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Theory of practices as a means to uncover the customer needs

João Flores[1], António Gonçalves-Coelho[2], António Mourão[2], Miguel Cavique[3*]

[1] *Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus de Caparica, Caparica 2829-516, Portugal*
[2] *UNIDEMI & DEMI, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa, Campus de Caparica, Caparica 2829-516, Portugal*
[3] *UNIDEMI & DEM, Escola Superior de Tecnologia, Instituto Politécnico de Setúbal, Campus do IPS, Estefanilha, 2914-508 Setúbal, Portugal*

* Corresponding author. Tel.: +00351927519613 E-mail address: mjnflores@gmail.com

Abstract

Most of the Axiomatic Design research work focuses on the design as being a relation between the functional domain and the physical domain. Yet, the outcome of a successful design results from a definition of the functional requirements that accurately reflect the customer needs. The contribution of this paper is to help defining a theoretical framework to describe the customer needs and the related functional requirements, using the 'Theory of Practices' (TP). This theory highlights every human activity in terms of a set of actions called 'practices'. Practices relate to the actions required to fulfill a need through three variables: a material support, a competence to perform the action and a meaning that arises from the action. TP also takes into account the surrounding functions of the practice, defining them according to the milieu of its usage. Thus, TP allows a clear identification of the customer needs to fulfill and facilitates the scrutiny of the related functional requirements.

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1. Introduction

In Axiomatic Design (AD) "the design process begins with the recognition of a societal need" [1]. The societal needs that the customer is looking for in a product, process, system [2] (hereafter called 'product' or 'artifact') help defining the artifact in the customer domain.

Nevertheless, "the customer needs (CNs), or attributes (CAs), desired in a product are sometimes difficult to define, or are vaguely defined" [2]. Moreover, AD "generally places the system boundary around the artifact and thus offers no methods for the classification of information related to (….) other stakeholders who (…) interact with the artifact" [3]. As a result, the CNs are formally a part of the AD scaffold while customers are not.

Because a 'need' is "the psychological feature that arouses an organism to action toward a desired goal, the reason for the action" [4], we should not separate the needs from who is engaged in the action that aims at satisfying those needs.

Actually, the 'Customer' starts and performs the action along with the artifacts, making the needs of the design to arise from a set that contains the customer and the artifact. The needs call for an action and the goal of the action is the satisfaction of the needs.

Therefore, if we analyze the action, we should consider both the artifact and the customer while we are searching for the related CNs. In other words, one need to seek the 'job-to-be-done', or what are the fundamental goals the customer is trying to achieve, or the problems he intends to solve using the artifact [5].

For this reason, the design must change the focus from the artifact to the 'job-to-be-done', thus requiring the analysis of the roles the people and the artifacts will play within an action.

At this point, the critical goal of the designer is to define the CNs. He needs, therefore, a tool or a methodology that helps systematizing the 'job-to-be-done''. As such, a thorough methodology to uncover the customer needs should clearly show and link:

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- the action the person intend to do in order to fulfill the needs and the reason to engage into the action;
- the person(s) who physically integrate the action;
- and the attributes of the artifact(s) required to perform the action.

Because "the design process begins with the recognition of a societal need" [1], it seems reasonable to call upon social sciences in order to turn societal needs into CNs.

Finding out the CNs should always precede the design of any artifact, no matter how we conduct the design process.

To the best of the authors knowledge, there is no previous research work on a systemic, scientific-based methodology for finding CNs that goes beyond the 'know-how' used to find them, in order to allow reaching the 'know-why' the proposed FRs and DPs of an artifact reflect, or not, the foreseen customer needs.

The most well known alternative to TP to deal with CNs is likely the House of Quality (HoQ) [6], which nowadays is considered as a standard tool of Quality Function Deployment (QFD) [7]. The toughest point of HoQ, is the easiness of use. However, it relies on benchmarking (or 'customer perceptions' in the HoQ terminology [6]) to access the set of CNs (or 'customer attributes' in the HoQ terminology) under consideration. This means that more than one design solution should exist as to allow benchmarking, and it is worth noticing that HoQ does not provide clues to find out the CNs.

This is why the purpose of the present paper is to introduce the use of the Theory of Practices (TP), as well as of the attributes of the elements outlined by TP, as a means to find out the CNs that should be known before starting the design of any artifact.

2. Theory of Practices

"Theory of Practices" (TP) is a social sciences theory based on the ideas that "individual behaviors are primarily performances of social practices" [8], and that practices are not conceivable as a set of individual actions, that lie just in the minds of the actors, but modes of social relations [7].

TP stems from the work of Pierre Bordieu, Charles Taylor, Theodore Schatzky, Andreas Reckwitz and Elisabeth Shove, among others [9, 10].

TP considers that the observable performance of practices (practice-as-performance) can be explained by three separate elements that should be considered together with the links between them (practice-as-entity), as shown in Fig. 1.

TP explains that the observable behavior of individuals (practice-as-performance) is a consequence of the existence and the interdependence relations of:

- meanings, expectations and status arising from the practice;
- competences, knowledge and skills to perform the practice;
- and materials, tools and infrastructures [9] (see Fig. 2).

Therefore, TP aims at offering an approach to explain the relationships between the artifacts and their users, by showing how, when and where they are used. It also helps to look up for interactions involving other practices, which interact with the practice the artifact being designed is intended for.

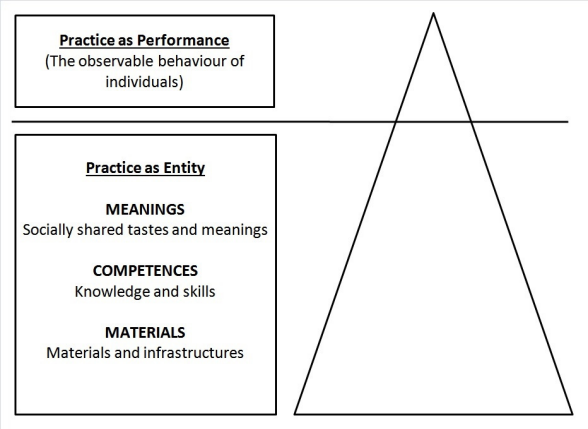

Fig. 1. The observable behaviors and the practice-as-entity.

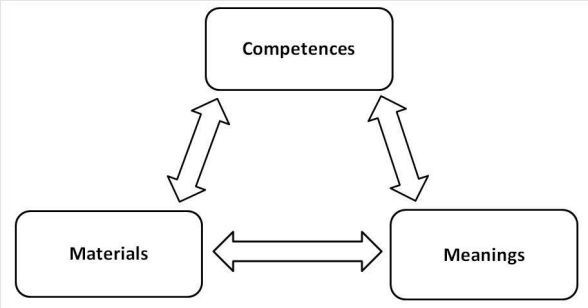

Fig. 2. Elements and links between the elements of a practice.

Although social theories do not constitute a handbook for action on technological changes or behavior, they can provide a relevant guide for understanding how problems are defined and framed, and for formatting interventions that can be considered possible, plausible and valid [9].

Nevertheless, TP is interesting, not only because it allows univocally defining practices through sets of three definite kinds of elements, but mostly because the TP elements contain the attributes required to define CNs.

Therefore, TP can help the designer to develop a systemic structure to find the attributes that the customer is looking for in an artifact.

2.2 Meanings, competences and materials

The *'meanings'* elements encompass intangible factors, such as socially shared tastes, purposes, ends, beliefs, emotions, moods, ideas or aspirations. Therefore, the motivation and the emotional satisfaction arising from performing it lie in the 'meaning' elements [11].

Clearly, it's not only due to its physical and chemical properties that gold is used to make high-end wristwatches. Those properties are just some of the attributes of the material element 'gold' that are required by the 'meaning' element of the practice the wristwatch is part of.

In order to find the CNs of the design, we should look for the attributes the 'meaning' elements require to be expressed DPs in the object of design *i.e.*, the artifact.

The *'competence'* elements of a practice are the set of skills, know-how, and the ways to perform the practice. Sometimes, competences are replaced by functions embodied in the material elements of the practice, instead of remaining as competences of the people who perform it.

For example, the starter motor of automobile engines replaced the need for the hand-cranking competence of the users. The functional requirement for starting the engine is still there, but it was assigned in a different way, *i.e.* a function that was embodied in the material elements took the place of a competence.

Likewise, keeping the bicycle's driving condition is a competence that is required to the cyclist, while the aforesaid competence becomes a function embodied in the material elements in the case of a tricycle.

The 'competence' elements are not restricted to the know-how to perform a practice; they also include the capabilities of recognizing, describing and discussing it. The skill to perform a practice also involves the awareness about what is good, normal, acceptable and appropriate, as well as the bodily and mental competences to reach these standards [10].

In order to find the CNs of an artifact under design, we must look for the attributes that are required to perform the practice that are embedded into the 'competences' element and that can be transferred to (and, sometimes, from) the artifact.

Actually, competences can be assigned to artifacts and vice-versa. For example, if parts or technical support for an automated feature of a machine are not available in a given market, then a non-automated version of the same feature can be used to efficiently deal with the customer needs of the given market.

The *'material'* elements of a practice are the tangible components (in a broad sense, without distinction between people, objects, and "other things not directly man-made, like air" [10]), which are used in the practice. In an up-and-down swing, the mass of the body of the player is a material element of the practice, not a competence of the player. The competence lives in the mode he uses his bodily mass.

In order to find the CNs of the artifact under design, we will look for the attributes strictly required from the 'material' elements in order to perform the practice.

2.3. Emergence, evolution and bundles of practices

As we have seen, a practice is defined by an interdependent relation between materials, competences and meanings, which makes it important to clarify the links between those elements.

Elements may form a proto-practice and they are essential, but they do not create a practice by themselves. When the links between the elements vanish, the practice will no longer exist [9].

In a classroom, projected media is replacing the practice of writing in the whiteboard. Even in the presence of board markers, the whiteboard no longer integrates the practice of 'writing in the board', though the board integrates a different practice when it is used as a projecting screen.

While practices result from linking either new or already existing elements, the integration of the elements of a practice is itself transformative, since materials, competences and meanings shape each other as a result of its integration in the practice.

The impact of the elements of a practice on each other, as well as its change over time, can make and break links, change materials, competences and meanings, leading to the evolution of the practice.

As practices can evolve due to changes in each of their elements, it is clear that they are not shaped just by the introduction of a new product or design. As dynamic entities, practices are shaped by the designers and the collectives of the performers of the practice [10].

Driving a car today is a very different practice from what it was in the early 1900's. Material changes opened the practice to new less skilled users, and the social evolution enforced changes in the automobiles as well, and many previously required intricate competences, such as 'parking the car', are being transferred to the material elements of the vehicle.

The relations between practices can also shape each other, even if they are not linked either in time or in space. They may be connected through shared materials (like the practices of riding a bicycle for commuting and riding a bicycle for leisure), competences (surfing, skateboarding and snowboarding) or meanings (cleanliness from laundering and cleanliness from showering). Furthermore, diverse practices may form bundles of practices, by sharing the same place or the same time slot, impacting each other, like in the example of reading: possible when commuting in a train to work but not when driving to work.

Other practices are definitely more strongly co-dependent, forming 'complexes of practices'. For example, shopping, storing, cooking and eating food are strongly co-dependent, *i.e.*, significant changes in one of them will trigger changes in the others.

As another example, vacuum cleaners with a water filtration system can abolish the practice of shopping vacuum cleaner bags.

2.1. The acquisition of competences

The acquisition and transfer of the practitioners' knowledge are not simple processes of sending and receiving information.

Competences circulate not only between people, but also between practices, since practices can profit from connections used and reproduced by other practices that co-exist or that existed before, as "know-how travels behind the confines of face-to-face interaction of master and apprentice" [9].

Knowledge can be 'abstracted', moved from place to place, and decoded or 'reversed' upon arrival. The codification, abstraction and reversal of the practice by its practitioners play an important role in the recruitment of new practitioners and in the dissemination of the practices.

Nevertheless, one can only transfer knowledge through abstraction and reversal to where performers are already prepared to receive and assume it due to previous practice-based experience [9].

For example, when one uses a novel software, some abstract codified notions, functions, features or attributes such as "open file", "import", "export", "save" or "save as" are

promptly reversed, from the knowledge acquired with some formerly used computer programs and, before the computer age, from the knowledge acquired through hard-copying practices, among others.

In the same way, video players adapted and reproduced the button codes of the audio recorders, as a means to facilitate the adoption of the new practice.

As far as artifacts can provide knowledgeable clues to its use within a practice [12], the material elements can facilitate, by themselves, the enrollment of new practitioners by providing clear cues for the required action, by facilitating the codification, the abstraction and the reversal of the practice.

3. An AD approach to the use of TP to uncover CNs

The knowledge about customer needs precedes the start of the design process, not only in AD, but also in any other manner of conducting the design of an artifact.

Whereas social sciences explain facts that have already happened, engineering design seeks making something that has not yet occurred. Although TP is a social science, we suggest considering the TP elements in an AD viewpoint, by proposing that the 'meanings' elements of a practice should be seen as CNs, the 'competence' elements as FRs, and the 'material' elements as DPs.

Following the typical AD reasoning, the decision-making process in any design should ideally lead to uncoupled relations between CNs and FRs. This paper will show that the TP-based approach may help finding this kind of relations, as well as the relations between FRs and DPs.

We propose the use of the attributes we can extract from the TP elements related to the practice, and not the TP elements themselves, as to uncover the Axiomatic Design's CNs of an artifact that allows the 'job-to-be-done'.

Taking the 'job-to-be-done' instead of the artifact as the object of analysis, we place the 'customer' into the designing space. This helps removing ambiguity, by conveying in a sharper manner the elements of the practice, as well as its links.

Practices highlight the opportunity to uncover interchangeable features between products and performers. In the example of the automobile starter motor, identifying the FRs helped defining new DPs that need fewer competences from the driver. In a broader outlook, TP may help surpassing some common troubles in finding out the CNs in an AD framework, namely when (i) the CNs are vaguely defined; (ii) the CNs are difficult to define; and (iii) the consistency of child FRs with the CNs is hard to check in the zigzag decomposition process.

When the CNs are *vaguely defined*, the element-based model of TP allows for a better use of AD (see Fig. 3) by

- centering the analysis on the action, and not on the artifact. Changing the focus allows uncovering the CNs of the complete action;

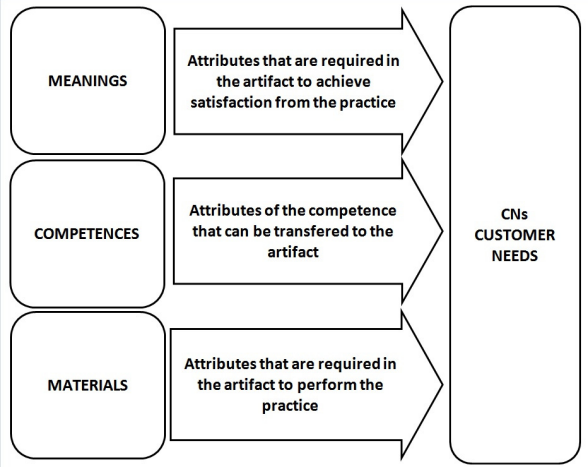

Fig. 3. Outlining *vaguely defined* CNs of an artifact from the three elements of the practice: meanings, competences and materials.

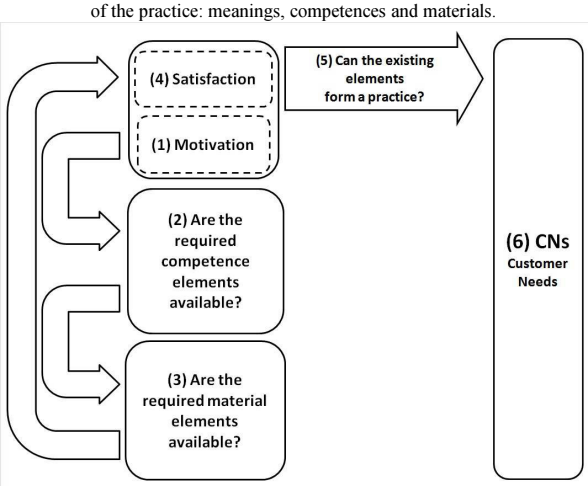

Fig. 4. Outlining difficult to define CNs from the motivation to perform a practice.

- clarifying the CNs of the materials that emerge from intangible 'meanings', from the motivation to perform the practice and from the satisfaction that results from performing the practice;
- allowing the search for DPs in the scope of both material and people;
- clarifying the allocation of DPs amongst artifacts and performers of the practice;
- opening the opportunity for a new mode for deploying the DPs among artifacts and individuals.

When CNs are *difficult to define*, the TP element model can facilitate applying AD to product design. From asserting a motivation to perform a practice (see Fig. 4) one can

- find the competences required to perform the practice;
- find the material elements needed to perform the practice;
- check the presence of the links required to form the practice;
- check if the competences, the material elements and the links between them ensure the satisfaction that should arise from performing the practice (see fig. 4).

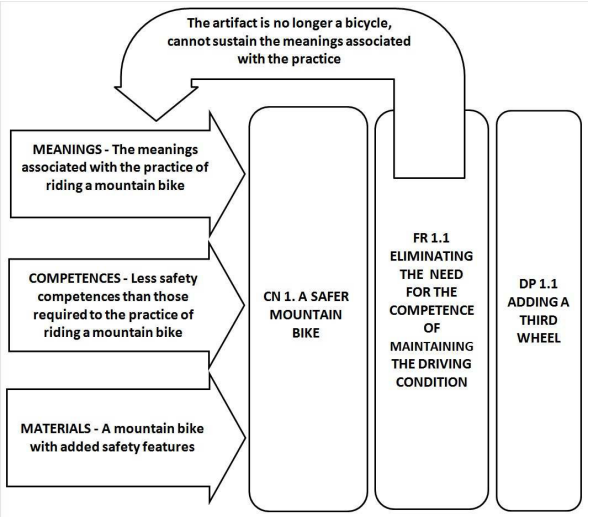

Fig. 5. A safer bike: Checking satisfaction, motivation enhancement, and FR-DP consistency with TP 'competence' and 'material' elements.

The zigzag decomposition allows ensuring the consistency of the new DPs with the existing FRs according to the independence axiom. Concomitantly, TP can help examining if relating the new DPs to competences or to materials would enhance both the motivation to perform the practice and the satisfaction that results from performing it.

Fig. 5 shows how TP could make easier to check the consistency between the child FRs and the CNs, every time one arrives to the customer domain coming back from the functional domain during the zigzagging process. Answering to the following questions could do it:

- Do the new child FRs enhance the motivation for performing the practice?
- Do the new child FRs enhance the satisfaction that results from the performance of the practice?
- Does shifting FRs from performer competences to material elements preserve or increase the customer satisfaction?

4. From TP to AD: Lids on recycling bins.

The experience of including specialized lids for trash, GAP (glass/aluminum/plastic) and paper recycling bins [10], instead of just tagged, open, recycling bins, increased the allocation of GAP items to the right container, and represents a good application of TP to the determination of CNs of artifacts.

With the bins just marked with tags for each type of items to discard, 35% of the GAP items were mistakenly disposed in the trash bin and 8% in the paper bin.

The lack of competence of the users to sort the items into the right recycling bins was most likely limiting the practice of recycling. A likely solution to the problem should be to instruct users about the right way of sorting items between paper, GAP and trash bins. Another way should be to transfer the right attributes from the competence to the artifacts.

Fig. 6. Recycling bins without and with specialized lids [10].

By placing specialized lids on the recycling bins (a 6 inch center hole on the GAP bin, a 2-inch narrow slit on the paper bin, and a flap on the trash bin (see fig. 6), the right disposal of GAP items raised to 92% (from 57% with the open, just tagged, bins).

As one could see, transferring an attribute from the competence elements to the material elements of the practice allowed finding a new design that enhances the dissemination of the practice of properly discarding GAP items.

5. Conclusions

The performance of an artifact is usually evaluated by its adequacy to the expected use. Because products are designed to do a job, one can use the whole job as the analysis object in engineering design. Thus, when looking for the customer needs in an AD framework, the 'job-to-be-done' approach has the advantage of definitely involving the 'customer' in the analysis of the design solution under development.

Nevertheless, a tool to devise the customer needs from the 'job-to-be-done' is required. Because products are designed to satisfy societal needs, it makes sense to call upon social sciences for this purpose.

'Theory of Practices' is a social sciences theory that helps translating performance into variables that make clear how the functions of an artifact under design can improve the links between the elements of a practice. More than this, those functions can enhance the reproduction of the practice and, ultimately, they can promote the use of the artifact.

By relying on a scientific theory to find out the CNs, one will help designers to 'know-how' to uncover customer needs. In addition, and more important, one will help them to 'know-why' the functional requirements and design parameters of design objects can ensure that the customer needs are fulfilled.

In conclusion, 'Theory of Practices" can help uncovering the customer needs within an Axiomatic Design framework.
In addition, the AD's zigzag decomposition can facilitate a systemic manner of checking the consistency of the FRs and the DPs with the CNs that are elements of the proposed TP-based structure.

In the future, the authors intend to expand the study of the approach introduced in this paper, according to the following research lines:

- To look for ontological definitions for the TP elements, because the social sciences approach does not provide such definitions. Instead of this, TP offers examples that follow a project-based learning approach;

- The scope of the Theory of Practices is the analysis of existing practices. This implies that materials, competences and meanings, as well as their relations, already exist. Thus, the CNs can be found through reverse engineering processes.

Understanding those processes and how they are related to the CNs and to the other AD domains, will be the aim of this research line;

- At last, the authors intend to use the knowledge acquired from the aforementioned research lines to apply the Theory of Practices to the meta-design of zero-energy buildings under an AD viewpoint. Indeed, the European Union is planning to spread the use of zero-energy buildings until 2020, and this target has to be achieved without compromising the CNs of nowadays. Hence, identifying those CNs should be a major step of such a huge task.

Acknowledgements

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