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abstract

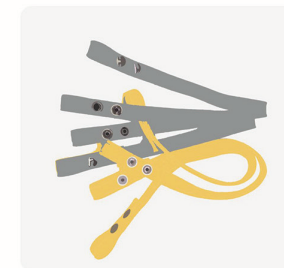
Modular design is considered by many as the key for a good design practice. Indeed, thinking products in terms of modularity has a tremendous potential, allowing the reliability and quality of the product, enabling maintenance, repair, easy assembly or disassemble, differential consumption and also the reduction of production costs by companies when a family of products with the same modules is created. These characteristics can have a major impact in the product life cycle, improving the extension of lifetime, reduction of waste and exploration of natural resources.

Modular design principles and their implications on the life cycle of fashion design product's, mainly in fashion accessories are presented.

keywords

modular design, fashion accessories, life cycle, sustainability.

Some prototypes developed under a research project\* on fashion accessories demonstrate modular design application to the development of more sustainable fashion products.



Modular design can be defined as a strategy to build systems or complex products from small individual subsystems/modules that work on as an integrated whole.

Each module is at least one functional unit, more or less complex, which together with the remaining modules contributes to a functional product. Therefore, a module can be defined as a unit, a structurally independent building block with defined interfaces (Holttä & Salonen, 2003).

In modular design the different modules should be well defined, the interfaces among components are specified and each one can be separated and transferred to other products within the same group (Lau et al., 2011). Thus, modularization is the process of decomposing a product structure into modules. This process is essential for the success of a modular strategy, in new product development or in redesigning existing products.

The approaches or methods to achieve modularity can be defined according to Daniilidis & Enßlin (2011) by three parameters, the product generation (product reengineering or new product development), the product variety (single product, product family or product portfolio) and the product life-cycle (design, assembly, services and recycling).

It is important to realize that in an ideal world, the modular design considers all the life cycle objectives simultaneously, but in reality this is difficult to achieve and conflicts are recurrent, so is important a compromise to the more important goals. In a life cycle perspective, it must be reflected for what phase the design will be because design for reuse or for recycling may imply different design approaches (Campagnolo & Camuffo, 2009). For example to product assembly the modules should ensure an efficient assembly and disassembly. In product reuse it is important to consider that the different components have different life duration, and they should be grouped into easily detachable modules. In recycling, special concern has to be taken to the material that constitutes each module (Gu & Sosale, 1999). And, for the extension of the usage time, the modules should

be design to promote an easy maintenance (Qian & Zhang, 2009).

Before opt to modular design, it is important to have enough knowledge about the product, the exact component structure, the relationships between the modules and their functions and the main objective of modularity (Campagnolo & Camuffo, 2009, Kusiak, 2002, Zhang & Gershenson, 2003).

In fashion context, modularity can be a solution for various issues, such as: repeated use which provokes damage in a specific part of the bag; when fashion raises the desire of following seasonal trends (spring/summer, fall/winter), urging a change of colours, fabrics and shapes (e.g. change of handles and pockets with different colours); when the choice of fabrics involves a specific intention (ex: waterproofed fabric during the winter), or when it offers different adaptations for a variety of occasions (e.g. use the same bag for day and night).

In bags basic modules that can be easily identified: body (outer shell and lining/interior), pockets and divisions, handles (shoulder/hand/ none).

The basic function/objective of bags is carrying objects: essentials (e.g. personal documents, coin purse, keys and cell phone), others (e.g. make-up, paper tissues, cigarettes, laptop/tablet, gloves and small umbrella).

The attributes can be arranged in terms of: performance - can be determined by size (quantity of objects or use occasion), handles (shoulder, hand or none, according to quantity of objects or use occasion), pockets (allow placement of essential objects or others), and by protection of inside contents (strong material; waterproof; closure solutions: zipper, springs, buttons, velcro, overlap of fabrics); comfort/ergonomic - depends on size (quantity of objects), handles (shoulder, hand or none, according to quantity of objects)

aesthetic/ fashion trends – defined by fabrics, colours, surface design according to trends or customer requirements

In the market already exist bags with modularity options (e.g. Obag [www.fullspot.it](http://www.fullspot.it); Ochobags [www.ochobags.com](http://www.ochobags.com)), but only giving consumers the opportunity to change aesthetic attributes of bags.

In the research project PT21- PPS 3 – High-tech Fashion, a project carried out with the wool industry, some prototypes of bags have been developed using as raw materials 100% wool fabrics, a type of material rarely used in the production of fashion accessories. The development of the bags also follow a modular design approach, allowing the change of handles, exterior panels, bottom, and pockets in one bag, but also interchange of these components inside the same family of bags. This modular approach has also been used in the development of bags with the technology incorporation of Arduino Lilypad board, microprocessor, electronic components and circuits, allowing it to be changeable across bags, and enabling features such as internal or external led lighting, burglar alarm, among others.

\*Project PT 21- Powered Textiles Século 21, PPS 3 – *Hightech Fashion, Projecto Mobilizador no 13848, Quadro de Referência Estratégico Nacional 2007-2013 (QREN)*

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