Structuring methods in the run-up of QFD for intralogistic facilities - what seems to be useful for stakeholders?

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Abstract:

The purpose of this paper is to present results concerning the applicability of structuring methods. What kind of structure enables a productive transfer into QFD? And going one step further: which stakeholder of an intralogistic facility will find this structuring most helpful? Accuracy in the run-up offers satisfactory results in QFD. And accuracy is often achieved by clarity. Handling intralogistic requirements means dealing with hundreds of data records. Only structuring can achieve a clear overview.

However, a structure can only be useful if the user finds it easy to handle. Therefore, it is also important to consider the different points of view of users. These users are, as a general rule, stakeholders in the facility - stakeholders that have to weight requirements in the run-up or have to deal with requirements as a part of the planning team.

In conclusion, the paper will point out how to structure requirements in order to give all stakeholders an all-embracing overview of the large amount of requirements.

Furthermore working with a large amount of requirements should become more effective and accurate. As a result clustering and weighting of requirement should become easier.

1 Introduction

In order to carry out Quality Function Deployment (QFD) you need to know the requirements of your customers and their priorities. In a project dealing with the design of an intralogistic facility those requirements can be numerous. Intralogistic facilities are internal material-flow systems that serve to bridge goods from the receiving point through manufacturing equipment towards the dispatching area [Jün00]. Intralogistic

facilities include systems like stock management (e.g. mini-loads, high rack warehouses,…) material handling technology (e.g. belt conveyors, lifts,…) and technology for picking procedures (e.g. sorter). Structuring is essential for planners to handle the large amount of information about those facilities. With the help of structure models requirements can be grouped in order to focus on them during planning stages. The planning stages involve several stakeholders. So the chosen structures should be adjusted to their needs.

The aim of the project A1 "A model for structuring and clustering intralogistic facility demands" in the German collaborative research project 696 [SFB696] is a systematical approach that can be used in the field of product development. This may lead to considerably more customer-oriented products.

2 Useful structures for intralogsistic facilities in the run-up of Quality Function Deployment (QFD)

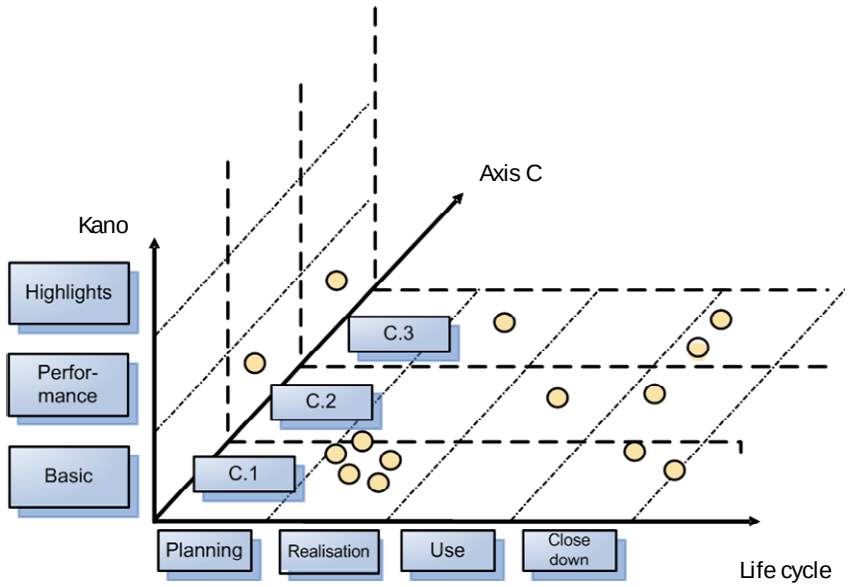
The origin of every QFD are the demands of different stakeholders and customers and their emphasis. QFD transfers this basis of information QFD into attributes of the product - in this case an intralogistic facility. Furthermore, interactions of attributes, benchmarking aspects and producibility are examined. Final outcome should be an optimum of product attributes – respectively facility attributes – that fulfil customers' demands.[Akao92]

According to this, a translation of demands into attributes can only be successful if information on demands and their emphasis are conscientiously gathered and handled.

In doing so, handling means structuring of demands. In the case of an intralogistic facility there are big amounts of demands mentioned by different stakeholders. Therefore, it is necessary to give the planning team of an intralogistic facility a comprehensible overview about all information. This can be achieved by a multidimensional structuring model.

In creating a multidimensional structuring model different kinds of structures are used as axis to span a vector space. The categories of each structure are sections of the axis. Thereby a multidimensional vector space is spanned and demands can be mapped as vectors in this space (see pic. 1).

So structures are needed that can classify demands and alleviate their handling. For example: the facility life cycle that divides axis A into the categories planning, realisation, use and close down. Another useful structure is the Kano-method. It divides demands into three categories: basic, performance and excitement requirements. Related to the demand's potential of fulfilling the customer's satisfaction and the fulfilment of the demand by appropriated attributes requirements are separated into those three categories. This is axis B (see pic. 1). With the help of these two axes demands can be displayed as vectors in a 2-dim space. The user of this 2-dim structure model gets to know what kind of demand excite his customer and when this demand will become important in the facility life cycle. (see also [Crostack07a, Crostack07b, Crostack08])

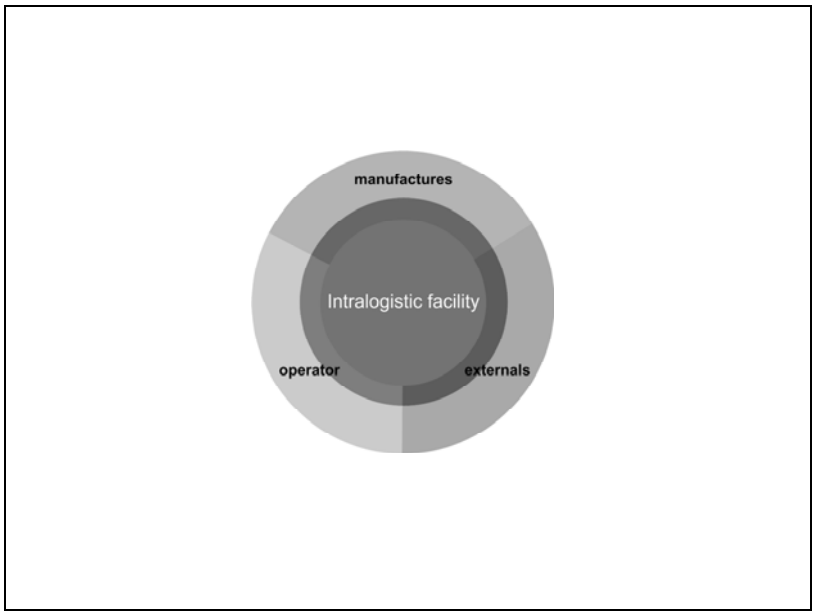


Picture 1: Example of a 3-dim space of a structuring model

But what kind of structure is useful for the different types of stakeholders? To find an answer to this question, stakeholders of an intralogistic facility have to be identified at first.

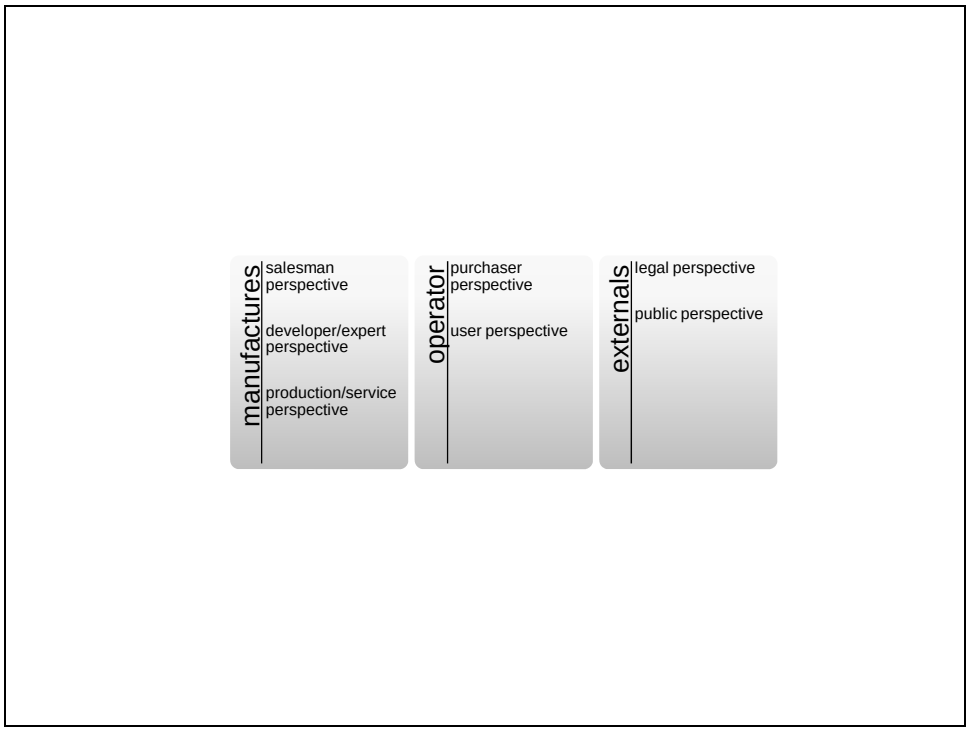
3 Stakeholders of an intralogistic facility

Stakeholders are groups of customers that have the same interests. Thereby a customer is every person that has demands concerning a product. [Herzwurm97, Janisch92] Examining stakeholders of an intralogistic facility it is recommended to consider three parties – manufacturer, operator and externals – to be able to differentiate their aims (s. pic. 2). For instance, the project managers of the manufacturer and of the operator might have different opinions.



Picture 2: The three involved parties

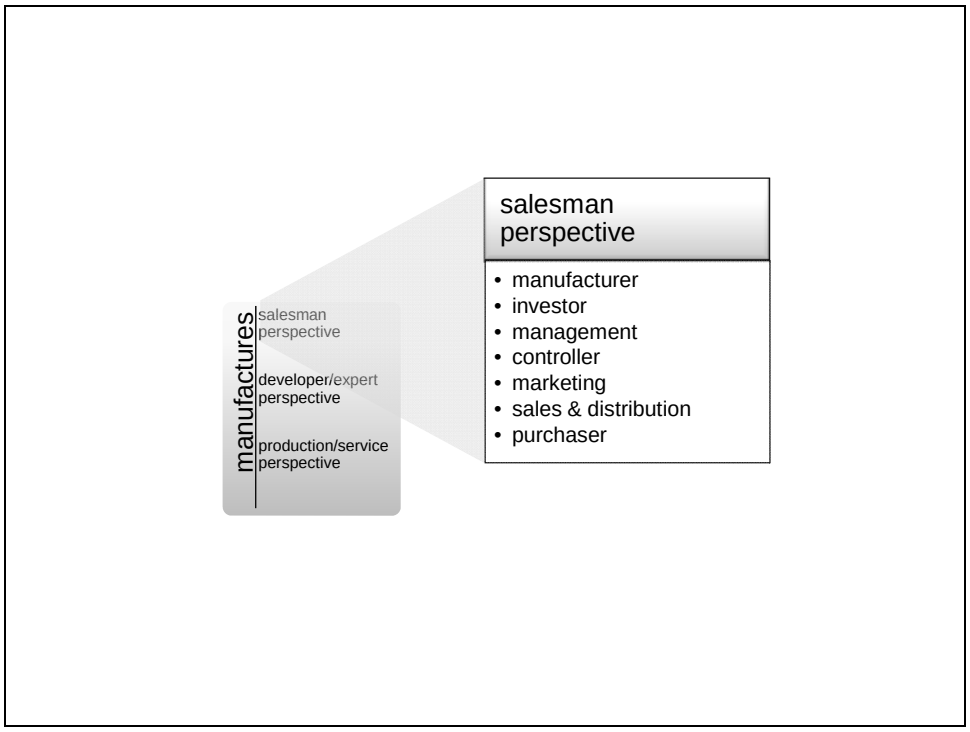
Each of these parties includes several stakeholders. Those stakeholders can be classified into two to three groups related to their perspectives. (see pic. 3)



Picture 3: The parties and their perspectives

Within those perspectives different kinds of stakeholders of those parties have to be considered.

Firstly examining the ***salesman perspectiv***e, there are several stakeholders that represent - directly or indirectly - strategic or financial interests of the manufacturer (see pic. 4).



Picture 4: Stakeholders of the salesman-perspective (manufacturer)

The *management* of the manufacturer is interested in the success and survival of its company. It develops strategic company objectives and implements them. The management possesses a strong power of decision and is able to get these interests accepted.

Investors are also interested in the success and survival of their company because they share the companies profits as well as risks.

Controllers support management decisions by editing the monetary business ratio. They include employees of the finance department and have funded knowledge about business economics.

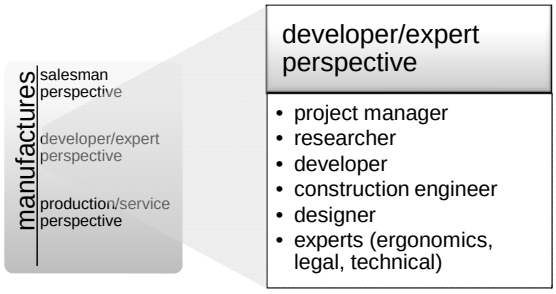
Purchasers of the manufacturer supply the company with resources that are needed for producing an intralogistic facility. They try to achieve this aim by lowering costs, and taking care of reliable delivery and quality.

The *marketing* determines customer needs and requirements in order to include those in the planning of the intralogistic facility. This includes presenting the company and its products in a positive light and keeping in touch with customers.

Keeping in touch is also important for the *distribution* stakeholders. But contrary to the marketing perspective only the interests and wishes of the company buying the facility are considered. Negotiations and contract conclusions are also a task of distribution.

In the following the stakeholders of the ***developer and expert perspective*** are explains (s.

pic 5). They are involved in the planning and development of a facility. But their demands affect the whole life-cycle of the facility.



Picture 5: Stakeholder of the developer/expert perspective (manufacturer)

Researchers develop new or optimized technologies to support the development of an intralogistic facility. Their work supports developers.

Developers convert customer wishes into an intralogistic facility. They are supported by other stakeholders who share their perspective. They aim for a facility that satisfies the customer needs. Therefore they use already existing or new technologies. But they also have to find solutions or compromises for problems that result from rival demands.

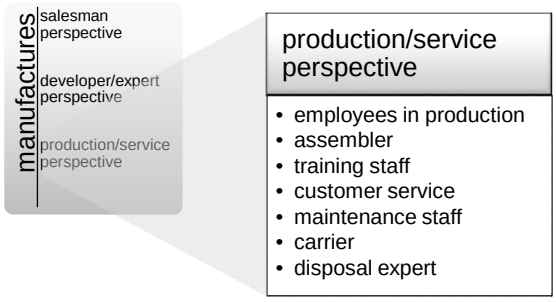
Construction engineers deal with the design of the facility. They design dimensions, define tolerances and characteristics and are responsible for engineering drawings.

In comparison to construction engineers *designers* focus on the aesthetical appearance of the facility. Their work also includes questions of ergonomic aspects.

Another group is represented by *experts*. This group includes ergonomic-experts that support developers concerning their ergonomic obscurities. Further experts are safety experts, legal experts or IT experts for example. This expert group should be divided into several sub-groups in reference to their different subject areas so that different opinions can be captured.

The project manager coordinates activities and demands of the different stakeholders. His job is to align the different demands.

Last but not least the ***production & service perspective*** includes production employees, assembler, training and maintenance staff, etc. (s. pic. 6)



Picture 6: Stakeholders of the production & service perspective

The *employees* of the manufacturer, that produce the facility, are interested in safe workstations. Just as well as the assembler. The latter require also a facility construction that offers easy assembly and also disassembly.

The *training staff* instructs the user of the facility into the handling of the facility. This training can also include contents like maintenance. Moreover this staff works with the facility manual and requires clear instructions.

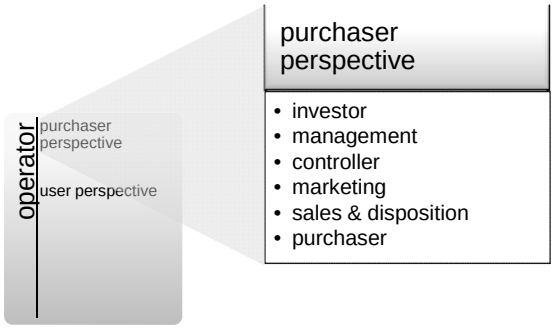
But it is also possible that the manufacturer offers maintenance as a *service*. Hence the *maintenance staff* can become a stakeholder.

The carrier, engaged by the manufacturer, is responsible for the transport. Often heavy transports are required, so the manufacturer favours the outsourcing of this process.

The waste manager deals with the closing down and disassembling of the facility. This process includes selling of the facility or facility-components, recycling and scrapping.

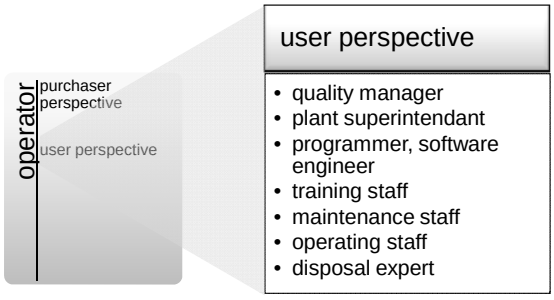
In the following stakeholders from the operator are determined. Firstly there is the salesman perspective. Stakeholders of this perspective are interested in strategic and financial aspects. They are the counterpart of the manufacturer's purchaser perspective. These perspectives include the same stakeholders. Also their tasks are similar. The only

difference is the point of view. The one group wants to take advantage for the manufacturer, the other one for the operator. (see pic. 7)



Picture 7: Stakeholder of the purchaser perspective (operator)

The second perspective of the operator is the user perspective. All stakeholders that use the facility are outlined in this perspective. (s. pic. 8)



Picture 8: Stakeholders of the user perspective

Again there are parallels between the manufacturer and operator. Some of the stakeholders are also mentioned in the production & service-perspective of the manufacturer. But in this case the stakeholders are not part of the same departments. In this case the stakeholder either exists on the manufacturer-side or the operator side. Here, for example the maintenance staff e.g. can only be part either of the manufacturer side (if the manufacturer offers such services or provides it by a service-company that fulfils the outsourced service) or the operator side if the operator has its own staff for maintenance.

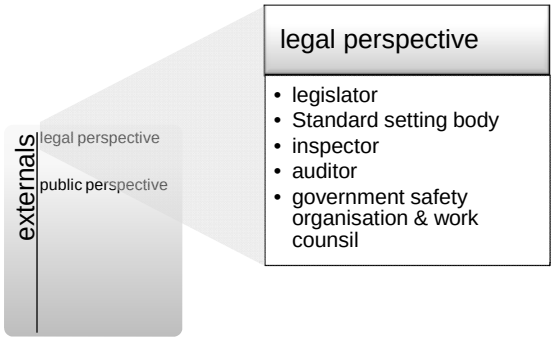
The same applies for assemblers, waste managers and carriers. Laminations should be avoided.

On the other hand there are also other stakeholders who can be allocated to the user perspective with certainty. Those are the facility staff (like pickers, warehouse staff, forklift drivers or cleaning staff) that interacts with the facility.

In addition, there are programmers and IT technicians who deal with data traffic and implement software applications.

The *Quality manager* controls the quality of the logistical output, the status of transported goods and optimizes processes.

The last party - the external party - implies the legal (s. pic. 9) and the public perspective.



Picture 9: Stakeholder of the legal perspective (externals)

The **legal perspective** includes the legislator that implements laws, controls compliance

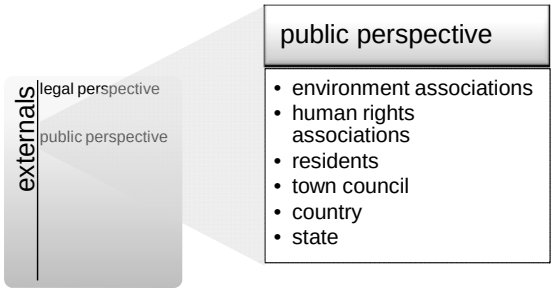
and sanctions defiance.

Standard setting bodies publish engineering standards that have to be considered during the whole life cycle of the facility.

Inspectors like the Technical Supervisory Association or the fire department also check the compliance of formalities.

The *workers' council of producers and operators* as well as *employment protection and collectives* are concerned with interests of the staff. Among other things they demand safe and health conscious working environment in production and utilisation of the facility. Since the workers' council is a legal body for the representation of workers' interests and as such does not have the perspective of the producer or the operator, but represents legal rights of the employees it belongs to the legal perspective and not to the producer or operator perspective.

It is important to examine the **perspective of the public** as the second external perspective to determine which stakeholder group they belong to. (see pic. 10)



Picture 10: Stakeholders of the public perspective (externals)

Human rights groups are fighting degrading working conditions and childrens' labour, which are especially common in foreign low wage countries.

Environmental groups concern themselves with the interest of the environment and environmental protection. They are especially active in the areas of emissions and facility extensions.

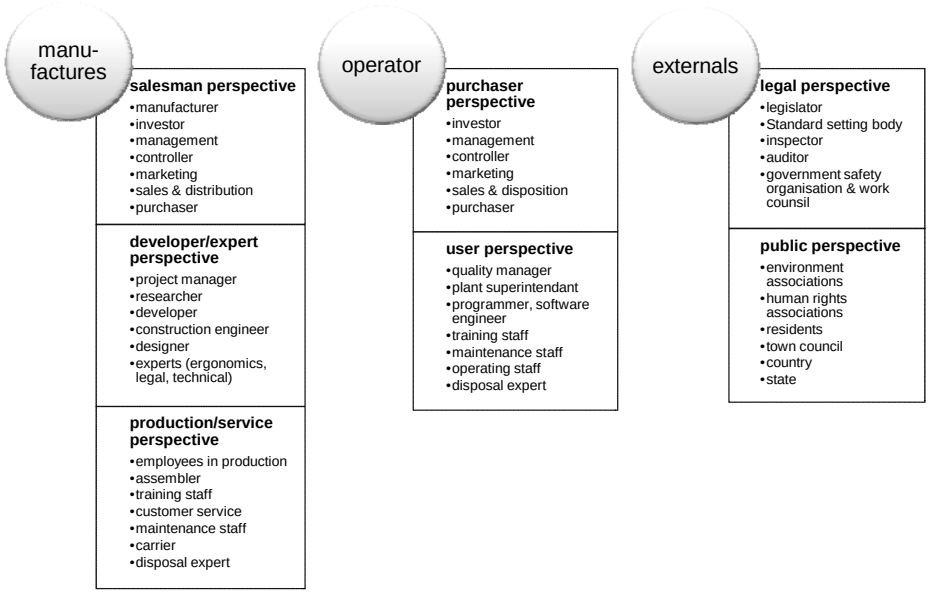
Also *residents and citizens*, which are effected by the emissions and the facility extension, are fore mostly concerned with their own health and the beauty of their neighbourhood, besides the impacts on the environment.

Communes as well as *regional and national governments* have the same requests as the residents and the environmental groups. However, they are also interested in taxation, subsidies and benefits as well as the number of jobs that are being created in connection with the logistical facility.

Further stakeholders, which belong to all the seven perspectives are the *project opponents.* These are stakeholder with a power potential, which are against the realisation of the facility project. In this way the purchasing of a logistical facility can lead job reductions or the reorganisation of the business, which can result in changes to existing working processes of each stakeholder. Also investors can have a negative attitude to the purchase of a logistical facility as investments can be very high.

Thus every stakeholder of a logistical facility can be a potential project opponent and in any case should be involved in the planning process as early as possible to prevent resistance. If this is not done the resistance of an opponent with a very high power potential can lead to the failure of the whole project.

In conclusion the following list of stakeholders can be presented:



Picture 11: Stakeholders of an intrlogistic facility

Please note that the above list represents the current research status and makes no claim to be complete. However, it offers a first attempt to take the complete set of stakeholders into account.

4 Useful structures for stakeholders

In order to identify what structure is useful the stakeholders´ main tasks have to be gathered. Based on the main tasks the respective demands of the stakeholders and their subject areas of interest can be derived. These perceptions can be found in table I below "structure needs of stakeholders".

4.1 Main tasks of manufacturer-stakeholders and their needs

Based on the given description of the facility stakeholders above the main tasks of the manufacturer stakeholders are identified as an example. Thereby, keywords are declined that are related to the stakeholder´s tasks. The stakeholder needs for structures are then derived from the information about their main tasks. Those requirements indicate what information has to be provided in what kind of structure to support the stakeholder´s work and decision making process.

Table I: Main tasks of manufacturer stakeholders and their structure needs

Stakeholder		Main tasks of stakeholder	Structure needs of stakeholders
Manufacturer	***Salesman perspective***		
	Investor	Checking of investments, risk assessment	Cost, time-frames, risks, potential
	Management	Strategic business decisions	Cost, time-frames, contract aspects, capacities, efficiency, marketing
	Controller	Cost minimization, monitoring, generation of figures	Costs, benefits
	Marketing	Growth in customer base, costumer loyalty	Performances, customer satisfaction, external demands and wishes,
	Distribution	Sale processes, bid proposal management	Customer satisfaction, time-frames, contract aspects
	Purchaser	Provision of resources	Time-frames, resources, costs, components, material

	Developer/Expert-perspective		
	Project manager	Coordination of developers and expert, processes, monitoring, controlling, mile stones	Costs, time-frames, demands of experts and developers, resources
	Researcher	Detection and dealing with potential fields of research	Engineer standards, law, technical and functional demands
	Developer	Implementation of innovations, problem solutions, fulfilment of functions	Technical and functional demands, expert opinions,
	Construction Engineer	Realization of planning, fulfilling functions	Engineering standards, laws, ergonomics, kinematics, dimensions,…
	Designer	Layout, aesthetics, ergonomics	Customer satisfaction, ergonomics, aesthetics, corporate design
	IT-Expert	IT-implementation; alignment of different systems	IT-demands, periphery, data base, control systems, material flow systems, material flow computers
	Expert for ergonomics	Elimination of risks for humans	Ergonomics, engineering standards, laws
	Safety expert	Warranty of safety	engineering standards, laws, fire prevention
	Legal expert	Compliance with laws, contractual hedging	engineering standards, laws, contract aspects
	technical expert	Solutions for specific technical problems	Kinematics, dimensions, functional and technical demands…
	Quality expert	Quality warranty, documentation, robust processes, inspections,…	engineering standards, laws, processes, inspections, measurement equipment
	Productions/Service-perspective		

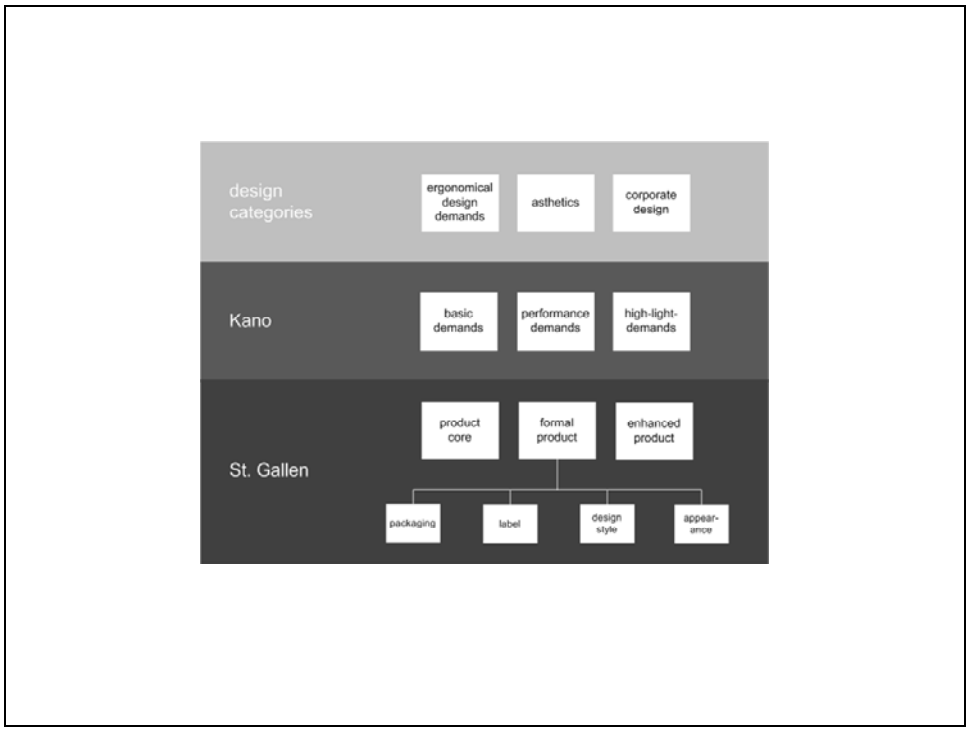
	Training staff	Organization and performing trainings	Process information, technical components, system data, handbook,…
	Customer service	Performing services	Customer satisfaction, system data, maintenance, service
	Maintenance staff	Attendance, inspection, reparation, improvement	Customer satisfaction, system data, service, technical and functional demands
	Carrier	carriage	Time-frames, costs, transported material
	Waste manager/ Environment manager	Organization and performing of recycling, disposal,…	Materials, endangerments, time-frames, costs, recycling aspects, engineering standards, laws, organization

In the following the stakeholder's designer and maintenances staff of manufacturers exemplify the main tasks of a stakeholder and their consequences for structure needs.

4.2 Stakeholder Designer

Designers deal with the aesthetic concept of an intralogistic facility. This includes the selection of colours that are related to the corporate identity, aesthetic design of forms and consideration of ergonomic aspects.

This means, that designer need information about ergonomic demands and customer design demands. Thereby customer design demands include not only assumed demands like corporate-identity colours but also customer unexpected demands whose fulfilment leads to customer satisfaction.



Picture 12: Structures and categories for designer (manufacturer)

Accordingly designer-orientated structures have to classify ergonomic demands. Furthermore a classification of aesthetic demands is useful to facilitate the designer's focus on his main task. Another potential structure is the product model of St. Gallen that divides demands of the formal product into the classes „packaging", „labelling", „design/styling" and „appearance". [StGallen]

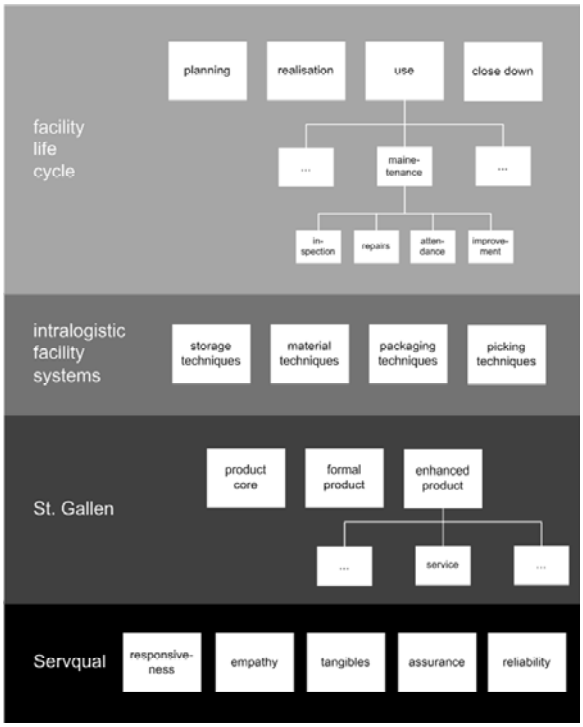
Moreover the classification of demands by Kano is of great importance. The classification in „basics", „performance" and „highlights" [ASI89, Cohen95] enables the designer to pick specific customer satisfying demands concerning and integrate them into the design of the intralogistic facility.

4.3 Stakeholder Maintenance staff

On the one hand the maintenance staff of the manufacturer deal with maintenance demands of the facility operator. On the other hand they bring in their own demands for a maintenance-orientated facility, so that an effective maintenance is possible during the operation of the facility.

The maintenance is a sub-process of the facility life cycle „use". So it seems to be useful to apply a structure concerning the process respectively to the sub-processes. In this context it can be reverted to the engineer standard DIN 31051 that divides the maintenance process into the sub-processes „inspection", „repairs", „attendance" and „improvement".[DIN 31051] In the first instance functional demands can be classified into these groups.

By more detailed sub-classifications it is possible to structure all kinds of abstract-level demands. This enables the maintenance staff to focus on a specific problem of a system or a component.



Picture 13: Structures for maintenance staff (manufacturer)

Alongside manufacturer demands of maintenance that have to be realized there are also customer demands related to the maintenance service that have to be considered by creating useful structures. At first structuring according to the product model of St. Gallen is advisable. Here demands of the service are objectively enlisted within the class „extended product“. Furthermore the use of Servqual as another structure is an important component for a customer-oriented maintenance. Servqual offers the possibility to measure maintenance-services by subjective customer values. [Hoeth02, Zeithaml92] With the help of a Servqual-structure the maintenance staff can analyze their service and improve future services and facility planning.

4.4 Stakeholder orientated structures

The given examples above already show that structures like Servqual [Zeithaml92], St. Gallen [St.Gallen], DIN 31051 [DIN31051] etc. can optimize the handling of maintenance demands.

For designers the Kano model is very important. Furthermore classes respectively structures like St. Gallen are needed.

With the help of other structures also other stakeholders should achieve use-oriented structures for an easy handling of demands. Potential structures for construction engineers are structures that break down functions and components. But also another structure based on the Servqual-systematic that displays the customers´ opinion about component or product elements is preferable.

On the other side managers and controllers have different perspectives. At the moment the redevelopment of structures according to Firchau, Krusche, Ehrlenspiel, etc. [Firc90, Krus00, Ehrlen03] should classify financial and resource-aspects for an efficient handling. A more detailed sub-classification is aspired as well so that the different abstraction levels can be considered. The same is applied to the classes „information“, „ergonomics“ and „demands from documents“, while the last mentioned class can be sub-divided according to origins like „engineering standards“, „law“, „guarantee“ and „patent“. With the help of this structure a displaying of external stakeholder relevant demands and an examination by the planning-teams is possible.

5 Conclusion

Considering the stakeholders´ needs for structures the described n-dimensional structure model should become more effective, because the handling of information becomes easier for stakeholders. Furthermore gaps in demand knowledge should be identified. So specified demand gatherings can close those knowledge gaps. The gathering of information, supported by this structure-model, should become more and more efficient.

The first results of a stakeholder oriented structure was presented in this paper and further research potential, e.g. a new structure for product quality based on Servqual, was identified.

Moreover stakeholder oriented structures should be examined concerning their possible integration into the n-dimensional structure model.

In the medium term practical tests will be performed. It is expected that practical tests require a more detailed sub-classification of already existing structures but also more structure aspects that lead to an enhancement of given structures.

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