Product essentiality: an introduction

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Abstract

This paper introduces the concept of product essentiality within sustainable operations management studies. It investigates the influence of location, gender, and family income on the perception of essentiality of ordinary goods and services. A total of 81 items, were classified according to a binary position of 'essential' or 'superfluous' by business students in both Brazil and UK. The results show there is no significant difference in perception either concerning gender or income in both countries. The only aspect that shapes the essentiality perception is culture. Our study contributes to the debates on operations sustainability and design of sustainable products and processes.

Keywords: Essentiality, Sustainability, Product Development

Introduction

The concept of sustainable development is apparently straightforward, elegant, and simple. However, translating it into practice for countries, cities, companies and even personal life-styles is a difficult task (Barber, 2007). This difficulty relates to the complexity and uncertainty in the design, implementation and assessment of environmental strategies and sustainability performance indices (Bossel, 1999; Boyko et al, 2012; Gasparatos et al, 2009).

In the book 'Our Common Future' (also called the Brundtland Report), the concept of sustainable development is embraced by the statement:

> *"Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs"* (WCED, 1987 p8).

However, the paragraphs that follow this statement are usually neglected. They provide further elaboration on the objectives of development by adding the aspirational needs of humans (i.e. beyond the essential needs):

> "*The satisfaction of human needs and aspirations is the major objective of development. The essential needs of vast numbers of people in developing countries for food, clothing, shelter, jobs - are not being met, and beyond their basic needs these people have legitimate aspirations for an improved quality of life. A world in which poverty and inequity are endemic will always be prone to ecological and other crises. Sustainable development requires meeting the basic needs of all and extending to all the opportunity to satisfy their aspirations for a better life*." (WCED, 1987 p43-44)

Clearly, one will note that sustainable development implies limits although "*not absolute limits, but those imposed by the present state of technology and social organization on environmental resources and by the ability of the biosphere to absorb the effects of human activities*" (WCED, 1987 p8).

Thus, despite the difficulties in applying the concept of sustainable development, two variables are explicitly visible: essentiality (which represents the needs of human beings) and environmental impact (represents the limits for consumption of resources). The latter should be minimised to ensure that future generations have access to natural resources (i.e. avoiding an ecological crisis), without neglecting the former. This is a particularly daunting task in a world where consumption and production systems have been globalised.

While the concept of need is discussed, how to measure sustainability in different contexts, considering their unequal stages of development, is unclear (Nunes et al, 2016). Recent demographic forecasts project the World's population to reach 9 billion in 2050. Currently, more than two thirds of the World population (71%) still live on less than US$10.00 a day. The historical consumption patterns of Western countries tend to be replicated by the population of low-income countries when they become richer. While this is an achievement to be celebrated as the means for having access to essential items and productivity gains, it unfortunately aggravates several environmental concerns and challenges the carrying capacity of our planet.

In a given economic system, the majority of needs and aspirations of people will be met through the consumption products, which can be delivered as goods or services by corporations, public organisations, or professional individuals. The next section presents the literature related to the concept of essentiality.

Literature on Product Essentiality

Essentiality is a concept that has already been used in the natural sciences. It can be found in Geosciences (Scholz and Wellmer, 2013), health sciences and nutrition (Uauy et al, 1998), toxicology (Goldhaber, 2003), and other areas of medicine such as oncology (Denkhaus and Salnikow, 2002).

More recently, Nunes et al (2016) have defined essentiality for social-ecological systems as follows:

> "*(…) a measure of how the consumption of resources meets a system's needs. In societal terms, essentiality is a value given to a unit of consumption relative to its ability to meet a societal need. It can be measured either as the need of an individual, a population or a sub-system (e.g. communities). Through essentiality we conceptualise how available resources can sustain survival*." (p.34)

Every production system is primarily a consumption system. It aims via transformation of resources to aggregate value and meet needs or wants of a consumer. In a discrete sense, the essentiality of processes can be differentiated from the essentiality of products resulting from these processes. For example, the production of a superfluous good can still create jobs that are essential for survival of a community or another social-ecological system (see Figure 1)

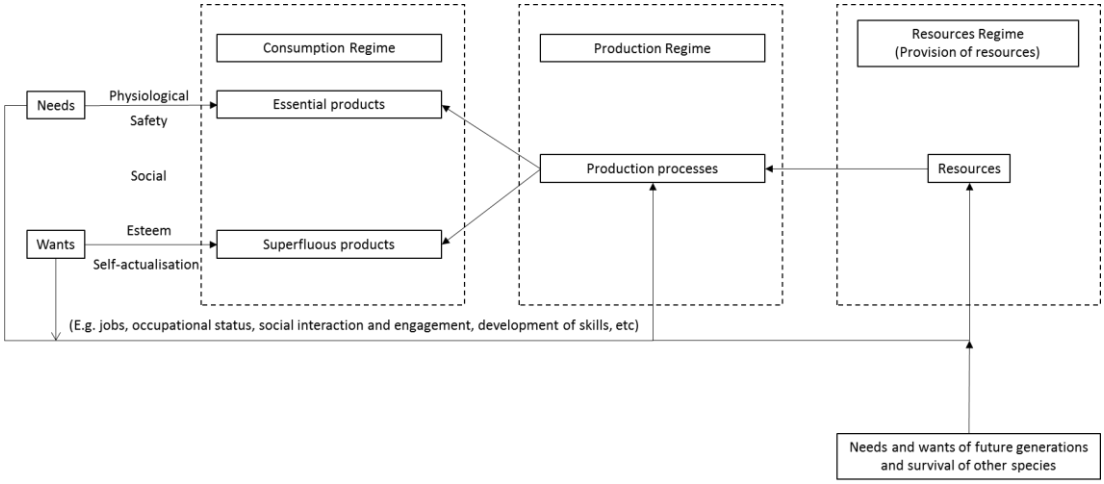

Figure 1 –The relationship of needs and wants with consumption, production, and resources regimes

Indeed, the notion of 'need' has existed for some time in the social sciences. Maslow's hierarchy of needs (Maslow, 1943) and Max-Neef's Human Scale Development (Max-Neef, 1991) are probably the most relevant starting points to discuss essentiality of products.

Maslow's hierarchy of needs has at its basic level the physiological, safety and social needs. These tend to be 'tangible' and essential needs to support the biological survival of beings, while social and psychological factors depend on esteem and self-actualization needs which are more subjective. Physiological and safety needs are fairly much the same for all humans. However, the resources to meet social and psychological needs might vary across cultures, time and geographic regions and so their link to aspirations may be stronger.

Max-Neef's Human Scale Development (HsD) methodology classifies the fundamental universal needs (e.g. protection, affection, etc) and the means or satisfiers

(e.g. food, shelter, etc). The method and choices of satisfying a need will impact on the use of resources.

Nunes et al (2016) explain that Maslow's hierarchy and Max-Neef's HsD provide a starting point to discuss the essentiality of economic and social activities. Consumption and production systems should be discussed in light of the population's needs and then assigned their essentiality levels. The essentiality of each socio-economic activity should be carefully defined. For example, although the food industry is linked to physiological needs, not all products meet essential nutritional requirements. Being a subjective concept, a product's essentiality value depends on cultural aspects and location-specific factors such as climate and infra-structure (Tukker et al, 2008).

Product essentiality is a new concept in the literature and can be assessed objectively and subjectively. While some physiological needs are objective (e.g. water, food), most social and esteem needs (or aspirations) are subjective. It is important to connect the concept with both time and space dimensions. This will reflect the fact that essentiality of products will change over time e.g. as public transport improves, personal car essentiality may fall.

Product essentiality differs fundamentally from the economic concept of utility because the former has at its core the notion of 'need' while the latter will rely on 'desire to consume'. However, both concepts use the logic of unit of consumption to make their case. An additional unit of consumption of an essential good may have its marginal essentiality value reduced if the part of the system's need has already been met (Figure 2).

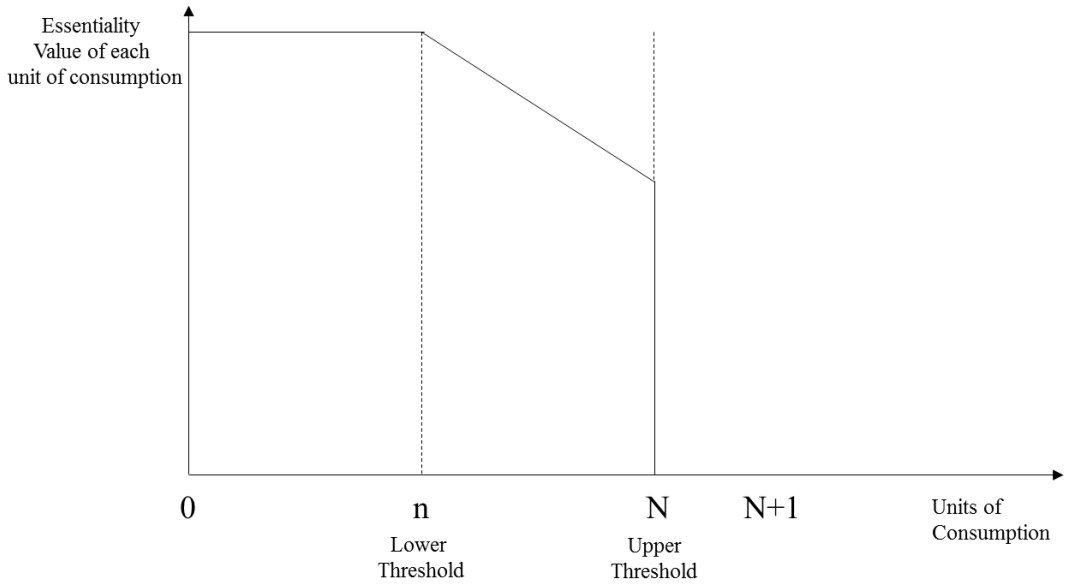

Figure 2 – Example of essentiality values of units of consumption of water

Product essentiality is an original concept and as such has not been directly addressed in the literature. There are however some concepts and approaches relating to individual life-styles that connect to the idea of product essentiality (Lorek and Spangenberg, 2001; Caeiro et al, 2012). For example, sustainable life-styles are advertised as those that consume as few resources as possible or as "mindful consumption" (Sheth et al, 2011), or "rational/reasonable consumption" (Kronenberg, 2007).

The observations of product essentiality alone can help in better understanding product demand and market risks. When associated with a product's environmental impact, the essentiality concept is a powerful tool to assist the development of sustainability policies

for both governments and companies as well as to instruct corporate and functional strategies and product design.

This is particularly important for operations strategy scholars who will take "market needs" as an input to formulate their theories. Obviously, it is also a key aspect for sustainable operations research, which will also benefit from this concept since it can be combined with life-cycle assessments to minimise the overall environmental impact of products and their production processes.

Methodology

An online survey questionnaire was sent to business students in Brazil and UK. A total of 147 students answered the survey in in Brazil and 397 in the UK. The cities of Porto Alegre (Brazil) and Birmingham (UK) were chosen due to their demographic similarities. Items were classified in a binary position of 'essential' or 'superfluous'. A total of 81 items were included in the survey belonging to four different consumption category: consumables, comfort, social, and household appliances (electronics). The list of all items are presented in Appendix A. The binary (e.g. 'essential' or 'superfluous') style of the survey benefited the breadth of items and the speed in responding the questionnaire.

Data collection via online survey has its benefits and limitations. While cost and speed are probably the main benefits of online survey over traditional paper questionnaires, the response rate may be disappointing. The questionnaire was sent to 1,000 students in the UK and 400 students in Brazil. The response rate was 39.7% and 36.75% respectively. In the questionnaire introductory page, it was made clear that the survey was NOT about intention to consume; it was instead about their views whether the item was essential or not.

Data analysis included descriptive statistics and regression analysis. The former allowed a visual representation of essentiality of goods in both countries. The latter allowed a better understanding of the differences according to gender, income, and location. The focus for this paper was not the discrete characteristics of a given product essentiality. Instead, it provides an initial understanding of the overall behaviour of product essentiality given four consumption categories mentioned earlier and the influence of gender, income, and location.

Survey Data Analysis

This section describes the analysis of the responses to our survey on perceived essentiality in Brazil and UK. We calculate the *perceived essentiality level* of a product as the percentage of persons classifying it as *essential*.

Figure 3 shows the difference in perception between the two countries. We plotted each product as a point on a graph for which the horizontal axis corresponds to the perceived level in Brazil and the vertical axis to the perceived level in the UK.

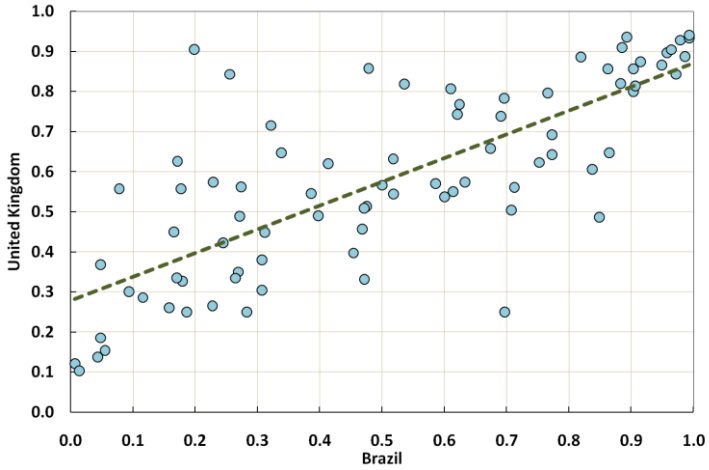

Figure 3 – Online survey on perceived essentiality. Values correspond to levels of perceived essentiality in Brazil (horizontal) and UK (vertical). The dashed line is an adjusted straight line.

For each country, the data were broken down into two subgroups – male vs. female and high vs. low income. The plots of Figure 4 compare the obtained values per country for each of the two subgroups.

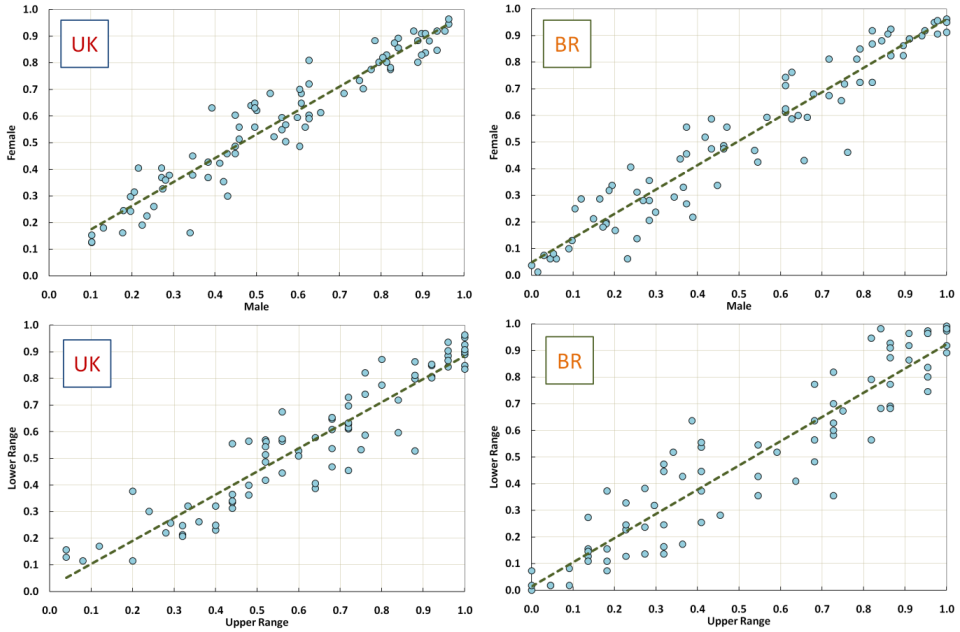

Figure 4 – Data from our essentiality perception survey separated by country and subgroup. Dashed lines are once again adjusted straight lines.

Table 1 contains the coefficients obtained by the adjusted lines as well as the correlation coefficient calculated between the series of values for each axis.

Table 1 – Coefficients of the adjusted lines from Figure4.

	Slope	Intercept	Correlation (ρ)
Brazil vs UK	0.5921	0.2784	0.77
Male vs Female (UK)	0.8958	0.0840	0.95
Male vs Female (Brazil)	0.9138	0.0478	0.96
Lower vs Upper (UK)	0.8622	0.0238	0.94
Lower vs Upper (Brazil)	0.9093	0.0144	0.93

The table reveals an unexpected behaviour. According to the answers to the survey there is no significant difference in perception concerning *gender* or, even more strikingly, concerning *income* in both countries. Equality of perception is represented by a diagonal line. We can see that the slope is very close to 1 and that the intercept is very close to 0, showing that the lines are almost diagonal. Also, the spread around the adjusted lines is very small, which can be seen by the very high value of the correlation coefficients.

Compared with the internal data, the difference between countries is very clear. While the difference between subgroups is at most 0.03 in the same country, the difference between countries is around 0.2.

The similarity in perception across gender might be due to the fact that most products in the survey are not usually attributed to the particular culture of any of them. Some products, however, present such a high difference that it is interesting to list some of them. For instance, in Brazil, the greatest disagreement concerns 'drinking fruit juices daily'. It has an essentiality of 0.76 to men and only 0.46 to women. Curiously, the same product in the UK is rated 0.45 by men and 0.60 by women, showing the opposite behaviour in the two countries. Yet in another example, in the UK e-books are rated 0.63 by women and only 0.39 by men.

Most surprising is the comparison between the upper and lower income range in both countries. If it is assumed that the higher income person will be able to afford a larger basket of products, it is reasonable to expect a smaller correlation between the two ranges, but this is not what is observed. A possible explanation might be on the profile of those who answered the survey. A large amount of data came from students who, although might be part of similar economic classes, would allocate their income range within what they earn themselves, even if most of their money comes from their parents.

The above presented data describes a scenario in which the perception of what is essential is strongly shaped by each country's culture and therefore influences the groups within it in much the same way, which is reflected by the difference in the correlation coefficients of the Brazil vs UK full data. However, this correlation is still high (0.77), which is not entirely surprising given the cultural similarities (both are western hemisphere democracies).

Another interesting piece of information provided by our data is that the plots show that UK based respondents are much more inclined to classify products as essential than Brazilians. This might be due to the fact that many of those products might be more affordable in Europe, which would make them more widely used and create a buying habit that would make the product be perceived as essential.

Figure 5 shows a comparison chart depicting the values of the essentialities perceived in Brazil *minus* the values in the UK. The products are organised according to four main categories. It is clear that many more products are considered essential in the UK than in Brazil. The only category in which essentialities are greater in Brazil is that of consumables, most of them being food and drink items.

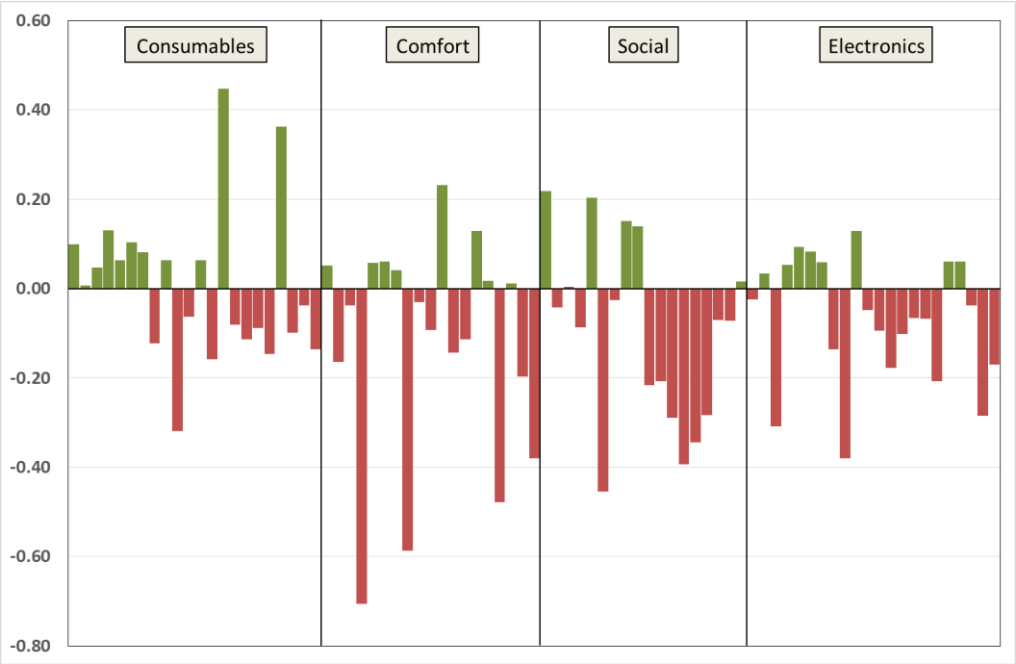

Figure 5 – Difference in perceived essentiality (Difference = Brazil – UK) for all products in the survey. The data is separated in four categories by vertical lines, the names of which are indicated in the grey text boxes on the top of each band.

Conclusions

This paper introduces the concept of product essentiality as part of the sustainable operations management agenda. Sustainable operations literature has traditionally been linked to efficient use of resources and socially-fair practices. It has deliberately avoided being judgemental over the need of products and processes for individual, communities, and wider social-ecological systems (e.g. regions, countries, etc). In this paper, we have shown that there might be significant differences in the perceptions of product essentiality based on country and cultural differences through a comparison of Brazil and the UK. However, the research is without its limitations. First, we acknowledge the methodological limitations due to the use of a binary choice in the questionnaire, the sample method, which focused on similar-age individuals, and finally, the number of products classified. Still, the results show that the topic merits further investigation. Hence, an agenda for future research in the field of sustainable operations management is recommended below

Future research on essentiality should include more in-depth and focused study on a single particular segment of items allowing the use of Likert scale or experiments in sustainable consumption and production systems. Other variables influencing the perception of essentiality should also be included (e.g. age of consumer, age of product, number of substitute products, etc).

Another option to enhance the significance of the essentiality concept may include: a cross-data analysis against product environmental impact. For industrial policy and

operations strategy studies, a recommendation is to investigate the connection of essential and superfluous consumption versus local and global production systems. In the agenda of supply chains, product design, or new product development, it would be useful to examine the evolution of product essentiality over time, i.e. the connection between product essentiality and product life-cycle.

The introduction of a new concept to operations management literature is seen as one of the theoretical contributions of this paper. The findings presented here are empirical contributions that illustrate the meaningfulness of the concept. As for the practical contribution, the paper is quite timely since several countries are currently discussing reforms in their tax system to battle dysfunctional characteristics of modern societies (e.g. obesity, inequality, drug and alcohol abuse, etc). Reflecting about what is essential and what is not for both consumption and production is a primary step to fight socio-economic and ecological dysfunctions.

References

Barber, J. (2007). "Mapping the movement to achieve sustainable production and consumption in North America". *Journal of Cleaner Production*, 15(6), pp. 499-512.

Bossel, H. (1999). *Indicators for sustainable development: theory, method, applications*. International Institute for Sustainable Development. Winnipeg: Canada, pp 138.

Boyko, C. T., Gaterell, M. R., Barber, A. R., Brown, J., Bryson, J. R., Butler, D., Caputo, S., Caserio, M., Coles, R., Cooper, R., Davies, G., Farmani, R., Hale, J., Hales, A. C., Hewitt, C. N., Hunt, D.V.L., Jankovic, L., Jefferson, I., Leach, J.M., Lombardi, D.R., MacKenzie, A.R., Memon, F. A., Pugh, T. A.M., Sadler, J.P., Weingaertner, C., Whyatt, J.D., & Rogers, C. D. (2012). "Benchmarking sustainability in cities: The role of indicators and future scenarios". *Global Environmental Change*, 22(1), pp. 245-254.

Caeiro, S., Ramos, T. B., & Huisingh, D. (2012). "Procedures and criteria to develop and evaluate household sustainable consumption indicators". *Journal of Cleaner Production*, 27, 72-91.

Denkhaus, E., & Salnikow, K. (2002). "Nickel essentiality, toxicity, and carcinogenicity". *Critical reviews in oncology/hematology*, 42(1), pp. 35-56.

Gasparatos, A., El-Haram, M., & Horner, M. (2009, September). "The argument against a reductionist approach for measuring sustainable development performance and the need for methodological pluralism". *In Accounting Forum*, Vol. 33, No. 3, pp. 245-256.

Goldhaber, S. B. (2003). "Trace element risk assessment: essentiality vs. toxicity". *Regulatory toxicology and pharmacology*, 38(2), pp. 232-242.

Kronenberg, J. (2007). "Making consumption reasonable". *Journal of Cleaner Production*, 15(6), pp. 557-566.

Lorek, S., & Spangenberg, J. H. (2001). "Environmentally sustainable household consumption: From aggregate environmental pressures to indicators for priority fields of action" (No. 117). Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany, pp. 57.

Maslow, A (1943) "Theory of Human Motivation", *Psychological Review*, 50 (4) pp. 370-96.

Max-Neef, M., (1991). *Human scale development: conception, application and further reflections.* The Apex Press, New York, USA, pp. 114.

Nunes, B., Alamino, R. C., Shaw, D., & Bennett, D. (2016). "Modelling sustainability performance to achieve absolute reductions in socio-ecological systems". *Journal of Cleaner Production*, 132, 32-44.

Scholz, R. W., & Wellmer, F. W. (2012). "Approaching a dynamic view on the availability of mineral resources: What we may learn from the case of phosphorus?". *Global Environmental Change*, 23, 11-27

Sheth, J. N., Sethia, N. K., & Srinivas, S. (2011). "Mindful consumption: a customer-centric approach to sustainability". *Journal of the Academy of Marketing Science*, 39(1), 21-39.

Tukker, A., Emmert, S., Charter, M., Vezzoli, C., Sto, E., Munch Andersen, M., Geerken, T., Tischner, U., and Lahlou, S. (2008). "Fostering change to sustainable consumption and production: an evidence based view". *Journal of cleaner production*, 16(11), pp. 1218-1225.

Uauy, R., Olivares, M., & Gonzalez, M. (1998). "Essentiality of copper in humans". *The American journal of clinical nutrition*, 67(5), pp. 952S-959S.

WCED, World Commission on Environment and Development, (1989), *Our Common Future*. Oxford: Oxford University Press, 1987.

Appendix A

Product or Service			
Consumables	**Comfort**	**Social**	**Household appliances (electronics)**
Two meals a day	Beds and bedding for everyone	Two pairs of all-weather shoes	Oven/stove
Fresh fruit daily or every other day	Reclined chairs to watch TV, read a book, play video games, etc	Appropriate clothes for job interviews	Barbecue Grill
Vegetables daily or every other day	Bedside tables	Roast joint/vegetarian equivalent in a restaurant once a week	**Toaster**
Medicines prescribed by doctor	**Heating to warm living areas of the home**	Presents for friends/family once a year	Refrigerator
Beef, chicken, fish or equivalent daily or every other day	Air conditioner	**A holiday away from home once a year not with relatives**	Replace or repair broken electrical goods
Potato, Rice, Spaghetti or another source of starch equivalent daily or every other day	Safe and damp-free home	**Replace worn-out furniture**	Washing machine
Bread daily or every other day	Visiting friends or family in hospital	**Dictionary**	**Car**
Milk daily or every other day	**Warm, waterproof coat**	**Hardcopy of university text books**	Conventional landline Telephone
Fruit juices daily or every other day	Celebrations on special occasions such as Christmas	Hardcopy science fiction, thrillers, novels books	**Deep freezer/fridge freezer**
Soft drinks daily or every other day	Ornaments to keep home in a decent state of decoration	E-books	Television
Alcoholic drinks such as Beer, wine or spirits on the weekends	Visits to school, e.g. sports day	**New, not second-hand, clothes for social occasions**	Microwave oven
Coffee or Tea daily or every other day	Attending weddings, funerals	Attending place of worship	Video cassette recorder
Eggs every daily or every other day	Insurance of contents of dwelling	Coach/train fares to visit friends/family quarterly	Tumble dryer
Beans daily or every other day	Hobby or leisure activity	An evening out once a fortnight	CD player
Yogurt every other day	Collect children from school	Gown or suit for weddings, work, and other occasions	Home PC computer
Cigarettes every other day	Carpet floors in living rooms and bedrooms	Having a daily newspaper	Laptop computer
Cigars on special occasions	TV stand	Going to a bar/pub once a fortnight	Dishwasher
Chocolates every other day	Curtains / Blinds	**Holidays abroad once a year**	Mobile phone / Smart Phone
Mineral water (NOT tap water) daily	Rugs, mats or similar in the house		Daily access to the Internet
Sparkling water every other day			Satellite television
Muffins, custards, pudding, and other types of sweets every other day			Tablets computers
Microwaveable / ready meals every other day			Video game console

*** Items in bold had a significant difference between their essentiality perception in Brazil and UK.**