15th European Roundtable on Sustainable Consumption and Production
(15th ERSCP)
2012, May 2 – 4, Bregenz, Austria

Investigating the Life-span of Cork Products Through a Longitudinal Approach With Users – Interim Results

Pereira AC[1,2*], Brezet H[1], Pereira H[2], Vogtländer JG[1]

[1] *Design for Sustainability, Faculty IDE, Delft University of Technology, Delft, The Netherlands*
[2] *Forest Research Centre, School of Agronomy, Technical University of Lisbon, Lisbon, Portugal*

**a.c.dasilvapereira@tudelft.nl*

Abstract

Products with long life-spans are generally preferred form an environmental perspective. This paper addresses the longevity of cork products, and the respective influencing aspects. This is accomplished through a longitudinal study where several cork products are used, and at different moments in time interviews are performed with the users about multiple aspects, such as satisfaction, performance, quality, aesthetics and attachment.
The results from the eight months moment are presented here, with a focus on situations of moderate and low attachment. With few exceptions, the life-span of the cork products is good, and the general appreciation and evaluation is good/ very good or excellent for most product-user situations. From the cases analyzed, several influencing aspects and interrelations were identified. With regard to material related aspects, two main issues have been identified which could benefit from improvement: surface changes and water interaction.

Keywords: Sustainable consumption and production; life-span and use(r); cork products and materials

1. Introduction

1.1 Cork – origin, applications and materials

Cork is a renewable resource, the outer bark of the cork oak tree, and can be removed periodically from the stem without endangering tree vitality. The cork oak forests occur in the western Mediterranean region, and in addition to their productive economic role they provide multiple important functions, such as preventing soil erosion and the protection of biodiversity (Costa and Pereira, 2007; Pereira et al, 2009). Since tree growth is slow, and regeneration often difficult, this can be considered a limited resource; as such, in this context, addressing the life-span of cork products is an important resource conservation strategy (Pereira et al, 2011b).

Wine stoppers are the main cork application, and others include construction materials, floating devices, and use in aeronautics (Gil, 1998; Pereira, 2007); more recently cork has also been increasingly explored in the field of design (e.g. Mestre, 2008). As a material, cork is light, rather impermeable, and chemical and biologically stable (Pereira, 2007). In addition to natural cork, there are already several other cork materials, such as: white agglomerates, black agglomerates, rubber-cork, cork gel, CPC - cork polymer composite, cork wool, cork paper, cork textile/ skin (e.g. Mestre, 2008; Gil, 2009).

1.2 Product life-span, attachment, and materials use

Products with long life-spans are generally desirable from an environmental sustainability perspective (Meadows et al., 2004; van Nes, 2003; Vezzoli and Manzini, 2008), because they enable to reduce resource use and the subsequent outflows to the environment. The relevance of addressing product longevity has been recently presented by Cooper (2010), as well as a clarification of related designations: while *life-span* (or lifetime, longevity) are acknowledged as broader concepts, by including multiple influencing factors, *durability* refers mainly to product intrinsic characteristics. The scope of this research is on product life-span, and durability is also considered as a sub-component.

The life-span of products is intimately connected with consumption, and these are complex processes influenced by multiple factors at different levels. In Røpke (1999) these are categorized in three groups: economic macro-level explanations; historic and socio-technical meso-level explanations; and socio-psychological micro-level explanations. Also van Nes (2003) distinguished three groups of factors: *product characteristics, situational changes* (such as in personal life or on the market), *and consumer characteristics*, and four general categories of replacement motives were proposed as a typology: *wear and tear, improved utility, improved expression, and new desires.* Among product characteristics the following were identified: *wear and tear, comfort of use, quality, design, social value, emotional value, upgradability, safety and economy of use.* Several of these aspects (and others) were also identified and addressed in Eternally Yours (van Hinte 2004), such as wear and tear, quality or emotional value; this was a major project to investigate and explore product endurance.

Mugge (2007) constitutes another contribution in the field, but focusing more specifically on product attachment, and some of its determinants: self-expression, group affiliation, memories and pleasure. Product attachment is defined as the 'strength of the emotional bond a consumer experiences with a specific product', implying a strong relationship or tie between the individual and object. Attachment differs from satisfaction since people can be satisfied with average performing products, but the development of attachment requires a special meaning. Possible consequences of product attachment are taking better care of the product and increased longevity (Mugge, 2007).
In the present work, while life-span refers to the effective use or possession of a product, attachment represents the significance of a product to a user, and provides an expression of intention or willingness to use.

Materials are a specific product feature influencing the life-span of products; how these age is directly related with the materials they are made of. Even though some properties in databases provide an indication on how materials withstand use, such as hardness, there is generally no specific information on the issue available to the designer. Following, two examples of research in the field are succinctly introduced.

In *Eternally Yours* (van Hinte, 2004), one of the projects addressed plastic materials; a *Proud Plastics Survey* was performed to collect information about plastic products, originating in a *Plastic Experience Guide*, and production experiments were performed to enrich the aesthetic quality of plastics (pp.285-287). Fisher (2004) investigated how plastic materials age with use and gather dirt in ways perceptible by users, and that may elicit strong feelings and promote the disposal of products. In van Nes (2003) little was found with regard to materials.

From a methodological perspective, longitudinal approaches aimed at investigating the life-span of products, as proposed by Evans and Cooper (2010), are rare; one such study, with a backpack, was performed by Mugge (2007). In general, research in the field includes different methods – interviews, surveys, focus groups, either with qualitative or quantitative approaches, and sometimes with a mixed-methods design.

Concluding, the life-span of products is influenced by multiple aspects at different levels and perspectives, making it a complex issue. Although there are already interesting and important contributions on the topic, and from several disciplinary fields, further research is needed.

1.3 Preliminary working model on the construction of life-span

A preliminary working model on the 'construction' of life-span was established to visualize the different issues involved (Figure 1). Categorization is not straight forward: aspects such as performance seem more objective and determined by product characteristics, while attachment is perceived as more subjective and user related; therefore these are more closely positioned as such.

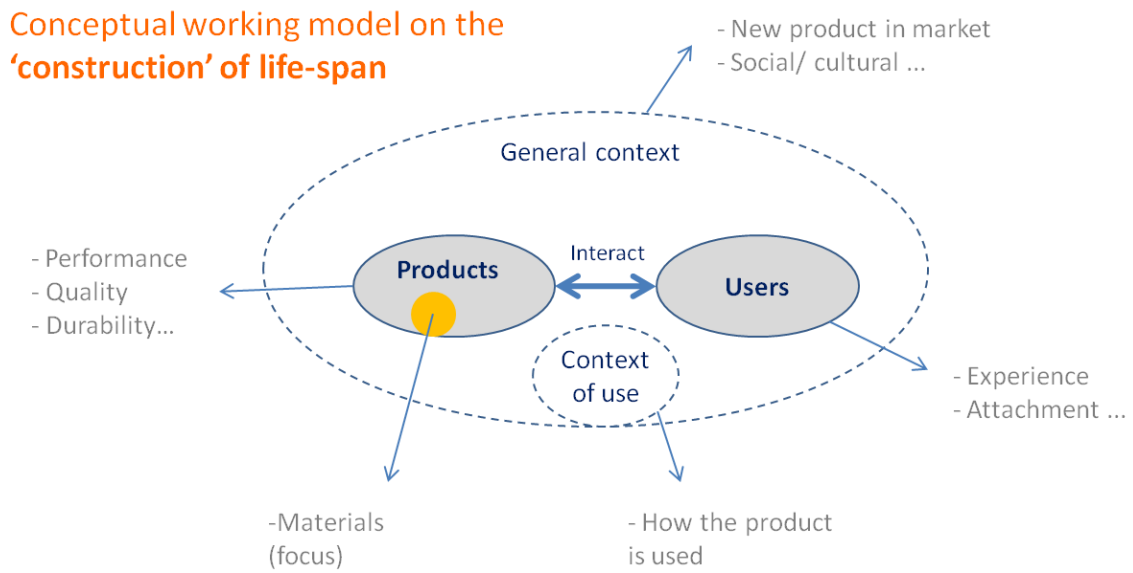


Figure 1. Schematic conceptual working model for the construction of product life-span

1.4 Research aim and questions

This work aims to investigate the life-span of cork products and the influencing aspects, through a longitudinal approach, and considering the following research questions:

RQ1 – How is the life-span of cork products? (How long do they last?)
RQ2 – What are the aspects (factors) influencing the life-span of cork products?
RQ3 – How are these aspects interrelated?
RQ4 – What can be learnt about the material?

2. Methodological Aspects

2.1 Study setup

Several cork products are being used in a longitudinal study; at specific moments interviews are performed with the users, and photographs are taken to register changes in time.
Planning: the planning of the moments to collect information is (in months): [0m], 3m, 8m, 16m, 24m, 36m. Here, results from the eight months moment are presented. Results from the three months moment can be found in Pereira et al (2011a, 2011c).
Products: 18 cork products for household (bath, kitchen) and personal use (leather market, stationary) were selected and acquired, contemplating different cork materials and producers. With few exceptions, a minimum of three units of each product is being used.
Participants: there are 31 participants, and approximately half of them are related with research on cork or wood; the study is being performed in Portugal.
Interview: the interview is semi-structured, including open and closed questions coherently organized. This was considered appropriate for the explorative scope of the research.

2.2 The products (a selection)

Figure 2 shows a selection of cork products for household and personal use from the study.

Household		Personal Use
		
(PA) Bath mat dry [White agglom.]	(PC) Soap dish [White agg. (small)]	(PJ) Keychain [Skin/ Textile]
		
(PH) Place mat bk [Black agglom.]	(PF) Fruit bowl [White agg. (small)]	(PO) Notebook [Skin/ Paper]

Figure 2. Six examples of cork products for household and personal use included in the study

2.3 Contents of the interview

A) Use of the product (general characterization)
The 1st group of questions aimed to characterize the use conditions: to confirm if the product is being used, how the product is used (context of use) and how often it is used (intensity of use).
B) Product appreciation (general)
In the second part the aim was to accomplish a general appreciation of the products, and users were inquired namely about likeness (if they like using the product), and satisfaction (if they are satisfied and would recommend the product).
C) Product evaluation (specific keywords) – five aspects
To accomplish a more specific appreciation and evaluation of the products, five aspects were selected for exploration and assessment in the study. These are: performance (e.g. functionality), quality (technical or broader concept), durability, aesthetic appreciation, and attachment. At this moment participants were asked to evaluate the aspects with a one to five [1-5] scale, except for attachment which was interpreted as no, yes but or yes (2 to 4 respectively).
D) Comparison/ others (several)
A last group of questions addressed some other aspects: observed differences in time (comparison with new); required maintenance/ cleaning; and, possibility to offer as a gift (answered in B).

3. Results

The general results are introduced according to the structure of the interview, then some cases are analyzed, and a synthesis of moderate and low attachment situations is given. The results concerning the material related issues are also presented. At this moment, from the initial 31 interviews, five user contributions are not included: three were not performed in the same time; in the case of a returned product there was a short communication stating similar events to previous product (2nd test of notebook); and in another situation there was a non-structured communication, stating that in general everything was the same.

3.1 General results (according to interview structure)

A) Characterization of use

In a general way, after eight months the products continue to be used. The context of use remained *equal* for almost all the products, and a few exceptions had a *similar* context of use, such as a fruit bowl having different fruit in summer. Concerning the intensity of use, in most cases this was acknowledged as *equal* (77%). In this first part of the interview participants were also invited to point out key issues; the aim of the question was to provide a spontaneous access to the most relevant aspects. Overall, most issues mentioned were positive (64%), neutral or mixed (25%), and four main categories arose: durability, dirt or darkening, aesthetics, and functionality.

B) General appreciation

With regard to the general appreciation, most users mentioned to like using the products, and 92% declared to be satisfied and that would recommend them; exceptions will be presented later. Concerning the possibility of offering the products as a gift, most answers were also positive; although, some household products were excluded due to the kind of products (being for the home or being simple). Additionally, participants were also asked about what surprised them, and what was the most appreciated aspect; the main issues arising can be observed in Figure 3.

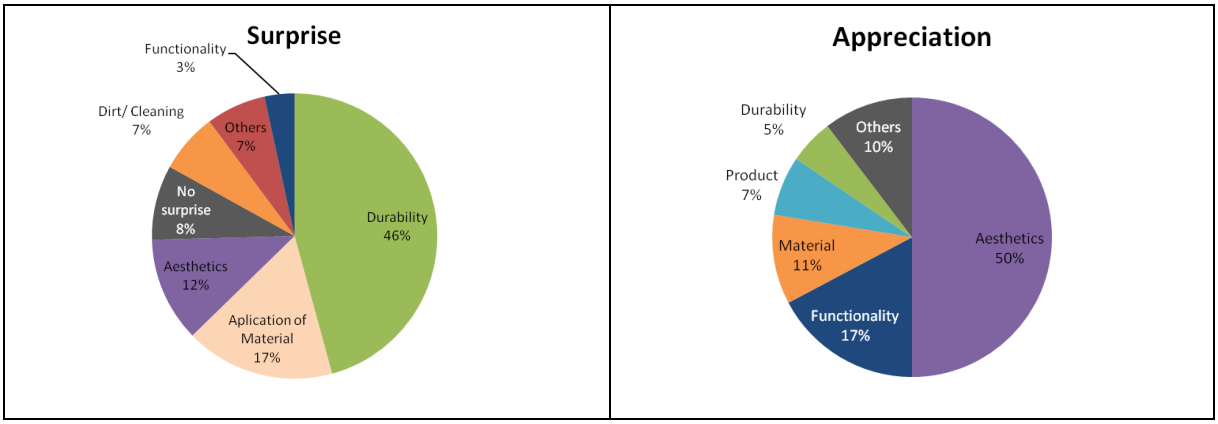


Figure 3. Distribution (% of total) of the main issues referred to by users in relation to surprise and appreciation

It is interesting to notice that while durability appears as the most surprising issue (high durability, e.g. ”the product is still in good condition”), the most appreciated aspect was related with the aesthetics of the products (50%), and durability is only mentioned occasionally.

C) Specific evaluation

From a total of 61 product-user situations, for all the five aspects, most responses were in general good/ very good [4] or excellent [5], as presented in the per product evaluation charts (Figure 4). For each aspect, a few exceptions were observed, of either negative or sufficient evaluations.

With regard to durability, it should be noticed that some users provided moderate evaluations due to the early moment of eight months (still soon for higher assessments even though the products are fine). Concerning product attachment, most situations were also good/ very good [4], with eight exceptions; these are detailed in the following section since this paper has a focus in attachment cases and its determinants. The motives for this low or lack of attachment are diverse.

In general there is a slight higher incidence of lower assessments in household products. This may be related with the diversity of cork materials available in the category, and the novelty of some applications (e.g. for the bath area, which may not be very well perfected yet). This is more expressive

in attachment, and perhaps due to the kind of products (being for household there will be more distance from users then the ones for personal use). This is expected to become clearer later.

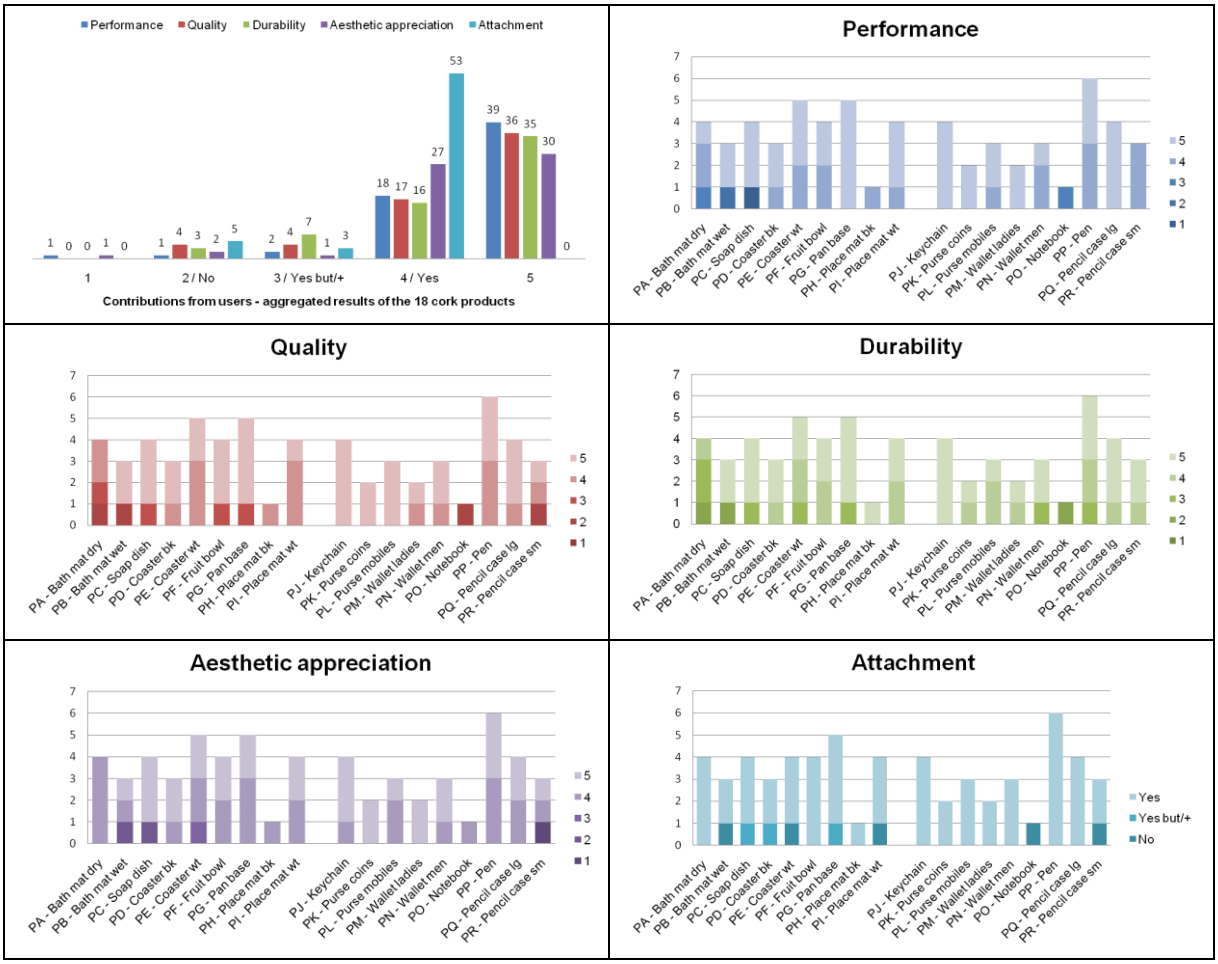


Figure 4. Appreciation charts for the different products regarding performance, quality, durability, aesthetic appreciation, attachment, and an aggregated comparison of the five aspects

Even though different and not coincident, performance, quality and durability are relatively close or conceptually overlapping for many users; assessments are also often similar, interrelated, and have origin in the same issues. From the charts above, it can be concluded that the somehow more 'delicate' products (according to some user evaluations) about their performance, quality and durability are: PA – Bath mat dry, PB – Bath mat wet, PC – Soap dish, and PO – Notebook. These would benefit from opportunities for improvement.

D) Others/ comparisons

Participants were also asked to compare the cork products with other similar ones but made of different materials. Details on this will be presented separately; although, it is relevant to point out that in circa 50% of product-user situations durability was mentioned, among other issues. This seems to suggest that durability is one of the key issues noticed when comparing products. With regard to maintenance, the necessary operations were cleaning related, and these were generally considered normal, easy and relatively efficient (with few exceptions). Additionally, a substantial difference in responses for household and personal use products was observed: household products had a higher need for cleaning (55%) then the personal use ones (14%).

3.2 Situations of moderate and low attachment – cases detail and synthesis

The cases with moderate and low attachment are presented, with the aim of identifying the influencing factors of life-span, and interrelations of the different aspects. It should be noticed that the cases described are specific product-user situations, not representative of product opinions.

PB – Bath mat wet (U24) [No – low attachment]

In this case a specific motive lead to cease its use: a cat (ill) urinated on the product; it was cleaned but wouldn't be used again. Although this is mentioned to be the final reason to stop use, another specific event triggered several unpleasant aspects: the product released ink since the beginning, and among other issues got stained and deformed; these problems had negative repercussions in all parameters. Details can be observed in figures and chart below (Figure 5). In this case everything is very interrelated: it seems to be mainly acknowledged as a performance problem, and affecting attachment directly, but it influences all the aspects. With regard to durability, the user mentioned that it seemed to be durable but didn't turn out as such. It is also pointed out that, apparently, bath products should be changed often to avoid bacteria's, and that perhaps there is no need for a long durability.

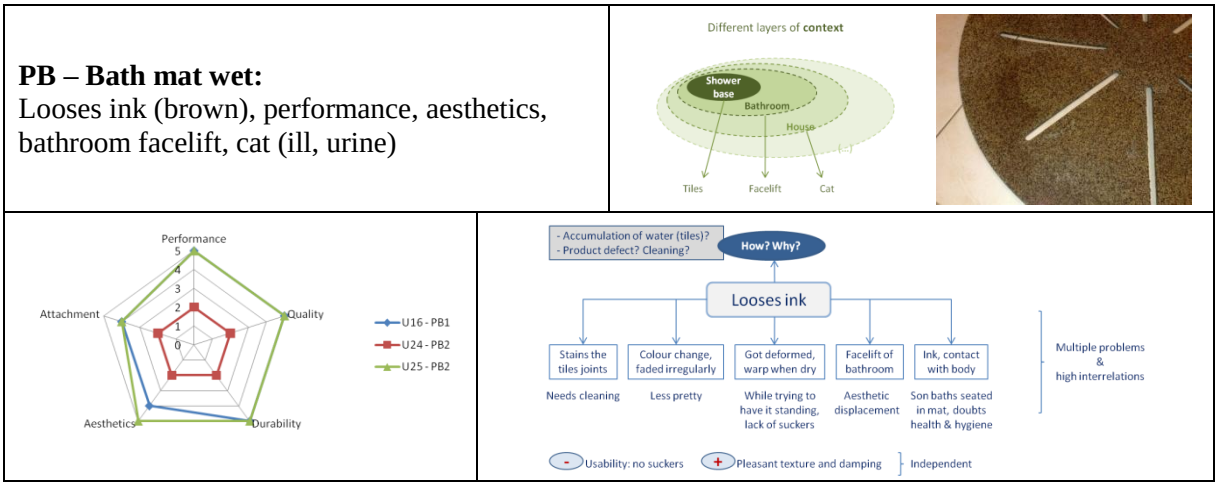


Figure 5. Representation of occurrences regarding the use of PB-Bath mat wet

PC – Soap dish (U5) [Yes but – moderate attachment]

In the soap dish two problems were noticed: usability – when the soap dries it gets attached to the product, and deterioration in the centre – main wet area in contact with the soap. In the user's opinion the object is beautiful but should be for a different function, and it is mentioned that it can last a whole life but gets ugly. In this case attachment is still positive but moderately [yes but/3]; images and details of the evaluation appear below (Figure 6). The interrelations of the different aspects are not very clear in this case. Deterioration is the main problem affecting all aspects, and mainly (negatively) performance and aesthetics. These parameters are also influenced by two other issues respectively: usability (soap gets attached), and visible white soap in the borders.

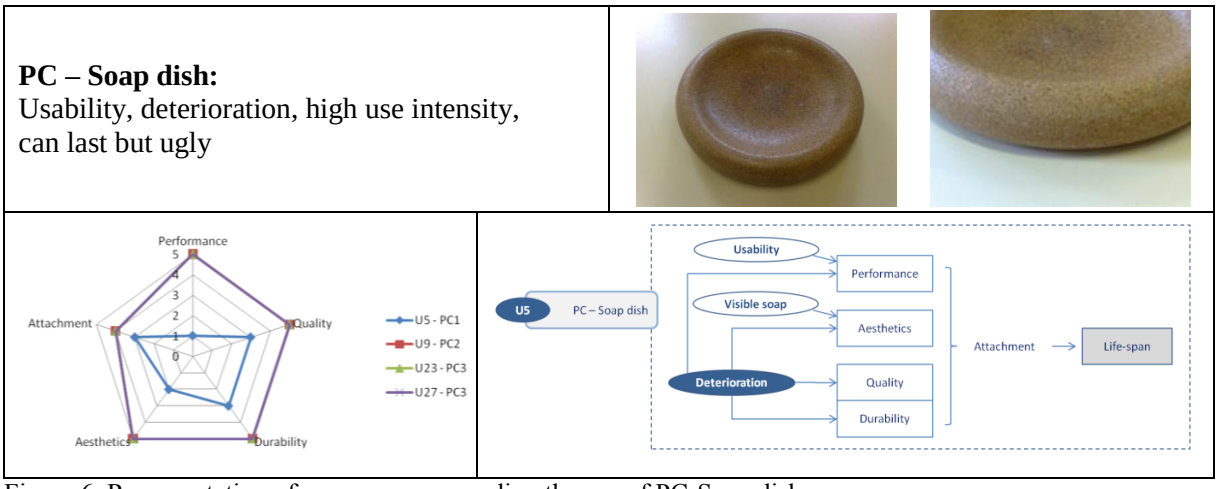


Figure 6. Representation of occurrences regarding the use of PC-Soap dish

PI – Place mat wt (U19) [No – low attachment]

In this case, the user is generally satisfied with performance and durability, but presents some suggestions (mainly aesthetic): being smaller, having a decorative border, and stronger colours.

Evaluation details are presented in Figure 7. As can be observed attachment is negative; this user would prefer to use new towels she has at home instead, and several aspects may contribute to this:

- Availability of alternative new towels at home (and eventually more beautiful);
- Before had normally used towel (kind of product); place mat only used occasionally;
- Suggestions for decoration of the product (moderate aesthetic appreciation as it is);
- User's age: mid 80's – wanting to get the most of the time left;

Concerning the interrelation of the five aspects, while low aesthetic appreciation seems to influence quality and attachment directly, durability seems independent, and performance may be affected by the kind of product.

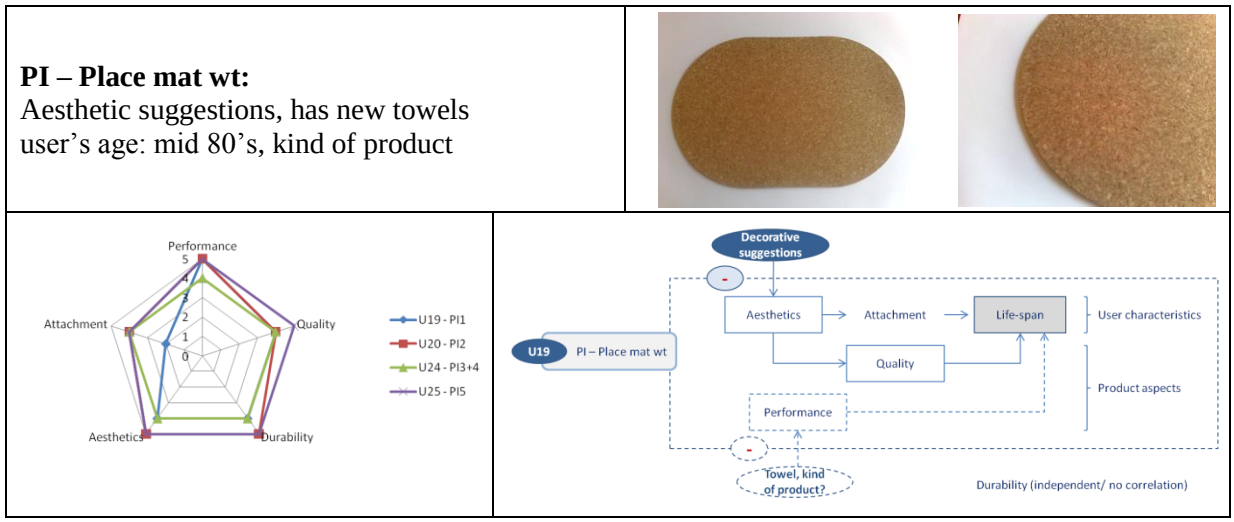


Figure 7. Representation of occurrences regarding the use of PI-Place mat wt

PO – Notebook (U1) [No – low attachment]

In this product there is a binding problem, but the user continued to use it due to aesthetic appreciation. This had already been detected in the previous moment; since then the damage didn't increase much, but the user has been more careful. It has also been used for holding loose paper notes with a binder clip, and 2 sheets got loose. Details of the evaluation and images are presented below (Figure 8). At this moment, the user would return the notebook afraid that more sheets get loose, but doesn't want to because it's beautiful. As such two clear sequences of interrelations can be observed, and resulting in a conflict. This case is an example that when we like something, we may continue using it despite performance deficiencies, or even beyond acceptable functionality.

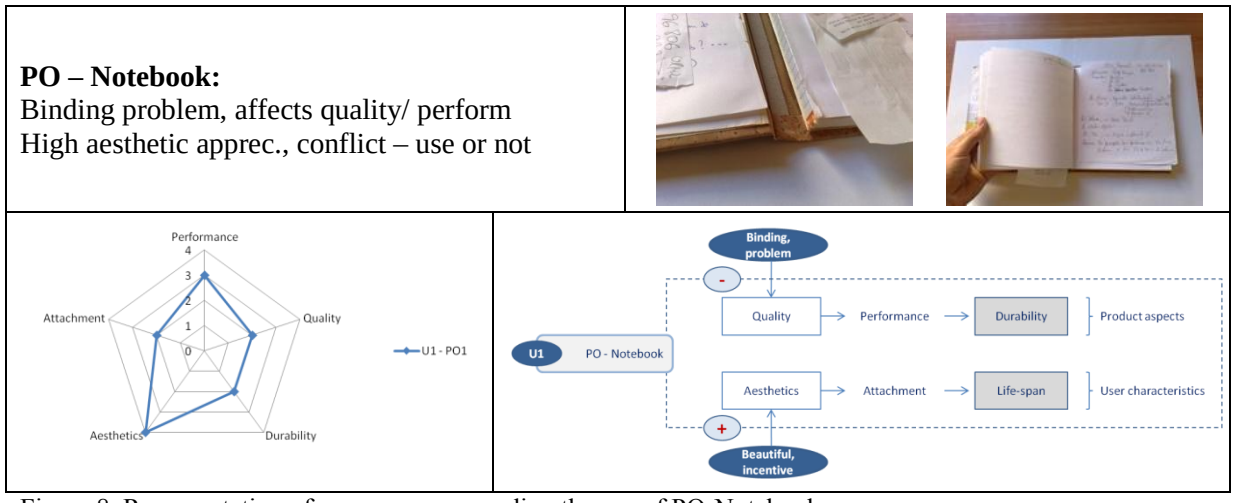


Figure 8. Representation of occurrences regarding the use of PO-Notebook

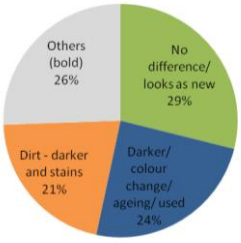
Figure 9. Product attachment exceptions – synthesis of moderate and low attachment cases

	Cases	User motives	Product aspects	User characteristics	Contexts
Moderate attachment (Yes but / [3])	PC – Soap dish 	**low usability and aesthetic appreciation**	usability affecting performance	low aesthetic appreciation mainly due to deterioration	high intensity of use; use of blue and white soap (strong)
		Observations: 'product can last but ugly'			
	PD – Coaster bk 	**not very useful**	kind of product (not very useful)	user habits/ needs	- / (house setting, furnishings (?))
		Observations: product not very useful to user			
	PG – Pan base 	**has others at home**	kind of product, for the house versus personal use	- / (lives with parents, doesn't has own house yet (?))	has others at home
		Observations: product of low(er) interest for the user			
Low attachment (No / [2])	PB – Bath mat wet 	**cat (ill) urinated and use ceased**	looses ink, affecting performance and quality	product changes have aesthetic repercussions; son baths seated in mat	facelift in bathroom, displacement; cat urinated, use ceased
		Observations: one issue (loose ink) triggered multiple problems			
	PI – Place mat wt 	**has new towels at home that wants to use**	kind of product (towel versus place mat)	aesthetic suggestions were made; user's age - mid 80's (little time left)	user has new towels at home (eventually more beautiful)
		Observations: user characteristics are key; had mainly used towel			
	PE – Coaster wt 	**(product complementary of PI – Place mat wt)**	-	- / aesthetic suggestions were made	used in complement of PI – secondary use
		Observations:			
	PO – Notebook 	**eventually loose notes**	binding problem afecting quality and performance	high aesthetic appreciation	- / (use for notes – not permanent record (?))
		Observations: conflict – use or not			
	PR - Pencil case sm 	**low aesthetic appreciation**	Material	low appreciation of aesthetics (material), image and quality (product)	- / (low use – computers (?))
		Observations: user doesn't likes it from beginning (unique situation)			

3.3 Differences observed and material related issues identified

Concerning differences in time observed in the products, these are mainly related with darkening and ageing, or dirt and stains. Other aspects such as corners showing wear are grouped in a single main category; and in several products no differences were noticed, or it was stated that the products look as new. This is presented in the chart below (Figure 10).

With regard to material related aspects, two main issues have been identified: surface changes and water interaction; these could benefit from research and improvement. In the previous moment (three months), surface issues had already been identified. Some surface changes occur early, as can be seen below in the image of the purse coins (dirt/ darkening). This is not necessarily negative because it's easy to clean; in some cases is perceived as ageing, and in enhancing the product aesthetically.



Differences observed in time

Purse coins: surface dirt or ageing

Soap dish: deterioration in centre

Figure 10. Material related issues: distribution of main differences observed and images of two products

The other issue noticed now concerns the interaction of the material with water. Natural cork is rather impermeable (although not entirely), but it is not clear how this property is 'transferred' to other cork materials, and reflected in the products (e.g. in relation with shape). Results indicate that the two products with high water interaction could benefit from improvement; these are the PB – Bath mat wet, and PC – Soap dish. This last one, as presented in the figure above, is already starting to deteriorate in the center, in the situation with higher use intensity.

4. Discussion

At this eight months moment it is interesting to notice that the good/ long durability of the products is already pointed out by several users, even though generally acknowledged as an early evaluation.

Also, it is important to distinguish life-span and attachment. It can be inferred that situations with high attachment may result in long life-spans, but the opposite is not necessarily so: there can be situations of low or moderate attachment resulting in long life-spans, e.g. due to convenience or lack of interest in change (e.g. indifferent products, utensils; pan base situation).

5. Conclusions

It can be concluded that life-span is influenced by multiple aspects, and that there is already important work in the field, although more research is needed.

Concerning the methodology, while the methods employed are common (interviews, photographs), the research design and methodological approach (longitudinal) is original, and for the moment it is considered appropriate. Qualitative research delivers large amounts of complex information, which is naturally time consuming, but results are very enriching.

With few exceptions, the life-span of the cork products is good; the general appreciation and evaluation of the five aspects is good/ very good [4] or excellent [5] for most product-user situations (RQ1).

Concerning the aspects influencing the life-span of the products, several have already been identified, which can be categorized as product aspects, user characteristics, and context related issues. In the analysis of cases with low or moderate attachment, several influencing issues were identified in each case, and belonging to different categories (e.g. product aspects and user characteristics); a single cause is not often or clear yet. This seems to confirm the complexity of the topic (life-span), and the multiplicity of factors involved (RQ2).

As noticed before, the five aspects are indeed interrelated, but this is only perceptible in some situations. As such, more research (cases analysis) is required for further conclusions. Each case provides complementary information and contributes to an enhanced understanding. For the moment there is suggestion that while the 'construction' of life-span (and attachment) requires multiple aspects (good performance, aesthetics,…) the failure of one issue can compromise the whole; hence, the importance of good (whole) products. Additionally, it is also suggested that aesthetics have a significant importance in this process (RQ3).
With regard to the material related aspects, two main issues have been identified: surface changes (as already before) and water interaction. These could benefit from improvement, and are therefore suggestions for further research (RQ4).

Acknowledgements

We gratefully acknowledge the PhD grant attributed to the main author by the Portuguese Foundation for Science and Technology (FCT), enabling this work (FCT reference: SFRH / BD / 46646 / 2008). Furthermore, this would also not be possible without the collaboration of all participants, and who were available without any specific retribution. Thank you!

References

Cooper, T. (2010), The significance of Product Longevity *in Longer Lasting Products. Alternatives to the Throwaway Society*, ed. T. Cooper, Gower, UK, pp.3-36.
Costa, A., Pereira, H. (2007), Montados e sobreirais: uma espécie, duas perspectivas, in *Os Montados. Muito para além das árvores*, Colecção Árvores e florestas de Portugal, Publico, Comunicação Social, SA; Fundação Luso-Americana para o Desenvolvimento. (Corkoak Montado and forests: one species, two perspectives *in The Montado: much more beyond trees*)
Evans, S., Cooper, T. (2010), Consumer Influences on Product Life-Spans *in Longer Lasting Products. Alternatives to the Throwaway Society*, ed. T. Cooper, Gower, UK, pp.319-350.
Fisher, T. H. (2004), What We Touch, Touches Us: Materials, Affects, and Affordances, *Design Issues*, Vol.20, No.4, pp.20-31.
Gil, L. (1998), *Cortiça: Produção, Tecnologia e Aplicação*, INETI, Lisboa. (*Cork: Production, Technology and Application*).
Gil, Luís (2009), Cork and design, Proceedings of the *First International Conference on Integration of Design, Engineering and Management for Innovation IDEMI09*, September 14-15, 2009, Porto, Portugal.
Meadows, D., Randers, J., Meadows, D. (2004), *Limits to Growth: the 30 year update*, Chelsea Green, US.
Mestre, A. (2008), *Design Cork for future, innovation and sustainability*, Susdesign, Lisbon.
Mugge, R. (2007), *Product Attachment*, PhD Dissertation, Delft University of Technology.
Pereira, A.C., Brezet, H., Pereira, H., Vogtländer, J.G. (2011a), Exploring the durability of cork products – a longitudinal approach, *Sustainable Innovation 11, 'State of the Art' in Sustainable Innovation & Design 16th International Conference*, 24-25th October 2011, Farnham, UK.
Pereira, A.C., Brezet, H., Pereira, H., Vogtländer, J.G. (2011b), Cork and sustainability: discussing the sustainable use of the material from a design perspective, *ICEM-10, 10th International Conference on Eco-materials*, 21-24th November 2011, Shanghai, China./ Journal of Shanghai Jiao Tong University, Springer (coming issue, 2012).
Pereira, A.C., Brezet, H., Pereira, H., Vogtländer, J.G. (2011c), Materials and Design: Investigating the Durability of Cork Products – a Longitudinal Study with Users, *EcoDesign 2011*, November 30 – December 2 2011, Kyoto, Japan.
Pereira, J.S., Bugalho, M.N., Caldeira, M.C. (2009), *From cork oak to cork, a sustainable system*, for APCOR (Authors from ISA – UTL, Agronomy Superior Institute – Technical University of Lisbon).
Pereira, H. (2007), *Cork: Biology, Production and Uses*, Elsevier, The Netherlands.
Røpke, I. (1999), The dynamics of willingness to consume, *Ecological Economics* 28, pp.399-420.
van Hinte (2004), *Eternally Yours: Time in Design. Product, Value, Sustenance*, 010 publishers, Rotterdam.
van Nes, N. (2003), *Replacement of Durables; Influencing product lifetime through product design*, PhD dissertation, Erasmus University Rotterdam, 2003.
Vezzoli, C., Manzini, E. (2008), *Design for Environmental Sustainability*, Springer-Verlag London Limited.