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A Classification of Consumer Involvement in New Product Development

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Abstract

Processes such as co-design, crowdsourcing and open design are challenging previously held notions about the role of the consumer within New Product Development. The degree and validity of consumer involvement in product creation varies according to the process concerned, however to date little research exists to classify this involvement. In this paper the New Product Development process is divided into four phases: conception, specification, design and manufacture. The ability of the consumer to influence each phase when engaged in design activity is assessed. A graphical classification of New Product Development strategies is presented, mapped against the commitment of the designer to consumer involvement, and a number of new categories of design are proposed. The changing role of the designer from interpreter to facilitator of consumer wishes is also discussed.

Keywords:

New Product Development; Design Processes, User Participation; Consumer Design

In recent years the notion that industrial design is an activity in which anyone can take part has become increasingly common. Design has been described as everything from “the teacher arranging desks for a discussion [to] the team building a rocket” (Dubberley, 2004). According to Norman (2004: p.224), deciding where to put your coffee cup and book is an act of design. Within mass customisation literature it is common to read of the “user-designer” or “user as designer” (e.g. Ciccantelli and Magidson, 1993; Franke and Piller, 2004; Koren and Barhak, 2007), and even that “the professional designer is replaced by the user,” (Randall, Terwiesch, and Ulrich, 2003). Unsurprisingly, such assertions have caused consternation amongst design practitioners, who sense that their skills and professionalism have been misunderstood and devalued¹. They point out that the consumer choices often presented as ‘design’ represent only a fraction of the tasks a designer will undertake in the course of a typical project (Parsons, 2009). Some have attempted to simply shut down the argument by protesting that “Consumers consume; designers design. End of Story” (Duffy and Keen, 2006).

Yet this polarisation of the argument into two extremes, summarised as either “everyone is a designer,” or “only professional designers can design,” has done little to illuminate the

1. See for example <http://boards.core77.com/viewtopic.php?t=16060>

ways in which new technologies and processes have allowed consumers to engage in the design of their own products (Stappers, Visser and Kistemaker, 2011; McGuirk, 2012). Fischer (2002) notes the over-simplification of this position when suggesting that 'consumer' and 'designer' are not binary choices, but that a continuum exists between the two. To date however, little research exists to compare the extent to which new methods of design enable the consumer to engage in design activities. Olsson (2004), whose classification of degrees of user involvement defines users as co-operation partners, informants or subjects, is a notable exception. However by concentrating on the traditionally modelled design process, Olsson's classification excludes user interventions through (for example) mass customisation, 'modding' and crowdsourcing. Etgar (2008) considers mass customisation in a model of consumer involvement in production, but again focuses only on activities mandated by the manufacturer in a traditional model of product development.

The New Product Development (NPD) Process

Walton (1999) presents four models of product development (see Figure 1). In addition Perks, Cooper and Jones (2005) construct a NPD model based on Cooper's (1994) stage gate process. These can be broadly defined² as follows:

Definition: The identification of a consumer need or market opportunity, and an initial identification of a product archetype (or lack of existing archetype) which might meet that need.

Specification: A list of the characteristics of a product which would be required to satisfy the previously identified consumer need, including modularity and customisation strategies if applicable.

Design: The process by which an agreed solution to the specification is arrived at; it includes industrial, engineering and process design functions.

Manufacture: Pilot production and ramp up to full production of the designed product.

Within this paper, NPD refers to the development of consumer products (including consumer electronics, furniture and household goods, personal transportation and FMCG) and professional products (including office, scientific and medical products, public transportation, heavy machinery and military). It does not include graphic and user experience design, fashion design, or architectural and interior design, and so the conclusions of the paper should not be taken as applicable in these fields.

2. The fifth stage in Anderson's process - 'Follow Up' - and Perks, Cooper and Jones's process - 'Launch' - is discounted in this case.

| | | | | |
|----------------------------|------------------------|---------------------|-----------------------------|--|
| Clark & Fujimoto (1991) | Product Definition | Product Planning | Product Engineering | Process Engineering |
| Wheelwright & Clark (1992) | Concept Development | Product Planning | Product/Process Engineering | Pilot Production/Ramp Up |
| Ulrich & Eppinger (1995) | Concept Development | System-level Design | Detail Design | Testing & Refinement Production Ramp Up |
| Anderson (1997) | Product Definition | Architecture | Design | Ramp Up |
| Perks et al (2005) | Identification of Need | Concept Generation | Design and Development | Production |
| Authors (2014) | Definition | Specification | Design | Manufacture |

Figure 1: Models of New Product Development, adapted from Walton (1999) and Perks et al (2005).

Approaches to Design within NPD

Past definitions of design within NPD have typically viewed the consumer or end user as an external component, either as an influence on the solutions that designers arrive at, or as part of a target market (Holmes and Azam, 1995; Pahl and Beitz, 1996; Clarkson and Eckert, 2005). Furthermore, definitions of industrial design, for example, in referring to ‘mass manufacture’ or ‘volume production’ (e.g. McDermott, 2007; Design Council, 2010) have increasingly proved inadequate at describing design for mass customisation or rapid manufacture, in which low volume or even unique products are the outcome.

This problem is overcome somewhat in definitions of design which stem from an observation of process, rather than a description of the service which professional designers offer. Fiell and Fiell (2003) for example, describe industrial design as

“the conception and planning of products for multiple reproduction - [it] is a creative and inventive process concerned with the synthesis of such instrumental factors as engineering, technology, materials and aesthetics into machine-producible solutions that balance all user needs and desires within technical and social constraints.”

This definition is not without weaknesses: the term ‘multiple reproduction’ is problematic in this context. Importantly though, by listing the tasks typically undertaken by the designer, the definition suggests the possibility of quantifying the extent to which the consumer is acting as a designer, rather than a simple yes/no classification. This paper exploits such a

possibility in order to ascertain the degree of consumer involvement in design in each of the four stages of NPD given in the table above.

It may be noticed that throughout the paper the term 'user' rarely appears. This follows Redström's (2008) contention that traditional ways of describing design, and its reliance on ever more sophisticated methods of understanding the user, break down in situations where users themselves participate in acts of designing. In such situations the commonly accepted necessities and practices of user centred design and user research become confused, if not nonsensical. Redström proposes instead that there are two ways of defining a product's use: the definition which designers do in predicting a product's usage, and the definition which users do in actualising it. The example is given of the record player, whose redefinition by hip-hop DJ's as a musical instrument was entirely unforeseen by audio equipment designers. This paper continues that theme by considering acts of customisation and appropriation, but goes beyond the redefinition of existing products to consider the consumer's involvement in the design and definition of products yet to be manufactured. In such situations the term user seems paradoxical: "there must be something to use for actual use to happen" as Redström puts it. Thus the terms 'consumer designer' and simply 'consumer' are preferred.

Conventionally designed products

For the purpose of this classification, conventional products are those whose definition, specification, design and manufacture occur with no consumer input. Such products are created using a process first identified by Archer (1965) in which "readily available information" on users is collected before the "Creative Phase" begins. Thus techniques such as trends analysis and consumer feedback (on existing products) may inform the creation of a conventional product, but the consumer's first engagement with the product will be during his/her decision as to whether to purchase it.

Bespoke products

Bespoke products are those whose specification and/or design occur with direct input from the individual consumer, usually through personal consultation with the designer or manufacturer. The term originated in the 17th century to describe individually tailored clothing, made to the customer's specific measurements and requirements (Mahon, 2005). Nowadays bespoke is used to describe products as diverse as watches, shoes, wallpaper and computer software, though in consumer goods markets it is typically understood to signify high cost, often handmade, luxury items.

Customised products

Customised products are conventional products whose specification and/or design and/or manufacture are modified by the individual consumer after purchase. Crucially, such modification occurs without the manufacturer's express permission, and although such activity, (when carried out by individual consumers) is largely tolerated or ignored, the legality of customising products is something of a grey area (Oram, 2005). One of the best known genres of customised products are 'hot rods' - cars whose engines and bodywork are modified to improve performance or alter the appearance.

Mass Customised products

Mass customised products are those whose specification and/or manufacture occur with direct consumer input, usually through online configuration tools. The concept has been defined variously as “the ability to provide your customers with anything they want profitably, any time they want it, anywhere they want it, any way they want it,” (Hart, 1995), and less dramatically as “a strategy that creates value by some form of company-customer interaction at the fabrication/assembly stage of the operations level to create customized products with production cost and monetary price similar to those of mass-produced products,” (Kaplan and Haenlein, 2006). In practice this typically involves the consumer choosing from pre-determined selections in order to configure a product uniquely suited to their own requirements; the Dell computer and NikeiD websites are two of the best known examples.

User centred design and Co-designed products

User centred design and co-design are closely related, though distinct, approaches to increasing the involvement of users in the product creation process. Definitions of each do not always concur, (see for example Vredenburg et al, 2002 and Black, 2006), however the purpose of this classification is to determine the degree of user involvement in the design of products, rather than the methods employed, and in this the literature is in general agreement: user centred design involves observation, whereas co-design involves participation (Sanders and Stappers, 2008; Binder, Brandt and Gregory, 2008; Press, 2011: p.519). User centred design products therefore refer to products whose definition and/or specification occur only with *indirect* individual consumer input - users are observed in context and may even be invited to give opinions on product concepts, but are unable to contribute directly to the creation of a product. Co-design products, in contrast, are those whose definition and/or specification and/or design occur with direct consumer input, by working with professional designers in a collaborative effort.

Crowdsourced products

Crowdsourcing refers to products whose definition and/or specification and/or design occur with multiple direct consumer inputs. Crucially, it involves an ‘open call’ to any interested consumers to submit designs or help solve a problem (Howe, 2006a); potential solutions are then discussed, vetted and (in some cases) voted on by ‘the crowd’ with the purpose of arriving at a popular solution which then moves forward to production (Howe, 2006b). It is particularly important to stress that crowdsourcing is not the same as either open source or open design (defined below), since although solutions will have been generated openly, the intellectual property (IP) of crowdsourced products will be owned by the company or entity which first initiated the call for solutions (Brabham, 2008). Kleeman,

Voß and Rieder (2008) identify seven types of crowdsourcing, of which the first two - participation of consumers in product development and configuration, and product design - are relevant to this research.

Open design products

Open Design is an approach, closely related to Open Source, "characterised by the free revealing of information on a new design with the intention of collaborative development of a single design or a limited number of related designs for market or nonmarket exploitation" (Raasch, Herstatt and Balka, 2009). Katz (2011: p. 63) characterises Open Design as:

"bear[ing] four freedoms. One: The freedom to use the design, including making items based on it, for any purpose. Two: The freedom to study how the design works, and change it to make it do what you wish. Three: The freedom to redistribute copies of the design so you can help your neighbour. Four: The freedom to distribute copies of your modified versions of the design to others so the whole community can benefit from your changes. Access to the design documents is a precondition for these freedoms."

Within this classification therefore, open design products are those whose IP rights have been relaxed by the owner such that their conception and/or specification and/or design and/or manufacture may be changed with direct consumer input. Subsequent IP rights accrue to the consumer, though a condition of some open source licences is that subsequent works must be offered under the same terms (see for example the 'Attribution-Share-Alike' licence from Creative Commons).

'Opened design' products

Despite the general acceptance of Katz's definition of open design (see also, for instance, Avital, 2011: p. 55), the strict conditions of the definition means that products which allow modification but which restrict distribution (for example) cannot be classed as open design. For this reason a new term, 'Opened Design', has been conceived to describe products whose IP rights have been relaxed by the owner, but not to the same degree as with open design. Opened design products are therefore those whose original specification and/or design may be changed with direct consumer input. Subsequent IP rights may accrue to either the consumer or the original owner, depending on the terms of the license. Opened design as a recognisable genre of products can first be identified amongst PC games, where increasing internet access amongst gamers saw the rise of fan-based websites and the sharing of knowledge needed to change a game's code to introduce new rules, characters, scenarios, etc. (Postigo, 2003). Rather than attempt to stamp out this IP-infringing activity, games companies recognised the value it brought in terms of increasing the longevity of sales, bug fixing, market research and prototyping of new concepts, all of which were carried out, for free, by dedicated hobbyists. Nowadays such activity is often encouraged through the free distribution of software development kits (SDK's).

| | Conception | Specification | Design | Manufacture |
|------------------------------|------------|---------------|--------|-------------|
| Conventional Products | No | No | No | No |
| Bespoke Products | No | Yes | Yes | No |
| Customised Products | No | Yes | Yes | Yes |
| Mass Customised Products | No | Yes | Yes | No |
| User Centred Design Products | No | No | No | No |
| Co-Design Products | Yes | Yes | Yes | No |
| Crowd-Sourced Products | Yes | Yes | Yes | No |
| Opened Design Products | No | Yes | Yes | No |
| Open Design Products | Yes | Yes | Yes | Yes |

Figure 2: Summary of direct consumer involvement in NPD.

A Classification of Consumer Involvement in NPD

Figure 3. shows a classification of the types of consumer involvement in industrial design defined above, mapped against two axes: the degree of consumer involvement and the degree of the designer's commitment to that involvement. A number of issues are raised by this classification, and are examined below.

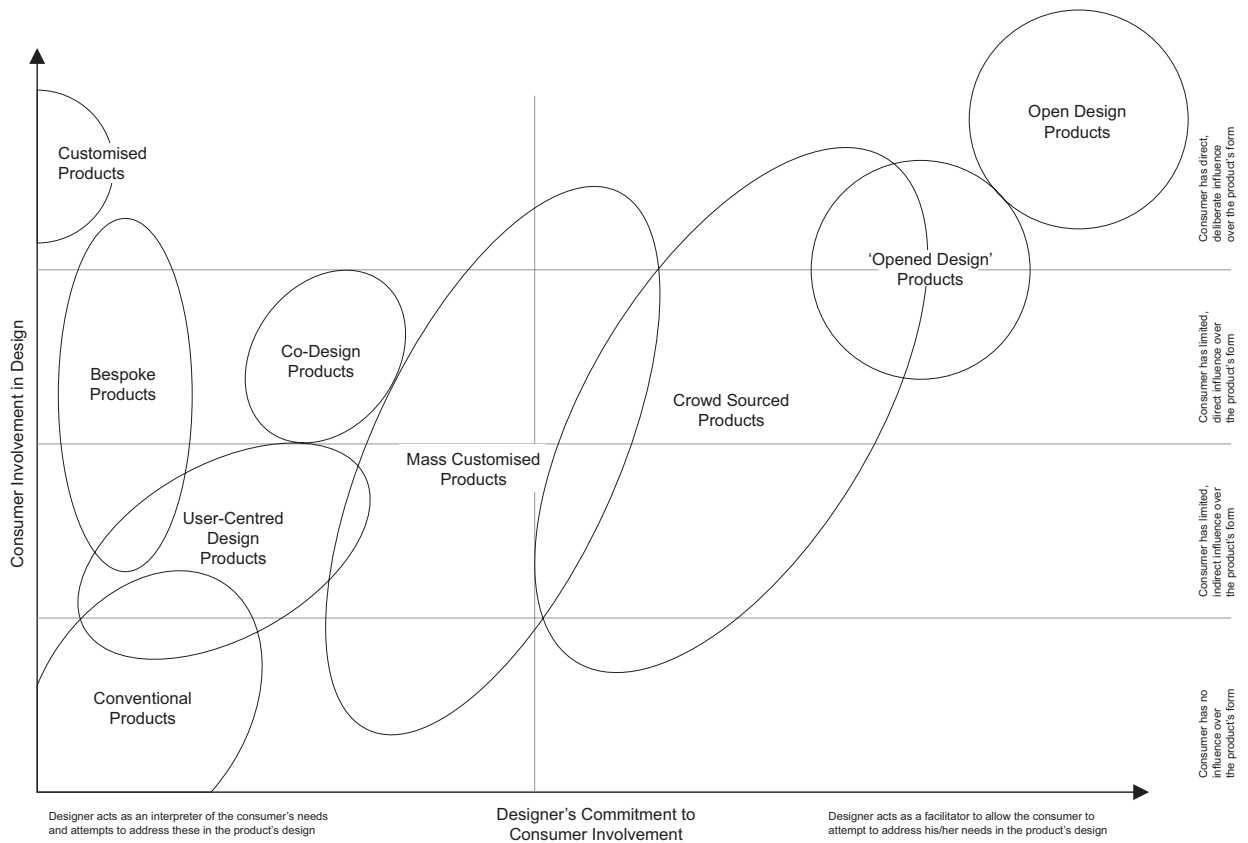


Figure 3. A classification of consumer involvement in New Product Development

The Consumer's Involvement

The extent of consumer involvement in NPD is based on two factors. Firstly, the more phases (Conception, Specification, Design and Manufacture) that a consumer is able to influence, the higher the degree of overall involvement; thus open design products represent a high degree of involvement because the consumer has the possibility to exert influence in all four phases. Conversely a conventional product, which offers the consumer no possibility of influencing a product's development at any phase, represents a low degree of involvement. Secondly, consumer involvement is also measured by the effectiveness of the consumer's influence, i.e. the extent to which their needs and opinions affect the creation of the product. Bespoke products, for example, allow the customer to influence only two phases: specification and design. Many bespoke products reflect this limitation and are only slight variations of a standard product, perhaps made in a unique colour or material, or incorporating an engraved logo. On the other hand bespoke offerings also allow for the creation of highly individualised products, a handmade shoe or bicycle for example, 'tailored' to the unique measurements of the customer. Thus the bespoke category spans an area ranging from a relatively low to a relatively high degree of consumer involvement.

The types of NPD with which this research is concerned mean that both the degree and the effectiveness of consumer involvement are manifested in the three dimensional form of a tangible object. It is therefore possible to subdivide the vertical axis of consumer involvement into four regions corresponding to an increasing influence over the product's form. At the lowest level of involvement the consumer has no influence over a product's

shape. This is the region in which most conventional products appear, offering consumers no possibility of influencing the product's design. Many mass customised items, despite giving consumers opportunities to decide the configuration or performance of their products, also appear in this category, since the type of customisation offered has no consequence for the product's external form.

At the second level of consumer involvement the consumer is able to exercise limited, indirect influence over product form. Such influence can take two directions; in the first, particularly with regard to user-centred design products, it is exerted through interactions with the product's designer, whose expertise determines the extent to which those interactions modify the object's design. Whilst the theoretical possibility exists for the consumer to significantly influence a product's form in a user-centred design process, any such influence is mediated through the designer and therefore always applied indirectly. The second method of influence applies particularly to mass customised products, and occurs when a product's form (usually its size) can be changed to accommodate a certain fit. Thus a consumer involved in mass customising a shoe (for example) can only influence its form in a way which is both limited (to the size of the customer's foot) and indirect (if a particular size is not offered then no further opportunity for involvement is possible).

It is at the third level of involvement that the consumer begins to exert direct (albeit still limited) influence over product form. In the majority of cases this influence will occur through the consumer's selection of parts, components or modules which, when assembled, modify or dictate the product's shape. The ability of selections to modify a product's shape may be relatively minor (for example choosing to add a sunroof or rear spoiler to a new car) or they may extend to control of the whole of the product's form (for example when determining a kitchen's layout using standardised cabinets and appliances). In both cases however, the opportunity to influence form is limited to the number and type of components available; in that sense the form is always expected, even if it cannot be precisely predicted.

Only at the fourth level of consumer involvement do opportunities for true consumer design arise. In this region of the classification, influence over the product's 3D form is both direct and deliberate, i.e. the consumer can define form without the need for the designer's approval and without the limitations of predetermined modules or components. This is not to say that no constraints exist - clearly the consumer-designed object will need to take account of the realities of production and operation in the same way that any professionally-designed object would. However the key determining factor for a product to appear at this level in the classification is whether its form can be freely manipulated within the constraints necessary for its manufacture, and more importantly, whether the results of this manipulation can be manufactured without the designer's explicit consent.

The Designer's Commitment

The commercial realities of the design and mass manufacture of products are such that the designer involved in NPD is rarely at liberty to act as a free agent. That said, at the point at which a product brief is conceptualised through to the point where a final design is agreed, the designer must act as arbiter of these influences. This paper therefore refers to the 'designer's commitment', whilst acknowledging that the designer may not have direct responsibility for all of the decisions s/he is required to implement.

The designer's commitment to consumer involvement in product creation is partly a measure of how much autonomy the consumer has in making decisions, but also of how much autonomy the designer consciously 'hands over' to the consumer. Customised products allow the user considerable freedom in decision making about a product's functionality, its appearance and the tools and methods used to customise it. Nonetheless, such decisions are taken *in spite of* the designer's vision, rather than as a result of his/her intent. Thus customised products exhibit a high degree of consumer involvement, but a very low degree of designer's commitment. This can be contrasted with opened design products, where the designer must make a deliberate decision, not only to allow the consumer to change the product, but to help the user to do so, either by providing the tools or by supplying the product in an easy-to-modify format.

In moving along the horizontal axis from left to right, increasing the consumer's opportunity to affect decisions about a product's creation, it becomes clear that not only the nature of the designer's relationship with the consumer changes, but also the nature of the designer's own work. On the left of the diagram, the designer acts as an interpreter of consumer needs and wishes. Whether these are understood by acting on intuition, or reading research reports, or even talking directly to the consumer, the power to make decisions about the product's creation, its form and its ultimate usage lie with the designer and the designer's clients. This "executive approach" (Oudshoorn and Pinch, 2003: p.7) "assumes a specific type of power relations... in which designers are represented as powerful and users as disempowered relative to the experts." Perhaps understandably, this is a situation which designers are often keen to see perpetuated. Krippendorff (op. cit: p. 268), for example, writes that

"medicine could be a good model for design... [they both] are practical professions that fix things: in the case of medicine, restoring biological normalcy and in the case of design, proposing something better... Medical discourse enjoys an enormous respect by nonpractitioners. Patients are in awe of its vocabulary, and know just enough to find a doctor and pay the bills for treatment often beyond their comprehension... design discourse can acquire a comparable understanding if it adopts an easily recognizable and productive boundary."

The undisguised insinuation in such a statement is that those with no formal training should not be allowed to practice design, any more than those with no training should be permitted to conduct surgery. The consumer's role is simply to pay for design without understanding how it is conducted. Similar sentiments are often expressed by practitioners; Marc Newson, for example, has stated that he "lack[s] faith in consumer's ability to know what they want," and that "democratisation ultimately pollutes design," (quoted in Pacey, 2009).

However, as the different design methods presented above demonstrate, some design professionals have begun to challenge this perspective. In moving along the horizontal axis at a certain point the traditionally unchallenged power relationships between designer and consumer changes: having passed this point, the designer no longer acts as an interpreter of needs, but instead as a facilitator (Siu, 2003) to allow the consumer to address his/her own requirements. Such a designer will have given up a significant degree of control over the way in which the product manifests itself, and will have entered the realm of what Tonkinwise (2005) describes as the design of "things that are not finished." Increasingly developments in manufacturing technologies which allow low

volume or one-off production have been recognised as offering such potential (Campbell et al, 2003).

Consumer Design

The realisation that some consumers are both interested and skilled enough to design and manufacture their own products has provoked considerable debate amongst practicing designers, including an IDSA conference dedicated to the subject in Summer 2010³. Nonetheless the scope of consumer design, and the extent to which consumers are able to act as designers of products, remains widely contested.

The top strata of consumer involvement shown in Figure 3, in which the consumer has direct, deliberate influence over a product's form, is the area in which consumer design is manifested. The primary criteria for a product or process to be considered an example of consumer design is that the design activity is undertaken by a non-professional: this may be the work of a lead user as conceived by von Hippel (1986), a so-called pro-am (professional-amateur) as described by Leadbeater and Miller (2004), or a relatively unskilled consumer who has been provided with easy-to-use tools. Within the definition of consumer design a number of sub-sections exist as shown in Figure 4. These broadly relate to the level of freedom given to the consumer as the designer's commitment to consumer design increases, and are considered further below.

Appropriated Consumer Design (ACD)

Appropriated consumer design refers to design activities which the owner of the product's IP rights has not sanctioned. One manifestation of ACD is the previously mentioned modification of cars to create hot rods, computer 'modding' (upgrading components, over-clocking processors, fabricating individual cases, etc) is a more recent manifestation of the same activity. ACD also emerges in situations where consumers are unable to purchase goods to satisfy their needs and are forced to recycle or reuse products in creative ways; examples include tools fabricated by prisoners as documented by Temporary Services (2003) and products fashioned from waste by residents of the former Soviet Union (Arkhirov, 2006).

3. See <http://idsa.org/category/tags/diy-coverage>

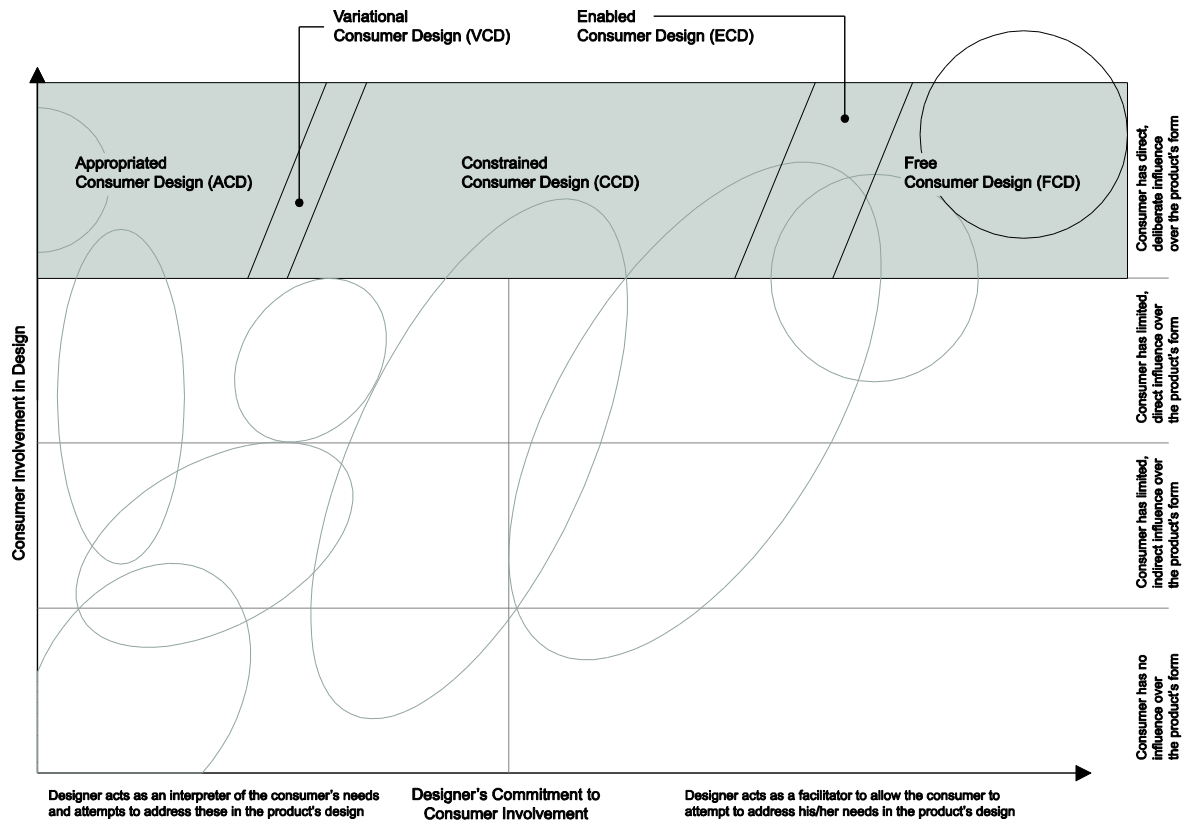


Figure 4. Types of Consumer Design

Whilst the examples above rely on the skills of an expert amateur to craft a new product form, it is also possible to envisage a future where additive manufacturing technologies and the sharing of 3D CAD models make ACD much easier for the unskilled consumer. The Apple Collection⁴, for example, is a website where fans upload designs of new Apple products. Were these fans to create CAD models rather than just images, it would be relatively simple for someone with no CAD modelling skills to nonetheless download the file and 3D print a new casing for their iPod. On the fringes of legality, such designs might be sold or made freely available. They would have none of the assurances (of safety or functionality) afforded by an established brand, but at the same time would likely explore design directions which no established brand would countenance.

Constrained Consumer Design (CCD)

One way in which brands might counter the rise of a "Pirate Bay of products" (Scott, 2009) would be to provide their customers with opportunities to engage in constrained consumer design. CCD refers to the use of systems and tools, often software based, which simplify design and manufacturing tasks whilst at the same time setting limits on what such tasks can achieve. CCD systems are therefore subject to many of the same conditions and limitations as mass customisation systems, but differ by providing the opportunity for freeform manipulation of a product's shape. The advantage to brands of CCD over ACD is

4. See <http://www.theapplecollection.com/design/macdesign/index.html>

obvious: it allows the retention of a degree of control over the forms, materials, colours, etc (and thus the design language) which the consumer designer is able to work with.

CCD also offers significant advantages to the consumer: any product resulting from a commercialised CCD system would have the brand's promise that it would function safely, that it complied with trade standards and consumer law, that it fitted and worked with other products if required to do so, and (possibly) that it came with a manufacturer's warranty. The Lego Digital Designer is an example of a system which offers exactly these reassurances, giving customers the opportunity to create unique products within the constraints imposed by the use of standard Lego bricks.

Variational Consumer Design (VCD)

Variational consumer design is a largely conceptual category which refers to a scenario in which the consumer subjects a 3D CAD model to software algorithms which generate new design variations. One example is that of the Tuber system by Lionel Theodore Dean (Atkinson, 2008), in which a computer script continually morphs the design of a lamp, and the consumer is able to 'freeze' the design at any point. A trial involving consumer designers in the VCD of a USB memory stick is also described in Sinclair and Campbell (2009).

VCD sits between ACD and CCD in the classification since it is able to work with either authorised or unauthorised CAD models, however in practice it is more likely to appeal to proponents of CCD due to its inherent ability to constrain (within its algorithms) the limits of variation. VCD is unlikely to interest consumer designers who wish to exercise their personal creativity, however it may appeal to those who would prefer simply to choose from a library of possibilities.

Enabled Consumer Design (ECD)

Enabled consumer design refers to scenarios in which the consumer is given access by the owner of a product's IP rights to the drawings or CAD files which describe its design; at the same time the consumer is given permission to modify the design using any tools or techniques available to him/her. One of the earliest examples of ECD was that created within the Ponoko manufacturing system on occasions where a product's original designer makes the plans available, either for free or for a fee. ECD, with its requirement for expertise with certain design tools, clearly holds attractions to expert amateur designers rather than less skilled consumers; it also places considerable responsibility on the consumer by offering no assurances as to the safety or functionality of the resultant product. ECD thus allows greater design freedom than CCD, but also entails greater risk.

Free Consumer Design (FCD)

Free consumer design is very similar to ECD in that the consumer is given access to a product's plans as well as permission to modify them. Crucially however, ECD only allows the consumer to manufacture products for their own use. With FCD, all IP rights are given up by the original designer, allowing the consumer to then offer a modified design to others, either for sale or for free. Few examples of FCD exist, though one notable

example is the Openmoko FreeRunner⁵, a mobile phone whose designers made available the original CAD files (in Pro Engineer and .stp formats) such that anyone could modify, improve or redesign the product.

Conclusion

This paper has developed a graphical classification of design methods within NPD. By mapping these approaches against two axes - the level of consumer involvement and the level of designer commitment - it has been possible to demonstrate the power relationships between consumer and designer (i.e. the relative importance of the consumer's opinions and skills) in each method.

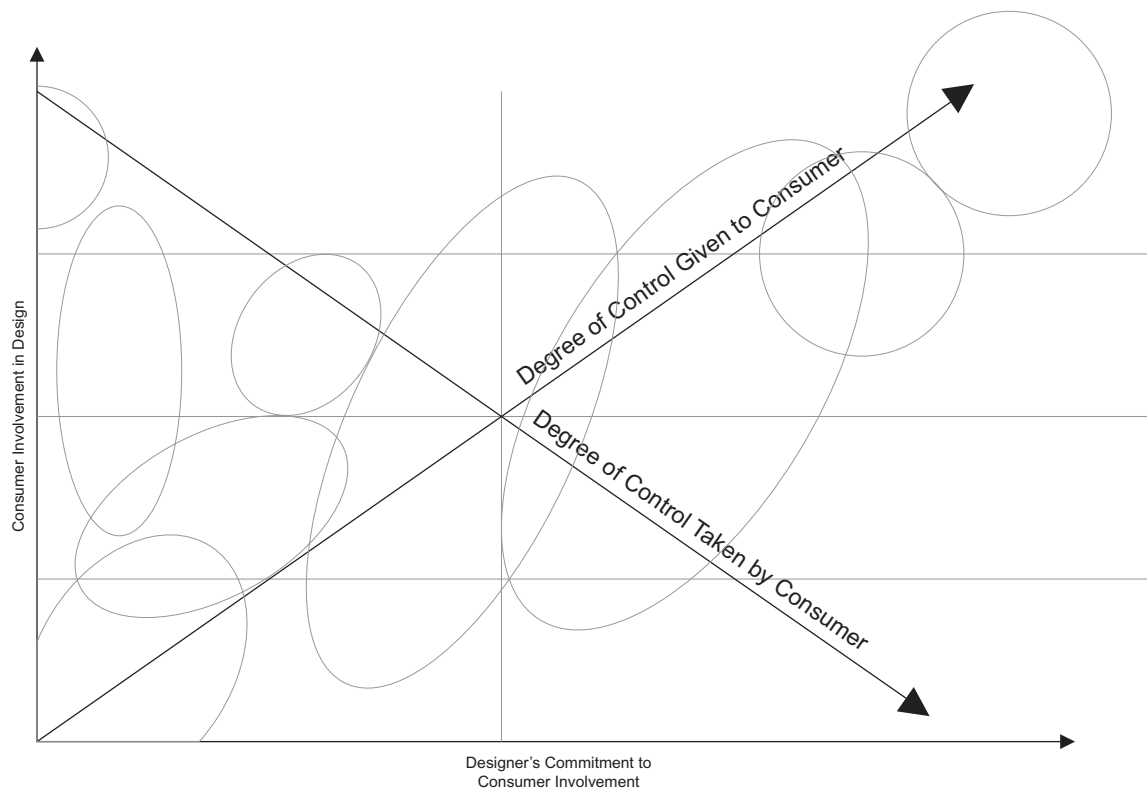


Figure 5. Degrees of control in the designer-consumer relationship

These power relationships have important implications for both practicing designers and the manufacturers and brands which employ them. Figure 5 shows a rising line, from conventional products through to open source products, representing the degree of control *given to* consumers. The converse of this is a falling line representing the degree of control *taken by* consumers, often without the sanction of those who own the product's IP rights. In an age of mass manufacture, where access to the means of production was largely restricted to professional designers and engineers, the opportunity for consumers to design and manufacture their own products was limited. Direct digital manufacturing (technologies such as 3D printing and laser cutting), with no requirement for expensive tooling, will continue to make it increasingly easy for consumers to gain access to the

5. See <http://wiki.openmoko.org/wiki/Introduction>

means of production, through services such as Ponoko and Shapeways. Cheap or free CAD modelling software such as Autodesk 123D or 3Dvia (as well as pirated versions of more sophisticated packages) will allow consumer designers to create 3D models in the same formats as their professional counterparts. For those less skilled, libraries such as TurboSquid, Thingiverse and Google's 3D Warehouse will give access to ready-made CAD models. At such a point, designers may find the need to answer a decisive question: should they facilitate the growing demands and skills of consumers, and help to make the consumer design of products easier, or should they continue to believe in their own abilities to design the best products to answer consumer's needs?

An obvious question which arises from the classification is whether it also applies to disciplines other than industrial design, and indeed whether it is possible to create a general classification which applies to all disciplines. One issue is that the approaches to design identified in this paper have different degrees of prominence in other fields. Within fashion design for example, bespoke (or couture) design is significantly more important than within industrial design, whilst co-design receives little attention. The size of each process within the classification is not a measure of its importance, but instead signifies the diversity of possible consumer involvement, thus it may be that the classification remains valid, even where the population of each area changes. However, determining the extent to which a general classification is valid requires further research.

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