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THE KNOW YOUR PRODUCT METHOD - DEVELOPING A PROSTHETIC LEG FOR DISABLED PEOPLE IN INDIA

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ABSTRACT:

This article illustrates how the Know Your Product Method can be used in product development in the framework of development aid. The method is explained through its application in a case example of below knee prostheses for underprivileged Indian people. Along with this case study, analyses and discussions of ontological and epistemological views in the original method provide the foundation for a suggested enlargement of it to place more emphasis on social and cultural needs. Additionally, the principles of Appropriate Technology formulated by the Germaneconomist and philosopher Schumacher are incorporated in the method. It is argued that the perception of the quality of a product is not restricted to its physical properties, but formed through the interplay of relationships between product, user, society, and culture.

Keywords: Development aid, people with disabilities, cultural and social needs

1. INTRODUCTION

Design is often associated with making aesthetically pleasing expensive products, but the scope of design reaches far beyond development of decorative products. The creative and analytical skills of designers can be useful in development aid projects which involve development of new products and services. For example, designers can participate in development of assistive devices as an integrated part of rehabilitation services to improve the life of underprivileged people with disabilities in developing countries.

Appropriate assistive devices contribute to enabling disabled people to get access to education and vocational training and become integrated members of society. Along with medical care and rehabilitation, proper assistive devices improve disabled people's potential to develop to the best of their abilities and have meaningful lives. In many countries disabilities are thought of as "diseases" and individuals with disabilities in developing countries have, in general, low social status and may in some cases be considered as worthless (NORAD, 2002). However, when disabled people are taught how to cope with their disability, other disabled are inspired and consequently aspire to a better future. By displaying the ability to provide for themselves disabled individuals are also able to affect the attitudes of non disabled people. Gradually the community learns that it should not look down on and pity disabled people but acknowledge that they can be contributing members of society (Werner, 1998).

For assistive devices to have the desired impact on the situation of people with disabilities in developing countries, it is necessary to consider cultural and social aspects instead of focusing merely on technical and economic requirements. An integrated approach, focusing on rehabilitation, medical care, assistive equipment, accessibility in the physical environment, as well as changing attitudinal barriers is necessary to prevent social exclusion and change attitudes (Werner, 1998).

The interdisciplinary approach required for addressing the needs of disabled people in developing countries, illustrates well the complexity of development aid projects. The Know Your Product

Method (KYP) can help product developers with applying an interdisciplinary approach. The method gives a graphic representation of the many various aspects that should be considered in product development. It is developed by Sigurd Støren and Morgens Myrup Andreasen (1993) and seeks to give an understanding of user needs and the weaknesses and strengths of an existing product.

The KYP-method was originally intended for general use in product development in the industrialised world. The aim of this article is to show how the KYP-metod can be used in development aid projects as a means for achieving a holistic understanding of product development. The method will be described through its application in a project for people with disabilities in India. Experiences from applying theoretical aspects in this case study will be evaluated and discussed further. The KYP-method will be enlarged based on the discussion to put more emphasis on cultural and social requirements. Additionally, analyses of the underlying ontological and epistemological view in the original method will be important for the suggested enlargement. Information is organised and structured and the relationships between different aspects are analysed.

The development and implementation of new technology in the framework of bilateral aid also brings forward questions on business development and national and international political and economical issues. Even though these questions are important they will not be addressed in this article.

2. KNOW YOUR PRODUCT

The KYP-method gives a graphical overview of aspects that should be considered in product development. By understanding the weaknesses and strengths of an existing product, designers can gain a better foundation for redesigning it or making new products (Andreasen & Støren, 1993). In this chapter the method will be explained by applying it to prostheses produced by Jain

Hospital in Bangalore. Jain Hospital produces and distributes about thousand artificial limbs every year. The limbs are donated free of cost to users from Bangalore or rural areas outside the city. Private local donors finance the activity. There are also several NGO's providing similar artificial limbs to poor people in Bangalore. It is costly to hire designers and engineers to improve the prostheses. For this reason problems with the products in terms of both use and production are often neglected. However, for the ones who are dependent on using these products small problems can have a huge impact on their quality of life.

In this article we will look closer at the use and production of below knee leg prostheses made by Jain Hospital (fig. 1). All the parts of the leg prosthesis, except for the foot, are produced at a modest workshop in the hospital area. The prosthetic foot is bought from the nongovernmental voluntary organisation Bhagwan Mahaveer Viklang Sahayata Samiti in Jaipur, popularly known as the Jaipur foot. Since the production facilities in Jaipur were not visited, not all production details are known. Hence, as a simplification the emphasis will be on applying the method on the rest of the prosthesis. The prosthetic foot will be included in the method, but it will be regarded as one component even though it in reality consists of several parts.

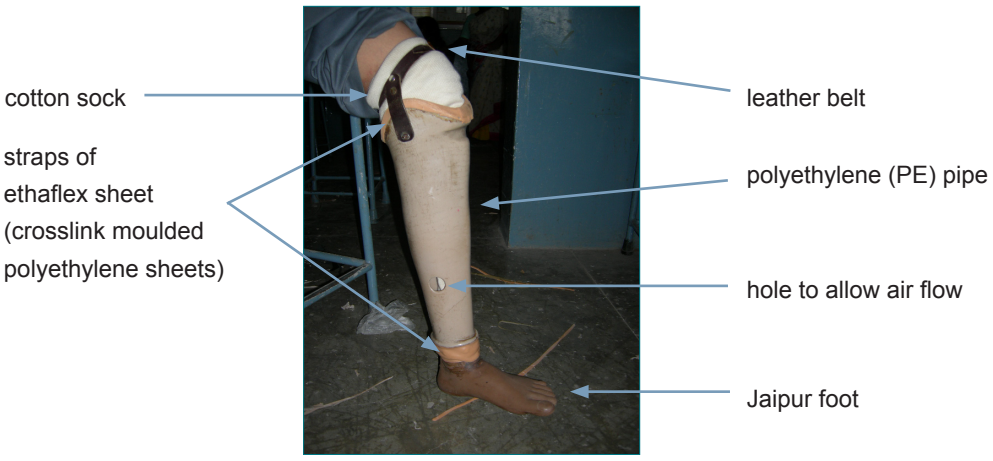


Figure 1: The below knee leg prosthesis.

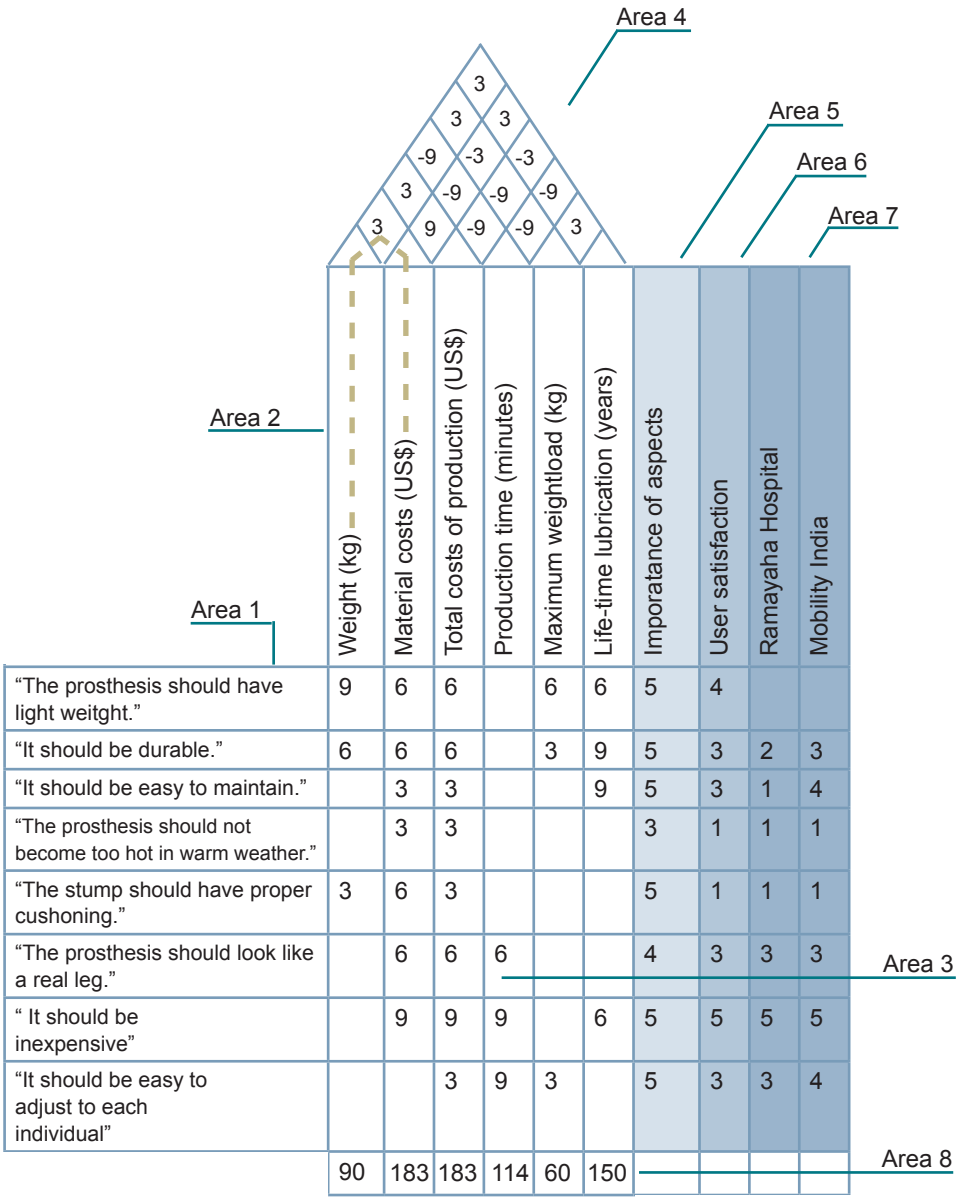
2. 1. THE HOUSE OF QUALITY

The first step in the KYP-method is to identify the strengths and weaknesses of the product. This is done by using the House of Quality which is a part of the Quality Function Deployment method developed by Mizuno and Akao in the late 1960s. The House of Quality assembles several deployment hierarchies and tables, and connects the Voice of the Customer with the Voice of the Engineer and Designer (Andreasen & Støren, 1993).

Figure 2 shows the House of Quality for the leg prosthesis made by Jain Hospital. Data was collected through interviews and observation of five users in their home environment. The age of the interviewees is from 9 to 70 years. In addition, three rehabilitation worker and technicians where interviewed. The data collection is limited but gives a general understanding of how the leg prostheses are perceived and shows that the prostheses are not satisfying all user requirements. The padding inside of the limb is pointed out as especially insufficient. Several users expressed that the prosthesis feels hard against the remaining leg, making it difficult to walk more than one to two kilometres at a time. This is in particular a problem in rural areas where walking distances are long. It is for example not unusual that children have to walk up to eight kilometres to get to school. It is also considered as a problem that the prosthesis becomes hot in the warm Indian weather and causes skin eruption.

Area	Aim	System of marking
1	Identify user needs by quoting opinions expressed by several people in interviews.	
2	List technical aspects of the product which are quantifiable and measurable	
3	Detect the correlation between user needs and technical properties.	Degree of correlation: 9 (high) 6 (medium) 3 (low)
4	Evaluate the correlation between different technical aspects. How will a change in one property affect the others?	Type of relationship: 9 strong positive 3 weak positive -3 weak negative -9 strong negative
5	Evaluate the importance of each aspect in section 1.	Degree of importance: 5 (high) – 1 (low)
6	Evaluate user satisfaction.	Degree of satisfaction: 5 (high) – 1 (low)
7	Compare the product with similar available solutions.	To which degree competitors fulfill user needs: 5 (high) – 1 (low)
8	Understand how the users find the quality of the technical proprieties.	The numbers in each row in section 3 are multiplied with the corresponding number in section 5 and added up.

Table 1: Desciption of the House of Quality.



	Weight (kg)	Material costs (US$)	Total costs of production (US$)	Production time (minutes)	Maximum weightload (kg)	Life-time lubrication (years)	Imporatance of aspects	User satisfaction	Ramayaha Hospital	Mobility India
"The prosthesis should have light weitght."	9	6	6		6	6	5	4		
"It should be durable."	6	6	6		3	9	5	3	2	3
"It should be easy to maintain."		3	3			9	5	3	1	4
"The prosthesis should not become too hot in warm weather."		3	3				3	1	1	1
"The stump should have proper cushoning."	3	6	3				5	1	1	1
"The prosthesis should look like a real leg."		6	6	6			4	3	3	3
" It should be inexpensive"		9	9	9		6	5	5	5	5
"It should be easy to adjust to each individual"			3	9	3		5	3	3	4
	90	183	183	114	60	150				

Figure 2: The House of Quality for the prosthesis.

2. 2. THE PRODUCT CHROMOSOME

The next step in the KYP-method, is to detect where the weaknesses of the product are located. This can be done by viewing the product as a set of elements that affect each other: transfortions, functions, organs or components. These four elements or aspects are parts of "the product chromosome", the product as a whole, and represent different ways of viewing the product. They can be complementary to each other, since one aspect might describe a quality better than the others (Andreasen & Støren, 1993).

Transformations

The product can be perceived as a set of transformations of substance, energy or signals. In the case of the artificial limb, muscular energy is transferred from the user's stump, the remaining limb, to the prosthesis and further to the ground. The main purpose of the prosthesis is to make mobility and stability possible for a one-legged person.

Functions

Another way of interpreting a product is to investigate the functions it serves. The main function of a leg prosthesis, for example, is to provide the user with balance and mobility. By looking at the more subordinate operations that this assistive device allows for, we can detect several functions as carrying load, giving support, keeping the prosthesis in place, and providing cushioning to the stump.

Organs

Products can also be understood as organs functioning together. The organs of a product are the physical parts that create its functions. In the leg prosthesis, for example, the foot and the polypropylene leg carries the load of the user, the upper part of the limb gives support to the stump, while the leather belt keep the prosthesis attached to the residual limb.

Components

Finally, we can also view a product as an assembly of physical components building up the organs. Figure 3 shows all the components of the leg prosthesis. As explained earlier, the foot in reality consists of several parts, but is treated here as one single component.

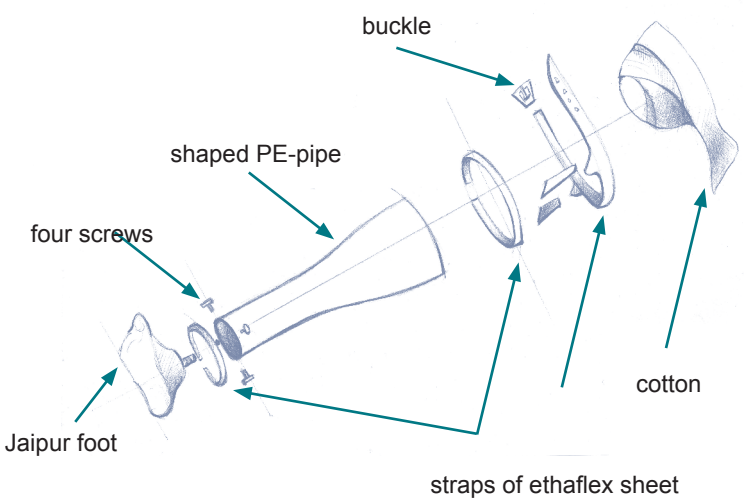


Figure 3: The components of the prosthesis.

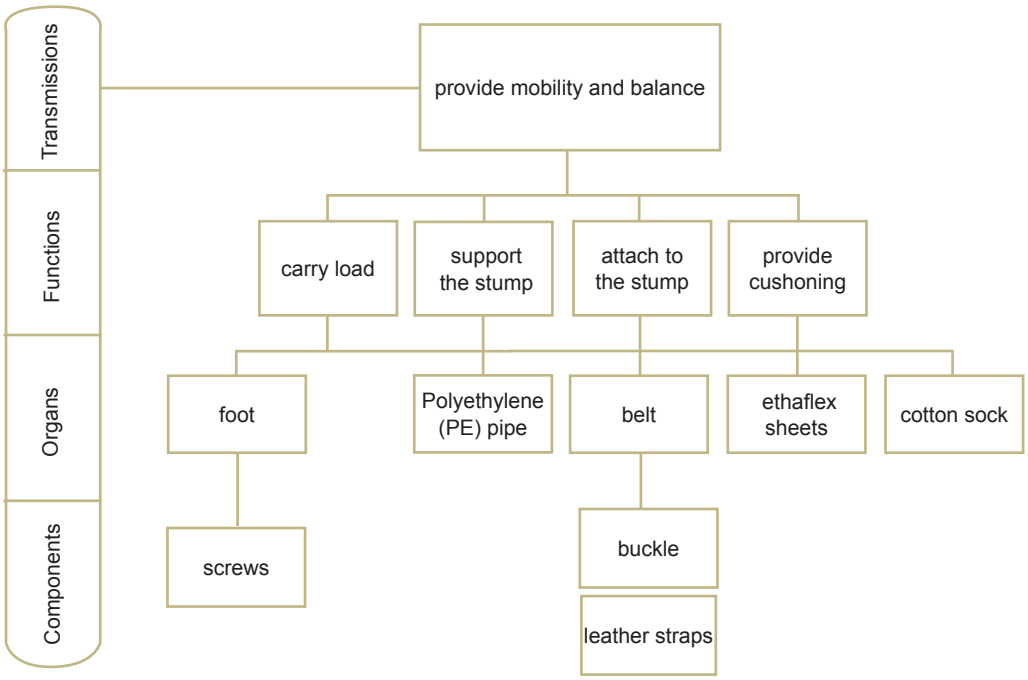


Figure 4: The Product Chromosome for the leg prosthesis.

2. 3. THE PRODUCT-PROPERTY DIAGRAM

By dividing the Product Chromosome into four elements, we get a better understanding of how technical and functional properties can be gained. The Product-Property diagram gives an overview of how the quality of a product can be created through production.

Area	Content/ Aim
1	Transformations, functions, organs and components.
2	The technical aspects of the product which are quantifiable and measurable
3	Detect the correlation between the elements of the product chromosome and the technical aspects.
4	Indicate internal relationships between the elements.

Table 2: Desciption of the Product-Property diagram.

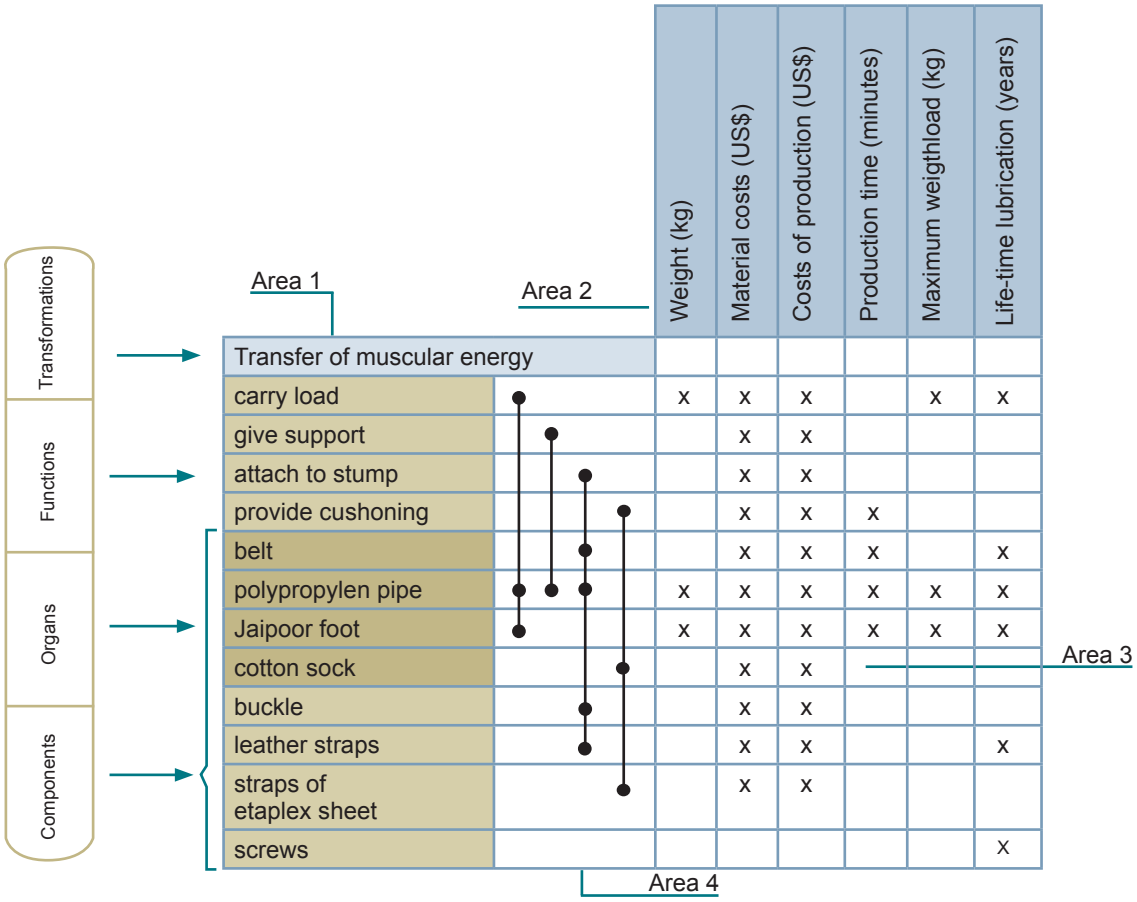


Figure 5: The Product-Property diagram for the prosthesis.

2. 4. THE PRODUCT-PRODUCTION DIAGRAM

When developing a product it is necessary not only to design the product but also to plan its production, as the chosen production methods will influence how the product functions and its aesthetical appearance. Selection of materials, functions, production methods, and shapes are all integrated components of a design process and have to be viewed in conjunction with each other. Moreover, designers have to be aware of production limits to make sure their solutions are technically feasible (Andreasen & Støren, 1993). In the framework of development aid it is especially crucial to choose production methods that are cost effective and within the capacity of the country (Schumacher, 1999).

1. A plater cast is made of the stumP. After drying, the cast is filled with plaster to make a postive mold.

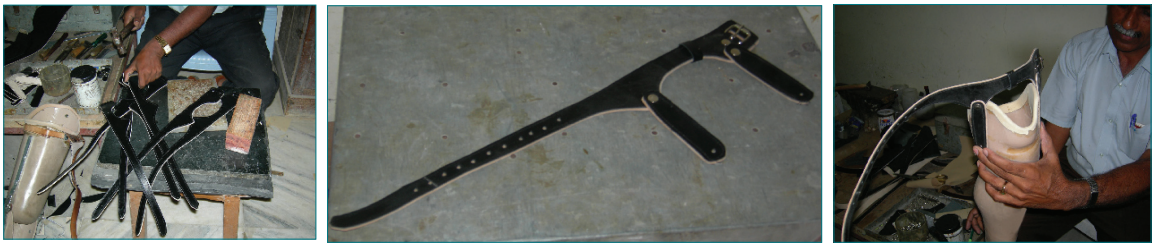
2.The positive mold is extended to make the shape of the whole leg below the knee. A foam funnel is placed on top of the mold and filled with plaster. After drying the extended mold is shaped to match the user's natural leg.

3.Plumbing pipes of polyethylene are heated to 160 degrees celcius for about half an hour.

4. The heated pipe is put on the mold and patted in place.

5. The lower part of the limb is heated and placed on the foot. The foot is fastened with four screws which are manually drilled.

6.The scRews and the upper part of the limb is covered with etaflex sheets wich are glued to the limb. The screws are covered to protect from water and prevent rust.



7. Finally a leather belt is made by hand and glued to the limb.

Figure 6: Production of below knee prostheses

The Product-Production diagram seeks to give a better understanding of how appropriate the chosen means of production are in terms of time, cost, environmental impact etc. Understanding all production details, explained shortly through figure 6 is necessary for being able to fill in the diagram. Table 3 and figure 7 explain the diagram.

Area	Content/ Aim
1	List all components.
2	Illustrate which elements are part of each assembly process.
3	Give each assembly process a indentification number.
4	Indicate important aspects regarding each component's production. These aspects are critical for giving the product satisfactory quality.
5	Specify aspects that affect the production such as cost, time, weight, and environmental impact. These aspects can be adjusted to each project and product.

Table 3: Description of the areas in the Product-Production diagram.

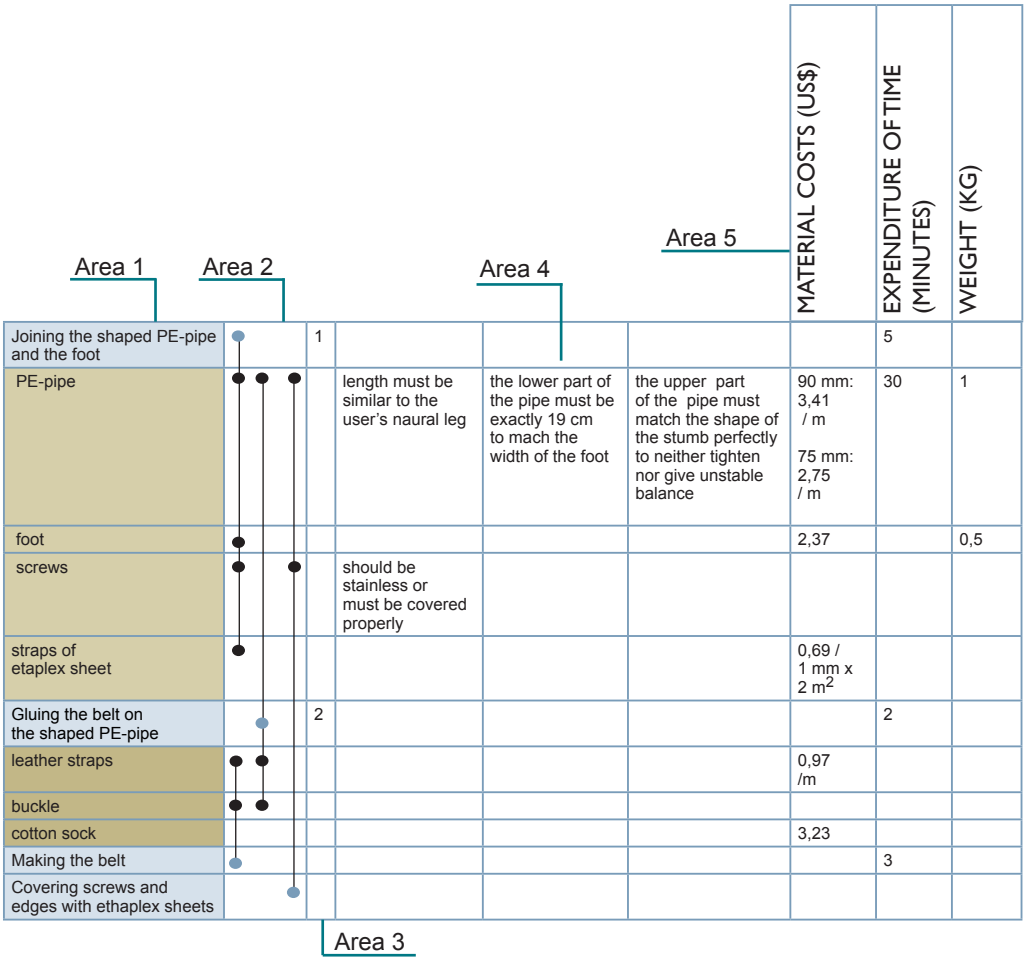


Figure 7: The Product-Production diagram for the prosthesis.

Area 5 of the Product-Production diagram should be adjusted to reflect the challenges in each design project. We have chosen to use material costs here rather than production costs. This is done because labour is cheap in India and does not notably influence the total production cost. Environmental impacts can also be included in area 5. Product development involves social and environmental responsibility (Papanek, 1985).

2. 5. THE QUALITY OF A PRODUCT

The KYP-method is based on the opinion that quality is within a product and manifested through physical properties. The quality of a product, how the product is perceived by its users, is created through design of transformations, functions, organs, and components. The quality relates to the products entire lifecycle and all the interested parties in the different faces. It can be divided in two parts:

Q: The properties that the users describe as positive.

q: The properties that allows the creation of Q in an cost-efficient and sustainable way. (Andreasen & Støren, 1993)

Area 3 in the Product-Production diagram pays attention to aspects which are important for q and thereby increases user satisfaction. The quality q will be different from component to component due to production inaccuracies. Engineers have to ensure that the prevarication of q is at an acceptable level.

2. 6. ANALYSING THE DIAGRAMS

The three diagrams in the KYP-method build on each other. The technical consideration from the House of Quality is further used in the Product-Properties diagram, and the components in the

Product-Properties diagram are transferred to the Product- Production diagram (fig. 8).

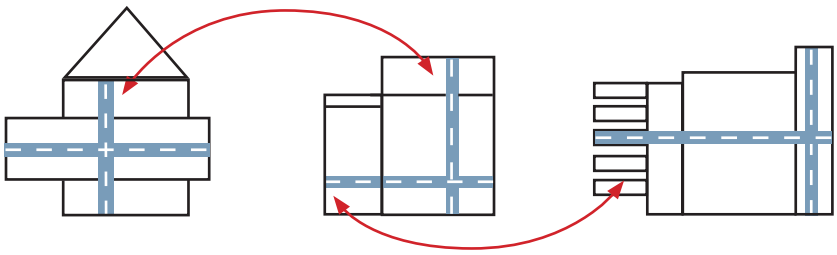


Figure 8: The diagrams build on each other.

Together the three diagrams provide an overview of what product properties should be changed or kept. The diagrams also make it easier to detect that two or more considerations can be contradictory. For example the House of Quality (fig. 2) shows us that users are satisfied with the light weight of the prostheses. However, they also think that the artificial limbs should be more durable. The Product-Property diagram (fig. 5) shows that weight and durability can be connected. If thicker polyethylene tubes are used, the durability will be improved but the weight will also increase. This can be avoided by using another material. Titanium, for example, can offer both high durability and light weight. However, titanium is an expensive option. Hence the properties weight, durability as well as costs can have an impact on each other as shown in area 3 of the House of Quality. Additionally, the Product-Production diagram (fig. 7) shows that many of the critical aspects regarding q are connected to properties of the moulded polypropylene pipe. This is, along with the foot, the main component of the prosthesis and its weight, cost, and durability is significant for how the prosthesis is perceived by users.

3. THE PERCEPTION OF QUALITY

The aim of the KYP-method is to understand what consumers want and how it can be produced in a cost-efficient and eco-friendly way. The users' needs and differences are considered here mainly as physical properties of products and functional needs while sociological and cultural

aspects are neglected. Cultural identification may, however, increase user satisfaction (Razzaghi & Raminez, 2006, Norman, 2002).

In development assistance it is often believed that products should solve only specific functional problems. Qualities which are beyond the scope of functionality and technical usability aspects are seldom considered. As Victor Papanek (1985) points out, the awareness of how the product aesthetically appears to users is important even when designing solutions for underprivileged people. Sensory and emotional qualities will determine how the users perceive the quality of the product and if they choose to use it. This is especially true in the case of assistive devices for people with disabilities.

Assistive devices are often, as with crutches and prostheses, extensions of the users' bodies. The users are usually dependent on these products but they also wish not to separate themselves too much from other people, and to be accepted as regular members of society. (Werner, 1998, Gallagher 2004)

This article will enlarge the KYP-metod by users' emotional and aesthetical experiences with references to human perception, ontology and epistemology. Human perception is here defined as "the process whereby sensory stimulation is translated into organised experience. The experience, or percept, is the joint product of the stimulation and of the process itself (Britannica Concise Encyclopaedia, 2006)." For the purpose of this article, the terms ontology and epistemology are used in a simplified way: ontology is "what you know" and epistemology is "how you know it" (Almklov, 2005).

3. 1. THE PERCEPTION OF QUALITY IN THE KYP-METOD

In the KYP-metod the communication between the user and the product has one direction; from the product to the user. In the model illustrated in figure 9, what we perceive is exactly the same as the image we receive on our retina when looking at our surroundings.

This way of interpreting human perception indicates that designers, engineers and others involved in the development of a product can fully control its quality, the way the users experience the product, by giving it certain properties. Hence quality is seen as being within the product. Moreover, the quality which is materialised through physical and functional properties will be perfectly mirrored in the users' minds.

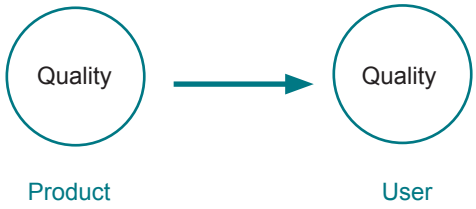


Figure 9: Direct perception.

3. 2. AN ALTERNATIVE INTERPRETATION OF THE PERCEPTION OF QUALITY

The understanding of quality is highly subjective and cannot be communicated directly without any distortions between product and perceiver.

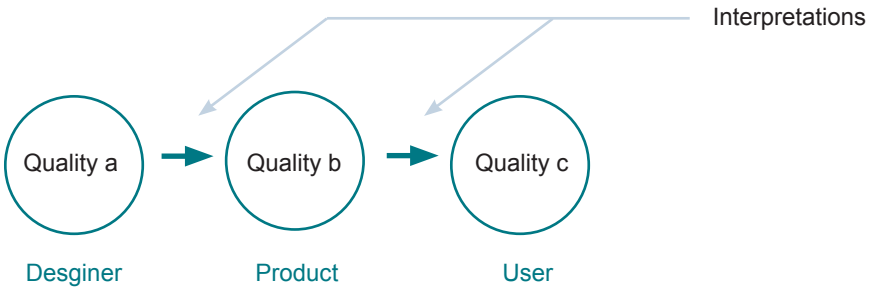


Figure 10: Products and their quality cannot be perceived objectively.

As argued by Bohm and Peat (2000, pp. 64): "What we 'see' is as much a product of previous knowledge as of incoming visual data." The perception of an object is not mirroring its visual appearance but influenced by pre-understanding; previous experiences, prejudice, cultural background, associations, biases, etc. (Almklov, 2005). In "Truth and Method" Gadamer (1975) writes about understanding through interpretations. According to him we understand something within dynamic processes and in the framework of a prior understanding. Experience gives us a new understanding which is our pre-understanding when we interpret an additional experience (the hermeneutic circle).

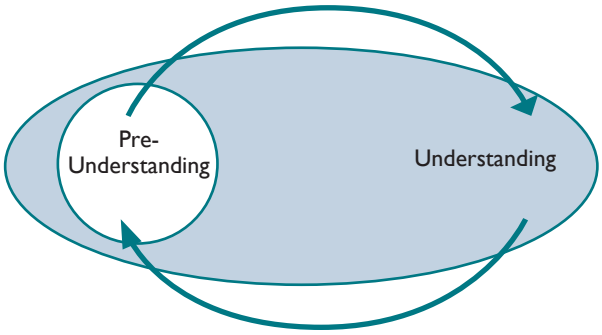


Figure 11: The hermeneutic circle.

Based on the argument that prior experiences will always affect how new sensations are interpreted, Bateson (1991) concludes that an object cannot be viewed independently from the perceiver's pre-understanding. As an An extreme consequence, meaning is entirely subjective since it is constructed through individual experiences. Product developers can therefore never control how users understand the quality of a product but can at best tailor it to meet the preferences of as many users as possible.

In a society people tend, however, to have a somewhat coordinated understanding of the world. There is a also certain cultural grammar within a society that helps us to communicate with each other, even though we probably do not interpret experiences exactly the same way (Almkov, 2005). Interpretation becomes "validated" within a certain "community" through "consensus," while remaining open to other possible interpretations. Since the members of a society share history, interpretations are not utterly subjective. The social anthropologist Almkov (2005, see fig. 12) draws a parallel between important common experiences as rituals. They create reference

points which influence how we interpret the thin lines. The thick lines do not only indicate what we should see (ontology) but also how we should see it (epistemology). In a similar way important shared events will affect how our individual experiences are analysed and understood. A culture's epistemological principles will affect our individual epistemology and ontology.

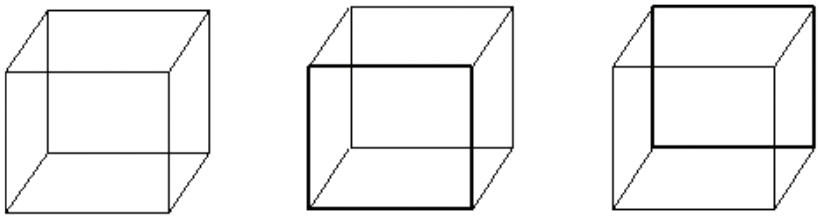


Figure 12: The cube to the left can be interpreted in different ways. The thicker lines indicate two possible interpretations of what is the "front" of the cube (Almkov, 2005, pp. 7).

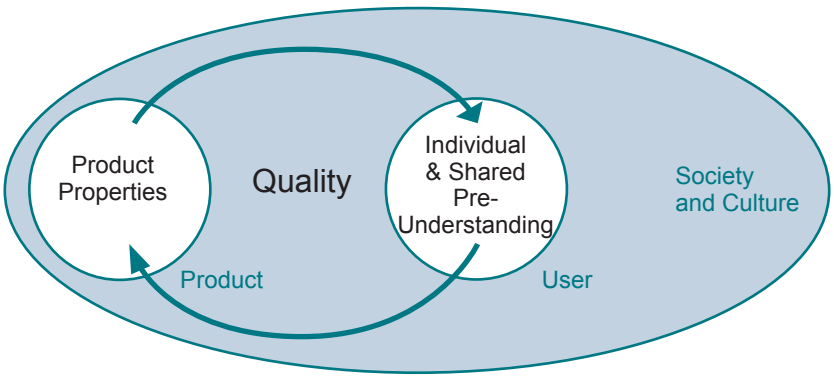


Figure 13: The Integrated Influence Model.

This holistic way of interpreting the perception of products and their qualities can be represented by the Integrated Influence Model in figure 13. In this model the individual is not viewed isolated but within a cultural and social context. By belonging to the same culture and society[1] we develop a shared prior understanding that let us understand our surrounding world in a fairly similar manner. Since designers themselves are part of these life-worlds, they have to consciously reflect over the culture of the users. They also have to be aware of that in spite of that man is a zoon politikon (social being), all individuals will have their own interpretation of

[1] A society is a self reproducing group of individuals which have its own distinctive culture and institution and is occupying a particular territory. The word society may refer to a particular people, such as the Tamils, to a nation state, such as India, or to a broader cultural group, such as the South Asian society. The word culture generally refers to patterns of human activity and the symbolic structures that give such activity significance.
(Oxford English Dictionary, 2006)

products due to their personal experiences and prior understanding; there is always a chance of not liking a product which all your friends find attractive. The necessity considering individual needs is especially visible in the case of prosthetic appliances, which have to be tailored to the user's physical measurements in addition to his aesthetical and emotional needs (Gallagher, 2004, Murray, 2004). There is nothing such as "one solution fits all" in the world of prosthetics and rehabilitation.

4. AN EXTENDED VERSION OF THE KYP-METHOD

The Integrated Influence Model and the discussion regarding user experiences and the perception of quality, give opportunities for enlarging the KYP-method. The principles of Appropriate Technology formulated by the followers of the German philosopher Schumacher can also be included in the method. In this chapter an extended version of the KYP-method will be presented and applied to the case example in chapter 2.

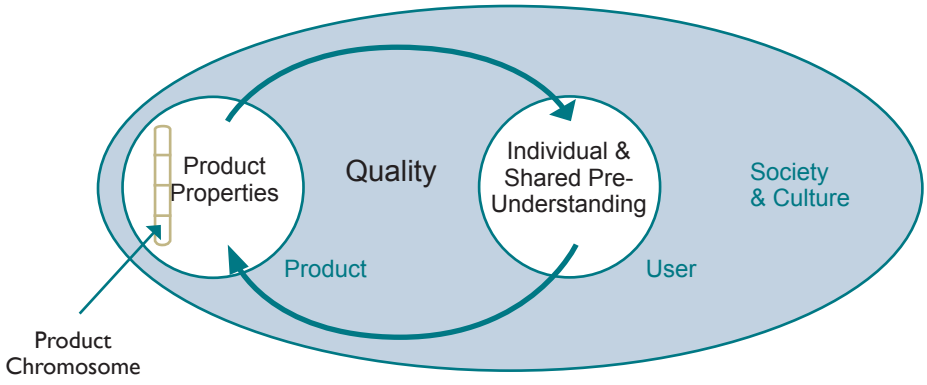


Figure 14: The product chromosome reflects upon the physical properties of products and can be incorporated in the Integrated Influence Model as illustrated.

4.1. EXTENSION OF THE HOUSE OF QUALITY

The relationships linked to the perception of a product, provides a foundation for adding elements to the House of Quality. The House of Quality in its original state uses quotations from interviews to capture the Voice of the User. However, as argued by Bateson (1972), human beings are not always capable of communicating directly how their pre-understanding affects them. Often functional needs are easy to express, whereas cultural and social needs are more difficult to word. For product developers it is therefore not enough to rely on opinions expressed in interviews. Designers have to spend time with the users and form a relationship with them. To only use quotations in area 1 in the House of Quality can reduce a project team's ability to capture hidden needs. Further to this, quotes constructed on the behalf of users, in the cases where they are not able to express their own needs, may be misleading. The House of Quality has therefore been extended by adding social and cultural aspects that may not necessarily have been communicated directly through words by the users, but revealed through observations and interviews with health professionals who have worked closely with disabled people for many years. This helps shifting the focus from functional needs towards non physical desires and requirements.

Figure 15 shows new needs that were discovered due to the enlargement. In India, as in many developing countries, the cultures and life styles in the cities are quite different form the ones in rural areas (Schumacher, 1999). Many of the people who get free artificial limbs at Jain Hospital are from rural areas outside of Bangalore. However, the limbs are developed and manufactured by people living in the cities. Some cultural and social aspects in rural areas are therefore ignored. According to Amala Proviamira, a rehabilitation worker at the Association of the People with Disabilities, some temples in rural areas do not allow users of artificial limbs to enter. Leather is viewed as impure and prohibited in holy places. The leather belt used on prostheses can therefore prevent people with disabilities from visiting temples. At Hindu holy places, such as temples, it is necessary to take off footwear at the entrance. The foot of the prosthesis is considered as foot wear, especially if the user is not wearing a shoe on the artificial leg. The artificial leg makes it impossible to wear inexpensive, open sandals. For poor people other footwear can be too costly, and many users with artificial limbs therefore walk barefooted. This also creates problems with entering private homes, since shoes should never be brought into

somebody's house. Additionally, Hindu women traditionally wear toe rings as a symbol of being married. Black treads are also bound around the toes to give protection. These traditions are still practised in rural areas, but prostheses are not adapted to such cultural aspects. Furthermore, the Jaipur foot looks quite natural, but the polyethylene pipes used for the rest of the

	Weight (kg)	Material costs (US$)	Total costs of production (US$)	Production time (minutes)	Maximum weightload (kg)	Life-time lubrication (years)	Imporatance of aspects	User satisfaction	Ramayaha Hospital	Mobility India
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"It should be durable."	6	6	6		3	9	5	3	2	3
"It should be easy to maintain."		3	3			9	5	3	1	4
"The prosthesis should not become too hot in warm weather."		3	3				3	1	1	1
"The stumb should have proper cushoning."	3	6	3				5	1	1	1
"The prosthesis should look like a real leg."		6	6	6			4	3	3	3
" It should be inexpensive".		9	9	9		6	5	5	5	5
"It should be easy to adjust to each individual."			3	9	3		5	3	3	4
Should be allowed to wear in temples and private homes. (not have leather components)		6	6			6	5	1	1	1
Should be adapted for toe rings.				3			4	1	1	1
Should not require expensive foot wear.				3			4	2	2	2
Should not give associations to vitiligo.		3	3				5	2	2	2
	90	228	228	138	60	156				

Figure 15: The extended House of Quality for the prosthesis

prosthesis often have a fair skinned tone which does not match the dark skin colour of South Indians. The dark foot against the fair leg reveals the artificial leg, and some prosthesis users therefore dislike that their leg is visible. In some rural areas the pigmentation disorder vitligo, which causes white patches on the skin, is thought of as being contagious. This causes additional problems for users if the artificiallimb's colour does not match their natural skin tone (Amala Proviamira, personal contact, 8 Mai, 2006).

4. 2. EXTENSION OF THE PRODUCT-PRODUCTION DIAGRAM

Introduction of new technology is often believed to be one of the key elements for solving problems in third world countries. New inventions are sometimes unconditionally associated with progress and prosperity. However, only a integration of technology on one hand and individuals, community, and environment on the other will provide appropriate solutions (Acre, 2004).

Based on economist and philosopher E. F. Schumacher, the following criteria for Appropriate Technology can be formulated. The technology should:

- meet the needs of both men and women
- enable people to generate income for themselves and their family
- be designed, improved, managed, and controlled by local people
- be accessible for the intended users

- use local skills and materials as much as possible

Schumacher's principles of Appropriate Technology have tbeen added to the Product-Production diagram. Each component is evaluated against the principles and ranked from 5 (high fulfillment) to 1 (low fulfillment). An average value is calculated to consider the fulfillment of the whole product (fig. 16).

As shown in the diagram, the prostheses produced at Jain Hospital are in most cases in accordance with the principles of Appropriate Technology. The reason for this is probably that the hospitals are targeting poor people which cannot pay for medical services. This requires automatically that local materials and skills are used to keep the expenses as low as possible.

There are still some problems with the artificial limbs. The limbs are not recycled, and not all cultural and social issues are taken in consideration as explained earlier. Since women cannot wear toe rings, the product is better adapted for men than women. Additionally, people have to come to Bangalore for repairs or adjustments of the foot and the polyethylene pipe. The belt is the only part of the prosthesis that can be repaired locally even in rural areas.

						MATERIAL COSTS (US$)	EXPENDITURE OF TIME (MINUTES)	WEIGHT (KG)	MEETS THE NEEDS OF BOTH MEN AND WOMEN	ENABLES PEOPLE TO GENERATE INCOME FOR THEMSELVES	CAN BE DESIGNED, IMPROVED, MANAGED, AND CONTROLLED	IS ACCESSIBLE FOR THE INTENDED USERS	USES LOCAL SKILLS AND MATERIALS AS MUCH AS POSSIBLE	HAS A LIMITED IMPACT ON THE ENVIRONMENT
Joining the shaped PE-pipe and the foot	1						5							
PE-pipe		length must be similar to the user's naural leg	the lower part of the pipe must be exactly 19 cm to mach the width of the foot	the upper part of the pipe (the socket) must match the shape of the stumb perfectly to neither tighten nor give unstable balance	90 mm: 3,41 / m 75 mm: 2,75 / m	30	1	5	5	2	3	4	2
foot					2,37		0,5	4	5	2	3	5	5
screws		should be of stainless steel or must be covered properly						5	5	5	5		5
straps of etaplex sheet					0,69 / 1 mm x 2 m^2			5	5	2	3	4	
Gluing the belt on the shaped PE-pipe	2					2						2	
leather straps					0,97 /m			5	5	5	5	5	5
buckle								5	5	5	5	5	5
cotton sock					3,23			5	5	5	5	5	5
Making the belt													
Covering screws and edges with ethaplex sheets						3							
					Average value			4,88	5	3,88	4,25	4,5	4

Figure 16: The extended Product-Production diagram for the prosthesis.

4. 3. QUALITY IN THE ENLARGED MODEL

The ultimate purpose of the KYP-metod is to understand what gives a product its quality. By integrating issues discussed in section 3.2, quality can now be expressed like this:

Q: The properties that the users consciously our unconsciously value due to individual, cultural, and social factors.

q: The properties that allow the creation of Q in accordance with the principals of Appropriate Technology.

Figure 17 illustrates factors which determine how products are perceived. Product properties are only one part of the whole picture, it can therefore be misleading to say that the quality is within a product.

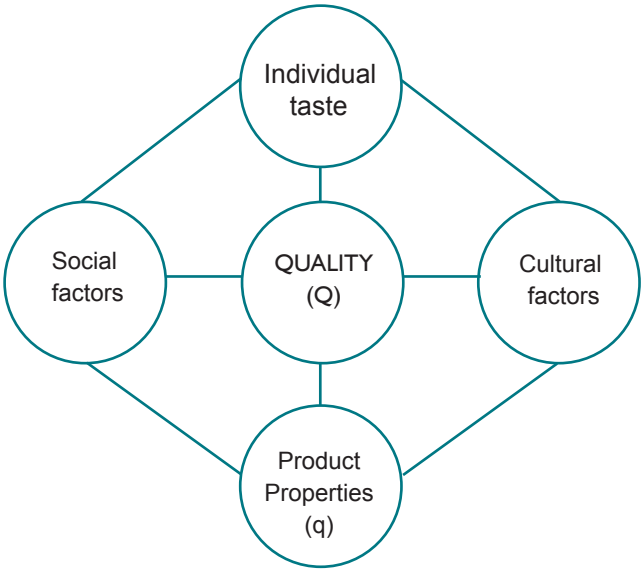

Figure 17: The Quality of a Product.

5. DISCUSSION

5.1 THE USE OF THE KYP-METOD

The KYP-method gives good overview of challenges and priorities in a project. The method can be helpful for discussing important topics and gain a mutual understanding within a team. This in particularly important when working in interdisciplinary teams, where people from different professions have to cooperate. One pitfall is, however, that information is mechanised and translated into numbers, which are summed up to say something about user satisfaction and quality. The resulting figures should not be treated as objective. They are made up by the team members on a discursive, inter-subjective basis. What is important is not the figures, but the discussions which lead to team to define the numbers. When using the KYP-method, the members of a project team cannot be indifferent to user-product aspects, but have to make up their minds and reach and agreement. The initiation of dialogue is one of the strongest benefits of using the KYP-method.

The method provides a comprehensive understanding of design challenges which might be useful for product developers with less experience and the overall project team in general. The members of a team will usually have different backgrounds and accordingly unequal degree of experience. The use of the method can help team members to benefit from each others experiences and gain mutual understanding of the challenges ahead. Gadamer (1975) referred to the activity of exchanging opinions and gaining mutual understanding as "fusion of horizons".

5. 2. THE USE OF THE EXTENDED KYP-METHOD

The changes to the original KYP-Method have been small but essential. The extension of the KYP-method gave useful information in the case of the leg prosthesis. Prostheses are products that many believe only have functional requirements. It is true that an artificial limb has to fulfill certain functional needs. However, usability is not only linked to functionality but also very much to culture and society as discussed earlier.

In this article the focus has been on development aid. However, the KYP-metod is adequate for all product development. Even when product developers and users are from the same country they may not have the same culture. If a designer is developing a product for elderly people or teenagers for instance, she has to understand needs and desires in the framework of their culture. The main challenge in product development is for the developers to understand and overcome their own culture in favour of the cultural needs of the intended users (Razzaghi & Raminez, 2006).

5.3. FURTHER DEVELOPMENT

For further development of the KYP-metod it is necessary to have more extensive testing of its applicability to design challenges in development aid projects. Testing should be conducted by applying the method to specific design projects. The method should preferably be used by interdisciplinary teams.

In this article, emphasis has been placed on acknowledging the importance of social and cultural aspects to improve product development. However, there are no simple methods for how to collect information about these aspects and "translate" them into product properties. Collaboration across professions is necessary for succeeding with fulfillling both physical and non physical user needs. Social anthropologists are trained at understanding other cultures, whereas mechanical engineers are experts on production. Designers have knowledge about understanding user needs as well as product development. They are trained in working interdisciplinary and can act as a link between social anthropologists and mechanical engineers, thus combining two very different professions together to provide a holistic perspective. Many authors have written about the importance of integrating cultural considerations in product development (among others: Holt (1989), Norman (2002), Portigal (1997), Samuels (2002)). Nevertheless, the issues of how to detect social and cultural needs and fulfill them in terms of product properties, still need more attention and research. This research should also be a part of the further development of the KYP-method.

6. CONCLUSIONS

In this article it has been illustrated through a case study how the Know Your Product Method can be used in development aid projects where new products have to be designed. To better fulfill user requirements, both at a physical and non physical level, small but essential alterations were done to the method. Underlying ontological and epistemological views have been the foundation for the discussion and the following enlargement. The enlarged KYP-method places more emphasis of considering non physical needs in product development. These needs are often desires and requirements based on social and cultural issues. In the enlarged method the perception of the quality of a product is affected by the perceiver's pre-understanding. Individual as well as cultural and social aspects contribute to the users' pre-understanding. The enlarged method also incorporates the principles of Appropriate Technology based on Schumacher's philosophy .

The use of the enlarged KYP-method can be beneficial in development aid projects where it is particularly important to consider social and cultural needs for the solutions to be accepted and implemented by the intended users. Nevertheless, the method can be useful in all product development, since designers and users will never have the exact same pre-understanding of a product and its surroundings.

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