**

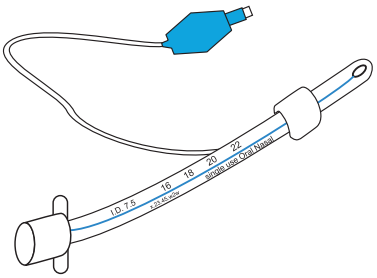
6.9 Establish your benchmark

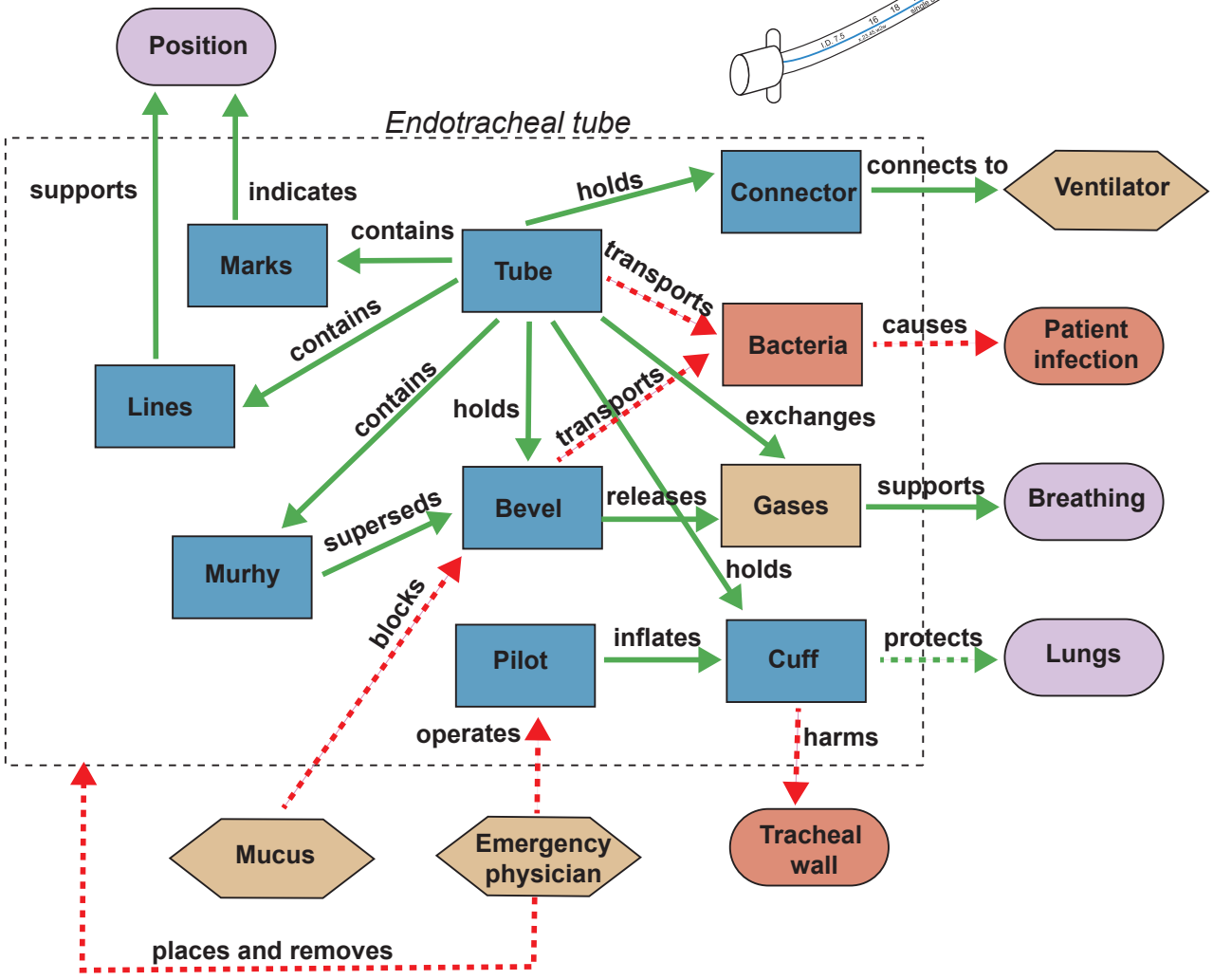
By listening to the various voices, you establish your benchmark, which combines known elements that can be safely utilized to create a new product. These elements may stem from your previous products, competitors' offerings, or insights from internal and external research. The benchmark represents the highest level of achievement that the world can collectively attain today, and every company has the potential to reach this standard. You can not incorporate unsafe or unproven concepts into the benchmark. The benchmark is not a high-risk concept but a low-risk concept. The benchmark should be a viable option to pursue. It will be your fallback alternative if more innovative concepts fail.

The benchmark is a critical reference point in your organization's development efforts. For companies recognized as technological leaders, the benchmark often reflects their existing product, enhanced by minor modifications or improvements. This could involve incorporating a new feature, solving quality issues, or adapting to emerging trends in customer preferences.

Furthermore, the benchmark lays the foundation for quantifying the approximation of customer value. It enables organizations to measure how much higher customer value the benchmark would have compared to their present product and other competitive products. By establishing clear metrics based on the benchmark, teams can identify areas for growth and opportunities for differentiation. This quantification process is vital for making informed decisions about further development efforts.

However, several challenges remain within the benchmark. The benchmark is the baseline, but a WoW product delivers higher customer value.





In addition to serving as a reference for customer value, the benchmark also acts as the starting point for the functional tactics required to achieve unrivaled customer value.

6.10 Identify Value increasing challenges

After creating your benchmark, you should be able to formulate your value-increasing challenges. This list of actions will enhance your benchmark's value if solved. Such a list can typically look like this:

- How to prevent the tube from transporting bacteria?
- How can we improve the cuffs' ability to protect the lungs?
- How can we simplify the process for the emergency physician to place and remove the endotracheal tube?
- How to prevent mucus from obstructing or blocking the bevel?
- How to ....?

It's rare to find a company with a comprehensive list of all the value-increasing challenges available.

However, I firmly believe that you can create such a list for your product by mastering the functional domain of information. This list will provide a clear direction for your product development efforts and uncover new challenges and opportunities for creating a WoW product.

The list will likely contain a mix of straightforward challenges that your product development team can tackle immediately and more complex issues that require further research and development. You'll need to incorporate the latter into your layered R&D portfolio, where they can be prioritized, resourced, and addressed over time.

In short, mastering the functional domain of information is key to creating a comprehensive list of value-increasing challenges. **If done right, your opportunity to create your WoW product will probably be on that list.**

6.11 Value-based selling

Your Value chart is an excellent starting point for value-based selling. Before you have even conceived an idea for the product, you can identify the metrics that would be suitable. Feeding this information into the innovation process increases the chances that you develop a product suitable for value-based selling.

Value-based selling is a sales methodology that focuses on demonstrating the unique value proposition of a product or service to potential customers. This approach emphasizes the total value a solution can deliver to the customer's business rather than just the product's features and price. It also involves creating a robust business case that justifies the purchase decision, highlighting the

return on investment, payback period, or other key metrics that resonate with decision-makers.

To create a compelling business case, customers are often required to input their own data into the model, which helps build a tailored value proposition specific to their organization.

6.12 Link to Value Analysis and Value Engineering

The standard defines customer value as the ratio between the satisfaction of customer needs and the use of customer resources. A customer need can only be fulfilled by the functions provided by your products or services. The Main and Additional functions represent the numerator in the value equation, while Unwanted functions represent parts of the denominator. The remaining portion of the customer's resources can be translated into costs. In this context, customer value can be approximated by the functionality-to-cost ratio, which is precisely the focus of Value Engineering or Value Analysis. This is how some define Value Engineering:

"Value Engineering is a systematic approach to analyzing and enhancing value in products, systems, or services, boosting customer satisfaction and overall value while reducing costs and improving performance."

What I have described here is a more practical way to achieve and implement the idea of Value Engineering. The strength of my approach lies in its practical approach and ability to seamlessly incorporate other powerful tools into its framework.

6.13 Functional model's role in FMEA

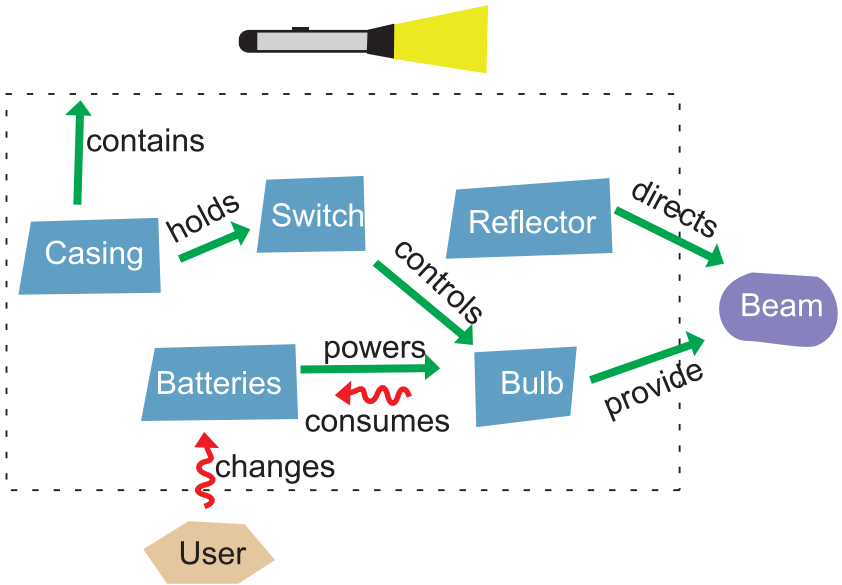
The American military pioneered the development of Failure Mode and Effect Analysis (FMEA) in the late 1940s, a method that has since gained significant traction across various sectors. Today, FMEA is not merely a beneficial tool. It is a mandated requirement within numerous international quality standards and industries, such as QS9000 and the automotive sector.

FMEA is designed to identify potential faults in both products and processes before they manifest, thereby enabling organizations to eliminate or mitigate risks associated with these faults. FMEA is versatile, with several types tailored to evaluate different aspects of products and processes. This discussion will focus on Design FMEA, which is a crucial tool in development projects to enhance customer value and product safety.

In my experience, however, when development teams engage in FMEA, the process often lacks structure and leans heavily on the participants' prior experiences. This reliance can lead to significant drawbacks as the teams only concentrate on familiar issues, neglecting to identify and assess all conceivable faults. In the context of FMEA, a fault is defined as a functional deviation. Since the functional model outlines all functions of a product, it provides an excellent framework for conducting a thorough FMEA. Among a product's functions, the Main functions are undoubtedly the most critical to safeguard. However, it is essential to recognize that losing the Main function is not always the worst-case scenario.

For instance, my work with electrical products shows intermittent function poses a more significant risk. A situation where the functionality of a product intermittently fails, leading to an unpredictable user experience. Such issues can culminate in disastrous outcomes, such as overheating, fires, or even serious injuries. Therefore, it is imperative to systematically evaluate all potential failure modes using a comprehensive checklist, ensuring that no aspect is overlooked.

To illustrate different failure modes more clearly, let us consider an ordinary flashlight designed to emit a beam of 3 ± 0.5 candela when activated. Below is a list of potential failure modes associated with this product:



- **No function**
  No beam, 0 c.

- **The function comes too early**
  The beam is always on.

- **The function comes too late**
  The beam activates with a delay.

- **Excessive function**
  Beam strength exceeds 3.5 c.

- **Inadequate function**
  Beam strength is less than 2.5 c.

- **Intermittent function**
  Beam flickers.

- **Deteriorating function**
  Beam intensity wanes after 10 minutes, measuring below 2.5 c.

- **Anti function**
  Beam is misaligned and blinds the user.

- **Unexpected function**
  Beam has an unexpected colour.

By meticulously analyzing each of these failure modes, development teams can not only address known issues but also proactively identify and evaluate potential faults that may not be immediately apparent. The functional model with all its functional providers is where the teams can look for reasons behind different failure modes. Identify weak subsystems that may have to be redesigned or extra controls that must be added.

This structured approach is essential for creating reliable and safe products, ultimately leading to higher customer satisfaction and reduced risk.

In conclusion, while FMEA is a robust tool for enhancing customer value and product safety, its effectiveness is contingent on applying a systematic and thorough approach. By recognizing and addressing various failure modes using a functional model, teams can ensure a more comprehensive evaluation of their products, ultimately leading to safer and more reliable outcomes.

Customers don't buy your product, they pay to have functions performed.

The different failure modes are rated on three different criteria on a scale between 1 to 10:
- Severity of effect
- Probability of failure
- Likelihood of detection.

The Risk Priority Number (RPN) is calculated by multiplying the three factors of severity, probability, and detection. Therefore, The RPN number is between 1 and 1000, helping the teams focus on the most critical failure modes to mitigate.

6.14 FAST diagram and Jobs-To-Be-Done

Some advocate using the Function Analysis System Technique (FAST) to create functional models. The three key questions addressed in a FAST Diagram are:

- How do you achieve this function?
- Why do you perform this function?
- When you perform this function, what other functions must you also consider?

I believe this approach to developing a functional model can be beneficial only in certain very unusual situations. The issue with FAST diagrams lies in the fact that one starts with a blank slate rather than leveraging the maximum potential from already known and proven functional providers such as subsystems, modules, or components. My philosophy has always been to maximize the reuse of effective subsystems from previous products. Changing everything is a challenging and risky path; it is a route that should only be traveled when you intend to transition from one S-curve to the next.

While the FAST technique can be advantageous in unique scenarios, relying solely on it may overlook the wealth of knowledge and experience embedded in existing products, systems, and services. Successful product development often results from iterative improvements and refinements

rather than complete overhauls of everything. You can mitigate risks and leverage existing successes by reusing proven subsystems with high-value contributions. Embracing a philosophy that prioritizes the reuse of successful elements can lead to safer, more effective product development strategies, ensuring a smoother transition between different stages of the S-curve.

Jobs-To-Be-Done Theory (JTBD) employs a syntax similar to mine for formulating functions. However, it lacks a classification of functions based on their contribution to value. Instead, JTBD divides functions into two primary categories: Main Jobs-To-Be-Done and Related Jobs-To-Be-Done. Each of these categories is further segmented into Functional Aspects and Emotional Aspects.

One notable limitation of the JTBD framework is its focus primarily on the functional domain, which can lead to an overly complex and convoluted structure. This compression of vast insights into the functional domain may result in overlooking critical aspects of other Domains, such as Needs, Solutions, and Processes. Furthermore, as far as I know, the methodology does not utilize functional models, which reduces its connection to other analytical tools such as Quality Function Deployment (QFD), Failure Mode and Effects Analysis (FMEA), and the Theory of Inventive Problem Solving (TRIZ).

JTBD may miss opportunities for deeper analysis and integration with other methodologies that could enhance its applicability and effectiveness. In conclusion, while JTBD provides a structured approach to understanding functions' roles in creating customer value, its limitations in classification and integration with other tools may hinder its overall usefulness in product development.

6.15 Summary

The Functions domain of information often stands out as the weakest in many organizations. Essential elements such as specifications, benchmarking, and innovative problem-solving become fragmented and unreliable without a standardized framework. It also hampers the quality of decision-making. Furthermore, a troubling absence of robust function- and cost-based thinking exists, leading to missed opportunities for improvement and innovation.

Value-critical information in this domain may include:

- A precise description and formulation of the Main, Additional, and Unwanted functions of the product you aim to enhance in terms of customer value. It could be either your current product or a benchmark product.
- A comprehensive Value Chart with easy-to-use and measured metrics.
- Your Value Chart populated with metrics specific to your product and any benchmarks.
- An analysis of your Value Chart to pinpoint value-critical metrics that require improvement to achieve unrivaled customer value.
- If possible, identification of metrics suitable for value-based selling, often referred to as "Money Bags."
- A functional model of your product or benchmark.
- An evaluation and ranking of all functional providers in your functional model from best to worst, based on their contributions to or detrimental effects on value, cost, manufacturing or supply chain, safety, positioning on the S-curve, or any other important information.
- One or several functional models at lower hierarchical levels of weak functional providers.
- A comprehensive list and precise formulation of all value-increasing challenges you're facing.
- A functional model of your final concept that will be utilized for your Failure Modes and Effects Analysis (FMEA).

