DESIGN THAT DEFINES A PRODUCT’S MEANINGS
An Integrated Approach to Design in the Digital Age

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Abstract: This study is an investigation of how to improve design in the current age of digital information. Systematic design, which is the basic principle underlying today's design methodology, is an analytical method. However, "what" is the focus in the design of digital products, and the synthesis process becomes more important. The following are regarded to be the requirements for a new design methodology: (1) The human/artifact system should be regarded as an integrated and reciprocal relationship that should be reconstructed as a whole. (2) The physical and social cultural environments must be completely understood and taken into consideration. (3) In designing information products, for example, design considerations must be expanded to include not only utilitarian goals, but also mental objectives such as the meaning of communication. (4) Perspectives must be consolidated independent of conventional design parameter definitions. (5) These concepts can be referred to as "design in which a product is defined in its true state."

Key words: Product Design, Digital, Methodology

1. Introduction
We can draw a comparison between the steam engine that led the way in the industrial revolution, and digital development that is now leading the way in the current IT revolution. Our industrial society, with industrial production as its center, is undergoing a transformation into an information society, with production of information as its center. This shift will give enormous impetus to new approaches to industrial design, to design as it should be, compared with design as merely a pre-conditional technique to the process of industrial product manufacture. We now see problems emerging, one after another, that we cannot solve simply by the application of conventional design theory for products with physical functions. In these circumstances, new design approaches are required. Designers must adjust to the new challenges as the phases of IT development occur. The purpose of this article is to propose new directions in design for the future. First of all, we will consider approaches to systematic design that have bearing on today’s general design methodology. We will seek to show what was lacking in the past, and what is now required to take us into the future. A comparison will be drawn between conventional design and novel features of design in a digital age. Then, with this comparative foundation, we will consider new approaches to design for the future.

2. Historical Trends in Design
2.1. Systematic Designing Method
The 1960’s witnessed the emergence of a diversity of attitudes and social values in an increasing materialistic environment that paved the way for the rapid expansion of technological development. This situation gave rise to an awareness that conventional design methods could not cope with these changes. It resulted in a search for new approaches to design. In order to accommodate the complexity of design functions and the scale of expansion, an objective and integrated systematic design methodology was advanced. Previously, design methods
had depended on experience and common sense [1]. Christopher Jones' "Design Methods," Christopher Alexander's "Notes on the Synthesis of Form," and Bruce Archer's "Systematic Method for Designers" are prominent theoretical works.

The main themes in these works were "scientific application to the designing process," and the "establishment of designing methods for the industrial production system." These types of design methods played down the function of artistic creativity in the process of developing designs. Concentration shifted to the technical side of the subject, coupled with experimentation with models of various "design processes [2]." The objective was "to seek out and establish a systematic method to solve problems concerned with design." The key ideas here were: "design problems," "their solutions," and "systematic processes," that link design problems to their solutions and to the "creative process [3]." The underlying principle was that the starting point is a given subject's "design problem," followed by a "systematic process," inevitably leading to the "solution." Using this methodology, the design process became a linear process from problem to solution.

In engineering design, engineers generally adopt, mathematically, the most suitable method. About this approach, we can say that design gives a single answer to a given subject, or that design is a process to find the most suitable design. Here, the logical necessity to reach the most suitable solution is paramount. The objective during this early period (the 1960's) was to change design "from an unconscious process to a conscious one," (Alexander) introducing engineering methods into design [4].

2.2. Archer's Theory of Method

One of the most prominent method theories is Archer's "Systematic Method for Designers [5]." Although his method does not always apply to present design issues, it is worth considering here as background to the current design method theories.

Archer asserted that the most important design element is writing a prescription, or developing a model of the targeted work to be undertaken, before attempting to shape the design. Archer also stressed that "one particular feature of the design process is its two phases: the analytic phase (objective observation and inductive reasoning); and the creative phase (subjective judgment and deductive reasoning)." He saw this as a concrete process involving: 1. Drawing up a checklist; 2. Information Collection; 3. Analysis; 4. Synthesis; 5. Development, and 6. Communication. These are the usual steps adopted in the design business that presently remain current.

According to Archer, design is a technique for achieving harmony. The various elements generated by function, market, and production, are all intertwined, yet distinctive, so they always clash with each other. To harmonize these elements is the purpose of design. In order to achieve harmony, Archer declared that "it is necessary to thoroughly collect all existing information, make a checklist, and categorize and organize the information for designers to make the right decisions." For example, let's assume that the designer attempts to reach a solution by considering the "reciprocal interaction of data." The collected data is first evaluated and divided into data having reciprocity and data lacking reciprocity. The data having reciprocity is further categorized into compatible and incompatible data. Incompatible data is evaluated in terms of its priority or its lack of priority, and ordered in its importance according to the total points for each category. Compatible data is evaluated by the degree of its compatibility. The analytical phase attempts to use information handling technology to give direction to the subject's design.

Archer's design method is a systems approach. Using this method clears the outer structure from considerations of purpose or restrictive conditions, and seeks to integrate the inner structure with the outer structure. For the process to move through its steps, all elements related to design must be picked up and analyzed, and the mutual relationship of the elements must be exposed [6].

2.3. Analysis and Synthesis

Theorists such as Archer accept that the design process must include the study of a subject's common elements. Two contrasting processes are involved: one is analysis; the other is synthesis. A special feature of these theories of design methodology is the inclusion of analysis, which is a mechanical process. Analysis, in this method, is also a step toward synthesis, which is sometimes called the "creative process."

In these design theories, it is, however, only analysis that is dealt with in a detailed systematic manner. Synthesis is not considered to be part of a concrete applied method. For example, the "creative leap" of Archer's theory doesn't really consider creativity to be integral to design. Although
Archer insisted that creativity was the most important element in design, he reduced "brain-storming" to an applied method. He did make a few references to analogy, but settled for an abstract discussion of its function. These may be considered the fundamental aspects of these theories. To this day, they continue to influence current design theory [7].

Considered in a design context, analysis and synthesis are in clear contrast. Analysis is, generally speaking, the work undertaken to clarify the "function, attributes, and efficiency of "substance;" on the other hand, synthesis is work directed toward finding the "substance" to satisfy the required function, property, and efficiency.

Traditionally, analysis is the methodical process that connects elements axiomatically by removing the theoretical basis from assumptions. In this process, the logical consistency of the detailed elements is questioned, and fields of analysis are subdivided to make more efficient use of required skills. This approach speeds up the development of design concepts and increases efficiency [8].

In science, natural phenomena are examined. The main purpose of this examination is to scientifically analyze the elements to establish their non-contradictory features. The purpose-integration feature of synthesis is ignored. On the other hand, the object of design is to join the purpose and the elements. Synthesis should be at the center of this process.

In design, each piece of information about a design solution is brought together as it emerges through the exercise of the designer's cognitive processes and judgment. Some sets of data, in and of themselves, cannot induce a reciprocal relationship except through the exercise of human intellect. One set of data may vary in importance from different perspectives. It is normal that such conflicts and contradictions occur when engaging in decision-making about the importance of information. The consideration of differences of points of views may also contribute to the creative process. Different ideas also occur because of variations in standards or because of values held by designers. A systematic method of data processing is capable of performing work in an intelligent way without any human contribution. It is essential that such a neutral role not be applied to the design process.

The proper conception of synthesis is "to cross and unite the dismantled fields of data and to produce a united vision." In order to "unite" the vision of the subject, the vision must first be clear. In this sense, the united design is the equivalent of the "united vision." Systematic design methods cannot produce a "united vision." They are limited to analysis, that is, to breaking up data into separate components in order to understand the whole. In the contemporary situation, conventional design methods are increasingly questioned, resulting in there being no clear consensus in regard to the merits of these methods. This is particularly so in this period in which modern design problems have expanded, and in which design has become more complex due to current advances in information technology. Synthesis has now become more essential to the attainment of a "united vision" than in the past.

3. Toward New Directions in Design Methodology

3.1. Changes in the Theory of Design Methodology

As our society experiences new developments in information technology, design problems are becoming more varied and more complex. Reflecting this situation, design methodology itself is now under pressure to change. In particular, past theories about methodology that focused on a rationalized, technical process based on engineering methodology have reached their limits.

We will now consider potential changes in design methodology [9]: 1) Designers have found that systematic design methods that solved problems using logical, technical procedures are not adaptable to providing solutions for the complex and varied problems of our times. 2) An experimental "new humanism" has emerged that is influencing designers. They are now pursuing more flexible designs through consultative processes in particular design contexts. This movement is also influencing a search for a design methodology based on a definition of what designing ought to be [10].

With this innovative approach, a new awareness in design methodology and designing has arisen. First, faced with more complex and advanced design problems, the process of finding new ways to consider problems is very important. We need to not only solve problems, but also to search out the problems and re-formulate them. This involves a change from the "design as problem-solution" approach to the "design as problem-finding" approach. In the digital age referred to in the next section, problems for most design subjects are not identified. A new task for designers is to try to uncover these latent problems.

Second, the main interest in the systematic design methodology was its process of designing; the quality
produced by the design process was rarely questioned. This methodology concentrated on “how” to design, and showed little concern with “what” to design. Modernism assumed everlasting growth through mass production and mass consumption. We can see now that it ignored the question of “what to make.” Now, in our present age with its environmental constraints, “what to design” has become an important issue.

3.2 Characteristics of Digital Design

In a previous article “Characteristics of Digital Design,” we selected and compared the design characteristics of digital products in the information technology age with the design of conventional products [11]. We will again present those ideas together with commentary on the theories of design methodology mentioned previously. This article will then look at what was lacking in conventional design methodology, and an appropriate approach from here on. The aim is to canvas potential new directions in design:

(1) When a design was commissioned, the design conditions, such as what should be achieved by the design, were usually given in advance. The aim of the design process was to achieve a solution. However, design projects in which the problems are ambiguous, such as when designing non-existing pieces of equipment or digital products, do not come with a complete set of conditions that the design process is expected to resolve. In these situations, the systematic design methodology mentioned above is difficult to apply.

(2) In more stable design areas, a product’s structure is usually fixed. Innovation rarely comes out of these areas, but in the digital domain, we see the daily appearance of new products. Existing products are superseded as new areas appear and products spread out into various new areas. It is virtually impossible, in these circumstances, to work under a clearly fixed design methodology.

(3) Well established design concepts cannot be applied to most digital equipment. Here, design requires flexibility at each stage of the process to allow for improvement. In most digital design situations, the problems are not clear. To uncover them is an essential aspect of design. The design problems themselves must be designed, if they are to be properly resolved in the design process.

(4) Digital design alters the basic meaning of a product. Reviewing the product’s place and its function in human life will be part of the design process. A key target of the design process will be to give a new meaning to a product.

(5) Design is able to give new meaning and add new values to a product. That makes us return to the basics to find the values that the design process must achieve. Value-related problems are capable of explanation in various ways, unlike the engineering design methodology of a single and best solution. Design choices depend on the designer’s values.

(6) The functions of digital equipment principally depend on network connections. The purpose of the equipment is to convey information and services through the network. In these cases, the value of received information and services are relatively higher than the product itself. The purpose of design is, therefore, not only about forming the shape of the product. Rather, the mission of design is to work out how to integrate the shapeless values of humans and society.

(7) Hence, the design of digital products involves not only consideration of physical elements such as structure and materials. This design is concerned with content transmitted through the networks, and therefore, requires a cultural and social approach. The conventional methodology of design that applied to the machine products of the industrial age is no longer appropriate. Designing digital products requires new visions that draw on the cultural and social aspects of society.

(8) Considering all these aspects, the function of design is to reconsider all the conditions that techniques, people and society require of a product, and the designer should be free to engage in their definition. This will involve reconsideration of production structure, definitions of the information and service transmitted by the product, and definitions of cultural life. These are foreseeable roles for designers.

In light of the above discussion about theories of design methodology, we will now turn to certain characteristics of digital design. These are:

- No information related to the best manner to solve the design problems is provided;
- A clear and fixed process, which can be used universally, is difficult to apply;
- Most design problems are not obvious and latent problems must be uncovered;
- An important purpose of design is to discover the values of a new product;
- Solutions are various and dependent on the
designer's values; they will differ from engineering solutions;
- Digital design is much more than giving form and shape to products - to their physical existence; a very important design task is to highlight the information and services functions of those products;
- Designing requires a cultural and social approach; and
- Digital design must restructure manufacturing conditions, and propose ideas on how things ought to be.

These points emphasize the need for new directions for the design methodology mentioned in section 3.1. To sum up, we need a change in the role of designers from the designer as the "solver" of problems, to the designer as the "discoverer" of the hidden aspects of design problems. The designer's values and vision must play a key role in bringing problems to light. We also need to focus anew on quality, and move from the approach of how to design to what to design.

4. Parameters of New Design

To briefly sum up to this point, in section 2 we considered historical trends in theories of systemic design methodology and the limitations of conventional methodologies. In section 3 we looked at the special aspects of design methodology related to information technology. Section 4 will now examine, in the light of matters raised in the previous sections, new parameters in design methods.

4.1. Parameters of General Design

Designing is an activity that defines the relationship of man-made work and humans in the process of developing the design of a product. But this relationship does not only involve these two factors. Other decisive elements are "environment" and "purpose."

Four components influence the design problems in creating products. They are: the "artifact" itself; the "humans" who will use the product; the "purpose" of the product to be achieved; and the "environment" that the product will affect. The relationship among these components is critical, and each must be treated comprehensively. These are the essential considerations for designing. We can therefore assert that, in creating design, the designer plans a system which includes: "humans - artifact - purpose - environment," as illustrated in the below chart:

**Figure 1. Design System Factors**

In the past, "purpose" and "environment" were relatively clear or obvious. For example, when designing a chair, its purpose, "to sit on," was quite clear, although the conditions of its use might vary. The "environment" was the visible space where the chair would stand. So when we designed a chair, the factors that shaped the composition of this artifact did not need to be questioned. Key elements, such as structure and the materials inherent in this product, shaped the form of its design. In this example of a design process, problems such as environment and purpose did not really arise. The purpose and environment of the design subject were given as pre-conditions of design, so they required little consideration. In this instance, the relationship between the product and humans was paramount. Harmony and co-existence were central ideas that defined the subject's design.

However, the purpose and environment of a design subject, in the circumstances set out in section 3, are sometimes not accurately prescribed, or information about them is not provided as design pre-conditions. In these situations, the designer, during the design process, has to uncover the issues of purpose and environment and restate them. Re-structuring the relationship between environment, purpose and the man-made object may also be required. Here we may find that exploring the purpose of the object is insufficient. The relationships among the whole system of "humans - artifact - environment - purpose" also become a purpose to be investigated in the design process. We now turn to a consideration of these four elements.
4.2. Man-made Products as Material and Information

Looking at products as they are presently designed, we see that a substantial input of information has now become an element that bears on the structure of a product. Products, except for some daily miscellaneous ones, have an information function. Usually they have an inbuilt Central Processing Unit (CPU) or something similar. Take a mechanical product like a car, for example. Information is critical to operate it. To put it another way, information is essential when humans relate to machines. We can therefore say that the "materialistic" and the "informative" functions both contribute as elements to the structure of products. Until recently, the cognitive process of design usually focused on the materialistic function. The time has come where the cognitive process of designing products must change.

4.3. Humans and Man-made Products

In the consideration of the relationship between people and products, the function of "operation" must be picked up. The function of operation is linked with the function of information. This linkage makes the information function more difficult. That is why inter-face design, whose main purpose is recognition of information, has become a key issue. But, when we think about the human-product relationship and digital equipment, our approach must go beyond "operation." We must start thinking about another key question: how humans and products interact with each other?

In the design of products having an informative function, the tendency of the human user to rationalize is an obvious factor to be considered. To operate a function on a multi-functional telephone, buttons are assigned certain numbers. A telephone cannot be used unless set numbers are known. For the phone to function, numbers are decided randomly. In this example, the user is confined to limited button numbers and the CPU. The design convenience of products forces humans to use the predetermined form each time they use the product. This is a phenomenon of modern life that has now become a daily occurrence.

This "black box" manner of treating information coupled with the complexity of products does not allow consumers to participate in product design. They remain passive users [12]. Consumers must accept the product as worked out by the designers. In other words, this rationalized design process is structured to deliver products based on a one-way relationship between designer and user.

On the other hand, in the manufacture of tools, where the materialistic function prevails, a collaborative human input into the design occurs. This applies to, for example, daily use of tools like carpentry tools, stationary, and cutlery, or machine products like cameras, sewing machines, and audio devices. As users become more familiar with using these kinds of products, they develop their skills and a familiarity and attachment to the products, and, in so doing, contribute to the creative design function.

In the age of information technology, this form of co-creative function is definitely being lost. People, as users, and information technology products, are related through product use. The products are designed through the rational design process of a manufactured product. Alienation between human user and product results; or self-expression is constrained. Moreover, these products form part of the living environment itself and influence our basic ways of thinking.

We need to renew our understanding of design principles in consideration of the present situation. We should move toward design as a process in which humans and products interrelate. The best use of the design process requires an understanding of the original purpose of the manufacturing material of a product. In a sense, this is like the way humans themselves created tools through their own use of tools [13]. This would fill the gap in the present one-sided rationalized design methodology and give support to new principles of design that incorporate the relationship between people and products.

What is being advocated here is a new approach. It would accept that people and products are not independent, but that they form an integrated relationship. We would need to see the reciprocal features of this relationship.

In industrial design the relationship between humans and the environment is considered in "interface design." While bearing in mind the approaches mentioned above, "interface design" sees humans and the environment as independent, but it searches for adaptability. When we use information equipment, our heads process a vast quantity of information. Machines also process vast quantities of information to produce ordered work. These information processes are performed independently according to their own rules. However, some form of interconnection is required. The interface acts
like an interpreter for different languages [14]. In interface design, the processing of human information is regarded as a machine process, so a problem of interface occurs as noted in the telephone example mentioned above. It forces human information processing into a coded operation separated from human consciousness.

On the other hand, “interactive design,” which focuses on the mutual relationship between people and product, is needed. In “interactive design,” people and products are integrated and, from this process, something new is created. It is not merely a question of their mutual existence. The integration evolves dynamically, not just once, but in a continuous process leading to the creation of new products [15].

The interactive relationship of people and machines obviously includes indicative and operational aspects, but their inner expressions are also very relevant. The interactive process relates the structure of a product to its purpose, ranging from “easy operation” to “communication” and “decision making.” It also transforms the role of humans from a passive role to having a positive input in the design of new products. Re-structuring a new relationship between people and product involves consideration of the interactivity between them as a whole.

4.4. The Environment of the Design Subject

Environment for the purposes of design means, generally, the environment surrounding people. The design subject is considered in terms of the relationship between people and products. This is the key factor in determining design conditions. The essential pre-conditions for design are, therefore, information and an understanding about the relationship of people, machines and environment. In the past, the environmental focus was mainly on the physical and spatial aspects, or on immovable materials. The environment of a machine with physical functions is easily grasped as a place and space where the machine operates with the use of tools. When designing a chair, the room is the spatial environment of the chair, a physical object. Clearly, the environment has a part in the design definition of the chair. In this type of situation, the relationships between environment and targeted product, and environment and users are easily grasped. They are visible and one can touch them.

Digital design, however, is more complex and notions of environment vary. The environment may be very different from a space in a room where a machine is placed. For information equipment, the environment extends to people, machines, space and society, which are all connected in a network. So we must accept a definition of environment to include the wider range of the physical, human and social environments. Considering a commercial environment, we cannot ignore the infrastructure of the information service - the “business platform [16].” Nor can we be limited by a narrow view of the conventional market environment: what hardware will sell well?

The cultural environment element will also be relevant to the design subject, because the design function involves the design of information content. When designing information services/equipment for another country, understanding its history and culture is absolutely essential. The environment in this case is the society and culture of another nation. It is not easy to define what an information environment is when designing relates to information services. For the designer, the definition of environment will be very broad. Often it’s the general public who receive information, and sometimes it’s the media that transmits information. Designers here are concerned more with a social and cultural environment rather than with the physical one.

Obviously, the design of physical products must take account of the social and cultural environment, but the environmental element will be much more influential in information-related design. Environment for the purposes of digital design will range, therefore, from a narrow to a wide perspective. For the future of design, how to understand the full impact of the environment will grow in importance.

Given the importance of environment in the age of information technology, the obvious step to take is to extend the study of the environment as part of the design process. In the information society, products are deeply connected not only with machines and space, but also with communication and the actual scene of human life, the social system. Design must be undertaken with a full awareness of these factors.

We are not just talking of the physical dimension of the environment. Recognition of the full range of the mutual relationships of humans, artifacts and the environment is required. In this context, the designer’s role will involve reconsidering the environment, including products and, in the process, contributing to the development of the human environment.
4.5. "Purpose" of the Design Subject

It is clear that purpose is a vital element in the design of new products. We can speak of a "physical purpose" and of a "cultural purpose." Achieving the design target, actively and economically, is "physical." The focus is directed on the activities of people and of human life, on specific kinds of life activities, their content, their dimensions in space and time, their ease of accomplishment, judgments, human relations, etc [17]. Obviously, "physical purpose" is concerned with physical products and locations. In this instance, design is focused on physical function, and the purpose of the design subject is "physical."

On the other hand, "cultural purpose" comprises various elements like spiritual & symbolic aspects, hidden & symbolic meanings of physical materials and places, and innate dependencies of materialistic & social aspects. It is concerned with psychology, feelings, awareness, and the social relationships of users. So emphasis is placed on seeking to understand humanity. The intention is to try to enhance the quality of life and the welfare of people [18].

The purpose of the design subject should embrace the interrelationship of human dignity, spiritual richness and man-made products. The purpose of design should be defined in these terms. These will be very important elements in defining the purpose of digitally designed products. For example, when the purpose "to communicate" is set for the design of information equipment, communication via a conventional telephone and via digital equipment will be very different. The conventional telephone is easily defined because it has a physical purpose for voice communication with others. But, the purpose of the mobile phone is difficult to describe because of the rapid expansion of its functions. Product development proceeds swiftly while the purpose remains unclear. This lack of purpose definition leads to problems of peoples' emotional responses and confused understandings of private space compared with public space, for example as on a train. The physical purpose of the mobile phone is treated in the same way as the conventional telephone. So we must emphasize again the importance of societal aspects, including "cultural purpose," in defining design purpose.

In our information technology age, various conflicts and contradictions about a product's target and development arise that stem from the established status of physical purpose in design methodology. Although the tool functions of speed, of communication, and of quantities of information, are endlessly developing, social and cultural communication functions have made little progress. Senders and receivers communicating via the Internet do not usually jointly occupy a common "Ba [19]." The flood of Internet communication without particular contexts worries them. Frequently we experience problems of receiving information trash; frequently crimes are committed through the transmission of information. These problems are not taken into account in the "purpose" of information processing design and information equipment design. The potential to develop a better relationship between people and the transmission of information is missed.

4.6. New Parameters

Design is not only concerned with the manufacture of products. It also involves the creation of linkages: humans - artifact - environment - purpose. Section 4 discussed the new digital design milieu for each of these linkages. We stressed the need to understand the dynamic relationships of humans, artifact, environment and purpose, and the way these change over time, with the design and development of new products.

In our information technology age, products and humans are not independent from their surroundings; they are conditioned by the world in which they live. Design must reflect the reality of the multi-dimensional and diverse character of this modern age. This "context" demands recognition and understanding of the whole mutual relationship of elements in the chain: humans - artifact - environment - purpose. Such a design-based approach amounts to a process of synthesis, of "crossing the borders of design and creating products based on an overall perspective." This leads us from a systematic methodology that handles various elements in a value-neutral design process like information processing, to a new design methodology emphasizing design quality. To make this transition, designers must take account of strongly held views. Conceptions of design will also expand, as designers reflect clearly stated views of the world in which we live in their design process.

5. Methods of Design

In the light of our discussion above, we can now say that a new approach to design will be required in our digital age, and that approach will involve "definition design." "Definition design" is design that concentrates
on the definition of products. In defining a material, we should question anew how the machine should work in the context in which the machine exists, and what sort of tools should relate to that context. The aim is to bring new meaning and value to a product.

During the period of industrialization, the design of industrial products concentrated on the shape of products. Little thought was given to reviewing the fixed parameters. Space was structured by material that undeniably existed and was accessible. Physical definition, or definition of mechanical conditions and movements, was the obvious and fundamental parameter. The form of a product was made by reference to parameters that were obviously held in common by everyone. For example, when making a chair, a desk, or a car, the form could be made without re-thinking the basic parameters of the products that already existed [20].

Now in the age of information technology, the design of digital products requires new ways of thinking about a product’s parameters because the definitions of a product are constantly and fundamentally changing. In designing a telephone, its fundamental function to transmit voice is too obvious to become a problem. In the design of a digital product called a mobile phone, the function changes from a tool to speak into to a different type of product. Here the obvious definition of telephone has no relevance. When undertaking such design tasks, we are forced to restart with a basic definition of what the products should be.

It is, therefore, unavoidable to extend the concept of definition. It should include parameters such as the content of communication to be transmitted through a machine, information and services supplied, and the type of platform created by networks. The objective of "definition design" here is to develop a design for the targeted equipment within such parameters.

The industrial revolution developed products with various and unexpected functions. At that time, the functions of the design process dramatically expanded. Society was filled with new products without an interface. The purpose of design, in these circumstances, was to design new products to permit their co-existence with people [21].

Therefore when we think about this age of industrial revolution, we see that a function of design was originally "to define products and materials." With this perspective, we can say that an essential aspect of the design process is the definition stage. It is a process of defining, one by one, each element of what a product ought to be. If we take this path, we will create better harmony of newly produced goods with people.

In the 20th century, the system of industrial production and of products became more settled. Completely new products were relatively less frequent. Compared with the 19th century that saw the emergence of the process of design, we can now see that a very different situation prevailed in the 20th century. The so-called industrial period ignored the artifact's definition, merely concentrating on changing its shape, while pursuing the sale of products to consumers. This trend has continued strongly up to the present time. Now in our age of information technology another transformation is at hand. It is widely held that digital development, and its influence on industry and society, is inducing a revolution, equivalent in scale to the industrial revolution.

As digital equipment, industrial structures, technical systems and production systems are in the process of transformation, new products appear one after another. Faced with this changed world, the new role of design is to restructure new materials, elements, knowledge and technology, and, then, to demonstrate new ways of seeing products. In designing, we should revisit the basics of design during the Industrial Revolution, and re-learn to define products objectively. We now need to restructure functions appropriate to a new society using new technology and, in the process, bring to life the conceptions of new products. This is "definition design."

6. Conclusion

In this article I have presented conceptions of design that I believe will pave the way for the future. I looked back on the theories of systematic methodology represented by Archer and others, and compared them with the context of new design in the modern age. I advocated "definition design" as one of the new directions. I believe that this is the conceptual foothold that is destined to take more concrete form in future study.

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