MODULE SYSTEMS AND MULTIFUNCTIONAL GOODS IN INTERIOR DESIGN

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Abstract: New lifestyle caused by a transition from Industrial to Information era starts a chain reaction of changes inside people's homes. For many centuries single or few functions interior goods like beds, tables, chairs, cupboards, etc were in use. Recently all over the world, especially in Japan, products with more complicated functions appeared. The interior goods designed to meet demands of multifunctionality and usefulness are classified here as system and multifunctional goods (multimono). Questionnaires and interviews have showed alternative usages of habitual interior goods. This research is proving the need of new approach to designing common furniture pieces. The target of this work was to formulate the directions of multifunctional and system goods development, the main problems of existing products and consumer demands towards traditional furniture pieces.

Keywords: multimono, multifunctionality, multipurpose, interior systems, joint system

1. Introduction

Moving from industrial society to the society of global communication meant coming from the society of machines to the society of information. Though the simplest telephone systems were created little much than a century ago the world of information and science develops so fast that it's hard to imagine life without all these useful machines. The communication systems become more compatible, connectible, standardized, and easy to use. Personal computers become more complicated machines with a lot of appliances [1].

The world of things we use at our homes develops slower. For many centuries the interior of our houses was a number of single or few functions things like: beds, tables, chairs, cupboards, etc. Such things were made the customary way to be used habitually. Recently a lot of things with more complicated functions appeared: folding beds and chairs, flexible products, etc. All over the world (especially in Japan) system furniture become more and more popular [2]. The interior goods designed to meet the demands of multifunctionality and usefulness compared to other products with similar functions are to be called module, system or multifunctional interior goods (or shortly multimono). Such products allow creating a unique interior from the same kit of details.

2. Modern household.

In the beginning of the 20th century the main task of design was to give a function a manufacture produced form. New producing method was a main influencing factor of design [3].

After the Second World War as a reaction to raised consumerism a lot of products with multiple functions were designed. Though it was a search for a new form and a new look of a product.

Gradually extravagant forms of 60s and 70s disappeared and it became important to reflect a function in a form of a product. A closer look to consumer usage of existing products allowed modern designers to create elegant products that suit new life style better [4].

Designing furniture became not only making functional things, but also making pieces of designer's artistic taste, modern fashion, philosophy and history background, consumer and market demands. Our lives change, our demands grow rapidly.

In Japanese traditional houses compared to Western houses the outside and the inside have not been parted.
Space was divided by sliding doors, tatami mats were standardized in size, zabuton pillows and futons can be thought as modules for sleeping and seating objects.

Contemporary westernized houses and interiors often lose in its multifunctional space usage, but urbanization and lack of free land space make Japanese architects and designers to find ways to live comfortably in small houses of average citizens [5]. Already system and multifunctional goods are more popular in Japan than in any other Western country. Perhaps this process will continue and a new style of interior goods and furniture eventually will be developed.

Western countries houses are generally bigger and life style changes there slower compared to Japan. On the other hand, designing multifunctional and system goods is a challenge. More than actual functionality the playfulness and original design of such products is more appealing to western consumers [6].

The contemporary Japanese home has become very “western”. Though some homes still consist of mostly tatami-matted rooms, in most new apartments or homes only a single tatami room remains.

Although many of the more intelligent aspects of new Japanese homes derive from older traditions, most Japanese of today switch easily from one mode of life to the other: from sitting at the dinner table for a meal to, say, sitting on the floor to watch television; from knife and fork to chopsticks.

3. The types of module systems and multifunctional goods in interior design

Interior systems and multifunctional products have analogs between kids’ toys. Comparison of system toys and multifunctional furniture revealed 5 main groups differing by basic characteristics of systemness or multifunctionality. A lot of products though have characteristics of at least 2 main groups. Combinations between first 5 main groups formed 10 subgroups (Fig.1).

The group of exceptions is described in the 16th group.

Unfortunately it was impossible to make a full collection of all multifunctional and system goods ever designed. Also not all collected examples, but only those products that can represent specifications of own group were described.

Mixing the characteristics of 2 or more main groups form new characteristics of the functions. Some of these subgroups may be illustrated with already existing examples, but some groups’ characteristics either haven’t yet inspired any products design or the author is not aware of its existing.

4. Description of system and multifunctional products groups and subgroups.

Fig.1 Groups and subgroups of multifunctional goods.

4.1 Constructor

Products of this system require joints combining [7]. Every component of a system has ins and outs to combine with each other. An important distinction is that a single detail doesn’t function by itself. Only a system made of joining details works as a functional object.

The Constructor principle is the main for joints fixing any structural objects, but only when the permanent and stable fixing is required. As for objects that are to change their primary forms from time to time the constructor structural methods were not widely used for a long time until recently.

4.2 Cube

The name of this system and multifunctional goods group come from the appearance of components. The main modules have the simple geometric forms like cube, ball, pyramid, etc. and they don’t require joints combing [8]. The components assemble and joint by simple putting on, under, in, onto, into, next to each other. This way the number of combinations is great, but limited, because the construction is getting more unstable and fragile if the number of components put together without fixation is too big.

4.3 Tube

A Tube group includes the systems of tubes/pipes and joints fixing them together into a construction. An important distinction is that this system provides structure building, but not the actual object [9].

4.4 Net

A net is the main module of this system. The net holes are used as joints for different features, which may be fixed at desirable place by hooks and similar instruments. The combinations are multiple.
Boards and nets can be fixed directly to any surface. Hooked on secondary storages can be usefully organized. Traditional surfaces of the furniture changed to hole boards become active element of interior.

4.5. Collapsible

Collapsible are objects with the capacity to adjust in size to meet the practical need. Usual collapsible objects have are two opposite states, one folded and passive, one unfolded and active. They grow and shrink, expand and contact, according to functional need [10]. However multimono collapsibles are objects with both active states: folded and unfolded. Collapsibility is above all a measure of convenience.

4.6. Cubicle (Constructor + Cube)

Geometrical components (like cubes and balls) become parts of a bigger construction.

4.7. Tubcub (Tube + Cube)

Components assemble without visible joints.

4.8. TubNet (Tube + Net)

Require combining tubes, joints, nets and hooks into some system.

4.9. Collanet (Collapsible + Net)

Examples of products, which have characteristics of both Collapsible and Net systems either haven’t been produced or haven’t been found during the research.

4.10. Constube (Tube + Constructor)

Using tubes and joints to make an object.

4.11. CubNet (Net + Cube)

Examples of products, which have characteristics of both Net and Cube systems either haven’t been produced or haven’t been found during the research.

4.12. Collatube (Collapsible + Tube)

Require folding a structural construction.

4.13. Netstructor (Net + Constructor)

Require joining modules into a net like system.

4.14. Nest (Collapsible + Cube)

Nesting objects without joints.

4.15. Collactor (Collapsible + Constructor)

Objects themselves join with each other to create another object or a function.

4.16. MultiMono (Exceptions)

Unlike system and multifunctional goods of all previous groups, which are being assembled or transformed, multimono are products, which accumulate 2 and more unrelated functions by themselves.

All multifunctional products and interior systems are shortly called multimono, however in this paper it will be referred to exceptions group only.

Fig.2 Examples of groups: Cube (Kazuhide Takahama, “Esa”), Collapsible (Ottakringer, chair-ladder), Nest (One’s Life Design Studio, stacking tables)

Fig.3 Examples of groups: Multimono (stool/magazine rack), stool with drawers, stool/basket

Fig.4 Examples of groups: Constructor (Richard Sapper, stacking chairs), Tube (Dupole Systems), Net (Hole Boards)

Fig.5 Examples of groups: Collatube (Joe Colombo, “Tube” chair), Cubicle (IDEO, Dilbert’s Ultimate Cubicle), Collactor (Scott Fellows and Crag Bassam, Tray Rack Series)

5. The results of grouping

The collection of chosen products is considerable, nevertheless there are samples not collected yet and there are a lot of new products appear [11, 12, 13]. However the certain conclusions can be made on the basis of collected examples and groups’ significance.

By far leading groups are Cube, Collapsible and their mix Nest (Fig.2).

Cube group products are very easy to assemble just by moving elements from place to place. Collapsible are very convenient for their space saving. The mix of both of them is an ultimate decision for dwelling indeed.

Multimono group is a collection of useful and graceful products, which primary and secondary functions successfully collaborate (Fig.3).

Such groups as Constructor, Tube and Net are very
potential. The biggest problem is their inflexibility and difficulty of assembly (Fig.4).

The rest of the groups, despite their potential, contain few examples (Fig.5).

The following observation is to find out the reasons for diversity between groups and also to understand what important functions have been failed to persuade in existing products.

6. Consumer demands research through questionnaires and interviews.

Although system and multifunctional goods have a long history they have never been selected into one group of objects by the characteristics of their multifunctionality or possibility to be put into a system.

What kind of products and what kinds of functions are in consumer demand? What products may become desirable? How do people use single function products? Do they try to make more of them than they are designed for at the first place? Through observation research, which included 2 steps of questioning and the interviews to follow these and many other questions have found their answers.

The task of the questionnaires was to collect consumer opinion on system goods, systemize secondary functions, find out which piece of interior is most popular to be used differently from its primary function, find out which secondary functions are most popular. These interviews helped to clear up the situations where objects got their original usages and to understand how one’s life style influences the need for multifunctional and system goods. 41 people of different ages, nationalities and life styles filled in the questionnaires. The questionnaires helped to systemize multifunctional and system products by popularity, but the following interviews helped to understand the reasons for it. It became clear that no products whatever useful they may seem could be appropriate without understanding the living conditions. The conditions of visited houses and apartments where the interviewees lived were often unique and hard to be put into a system, though the common usages of interior goods had its place.

| Table 1 Atypical usage of products (secondary functions) |
|---|---|---|---|---|
| product | change type | total | foreigners | Japan family | Japan students |
| Chair  | collapse  | 20 | 3 | 9 | 8  |
| table  | 22 | 7 | 6 | 9  |
| bed    | 9 | 5 | 2 | 3  |
| rack   | 15 | 3 | 6 | 6  |
| shelves | 7 | 2 | 5 |  |
| stand  | 10 | 3 | 9 | 7  |
| height | 24 | 4 | 12 | 8  |
| Table  | collapse | 15 | 2 | 7 | 6  |
| chair  | 9 | 2 | 2 | 5  |
| bed    | 7 | 1 | 4 | 2  |
| rack   | 7 | 1 | 2 | 4  |
| shelves | 5 | 3 | 6 |  |
| Sofa   | bed    | 19 | 5 | 7 | 6  |
| chair  | 5 | 2 | 1 | 2  |
| Bed    | collapse | 7 | 2 | 3 | 2  |
| sofa   | 15 | 5 | 3 | 7  |
| chair  | 7 | 2 | 1 | 4  |
| Rack   | shelves | 10 | 2 | 4 | 4  |
| combine | 7 | 2 | 5  |
| size   | 7 | 1 | 2 | 3  |
| Shelves| collapse | 8 | 1 | 3 | 4  |
| rack   | 13 | 2 | 5 | 6  |
| boxes  | 5 | 1 | 4 |  |
| Boxes  | collapse | 13 | 6 | 7 |  |
| table  | 14 | 6 | 4 | 4  |
| rack   | 14 | 3 | 6 | 5  |
| shelves | 12 | 3 | 4 | 5  |
| chair  | 9 | 5 | 4 |  |

Fig.6 The proportion of products used differently from their primary functions.

Secondary functions

One of the biggest problems was how to interpret the figures. Apparently in most cases the high numbers indicated such well-known multifunctional products as collapsible chairs, beds, sofas, assembling racks, which useful functions are popular and such products were meant while filling in questionnaires. These products exist and they are liked. They reflect the need for them.

Nevertheless interviewees demonstrated certain patterns in using habitual furniture atypically or by secondary functions (Fig.6, Table 1).
Chair

In most cases interviewees when asked about a possibility of a chair to change its height meant usual office wheel chairs or twisting bar stools, which can't be really called either multifunctional or system products. Some interviewees meant child seats like Stokke KinderZeat where the possibility of changing height not only of a seat, but also a table board makes a product multifunctional. Though these products already exist and using them by interviewees meant only that demand for such functions was already successfully satisfied, as a result the table's figures should be adjusted once more. Actually in case with height of a chair - though the function is obviously in demand no special requests were indicated, except may be putting zabuton like pillows on the seat for better comfort.

On the other hand, second popular way to use a chair was to use it as a table. A chair looks and functions similar to a table, and they can be changed mutually. Although a lot of table-stool like products that can be used few ways exists most interviewees often use usual chairs with backs as tables, shelves and racks and find it very functional. Most housewives feel the need to use a chair like a stand or a ladder in their kitchens. The same chair when not used for sitting is a very good device to put things on.

Different usages make a chair very creative material for possible multifunctional and system combinations. As questionnaires and interviews results showed, many chairs and stools are used differently, because their primary “sit on” function is not in use in everyday life. That way the possibility to use a chair by the secondary functions like primary ones - as table, rack, shelf, stand and endless other possible variations - opens a new, now intentionally active, stage of a chair and chair-like products design.

Third popular function - chairs collapsibility as any other kind of product collapsibility has its main goal to save some space. On the other hand this function arranges a lot of possibilities to make interesting and original design, to design the new kind of joint, the new collapsible form. The variety of possible ideas how to collapse a chair is almost endless. For it many designers produce great chairs, mainly useful and actually saving a space, and at the same time very different from each other.

In the questionnaires results it appears that Japanese people like collapsible chairs more than foreigners do. The reason for it is that Japanese people mainly seat on the floor using zabuton and they don't need actual chairs much. Also zabuton can be thought as Japanese version and replacement of collapsible chairs and even more functional in compare. Zabuton can be put on each other, so the height and comfort will rise accordingly. Zabuton can be put next to each other, so anyone can sleep on them. Etc... For the form is simple the functions are multiplying.

Another reason for Japanese people to prefer collapsible chairs may have its place, because the modern houses are not very big compared to European or American, where it is a usual thing to have a proper dining room with a big table and chairs. And there is enough space to have some extra chairs as well. In Japan most people don't have that space.

For example, in Russia too, during the Soviet Union period the apartments were built with small kitchens and no dining rooms of course. So collapsible chairs and stools were very popular at the time.

Japanese table with folding up legs is more natural as it can be folded and put away to open up some space. A low table suits Japanese style better. First of all, if such table is used in a small Japanese house it can be folded away for a night, when futon - a flexible replacement of a bed - takes the spared space. This way the same room becomes a multifunctional space with the help of few collapsible interior goods. Traditional Japanese house consisted of multifunctional empty spaces. For the space is empty the functions are multiplying.

![Fig.7 Popular secondary functions of a chair (table, stand, rack)](image)

![Fig. 8 Popular products to be used as a chair (box, basket)](image)

In modern houses where European “sitting on chairs” style is dominant, low Japanese tables are also used in Japanese tatami rooms when guests come, but usually they are folded away. When there are a lot of guests few low tables can be put together in different shapes. This function is hardly reachable with European extendable table.

Quite an extreme way to use a table or a chair as a bed (sofa) was surprisingly popular. Special popularity was among foreign students who seem to like using tables or 2-3 chairs put together to sleep on after late night parties. Some Japanese students seem to use tables the same way.
sometimes.

**Table**

Using tables as racks or shelves mostly meant putting things on them so the table only played the role of a rack or a shelf. But some interviewees by putting 2-3 low tables on each other made a construction where tables have lost their primary function and became modules of a rack/shelves system (Fig.9).

Some Japanese mothers use low tables as beds for little babies.

Unfortunately, the questionnaire was organized to eliminate only the questioned about piece of interior of the whole list of goods and that caused some confusion.

To use a chair as a table is a usual thing. It is difficult to refuse if there is no proper table around. To use a sofa for sleeping and a bed for sitting is even more natural. And for it there are a lot sofa-beds, which can be used as sofas at most of the time and folded out to beds when needed.

Japanese traditional houses didn't have analogs of western sofas or beds. A lot of Japanese still sleep almost on the floor using futons, which are folded and kept at closets at daytime. Some interviewees don't put them away but make of them sofa like sitting objects.

![Fig.9 Tables put together transform to a rack](image)

**Bed/Sofa**

**Secondary storage products**

The same rack, shelf or box can be used every time for different goods storage and it can be moved to different places easily. For the form is basic purposes are multiplying.

An important function of secondary storage is a possibility of change and growth. The standard sized boxes and drawers put on each other organize a functional system. When the amount of accumulated things grows the next to-become-a-module box, drawer or shelf can be easily added and the system advanced.

![Fig.10 Boxes are often used as racks, stands, stools, etc.](image)

In Japan secondary storage goods are very popular. Compared to western type wardrobes, cupboards and drawers with implied secondary storages Japanese built-in closets constitute an empty space with doors, sometimes horizontally divided by a solid shelf. Good to store valuable futons such closets require secondary storages goods for smaller objects.

The best module for secondary storage is a box. The wooden square boxes with one open side are the most popular between interviewees. The system of such boxes is stable and easy growing. This function is especially important for those who accumulate a lot of books in short time – students. The same boxes are also very good to sit on. The upper surface of boxes can be used as a little bedside table. The same boxes can be put on the wall as shelves.

When moving goods get to be packed to the same boxes. Usual racks are also often used as packaging boxes. Often the secondary functions of goods are better-used than primary ones. Products abilities haven't been fully used in traditional designs and methods of designing such products as a chair and a table should be reconsidered.

**Collapsibility**

A lot of interior objects collapse. This function is very important and popular. Chair, table and bed collapsibility according to interviewees experience becomes important mostly when number of people living in a house rises – the time when guests come and some extra seating/eating/sleeping space is needed. Otherwise folded chairs, tables and beds are stored away and taken a lot of place, what bothers most people, especially those who live in small houses or apartment and don't have too much storage space.

Interviewees suggested few interesting ways to make a table of another object. One temporary table was made with the help of fusuma (Japanese sliding doors) board and two boxes. Another one was made of 2 chairs and a board put on them.

Using something as a table, chair, bed or sofa has the same explanation as these products collapsibility – a need
for temporary eating/sleeping/seating device.

100% of interviewees answered that they are interested in having products, which can be used different ways. Though multifunctionality and usefulness by themselves is not the goal, these characteristics are very attractive for most questioned people.

Most interior products having more than one primary function would be welcome in case these functions can be used at the same time or almost at the same time. For example, if one would like to make a bed from a table it would mean that only a bed or a table could be used at the same time, but what if both are needed? So such a product may exist only as most collapsible things for some extra situations like guests.

Problems and solutions

The results of the observation and questionnaires have detected that furniture often gets used differently from its primary functions. Many patterns would be useful for future design developments.

For example, the results have determined a chair to be most popular by both characteristics: interviewees use chairs by their secondary functions and they use different unrelated objects as chairs. Also it had shown that one of the popular secondary functions of a chair is storage and collapsibility.

This way the goal was to design chairs/stools, which can be collapsed/stuck when not in use for sitting. The second goal is to activate the storage function during passive stage of “sitting on” function.

As a result, stacking stools have been proposed to design (Fig.11). These stools are classified as Collactor group product. Few problems detected through observation were solved:

a. A single stool has a drawer underneath (storage). Even when a stool is used to sit on there is no need to replace contents.

b. Two stools stack together (collapsibility). They become a high stool (or a low rack) with 2 drawers (positions of the drawers can be easily changed)

c. Three stools stack together. They become a high rack with 3 drawers. Also stools can be put in a pyramid-like structure, which can be used as a rack, 2 connected stools with armrest, low table.

d. 4, 5 and more stools can be stuck together in different variations. Stools lose their primary “sitting on” function by stacking. Instead they become assembled rack. Storage becomes the primary function. The rack easily turns into stools again if the need for stools appears (guests situation).

Fig.11 Stacking stools with drawers – one of probable solutions.

7. The Conclusion

Recently a lot of new original multifunctional products appeared. However the research has revealed certain constraints not allowing many products being as useful and necessary as it might have seemed.

Such groups as Cube and Collapsibles are leading for their easiness of assembling. It doesn't require skills or time. However Cube products have limited affordances and Collapsibles take space when collapsed and unused. Products of good balance between primary and secondary functions are most required. For example, sofa-bed (Fig.12) is an ultimate decision among Collapsibles. Its primary “sitting on” function modifies to the secondary one when there is no need for primary one. Simply saying, it is a sofa by day and a bed by night. There is no “dead” time for this product – no time when it is unused or taking space.

Some subgroups haven’t been yet explored by designers. However characteristics of subgroups promise interesting ideas for new designs.

Fig. 12 Rea pull-out-sofa-bed

Difficulty of assembly is the main problem in most other groups. Complexity of joints and clamps doesn't allow products of Constructor, Tube and Net groups/subgroups flexibility, playfulness and easy assembly. Simple joints used for children kits like Lego and playing gyms are not durable for interior systems. Further development of these groups' products depends on new solutions for joint systems.

Tube group products are the most dependable on joints, which allow flexibility and easiness of assembly. Scaffolding systems has the same principle of assembly as Tube groups systems. Next step of the research will be to study scaffolds in order to use existing samples of flexible joints for comparison with interior systems joints.
The next goal of research is classifying joints by both limitations and affordances in order to find better solutions for future designs of multifunctional and multiproposal goods.

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