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Design Education in Brazil:
History, Critic and New Approaches for Design Innovation

By

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Declaration

I hereby declare that, the contents and organization of this dissertation constitute my own original work and does not compromise in any way the rights of third parties, including those relating to the security of personal data.

Patricia Santos Delgado

2017

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I would like to dedicate this thesis to my biggest loves and adventure fellows, João and Fernando.

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Abstract

Never before in history people have been so connected. It is clear on people's minds that we are part of a system, and that everything is integrated. News travel across the world in seconds, distances do not exist anymore, cultures are mixed and the world has been increasingly more holistic.

Within this scenario, our demands and expectations regarding designers also are changing. In the past, we did hope that designers would bring modern and innovative products, capable of connecting us with the future. Today the needs go beyond. The roots are coming back with humanistic values, the contact with others and the social life. There is a growing concern about preserving nature, culture and traditions. This is what matters today. Therefore, it is not expected that designers solely design technological and innovative objects. Rather, it is required of them to project systems capable of connecting people, valuing culture, traditions, and welfare.

With that being said, comes the question: We demand this posture from designers, but are we preparing them for this? We await designers to have a holistic posture, while we give them a linear, Cartesian education, divided in modules and grades. Disciplines award higher value to issues like technology and economics, which are constantly changing, instead of human and social issues. Thus, the focus of the present work lies on didactics. Bringing these matters up to reflection, this study discusses further than the "what" has been taught: the "how" it has been taught.

The present work was performed in two parts, divided into a desk research and a field research. In the desk research, a study was conducted regarding didactic theories with emphasis on the constructivist approach. Then, a survey was carried out related to the development of design methodologies from the twentieth century to the present day, with emphasis in design thinking and systemic thinking development. In sequence, this study discussed the design education around the

world. To this end, a number of cases presenting a differential in design education were analyzed.

In the desk research, the contextualization of the problem was addressed, a study of Brazil in relation to its general characteristics and its characteristics related to design and design education, with focus on the Design School from UEMG.

In the field research, a case study was realized at the Design School of UEMG (Brazil), aiming to verify the feasibility of application of new approaches and techniques researched and to raise features that should be adapted to the local context.

At the end, a set of tools and approaches were presented considering that they can be employed in the university to induce students and professors to a new posture, leading to a new teaching model, more open, fluid and dynamic, prioritizing humanistic values in favor of the man, the community and the environment. In this way, it is hoped that the new professionals are able to have a contextualized and systemic performance, enhancing local identity, preserving resources, culture and still unveiling new possibilities of action for new designers.

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Chapter 1

Introduction

For a long time we have been hearing about how the world is changing. The industrial revolution followed by the consumption crisis, then the wave of ecological appeal and sustainability; afterwards, all technological advances of the age of internet, communication and speediness. Together, all these phases represent significant changes in the world, and they have changed people's value.

Today, we live in an age in which human value surpass material value. Designers are no more professionals who project exclusively for industry. They have started to solve problems, projecting services; being demanded of them an adequate posture in regard of our context, a holistic posture. They must develop environmentally friendly projects, with social appeal, innovative, accessible for all and with local identity.

Despite this, most of design schools keep repeating outdated patterns of teaching, related both to contents as well as to didactics. Technological, economic and strategic issues are still more valued than humanistic, cultural and social issues. The relationship between professor-student still possesses characteristics of hierarchy, presenting passivity by the students, causing them to bear a lack of participatory opening, culminating in underdevelopment of their critical sense.

All of this becomes increasingly more harmful within a context that should be creative, pursuing tendencies of connectivity, integration, valorization of welfare, when we think of how designers should be prepared for the future. The schools take a fundamental place when we think about the future; the schools are what mold the professionals.

Moraes (2014) defends that new design schools should be open, fluid, dynamic and conducive, and they should not be pretentious to have a single education model with predictable values. New design schools should prioritize humanistic values instead of technical, with more experimental content than predictable content.

Bonsiepe (2012), when discusses about what would be humanism design and how would be a humanistic attitude, argues:

> *The humanism design would be the exercise of design capacities to interpret needs of social groups and elaborate viable and emancipatory proposals, in form of instrumental artefacts and semiotic artifacts. Why emancipatory? Because humanism implies reduction of domination and, in the case of design, attention also to the excluded, discriminated, as they say euphemistically in economist jargon, <economically disadvantaged>, i.e. the majority of the planet population. (pg. 21)*

In the same text, Bonsiepe makes clear he does not intend to propose a naive and unrealistic approach; the intention is to develop a critical awareness related to social problems faced by society.

Germak and DeGiorgi (2008) also argue that industry, society and schools need minds primarily critical, then assertive and so proactive, never accommodated or submissive. According to these authors, the key to teaching in schools is relating and properly calibrating links between function, inspiration, innovation and adaptation to the context.

Design is a flexible activity, capable to connect different knowledge areas. It is characteristic of design action the interdisciplinary mix, what makes design an area of big contemporary potential, diffuse and effective, as well as relative and adaptable, extraordinary capable to relate theory and practice, between the possible and the viable (Celaschi, 2008).

Margolin (2014) argues that designers can meaningfully collaborate to the visualization of material forms for a more humane world; however, there is little content in a typical design curriculum that prepares students to figure future sceneries. To visualize the future is a hard task, since there are multiple visions, which describe how the world could or should be. Designers possess unique competencies to shape plans and proposals, but they need broad and coherent social sceneries to conduct them to their work.

As one can see, several authors theorize about the need of change in design education and about the need of contextualization with the needs and demands of

today's world. However, few elaborate on how to do it. This adaptation should be promoted both on curriculum as on didactics, providing students with a conceptual openness into a way that allows them to have, in the future, a contextualized posture on the world that is waiting for them.

The main objective of this study is to investigate how these changes can be made and which is the best way to enable innovation in design education, more specifically in the Brazilian context. Secondarily, was intended:

- To comprehend the universe of design methods, its evolution and the current approaches around the world.
- To discuss design education and its practice.
- To conduct a deep research about Brazilian design education, its origins, practices, as well as the context around it.
- To propose actions and make suggestions to induce Brazilian design schools to a more holistic and contextualized education.

To reach those aims, the study was conducted in two parts, desk research and field research. In the desk research a descriptive and exploratory research was developed, aiming to describe the characteristics of the three universes around the theme: education, context and design. The map of the thesis can be seen in the picture bellow:

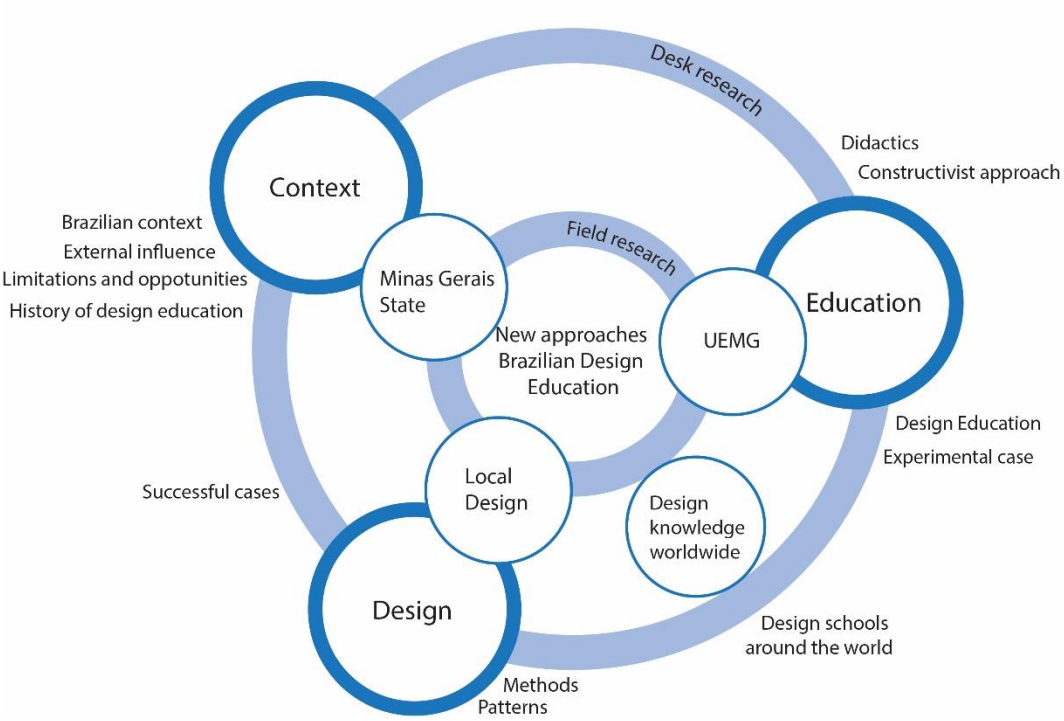

Figure 1: Map of the Thesis

More specifically, the actions carried out include:

(I) a study regarding the didactics and its evolution, with emphasis on the constructivist approach;

(II) a survey of the development of design methodologies from the twentieth century until today, with emphasis on design thinking and system thinking;

(III) an analysis about cases of innovative methods in design education around the world.

(IV) a research about Brazil, its characteristics and its characteristics regarding design and design education.

The desk research is presented in Chapter 2 as the state of art. It was based in literature review from previously published sources, including books, papers, journal articles and material available on line. In addition to present cases of innovative methods in design education, interviews were conducted by Skype with professors of some of the quoted institutions. In the case of the Polytechnic of Turin, the course of Systemic Design was followed, and interviews were performed with professors and students.

A case study at the Minas Gerais State University (UEMG) was realized, aiming to verify the feasibility of application of the new approaches and techniques researched. It also sought to comprehend the features to be adapted in the local context. The case study is presented in Chapter 3.

This consisted in a field research at the University and was developed through a survey about the context, i.e. a study about Minas Gerais state, its general characteristics, a study about the local design and a study in the University.

It was performed through visiting the University, following some classes, interviews with professors and students and consultancy to available literature, mainly in magazines, newspapers, articles from journals and books. In addition, interviews were realized with prominent actors, as the Dean of the Minas Gerais State University, former students and former professors that obtained success in their career.

As a result, this study presents and discusses a compilation of didactic tools and approaches to be used in the design teaching, based on the best practices researched, pursuing to attend the needs of Brazilian context. The focus relied in breaking the old Cartesian and rationalistic way and proposing a path to reach an increasingly fluid and dynamic education, based in human values, relations and welfare; in a way that such values can be developed into educational practices, rather than just the result of a project.

Chapter 2

State of Art

2.1 Didactics

The term didactic has a Greek origin and can be translated into teaching technique. It is known as a branch of knowledge and as a subject in teachers training courses, which makes the integration of theory and practice. Didactics has its basis in psychology, philosophy and sociology. According to Oliveira (1995) its objectives are: to reflect on the socio-political role of education and school; to understand the teaching process; to empower the teacher, theoretically and practically, to understand and solve problems posed by the teaching practice; to resize the teaching practice through the development of an educational proposal from a critical perspective of education.

Since the sixteenth century, there has been a concern regarding the teaching methods, starting with the Society of Jesus[1], an organization that lasted approximately two and a half centuries, exerting a profound influence in the educational model. In 1750, a few years before its annulment (1773), the Jesuits possessed 578 schools and 150 seminars, amounting altogether, 728 teaching houses (Franca, 1952).

During this time, educational institutions were committed to the process of evangelization and expansion of European culture. They met the interests of the bourgeoisie that craved for a solid education, directed to the knowledge of the past, with severe discipline to their students. The Jesuits followed strict discipline emphasizing repetition, disputes and questions. They believed it essential to form the man through the repetition of lessons, contests and interrogations. However,

[1] Society of Jesus is a religious order founded in 1534 by a group of students from the University of Paris, led by Ignatius of Loyola. The Pope recognized the congregation in 1540. Its members, the Jesuits, are known for their work in education, intellectual research, cultural projects and missionary presence (Taldivo, 2014).

these contests worked specifically within the matter taught in the classroom. Repetitions were highlighted in common rules for teachers in order that they become constant in the classroom (Lacanallo et al., 2007).

The professor's role was teaching issues into an efficiently way. Thus, the methods were intended to make the student record the information provided by the teacher and be able to repeat them without questioning or discussions. The learning process was painful and severe, as corporal punishment was part of school routine.

This model of work exerted a significant influence on the education and in the existing model of society. However, within this context of influence of the Jesuit legacy, came John Amos Comenius (1593-1670), considered later, the father of modern didactics (Lacanallo et al., 2007).

Comenius presents a methodology of how to teach everything to everyone, distanced from the practice of the time in which the teaching was just for the privileged few. His book, “The Great Didactic” (1633–1638) offers an educational concept based on a religious perspective. The book contains four parts: the first presents the man as the most perfect creature that exists on earth and includes theological and philosophical foundations of education. The second presents the principles of general didactics based on the laws of nature. The third, dedicated to special didactics, presents methods for teaching letters, sciences, mechanical arts, morals and piety. Finally, the fourth, presents an organic study plan for the four school grades in accordance to the general characteristics of child and youth development.

Comenius’s method is based on the following principles:

- What the student must know must be taught.

- What is taught must have practical application.

- The explanation of what is being taught should occur in the clearest possible way.

- Teaching in accordance to the needs and in due time.

The author points out in the course of his work the role of the senses in learning, highlighting that knowledge always starts necessarily in the senses (because there is nothing in the intellect that had not passed before the senses): why, then, education should start by verbal explanation of things and not by direct observation? Only after the object has been shown is that it can be best explained in words (Comenius, 2002, p.234 cited by Lacanallo et al., 2007).

Comenius proposed the fundamentals of teaching in schools mindful of an art that was superior and served as limitation, once the school intellectual production process would be equated to the process of material production of artisanship and manufacturing.

The art of teaching contemplates both the transmission of knowledge as well as the method used for this purpose. Thus, for Comenius, teaching consisted in the action of one person over another, so that the teacher's role would be to make marks on the student: in their intelligence, will, memory and emotions until such student becomes distinguished from people who did not attend school. Hence the meanings of the art of teaching are revealed: some relevant and determined by the material to be taught and some of coercive nature, such as corporal punishment, presenting positive results for that period, did remain in schools until the mid-twentieth century.

The Comenius teaching method had the following characteristics distinguished from methods of its time: to propitiate learning to produce good results that were dynamic, enjoyable for students and teachers. All this in response to the new mode of production, marketing, as well as the arrival of a new method to produce everything to trade with everyone; the school needed a new teaching to teach everything to everyone.

In his writings, Comenius extends the "art of teaching" to the other side of the human process, which is learning, indicating therefore that both the teacher and the student are constituent parts of the same process.

Another important thinker in the field of education and pedagogy was Rousseau (1712-1778). Taking in account the period in which Rousseau's work was written, the author had advanced and innovative ideas for the time. It highlights the role of observing the object to know it. In his book "Emilio", he deals with the principles to prevent the child from becoming bad, since the basic assumption is to believe in the natural goodness of man. Education for the author has two aspects considered essential: the development of the natural potential of the child and the removal of society's ills from her (Lacanallo et al., 2007).

One of Rousseau's concerns was to make the environment favorable for development. In his work, Rousseau refrains from specifically dealing with an educational plan or educational method, but describes in detail, the philosophical principles of education, which he considers indispensable. From this perspective, education should not aim to prepare children for the future or to shape it, but should respect the nature of the childhood.

To Suchodolski (2005), it appears Rousseau continued Comenius pedagogy, for also employing the notion of infantile nature. However, Rousseau envisioned a purely empirical way, rather than seeking nature within a sense of true essence of man, the author did not want to impose anything on man.

In the historical development of education theories, modern pedagogy consisted especially of traditional and progressive aspects. Regarding to the traditional theories, Pestalozzi and Herbart stand out and regarding to the progressive site, Dewey[2]. These theorists formulated important principles, theories and ideas that have great influence in the field of education, particularly in teaching (Zanatta, 2012).

According to Zanatta (2012), Pestalozzi[3] elaborated his educational proposal taking from Jean-Jacques Rousseau (1712-1768) the concept of education as a process that must follow the nature and principles such as freedom, the innate goodness of being and the individual personality of each child. He defended a non-repressive education, the learning as a mean of development of human capabilities and the cultivation of feeling, mind and character.

Even further, the intellectual and moral development of man must be articulated. In such endeavor, Pestalozzi formulated his teaching method based on the idea of sensing perception with the principles: from the known to the unknown, from concrete to abstract, from the intuitive vision to the general understanding, by a natural association with other elements and finally meeting the achieved views in the organic whole of each human consciousness. The author believed that the most important thing was rather than to teach certain knowledge, to develop the capacity of perception and observation of students.

In the understanding of Pestalozzi (1946), one of the basic principles of education is to develop the capacity in line with the acquisition of knowledge,

[2] Pestalozzi and Herbart were influenced by the German social-historical context of the early nineteenth century, in which the culture of the people was considered an essential element of the constitution of the German nation and the education as condition to train their citizens. Dewey was influenced by the ideal of freedom, progress and democracy in American society of the early twentieth century (Zanatta, 2012).

[3] Johann Heinrich Pestalozzi (1746-1827), Swiss educator, was born in Zurich; he belonged to this intellectual environment and experienced significant moments in the history of German thought, particularly the formation in 1815 of the German Confederation. Since his student days, Pestalozzi participated in political and social reform movements. He called the world's attention by acting as teacher, director and founder of schools. His major works are “Leonardo and Gertrude” (1781) and “How Gertrude teaches her children” (1801) (Zanatta, 2012).

which involved learning as a spontaneous process, resulting in a free activity, a lively and original product. To this end, the teacher should seek their own material in the environment that surrounds the students, that is, in a real situation.

However, according to Zanatta (2012), a criticism raised against Intuitive Pedagogy points out the passive position of the student in the process of assimilation of the knowledge transmitted using all the senses. In this process, the teacher presents the concrete, but the student does not act on it. Learning becomes just a memorization and a copy of that which the teacher shows.

J. F. Herbart[4] proposed the study of pedagogy based on reason, stating that the ultimate goal of educational practice should be morality and improvement of human character. Thus, the author resorted to the psychology, considering it the first science of the educator, proposing that the interests of students are an inherent tendency, which allows the retention of an object of thought in consciousness, requiring associations to its return (Lacanallo et al., 2007).

For Herbart, good teachers need to follow five formal steps to achieve success in their students learning: preparation, presentation of a new argument, association, systemic integration and method or application. He argued that teachers should wield a pedagogical theory, so that practice would not solely be based on their experience, which although important, would not be enough for effective teaching (Gomes, 2003).

Herbart, despite being inspired by Pestalozzi theories, brought into question the insufficient theoretical foundation and the woes of memorization. Therefore, he pioneered a proposition for pedagogy as a systematic science with well-defined purpose and method of teaching.

To the author, instruction causes the student to be interested in learning objects, so education consists in to educate the intelligence and the will of the student, producing its true interests. Herbart proposal was based on three concepts related to morality and purpose of education, which are government, education and discipline (Zanatta, 2012).

At the midst of the eighteenth century industrial revolution, the necessity of educating factory workers to know how to read, write and count emerged.

[4] Johann Friedrich Herbart (1776-1841), philosopher and educator, was born at a time in which exponents of German culture and philosophy were near their peak. The greatest pedagogical influence on Herbart was Pestalozzi, from who he took the fundaments to develop pedagogical design, valuing especially intuition (Zanatta, 2012).

Alongside new sciences and technologies, came the need for higher levels of education for the transmission of knowledge, followed by a criticism directed at traditional schools regarding the social and political transformations. The educational system began to be questioned by consolidating the New School.

The New School positioned itself against the dominant teaching, which had been limited to education. Instead, the New School advocated an education focused in child, life and activity, by placing the student as an active element in the learning process.

One of the precursors of the New School was the American John Dewey[5]. Dewey criticized the traditional school and refused to accept the education from instruction proposed by Herbart, offering education through action. For him, education is a directed activity that has not an end in itself, but for the experience. It must provide the children conditions to solve their own problems, as opposed to the traditional ideas of forming the child in accordance with previous models (Zacharias, n.d.).

Dewey advocated progressive education, accompanying the growth of the child's life to the extent that the content of the experience would be enhanced as well as the control that can be exerted on it. The author defends the interests of the child, manual activities, and teamwork. Dewey sees education as a social necessity and the school as the ideal instrument to extend such benefits to all individuals.

According to Zacharias (n.d.), to Dewey, the teaching-learning process would be based on:

- An understanding that wisdom consists of knowledge and experiences that intertwine dynamically, far from the predictability of previous ideas;

- Students and teacher hold own experiences, which are utilized in the process. The teacher has a synthetic view of the contents, the students a syncretic vision,

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[5] John Dewey (1859-1952) was one of the greatest American educators. He studied at the Universities of Vermont and Johns Hopkins, received in 1884, a doctorate in philosophy. Among his most prominent works are: Psychology (1887); My Pedagogic Creed (1897); Psychology and Pedagogic Method (1899); The School and Society (1899); How we Think (1910); Democracy and Education (1916); Reconstrucion in Philosophy (1920); Human Nature and Conduct (1922); Philosophy and Civilization (1931); Art as Experience (1934); Logic, the Teory of Inquiry (1938); Freedom and Culture (1939); Problems of Men (1946). More of him at: John Dewey, American Pragmatist. Available at: <http://www.dewey. pragmatism.org/>. Accessed in Nov. 2015.

which makes the experience a central point in the formation of knowledge, rather than the formal content;

- A collective learning, as well as collective production of knowledge.

Dewey's pedagogy has many innovative features, distinguishing itself especially by opposition to the traditional school. Mindful of the usefulness of education for life, his proposals have the subject's activity as central concepts, the experience as a condition for knowledge and knowledge as reconstruction of experience (Zanatta, 2012).

The teaching principles of the new school did not appease the interests of the dominant class. Man should adapt to the urbanization model and the factory system, being it necessary to rethink the process of teaching and learning. To fulfill these needs and interests, the psychologist B. F. Skinner (1904-1990) in addition to theorize about education, expounded his ideas through teaching methods and instruments. For Skinner, the conditioning occurred by associationism. Through experiments, involving association, the author applied programmed instruction to learning, hence creating the model called experimental analysis of behavior (Lacanallo et al., 2007).

The student should be strengthened to each task and immediately to it, conferring right or wrong to the response. Students could be grouped in series or classes, but each proceeding at their own level. Skinner (1972) developed this process in order to replace the teacher in certain situations of learning, by a teaching machine.

In this way, the didactic work has been refurbished, emphasizing new resources and teaching tools. It started to be more rigorous in planning both in relation to the objectives and goals; the production of textbooks was encouraged; the increasing use of audio-visual aids; the preponderance in the quantitative assessment, among other aspects came to prominence in schools, ensuring control of the process of teaching and learning with full effectiveness and efficiency (Lacanallo et al., 2007).

Within this educational concept guided by Skinner's ideas and their proposals for a teaching process through conditioning, strengthening and programmed instruction, it was noticed among educators and researchers the necessity to investigate how knowledge itself is processed.

Among these researchers, Piaget (1896-1980) and his work stand out in particular, alongside Vygotsky (1896-1934), since their discussions enabled a new understanding of the relationship between learning and development. Even though

both have not sought to develop theories or teaching methods, their ideas enabled a new vision for school teaching.

Piaget was an epistemologist who drove his studies to the genesis of human knowledge. His theory, known as Genetic Epistemology or Psychogenic Theory, argued that the individual builds knowledge from birth. Piaget (1998) considered that the experiences, the environment and the school itself are factors that affect this construction both to who is learning and to who is teaching. Piaget, from his theory collaborated to explaining the construction of knowledge by the child (Lacanallo et al., 2007).

According to Munari (2010), Piaget attaches great importance to education. For him, education is the primary task of all peoples, overlapping ideological and political differences. In this regard, it established an assortment of rules, the first being the cardinal rule: "Coercion is the worst teaching method" (Piaget, 1948).

Another equally fundamental rule is regarding the importance of the activity of the student, which argues that an activity learned is no more than a half-truth, while the whole truth must be rebuilt or rediscovered by the student himself. Piaget therefore proposes a school without coercion, where the student can experience actively rebuilding by himself what he has to learn.

The Russian psychologist Lev Semenovich Vygotsky (1991) relates education with material production of men, as a historical and cultural process. Through mediation, the teacher is able to provide students the knowledge accumulated historically and the understanding of reality (Lacanallo et al., 2007).

To Vygotsky, the child does not simply respond to stimuli, but acts on them, transforming them. The social environment, through culture, provides mediator's instruments, including signals. He emphasizes the importance of cultural environment and relationships between individuals in the definition of a human development path, considering that the student is an active receiver who is always rebuilding, reworking from the meanings that are passed by the social group.

Both the theories of Vygotsky and Piaget were classified as bases for constructivism in education, Piaget being the most important. His extensive work continues basing the most current research on the acquisition of knowledge (Leão, 1999).

According to Varani (2002), constructivism didactic is a philosophy that aims to break with old educational paradigms, in which knowledge is treated as an object passed from professor to student. This philosophy treats education as a complex process, depending of many integrated factors, from didactic environment, which

involves physical structure, classes and materials; to didactics structure such as curriculum and contents; as well as students, professors and all complexity around them. Regarding students, constructivism considers cognitive, affective, experiential and sociocultural factors. Regarding professors, beyond considering their knowledge and skills, it considers their emotional sensibility and reflexive capacity.

The constructivism approach, working on cognitive, social and situational contexts, offers a theory of knowledge, learning and communication. Students structure knowledge from their own experiences, interpreted by their own mental schemes. The individual meanings become mutually compatible in gradual process of accommodation and adaptation, through processes of change, dialogue and social negotiations. The role of professors moves from performances in the classroom to cognitive processes put in the act of learning. Professors and materials are resources embedded into a process in which learning occurs in many complex ways.

The figure below presents a synthesis of constructivist environment:

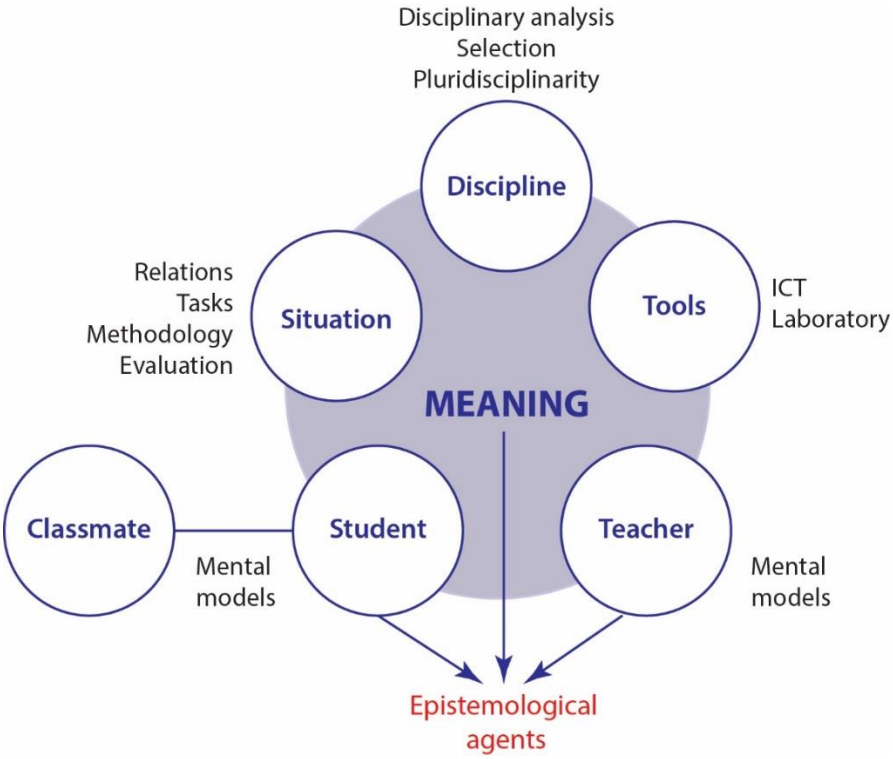

Figure 2: Constructivist environment. Adapted from Carletti e Varani (2002).

Jonassen (1996) explains that knowledge is the construction of meanings, which makes sense in each individual world. Physical world has humans as its natural interpreters and existent knowledge can be used as an explanation to new ideas and phenomena.

Carletti and Varani (2005) present strategies to represent consciousness through frames, scripts and conceptual maps, which are used as tools to analyze and govern the cognitive processes. They argue that metacognition should be present in every school's act because it is directly linked to emotion, interaction with others and the cognitive strategy.

Within constructivist approach, professors are the learning environment builder, where students can work helping one another, using a variety of tools and information resources on activities that guide for problem solutions. It is an interactive process, which people learn from each other, and not only through narrative and shows. It is human nature to form communities where learning is the result of a reciprocal exchange (Carletti and Varani, 2006).

Thus, the authors highlight the importance of cooperative learning, in which the construction of new knowledge is a product of negotiation with others, not solely an individual work. The transformation of the traditional classroom, from individual learning to cooperative learning, putting the group as a tool to enhance learning through the value added by the collaboration. This ability is not innate and must be learned.

In regard of learning resources, Carletti and Varani (2002) defend using technology. According to them, technology, hypermedia and Internet involve an amount of complex conceptual and practical activities that allow manipulating knowledge into a personal and original way, facilitating conceptual elaborations. The computer can provide an environment in which the user can apply knowledge to the problem and consider their actions as reusable events. Learners can control their own learning process; learn from others, developing metacognition.

Computers also emphasize and promote teamwork and cooperative learning, where the work group becomes a community of practice and learning. It is a collaborative and cooperative environment in which content is generated from the entire community contributions, putting learning back on its true nature of social process.

Inside of network, the problem can always be redefined and re-contextualized, constantly generating new questions. The technology provides an environment where it is possible to act and to try, breaking the rigid scheme of sections by subject. The technology holds the potential to redefine the old concept of school, in spatial and temporal level, embodying concepts of polycentrism, distributed school, distance education, continuing education. It can facilitate communication and cooperation between distant subjects and the construction of virtual communities with high levels of interaction.

Constructivism and its principles offers a series of guidelines that would add value to designers and professors in implementing collaborative environments at school, making a more attractive, reflective and authentic learning. Students become collaborators in the development of knowledge, as well as the creation of important practical projects.

The didactics history evolved from a hard and painful approach to a more humanized and contextualized approach. The prominent authors and the main characteristics of their theories can be seen in the figure below:

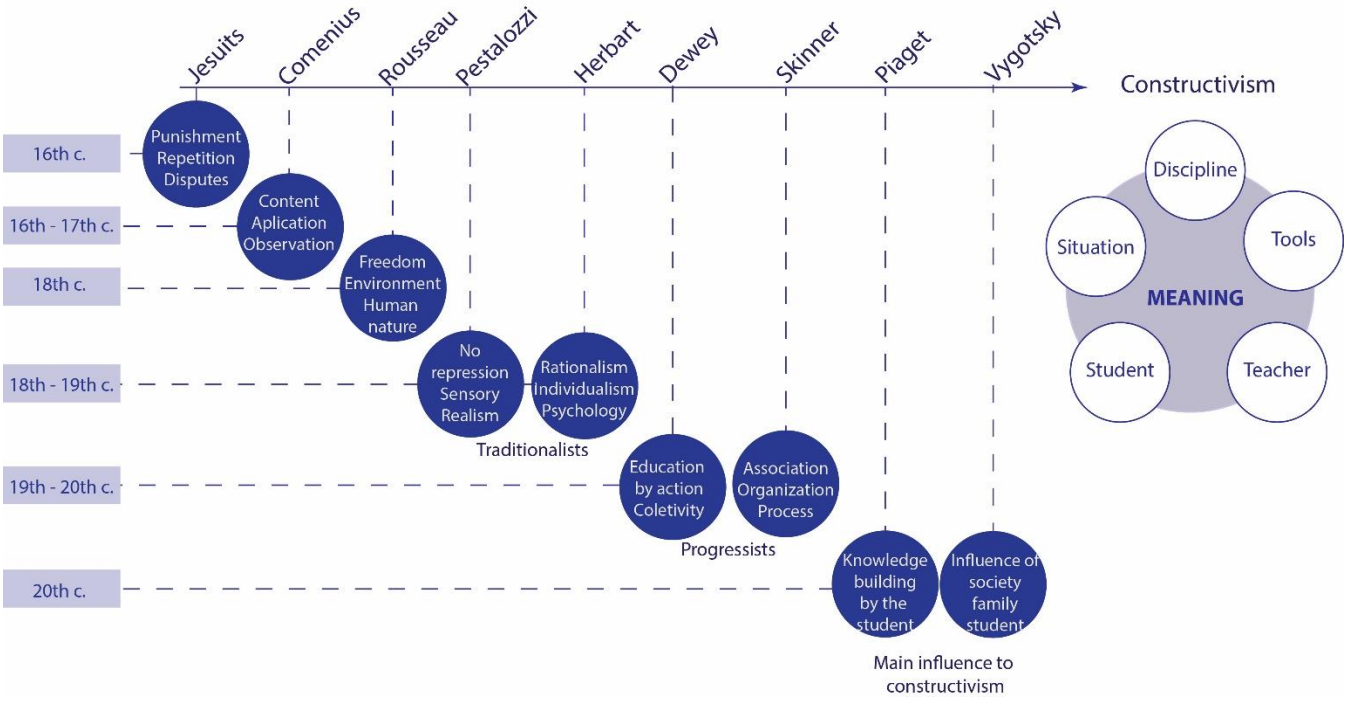

Figure 3: Didactics evolution.

As one can see, during the evolution of the didactics, the concepts were changing and values such as freedom, collectivity and realism made the process of learning more connected to the individual and to the context.

2.2 Design Methods

2.2.1 Evolution of Design Methods

The interest in methods and techniques directed to product development emerged at the end of the nineteenth century, at a moment in which industry began to give importance to this kind of knowledge. At the beginning of the industrial revolution, attention was focused on increasing productivity and organization of productive means, highlighting the works of Frederick W. Taylor[6] and his contemporaries (Cunha, 2008).

Later, according to Cunha (2008), a greater preoccupation with the product and its functional and structural constitution spurred from the technological development, giving room to the rise of technical systems. During this period, the method was restricted to scale drawing (Van Der Linden, 2010).

When the focus shifted to the product, the first literature directed to the systematization of design activity appeared. At first, such literature constituted a primitive level in terms of formalization of project development activity, passing, later on, to more elaborate proposals.

Then, the first studies directed to user behavior appeared, these works would later relate to market opportunities and to the development of specific product characteristics (Cunha, 2008). From the 80s, the emergence of globalization shifted the focus to the market.

The 90s brought the need of cooperation on large scale, emphasizing the collaborative work, and at the twilight of the twentieth century, the concern for product portfolio management was heightened in companies, leading the focus to innovation issues and strategic planning.

[6] In 1911, Taylor wrote a book called "Principles of Scientific Management". The main concepts addressed in the work were the factors that helped in production as well as the time required for each worker to take action in accordance with the right techniques, always taught through training. Taylor focuses his book on labor division, departmentalization, command and control (supervision). The book's main goal was to increase the productivity of industries by scientific analysis of the work in order to find a way to "ramp up production" and get better results. Among Taylor's followers are Henry Ford, who took the theory of mass consumption and worked concepts to reduce costs, increase production, etc. from the principles developed by Taylor. Available at: Portal Gestão. Available at: <https://www.portal-gestao.com/artigos/6650-frederick-w-taylor-o-mestre-da-produtividade.html>. Accessed in Dec. 2015.

Cunha (2008) summarizes this point of view concerning changes in product development focus in the figure below:

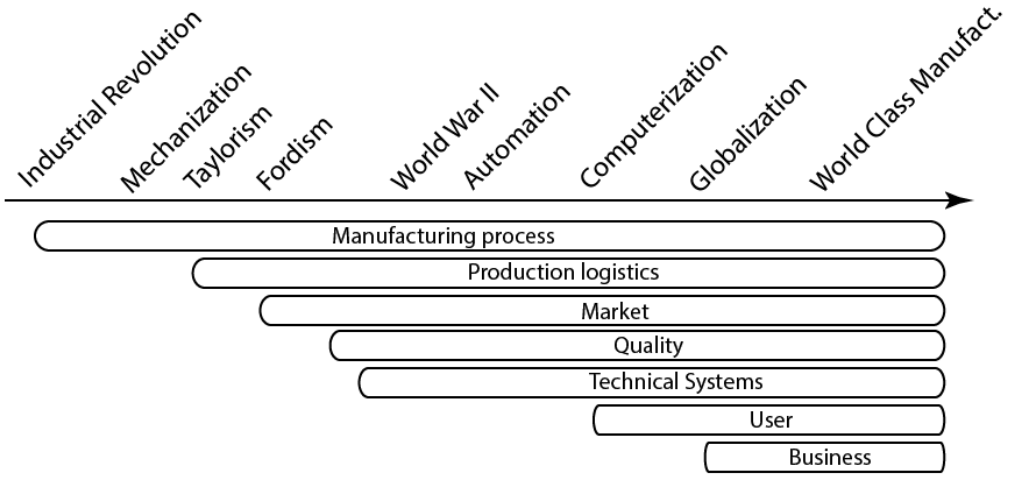

Figure 4: Progression of focus in the industrial world. Adapted from Cunha (2008).

To detail it in further depth and in order to present the most prominent works and authors related to the evolution of design methodologies, the present work will be separated into relevant decades starting from the early twentieth century to the present day. An overview of the authors, their works and their relationship to the period related will be made. In the following chapters, two methods of significant interest to this study will be discussed in detail: design thinking and systemic design.

The 20's: The establishment of pedagogical principles.

It was at Bauhaus[7] the most famous design school in the history of design education, where the profile of designers began to form and the pedagogical principles and theoretical concepts for design were settled. However, in the beginning the school presented no interest in design methodology. The focus remained on artistic and vocational training that allowed students to solve aesthetic

[7] Bauhaus worked in Germany from 1919 until 1933. It was a school of fine arts and avant-garde architecture, which aimed to "restore harmony among different art activities, among all craft and artistic disciplines and make them entirely supportive of a concept of building"(Gropius cited Pereira et. al. 2010).

and production problems all the while becoming highly qualified for industry. There was the interest in presenting a new industrial aesthetic through the formation of the artist-craftsman and in educating the public by means of exhibitions (Burdek, 2006; Cardoso, 2008 apud Van Der Linden, 2010).

According to Pereira et. al. (2010), the union of art and technic proved to be one of the greatest challenges of Bauhaus. Such union was applied at the school through action pedagogy, which rejected the teaching model focused on transmission of knowledge and prioritized the self-education of students. This model emphasized the integration between theory and practice, employing numerous workshops available to students.

The structure of the course had a preliminary introduction base that allowed students to hold a holistic view of the course before specialization. Therefore, students received an artistic and vocational training, enabling them to be qualified for industrial work. In the picture below, one can see the course structure, showing from outside to inside, as they first studied the general concepts, only then to follow the path of specialization, located in the center (Mattara and Nascimento, 2015).

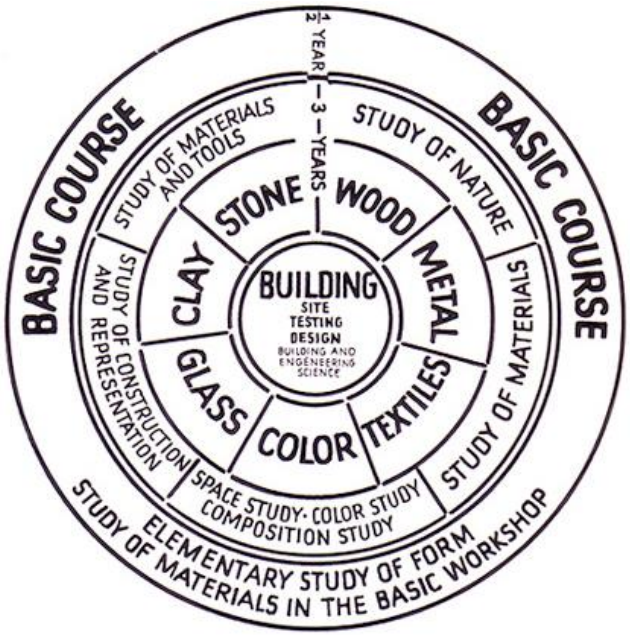

Figure 5: Bauhaus course structure. Source: <http://whatconsumesme.com/page/12> Accessed on Dec. 2015

The Bauhaus was a school that proposed to break paradigms and the revolution of applied arts teaching, through industrial production and freedom of creativity. This stance generated a methodology, which still reflects today on education and the process of product design (Pereira et. Al. 2010).

The 60's: Functionalism and complexity

From the 60's, methodologies for development of new products began to evolve. Two facts were outstanding at the beginning and influenced the development of design methodology as we know today: the foundation of the Ulm school and the Conference of London.

The method of Ulm school[8], was key to building design methodology in the 60's. The HfG Ulm articulated science and configuration, investigating and experiencing various scientific disciplines and methods regarding to its applicability. The school held a mathematical principle, executing product development methodically. According to Burdek (2006), the aspect of rationalization was emphasized by industry in the 60s, through technological possibilities, and the formal language was develop by an inaugural principle of style, the functionalism of Ulm.

The Ulm school was founded in 1951 by Max Bill, who was its Dean until 1956, when he was succeeded by Tomas Maldonado (From 1964 until 1966). Maldonado advocated the joining of theory and practice in design education and the standardization of object production. In this way, the methodology became the primary discipline, along with the concepts of rationality, order and control. The methodological structure proposed by Maldonado presented a strictly technological and scientific program, combining theoretical disciplines such as sociology, theory of perception and history of culture in order to develop students' critical capacity (Basso, 2010).

Ulm defined design as an activity centered on modern design, through a rigorous design methodology. According to Burdek (2006), it was in the Ulm school that the traditional design methodology was developed, starting with the systematization of the problem, analysis and synthesis, justification and the generation of alternatives. After its closure, several graduated students from Ulm and some professors sought new fields of action in different countries, thus

[8] The Hochschule für Gestaltung (HfG - School of Design), more knew as Ulm School, was a school of industrial design and visual communication in Ulm, Germany, which worked from 1953 to 1968. More about it in: <http://www.hfg-archiv.ulm.de/english/>. Accessed in Jan. 2017.

spreading the method of Ulm and influencing the teaching of design throughout the world.

To illustrate, Peruccio (2010), points out the important acting of Giuseppe Ciribini, who worked as a guest professor "gastdozent" at HfG between 1958 and 1959. After his leaving, Ciribini presented in 1961, in the International Council of Societies of Industrial Design (ICSID), a program of experimental school considerably close to the method of Ulm. In this way, according to Peruccio (2010), Ulm was a model to the foundation of design schools worldwide, both to Rio de Janeiro and Paris, as to Chile and India.

The Conference on Design Methods held in London in 1962 marked the launch of design methodology as a subject or field of enquiry (Cross, 1993). Joseph Christopher Jones[9] organized it and was called the Conference on Systematic and Intuitive Methods in Engineering, Industrial Design, Architecture and Communications. This moment brought attention to the need for understanding the design process and the need for development and formalization of clear methods for it (Ximenes and Neves, 2008 cited by Vasconcelos, 2009).

Several studies have shown the importance of this conference in the history of research on design methods, for gathering names that were of great importance for the development of design research. On this first conference, Jones himself comments: *"it was the first conference in this subject and allowed everyone who had any interest in 'systematic and intuitive methods' to knew the existence of each other"* (Oliveira and Pinto, 2009).

In addition to Jones, Christopher Alexander[10] and Bruce Archer[11] were high-profile names in the conference, which beyond being the starting point of discussion

[9] Joseph Christopher Jones was a Welsh designer born in 1927, in Aberystwyth, Wales. He studied engineering at the University of Cambridge and went on to work for AEI in Manchester, England. More of his work can be found at John Chris Jones Bibiography. Available at: <http://www.indiana.edu/~iucdp/ jonesbib.html>. Accessed in Oct. 2015.

[10] Christopher Alexander is Professor Emeritus of Architecture at the University of California, Berkeley, best known for his seminal Works on architecture including "A Pattern Language", "Notes on the Synthesis of Form" and "The Nature of Order". He was born in Austria in 1936 and raised in England. He holds a Master's degree in Mathematics and a Barcelor's degree in Architecture from Cambridge University and a PhD in Architecture from Harvard University. His website: Patter Language Available at: <http://www.patternlanguage. com/ca/ca.htmlv>. Accessed in Oct. 2015.

[11] Leonard Bruce Archer (1922 – 2005) was a British mechanical engineer and later Professor of Design Research at the Royal College of Art who championed research in design, and helped to establish design as an academic discipline. More of his work can be found at Monoshop Available at: <http://monoskop.org/L._Bruce_Archer>. Accessed in Oct. 2015.

on the development of design methodologies, contributed to the transition of the designer as an individual professional to a multidisciplinary team of development (Ximenes and Neves 2008 cited by Vasconcelos, 2009).

According to Vasconcelos (2009), Christopher Alexander discussed issues of complexity related to design problems and the need for an order to drive designers to work. Alexander enumerated arguments for defining a design methodology that discussed the intuitive path that designers used, the amount of information and problems that they had to handle, the type of problems and the lack of prior experience of the designer.

Alexander has an important role in the development of design methodology. His work is especially addressed to the issues of form and context. According to Burdek (2006), Alexander advocated the inclusion of rationalism in design, which first divided complex problems into its components, then to find concrete solutions. Alexander's method presents in one hand the Cartesian approach and on the other hand, deductive procedure.

His book, "Notes on the Synthesis of Form" (1964) represents the rationalization of the design activities, presenting a complex style, with strong relations to the formal sciences mathematics and logic. According to Peruccio (2014), the book was formulated to present methodological tools to be used in the design process because the amount of information needed to solve design problems was so huge that intuition alone was inadequate to deal with.

Jones also worked on Alexander's arguments, raising mainly the issue of the complexity of new problems as opposed to the established protocols of doing traditional design (Jones, 1992). As a result of this period, the book "Design Methods" (1970) testifies as reference, presenting a collection of technical assistance to the project, as well as a theoretical basis concerning the design process (Van Der Linden, 2010).

Archer, in turn, offers a model that starts taking distance from mathematical models, making the design methodologies mostly centered in engineering production and industrial design. He promoted the use of analysis in systems levels, design based on evidence and evaluations through field experiments in industrial

design. An outstanding work is "A Systematic Method for Designers" of 1965[12] (Vasconcelos, 2009).

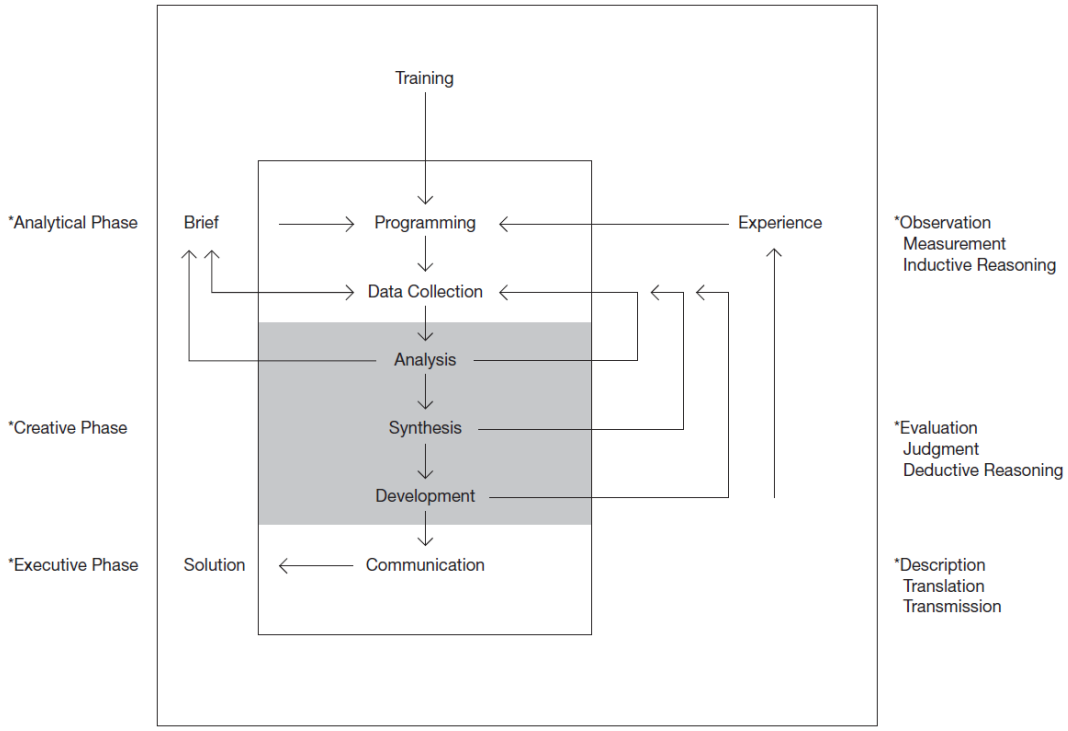

Figure 6: Archer's model – Diagram printed in the journal Ulm (1964). Source: Dubberly (2004).

After this first conference, an evolution of design methods erupted, expanding through research in various fields of knowledge, such as aeronautics, engineering, architecture, psychology, among others. Herbert Simon[13] wrote a book called "The

[12] Systematic Method for Designers, London: Council for Industrial Design, 1965, 40 pp. Based on a series of articles in Design magazine (1963-64). The method involves six basic stages: programming, data collection, analysis, synthesis, development and communication. Available at Monoshop Available at: <http://monoskop.org/L._Bruce_Archer>. Accessed in Oct. 2015.

[13] Herbert Alexander Simon (1916-2001), economist and North American psychologist, was one of the most influential social scientists of the twentieth century, whose research ranged from the fields of cognitive psychology, computer science, public administration, economics, management, philosophy and sociology Science. Available at: História da Administração Available at: <http://www.historia daadministracao.com.br/jl/gurus/193-herber-alexander-simon >. Accessed in Oct. 2015.

sciences of the artificial" published in 1968, in which Simon introduces the idea of "wicked problems" theorizing that an initial question would not be the same once you get answers, and these answers would lead to new issues that, in turn, would require new solutions (Oliveira and Pinto, 2009).

Concomitantly, the lights of recognition are shed upon names like Morris Asimow[14] and Mihajlo D. Mesarovic[15], authors that were heavily influenced by aerospace research, which presented complex problems, showing the effort in their models to divide the process into discrete and well defined steps (Burdek, 2006).

Asimow's model presented in his book "Introduction to design" from 1962 had an approach to engineering and was seen as a specialized process for troubleshooting. His model was among the first to include the life cycle of the product. It proposed three stages of needs analysis, with the study of implementation possibilities before determining the phases of the project. Then came the activities related to production, distribution, consumption and disposal, with suggestions for revision in every stage. In his model, there is a strong influence of the rationalist and reductionist thinking (Van Der Linden, 2010 and Vasconcelos, 2009).

Mesarovic's model presents a similar structure to that of Asimow's model. The former had been the first to present a cyclicality, which consisted of a cyclic structure with feedback loops among phases. It went from an abstract step with the definition of needs, ending with the production as the most concrete point. At each phase, there was the process of analysis, synthesis, evaluation and communication (Rowe, 1987 cited by Dubberly, 2004).

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[14] Morris Asimow (1906-1982) was for 30 years a professor at the University of California. He graduated in a polytechnic school in Los Angeles, where he followed up until his Ph.D. in engineering and has developed several research in the management area and production processes University of California. Available at: <http://content.cdlib.org/view?docId=hb4d5nb20m;NAAN=13030&doc.view=frames&chunk.id=div00007&toc.depth=1&toc.id=&brand=calisphere>. Accessed in Oct. 2015.

[15] Mihajlo D. Mesarovic (1928) is a professor of systems engineering and mathematics at Case Western Reserve University. Born in Yugoslavia, has taught in more than 60 countries, despite of their training has primarily been performed in the Yugoslavia, where he earned a master's degree in electrical engineering and PhD in technical sciences at the University of Belgrade, today, Serbia. More of him at: Complex Systems Biology Center. Available at: <http://systemsbiology .case.edu/participants/ faculty/Mesarovic.shtml>. Accessed in Nov. 2015.

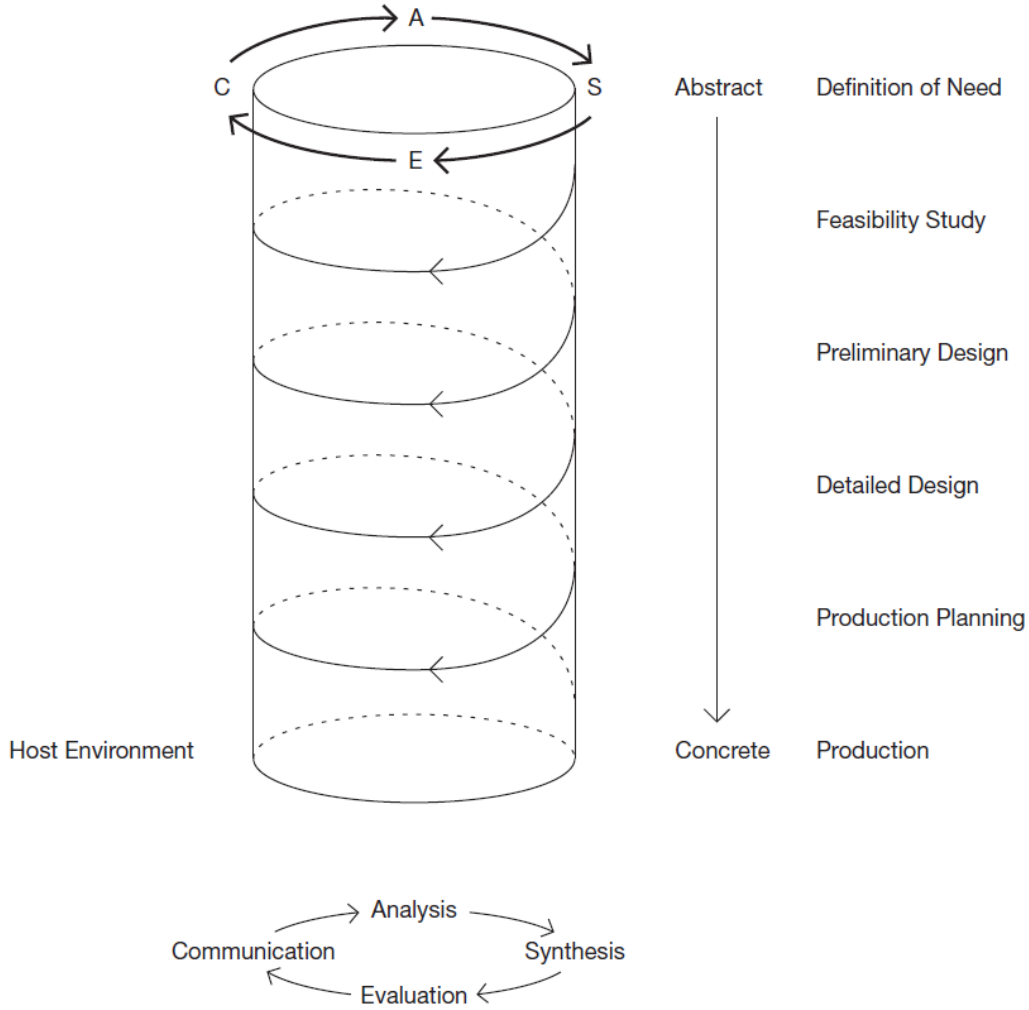

Figure 7: Mesarovic's model (1964). Source: Dubberly (2004).

In the late 1960s, Bruno Munari[16], one of the prominent names in his field, performed at the invitation of Harvard University a set of design and visual communication classes at the Carpenter Center for the Visual Arts of Cambridge in Massachusetts. These Classes culminated later in the book "Design and Visual Communication" (1989). In this work, Munari presents a methodology based on Archer's model and on the suggestions of Asimow, among others.

[16] Bruno Munari was born in 1907 in Milan. He was an artist and designer with great interest in futuristic movements. He was undoubtedly one of the most important professional for the methodological basis of design and his books are used by thousands of universities around the world. More of his work at Munart. Available at: <http://www.munart.org>. Accessed in Oct. 2015.

This model had great influence in the 70s, for being very clear and didactic, presenting linearity and rationality. It is divided into six main parts and sub-parts, the main ones being Problem Enunciation, Identification of Aspects and Functions, Limits, Technological Availability, Creativity and Models (Munari, 1997).

According to Vasconcelos (2009), the 60's had the presence of more descriptive theories, which had cyclical, linear and temporal models. Methodologies presented a mathematical and logical character, focused on production process relegating care to the user or product.

The essence of the methods was in the division of the design process on well-defined steps. According to Van Der Linden (2010), these steps could be separated in: understanding and defining the problem, collecting and analyzing information, generating alternatives by searching possible solutions, evaluating, testing and implementing the chosen alternative. The basis was in the Cartesian idea of understanding the problems and reducing their complexity in order to be able to address it properly.

The 70s: a scientific approach

In the 70s, following the rationalism of the previous decade, a scientific approach to design became a target, as well as the need for a method that gave preference to a variety of ideas. There had been a sudden change in regard of the methodological proposals and the design process (Vasconcelos, 2009).

As previously mentioned, it was in 1970 that Christopher Jones released his book “Design Methods”[17]. In its proposal, for the first time, ergonomics and user were observed as contents of a design methodology. As the author affirmed, *"it is not a different way of doing design, it's a way to do what designers do not do."* In this methodology, which discusses design focus, objectives and purposes, he returns to the ergonomics discussion, which had already been raised by him in 1959.

His process is divided into phases. The first, "divergence", seeks to conduct a research to know the product; the second phase, "transformation" is a creative phase of contextualization of ideas; and, finally, the "convergence" phase, in which there is reduction of uncertainty in order to reach a final solution. The phases proposed

[17] Design Methods: seeds of human future, John Wiley and Sons, 1970; 2nd ed., rev., Van Nostrand Reinhold, 1992; repr. John Wiley and Sons, 1998. Translated into Japanese 1973, Romanian 1975, Russian 1976, Polish 1977, Spanish 1978, Chinese. Available at Monoshop Available at: < http://monoskop.org/John_Chris_Jones >. Accessed in Oct. 2015.

by Jones can also be translated as *"breaking the problem into pieces, regroup them in a new way and testing to find out the consequences of the practical application of this new arrangement of pieces"* (Jones, 1992).

Another proposal presented by Jones is "Value Analysis"[18] (1970) in which Jones focuses the design process on product costs. In this process, the costs are always analyzed during the stages, and according with this analysis the project could be eliminated or rejected (Dubberly, 2004).

According to Vasconcelos (2009), the methodologies presented linear structures and flexibility in their steps with feedback between them. As an example, we have the work of the architects Thomas W. Maver[19] and Thomas A. Markus[20]. These authors discussed the process as a series of decisions with three layers: the outline proposal, the design scheme and the detailed design. Thus, a three-level structure is formed in which each level demands the classical four steps: analysis, synthesis, evaluation and decision. In these levels, both the complexity of the project as well as the detailing gradually evolve.

[18] In "Value Analysis" (1970), Christopher Jones presents a methodology that deals specifically with the reduction of product costs during its development.

[19] Thomas W. Maver Research Professor, at Maackintosh School of Architecture; Emeritus Professor, Department of Architecture, University of Strathclyde. His profile can be seen in: Architecture Profiles Available at: <http://www.gsa.ac.uk/research/ architecture-profiles/m/maver-tom/>. Accessed in Oct. 2015.

[20] Thomas A. Markus is an architect, building scientist, architecture historian and theoretician. Markus worked for twenty years as a professor of Building Science, at the University of Strathclyde Glasgow. From 1992 – 1993 he was Jubilee Professor at the Chalmers University of Technology, Goteborg (Sweden). TUDelft files Available at: <http://www.bk.tudelft.nl/en/current/agenda/ event/detail/lezing-thomas-a-markus-lichaam-als-metafoor-voor-gebouwen/>. Accessed in Oct. 2015.

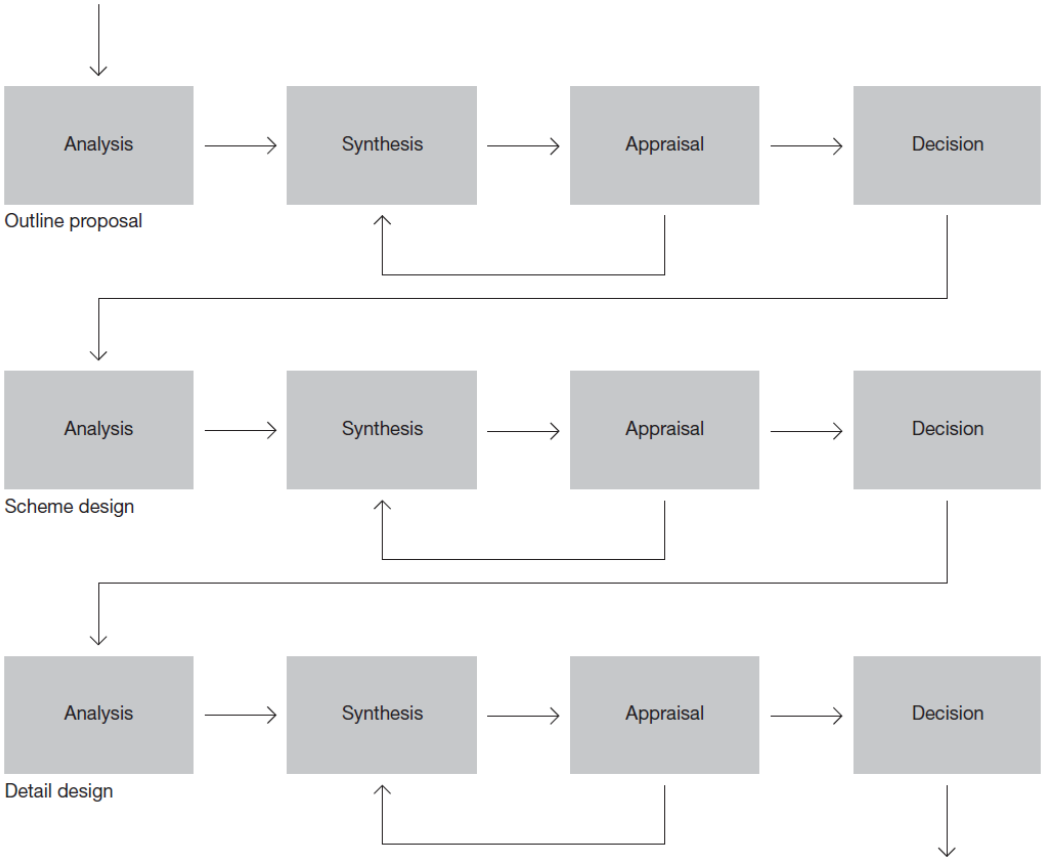

Figure 8: Maver and Marcus model. Source: Dubberly (2004).

Two prominent names in the 70s that still hold great influence in design schools today are Bernhard E. Bürdek[21] and Bernd Löbach[22]. Bürdek is famous for various publications, among them the "Einführung in Die Designmethodologie"[23]

[21] Bernhard E. Bürdek born in 1947, was one of the last students at the Ulm Design School. Since 1971 he has been working as a designer, teacher, author and consultant. At the Academy of Art, Design and Media at Offenbach am Main, where he teaches Design Theory, Design Methodology, Product Language and Strategic Design. He was guest lecturer in Brasil, Mexico, Roumania and Taiwan and is the author of numerous publications. In 1990 he founded Vision & Gestalt, an office for design and communication (Burdek, S/D).

[22] Bernd Löbach, born in 1941 in Germany. For years, he served on the design course of Fachhochschule of Bielefeld, Germany, where he made several important publications. Today he is a professor at the Hochschule für Künste Bildende, Braunschweig, where he has continued his research and publications, always geared to the educational aspects of the design (Lobach, 2011).

[23] Einführung in Die Designmethodologie (Introduction to Design Methodology), published in 1975 by Hamburg: Red. Designtheorie.

(Introduction to Design Methodology) stands out. In this work, the author discussed the shortage of basic tools in design methodology, and developed a practice model of the design process. He presented methods and techniques of easy employment, discussing the use of methodological repertoire according to the complexity of the problem. His model includes the use of different analysis, briefing development, creative methods to problem resolutions, representation methods, and testing. It is characterized by various possibilities of feedback taking distance from the linear model (Burdek, 2006).

Löbach, in turn, started, in the 70s, studies related to environmental movements and environmental problems, which culminated later on in the birth of his "environmentally critical art". He also carried out studies and lectures concerning history and theory of design, developing with his students the theoretical foundation of the creative act.

In his famous book, "Industrial Design", 1976, Löbach discusses the theoretical foundations of industrial design, addressing the principles and nature of activity within a socio-economic context, as well as practical aspects of the design process.

The proposal presented by the author defines that to lead with the complexity of design process, the former must be divided into four distinguished phases, even taking into account that in a real process such phases would never be exactly apart. This process begins with the analysis of the problem, followed by generation of alternatives, evaluation, selection and at last the development of the chosen alternative. The final alternative is revised and prototyped generating a series of visual and textual specifications, which are once again evaluated before being submitted to the production line (Follmann, 2015).

Other authors from the 70's that are worth mentioning are the mathematician and philosopher Siegfried Maser, the architects Don Koberg and Jim Bagnall; and the professors Cal Briggs and Spencer W. Havlick.

Siegfried Maser[24] developed a study of aesthetics, art and design through philosophical thought and mathematics, generating a methodology well supported in science. He conceived a design theory, as a "trans-classical science" within the field of planning sciences, as for example, the cybernetics. The works of Maser (1972, 1973) produced the first scientific theoretical assumptions (Burdek 2006).

[24] Siegfried Maser is a philosopher, mathematician and German physicist. He published these thoughts in his book Trans-classical Science (1972).

Koberg and Bagnall[25] presented a model called “Seven-step process as a cascade with feedback” (1972) in which there would be no need for one stage following another. At every stage, an assessment occurs that defines whether to return to any phase and the acceptance of the situation or problem as a challenge. It is a method to problem solution divided in acceptance of the problem, analysis, definition, idealization, selection, implementation and valuation (Schroeder, 2009).

Cal Briggs and Spencer W. Havlick[26] wrote “Scientific Problem Solving Process” (1976) where they defended the scientific method as the main process. They developed a model adapted from the traditional sciences to develop optimal solutions. Thus, it could have a more analytical approach, systematic and needed for developing solutions (Dubberly, 2004).

In Brazil, a prominent work was presented by Bomfim and others[27], in a booklet-shaped publication, the authors presented a model of product development based on the state of the art of the time (Van Der Linden, 2010). This was one of the first studies in the country addressing the issue, setting references to design products and influenced authors such as Lobach, Gerharhd Pahl and Wolfgang Beitz. The authors presented a proposal divided into 4 phases: questioning, analysis, development and deployment (Pujol, 2012).

The 80s

The 80’s could be defined as a state of transition between design methodologies, as Bürdek (2006) affirmed, it was a time methodologies came to have a more representative character of humanities, whereas they previously hoisted a character of natural sciences as predominant.

The methodological approach is prescriptive, as in the previous decade, but there is not much presence of flexibility. The linear structure of steps remains as the current model. However, it is possible to see a significant change regarding the presence of feedback. Contrary to what happened in the seventies, feedback between phases was determined by authors or simply did not happen, showing a

[25] Donald James R. Koberg and Bagnall are American architects and professors at Polytechnic California State University (Cal Poly) in San Luis Obispo, United States.

[26] Cal Briggs and Spencer W. Havlick used this method for teaching design to undergraduates of the College of Environmental Design da University of Colorado, United States.

[27] The handout "Fundamentals of a Methodology for Product Development" was presented by Gustavo Amarante Bomfim, Lia Monica Rossi and Klaus-Dieter Nagel in 1977.

clear reduction in the high flexibility of the processes seen in the prior period (Vasconcelos, 2009).

It was in the 80s that Bruno Munari, released his most famous methodology in the book "Things are born from Things" (1981). He advocated a methodology for any kind of Design. He defended that the design method to the designer is not unique or definitive; but can be modified in case the designer finds values that could improve the process (Munari 1998).

The process starts from the Cartesian principle of breaking down problems, analysis of the parties, rebuilding the product synthesizing possible solutions, and finally arriving at a solution through experimentation and verification of the models.

According to Vasconcelos (2009), eight years after introducing this methodological model, Munari developed a new model with a similar structure, introducing concepts of crucial importance to the process. He included cultural, historical and geographical analysis into the methodology; and amplified the research involving aspects of the product as wear time, existing parts, regulations and market in general. This new model also included predetermined feedbacks between its phases.

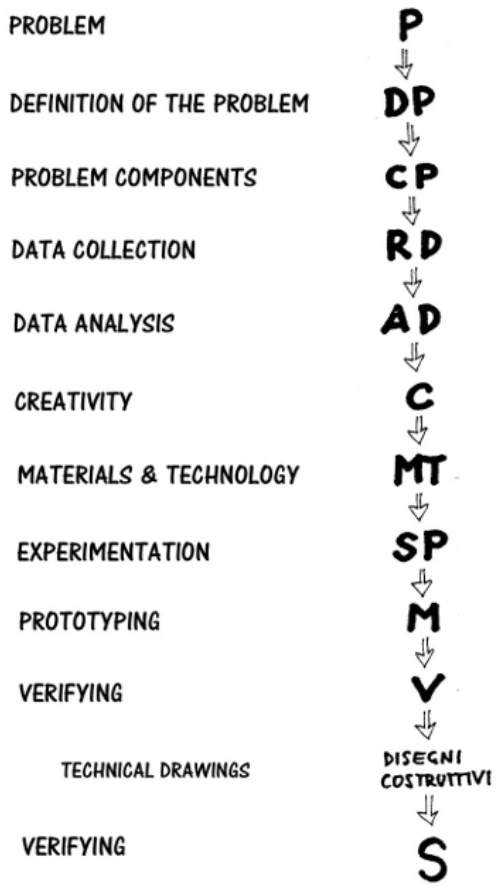

Figure 9: Munari model (1981). Source: <http://www.alessandracolucci.com/en/2016 /05/25/ bruno- munari-design-method-and-mine-steps-1-to-4/>. Accessed in Dec. 2016.

Another prominent author at this stage was Gui Bonsiepe[28]. Bonsiepe's work represents a considerable contribution to design theory. In his book "Metodologia

[28] Gui Bonsiepe studied design at hfg-Ulm (Hochschule für Gestaltung, Ulm) (1955-1959), where he also served as professor of the Department of Industrial Design and Visual Communication, until its closure in 1968. After that, he moved to Latin America. In Chile, he participated in an advisory program for small and medium enterprises in industrial design issues (1968-1970) and created the Product Development area in the Technological Research Committee (1971-1973). In Argentina, he created the Product Development area, the National Institute of Industrial Technology (1974 to 1976). In Brazil, he created and coordinated the Brazilian Laboratory of Industrial Design - lbdi in the city of Florianopolis (1984 to 1987). He worked in design offices and has been a teacher in several universities in Latin America, Europe, North America and Asia, as the School of Industrial Design - ESDI (Rio de Janeiro), University of Applied Sciences (Köln) and University of the Arts (Zurich). He has held the vice-presidency of the International Council of Societies of Industrial Design - ICSID (1973-1975). He has published several works on industrial design and visual communication, particularly: Theory and practice of industrial design (Milan, 1975), The A of Technology (São Paulo, 1985), Interface - Design neu begreifen (Mannheim, 1995)

Experimental: Desenho Industrial (1984)" (Experimental methodology: industrial design) he presents a linear approach divided in a macrostructure composed of steps or stages, and a microstructure, which describes techniques used in each previous step.

According to Mello (2011), the steps of Bonsiepe methodology, include from the discovery and assessment of the need up to the manufacture in pre-series. It may be noted the separation between two fundamental steps, the structure of the design problem and the project itself. Bonsiepe also draws attention to the importance of an approximation with the problem to be met in order to make the adopted solution consistently.

Mello (2011) also cites Pugh's method introduced in 1983 and improved by Pugh and Morley in 1986 and 1988, which had an approach to general design theory that attempts to integrate the social psychology of group work in the field of design and engineering, with an interdisciplinary approach, encompassing the study of people, processes and context.

Other important names cited by Vasconcelos (2009) are Bryan Lawson and Vladimir Hubka[29]. Lawson is the author of the books "How Designers Think", "Language of Space" and "What Designers Know", and published several articles on design, architecture, ergonomics, design methods, etc. (University of Sheffield).

Lawson's compares the creative process to the design process. His process is divided in five stages. The first is called "first insight", in which the formulation of the problem occurs and is considered the critical stage. This is followed by a sequence of conscious (preparation) and unconscious (incubation) efforts to solve the problem. In consequence, the sudden emergence of the idea happens in an "illumination" phase and finally there is a new conscious effort to develop this idea (Dubberly, 2004).

Hubka developed a model called "General Procedural Model of Design Engineering", 1982, which presented a coordination of the design process. The first

Design: From the Digital to the material (Florianópolis, 1997), Historia del Diseño in Latin America and El Caribe (coordinador, São Paulo, 2008). Available at: Blucher <https://www.blucher .com.br/autor/detalhes / gui-Bonsiepe-185>. Accessed in Oct. 2015.

[29] Vladimir Hubka (1924-2006) was PhD professor at the Eidgenössische Technische Hochschule (Federal Technological Institute of Zurich, Switzerland) and is the author of books in the field of design, such as "Principles of Engineering Design", "Theory of Technical Systems: The Total Concept Theory for Engineering Design" and "Practical Studies in Systematic Design" (Vasconcelos, 2009).

phase of his model generates design specifications and requirements. The second phase produces a functional structure diagram of an abstract representation in order to formalize the development built in the previous phase. In sequence, another structure, even more abstract, presents itself meeting the design requirements of the first phase. In the fourth phase, there is a dimensional description. Ultimately, in the final stage, the complete description of all characteristics and features, technical and visual detail is achieved, allowing the project to be developed (Evbuomwan 1995 cited Vasconcelos 2009; WTEC).

It is important to note that in the 80s and into the 90s, a significant development occurred through the emergence of journals of design research, theory and methodology. Cross (2001), presents some examples including: Design Studies (1979), Design Issues (1984), Research in Engineering Design (1989), the Journal of Engineering Design and the Journal of Design Management (1990), Languages of Design (1993) and the Design Journal (1997).

The 90s

In the 90s, there were changes in the traditional Cartesian model. The context had taken on a more significant place than the product itself and configuration issues were no longer linked solely to the shape.

According to Burdek (2006), in this new phase, functionalism began to dissolve and new areas such as usability and interface design have required new procedures. There was the need for more dynamic models and new approaches to design processes that were being driven increasingly by the digital age.

A distance begins to stretch from the linearity of the design process (problem-analysis-solution) to devote to user's interests and needs. There is an increase in research of behavior and market, which will determine the development process (Borchers 2001 cited Bürdek 2006).

Regarding the structure of the surveyed methodologies, the nineties presents homogeneous models, showing a strong trend in development processes in design.

In addition to be essentially prescriptive and the to the growth of cyclic structure models, methodologies raised performed flexibility between steps and feedbacks always present and predetermined by the author, continuing the trend started in the previous decade.

One example cited by Vasconcelos (2009) is the work of Steven D. Eppinger and Karl T. Ulrich. MIT professors, Eppinger and Ulrich are authors of the book

Product Design and Development (1995), used by more than a quarter of a million students in the world. Their work presents a search for development of complex design processes that can assist the optimization of industrial practices, however, never leaving aside the focus on the users and their needs. The model, which presents an increase of prototyping and constant testing, includes analysis of market, user preferences and technical possibilities.

To illustrate the cyclical nature present in the 90s we have the work of John Gero[30]. John S. Gero presented the FBS model in 1990, which considers the design process as a series of transformations, where the function, the structure and the behavior turns into a project description, or design. The FBS model (Function-Behavior-Structure) includes the interaction with the environment and shows the designer's aims (Santos, 2010).

In Gero's latest works, this model is called "FBS Ontology", which like this first model considers the design process based on three classes of variables, describing different aspects of a design object. The role of the designer is to build links between function, behavior and structure of an object by experience. The designer gives function to behaviors and take behaviors from the structure, without establishing a direct link between function and structure (Gero, 2004).

[30] John Gero is associate professor of "Science of Design" on Creativity and Cognition Studios at the University of Sydney, researcher of the Krasnow Institute for Advanced Study, George Mason University, and also a visiting professor in several countries. He is author and editor of about forty books and published over 600 papers and book chapters. As research areas of interest, we highlight the cognitive studies design, computational models of creative design, evolutionary systems Design and ontologies. More of him at: Mason University Available at: <http://mason.gmu.edu/~jgero/>. Accessed in Dec. 2015.

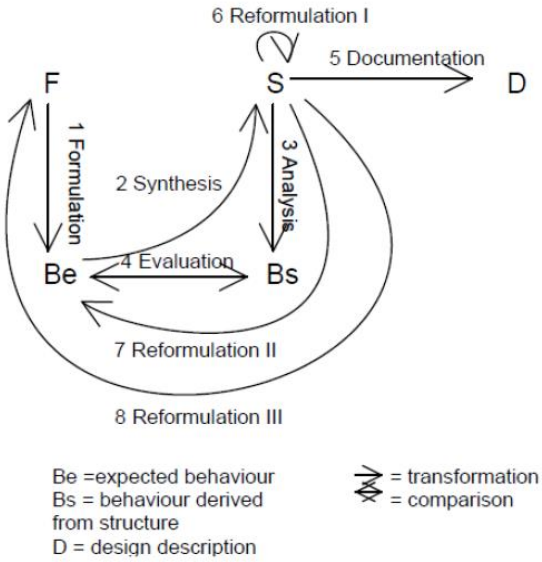

Figure 10: FBS ontology by Gero (Gero et al. 2004).

In turn, Roozemburg & Eekels[31], according to Van der Linden (2010), present a greater concern to the systematization of product development process. They understand that the principle of design activity is related to a closer relationship with the future users to understand their interests and needs.

The method presented by them initially provides a synthesis of new design solutions from the information gathered in the previous step, also relying on the creativity and potential solutions previously developed. This first phase produces specifications for the next, in which a proposal for a provisional design can be generated. Afterwards, a simulation of use of various alternatives is conducted, leading to a final assessment of them, at which point they are compared to the specifications made initially, generating the decision to go ahead and approve the design or not (Cunha, 2008).

[31] Eekels and Roozenburg developed the first model of innovation of Delft University and published several books and articles on design methodology. According to the authors, the "Basic Design Cycle" is the most fundamental design model, so that someone who designs solution to problems have used this cycle at least once (Roozenburg & Eekels, 1995).

Other authors that are worth pointing out are Pahl and Beitz[32] and Nigel Cross[33]. Nigel Cross developed a simple model based on essential activities that a designer must meet.

In his proposal, the problem is decomposed into four phases, so that the best solution found in each stage can be operated in the next in order to achieve a "cascading" effect in which the solution tends to be improved continuously until a great solution is obtained (Vasconcelos, 2009).

The work of Pahl and Beitz propose the project as a sequence of steps. The first step is the clarification of the tasks, where the specification of the objectives is usually expressed in form of quantitative magnitudes - which applies well to, for example, machinery and equipment design. Then the conceptual design is developed based on creativity and previous solutions developed. The next steps are design embodiment, and detail design, in which happens the definition of the structural configuration of the product and its detailing. In the method proposed by these authors, each stage contains a list of activities and objectives to be reached for the process to be completed with the product documentation and its solution (Mello, 2011; Cunha, 2008).

XXI Century (2000 – 2009)

In late 90s and into a most expressive way in the twenty-first century, design methodologies begin to have a multidisciplinary character, comprising experts from various fields. These professionals came to be taken into account during the design process.

As claimed by Alexander (1964), Jones (1992) Bomfim (1995) and van Aken (2005), the increasing complexity of the issues and the context in which they are inserted, require new and adaptive methodological models to meet the team's needs (Vasconcelos, 2009).

[32] Gerhard Pahl and Wolfgang Beitz are German owned the design semantics school. The systematic methodology created by these authors is considered classic in the field of design of industrial products and has been used as a basis for various researches (Borges and Rodrigues, 2010).

[33] Nigel Cross is a professor, graduated in architecture, holds a master's degree in Industrial Design Technology, and a Ph.D. in Computer Aided Design. Today, it has thought and cognition in design as the main line of research, and teaches at the design department and innovation of the Faculty of Technology, The Open University, England. More of him at: The Open University Available at: <http://stem.open.ac.uk/ people/ngc3#tab1>. Accessed in Nov. 2015.

Therefore, design teams start to be composed of different professionals who perform concurrent processes. A demand emerges for more flexible methodological models adaptable to different situations. Aken, who defends the prescriptive design, comments that this should present models of processes adapted to each type of project, especially from the simplest to the most complex (Aken 2005 cited Credidio 2007).

This phase highlights the authors Ernst Eder[34], Hosnedl[35] and the Brazilian Andre Neves. Eder and Hosnedl wrote together the book "Design Engineering: a manual for enhanced creativity" (2008), in order to propose a general model for design procedure which could be adapted for each design situation.

The methodology divided the process in five phases, with the presence of feedback in a cyclical interactive format. In the first phase, it determines the specifications of the project, which should be fully completed. In the second phase, it completes a process plan, followed by a better definition of the functional structure in the third stage. This functional structure will be improved in the later stages. The fourth phase has the representation and description of the complete technical system and finally the product can be prepared and tested in the last stage, suffering corrections to its final production (Eder & Hosnedl 2008, apud Vasconcelos, 2009).

André Neves[36] presents a methodology in which for each phase, there is a set of methods that can be selected and combined in accordance with the requirements and design specifications. In this model, the first phase aims to collect data to

[34] Wolfgang Ernst Eder (1930) is a PhD Professor from the University of Westv Bohemia, Pilsen, Czech Republic. Born in Austria he was also educated in England and graduated in engineering in 1951. Eder gained international reputation for systematic design, publishing more than 130 articles on design methodology and engineering education (Eder & Hosnedl 2008).

[35] Stanislav Hosnedl (1942) is also a PhD Professor from the same university. Born in Czechoslovakia, he graduated in design engineering still at the University of West Bohemia where he conducts research until nowadays. Hosnedl thesis have more issues related to computing and mechanical engineering, as well as its publications. He has authored several articles and software packages used worldwide (Eder & Hosnedl 2008).

[36] André Menezes Marques das Neves (1966) is a PhD Professor in Computer Science from the Federal University of Pernambuco - Brazil, where he also completed his master's degree. Born in Brazil, he completed his degree in industrial design in 1994, at the Federal University of Paraíba. Neves has experience in computer systems design and operates mainly in artificial intelligence, virtual environments of study and distance education and software, as chatterbots and games. He is currently a research professor of CNPq in the methodology area and development of digital artifacts, especially with regard to digital games, theme courses taught by the author. Available at: <http://lattes.cnpq.br/5194437042919213> Accessed in Dec. 2016.

enlarge the repertoire of information about the device that will be designed. Then to precipitate possible solutions for the problem worked on. Alternatives generated in the previous stage are selected to reduce the number of solutions to the problem, arriving at a solution. In the penultimate stage, the alternatives are evaluated, refining the proposed solution. Finally, in the description, the specifications of the final solution are prepared as well as the final adjustments (Neves et al 2008).

It is from the twenty-first century that we see the widespread of design thinking methodology, mainly through IDEO[37], one of the world's leading design firms. Despite the IDEO acting since the 90s, it was only in 2009 that Tim Brown, CEO of IDEO launched his book "Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation".

The non-linear methodology of IDEO, has a system of working that steers away from classical models. The process, or rather the design space, involves three fields of activities: Inspiration, Creation and Implementation. Inspiration corresponds to the circumstances that motivate the search for a solution (a problem, a note or both). The idealization involves generating, developing and testing ideas that might lead to a solution. Subsequently, in Implementation phase, there is the release of the product to the market. In a design process, the three spaces can be exploited, in particular the first two, in order to refine ideas and find new paths.

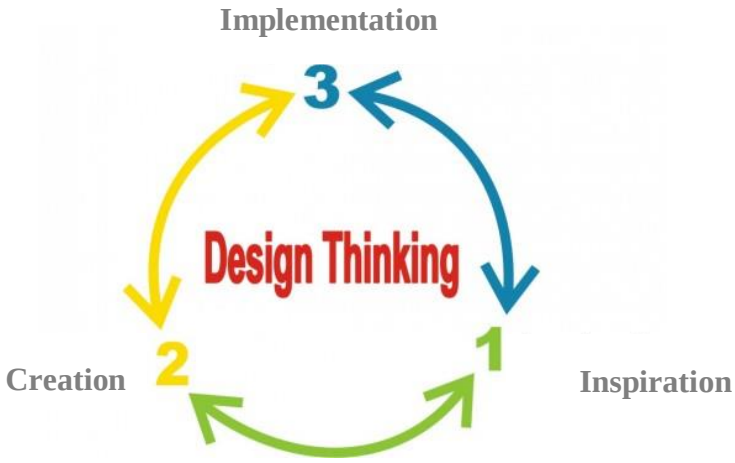

Figure 11: Design Thinking activities.

It is worth to note that the work of IDEO is conducted in close collaboration with its customers and, in the office side, it accounts with a qualified group with

[37] To know more about IDEO and Tim Brown:<https://www.ideo.com/by-ideo/change-by-design>. Accessed in Dec. 2015.

diverse backgrounds, giving their project teams a multidisciplinary nature. This fact allows various activities to be done simultaneously, saving time in comparison to linear processes with feedback (Van Der Linden, 2010).

The design thinking by presenting an innovative and important methodology for this work will be discussed in the next section, as well as its evolution and the main authors who have worked with the theme.

2.2.2 Design Thinking Development

Di Russo (2012) presents an evolution of design methodology in which it is possible to visualize, over the years, the construction of a human centered design process. The author raises theories that consider human factors in form of design thinking systems (Macedo, 2014). This analysis is divided into phases referred to as waves, between 1960 and 1980 (first wave) and from 1980 to 1990 (second wave).

In the first wave, it highlights three authors: Horst Rittel, Herbert Simon and Victor Papanek. Each of them representing different design ideologies during this period and were chosen by the impact their work had on design theory today.

Herbert Simon[38], analyzes in depth the artificial world that we project. To Simon, the main artifice created for man is the human brain, which he compares to computers, and his argument is that the brain, akin to computers themselves, faces a limited threshold. Therefore, the best that we humans can do is to feel satisfied, because neither a computer nor our brains understand the complexities and variables in our external environment.

Simon defends the concept of simulation (prototyping) as the best way of working with solutions considered satisfactory. He argues that to understand a system it should be built so that its behavior can be observed.

Today, considering complex environmental and social issues in large scale, Simon ascertains the most important factors for successful solutions to be having a common understanding between all stakeholders and to assume that the result had to be open and evolving, without ultimate goals.

Host Rittel, along with M. Webber[39], were those who raised questions concerning complex problems. According to Rittel, to solve a problem opens a new set of problems that can never come to a finite solution. He also believed that science is unable to solve open, evolving and ambiguous problems. He believed that these kind of problems need a more creative approach, and that the art of

[38] Herbert Alexander Simon wrote in 1969, “The Sciences of the Artificial” (First Edition), published by MIT Press. The thesis of the book is that certain phenomena or entities are "artificial" in the sense that they are contingent to the goals or purposes of their designer (Simon, 1969).

[39] Host Rittel and Melvin M. Webber formally described the concept of wicked problems in a 1973 treaty, contrasting "wicked" problems with relatively "tame", solvable problems in mathematics, chess, or puzzle solving (Rittel & Webber, 1973).

dealing with complex problems is the art of not knowing so early which kind of solution could be applied.

Victor Papanek (1971) appealed to the responsibility of the designer and advocated the use of design knowledge to solve social and environmental problems. His book, Design to the Real World, remained a landmark in sustainable design. To Papanek, man's needs were being neglected before their wants and desires. According to Di Russo (2012), Papanek was introducing what we call value and empathy in service design, human-centered design and design thinking.

The second wave is a stage in which design theory sought to reaffirm itself. It gathered many reflections on cognitive design aspects, as how much it means to be creative, how much it rests on intuition and how the process is personal. In this wave, the most renowned authors were Nigel Cross, Richard Buchanan, Donald Schon.

Nigel Cross (2001), in his work[40], highlights the intuitive process. According to him, tacit knowledge and intuition make the design process special. He argues that design can be an independent discipline from other disciplines, especially science. He promotes the professional in the process, describing the designer as the core of the process.

According to Gomes (2013), Nigel Cross sums up design thinking as understanding abilities of solving ill-defined problems, adopting cognitive strategies focused on solution, employing an abductive or appositional thinking and using non-verbal media.

Richard Buchanan, published in 1992 the paper "Wicked Problems in Design Thinking". Putting complex issues in the main line of thought in design. However, Buchanan, like most of his peers during this period rejected the notion of design as a science. He described design thinking as a "liberal art" that reflects the contemporary culture and is used by professionals as a vision to solve complex problems.

To the author, a liberal art is a discipline that can be shared by all people in their daily lives and which is dominated by a few people who practice the discipline and sometimes move on to new areas of innovative application. According to the

[40] See more at: Design Issues, Vol. 17, No. 3, pp. 49-55, 2001 Designerly Ways of Knowing: Design Discipline versus Design Science, Nigel Cross. This is a revised version of a paper prepared for the Design+Research Symposium held at the Politecnico di Milano, Italy, May 2000.

author, designers are exploring concrete integration of knowledge that will combine theory with practice for new productive purposes (Gomes, 2013).

Buchanan was profoundly influential, especially because he realized design thinking to be a multidisciplinary mentality, finding four main subjects, in which design is directly involved:

> 1. Symbolic and visual communication (What would be the current graphic design)
>
> 2. The design of material objects (Product Design)
>
> 3. Activities and organized services (Service Design)
>
> 4. The design of complex systems or environments for living, working, playing and learning (Politics, Urban Planning, Design).
>
> (Buchanan, 1998, p. 9 cited by Di Russo, 2012)

David Schon, also quoted by Di Russo (2012), wrote the book "The Reflective Practitioner", in which Schon refutes the idea that design should be based on science to be taken seriously. Akin to his peers, he attempted to individualize design as a unique practice through cognitive reflections and explanations of their process. His work was mainly in the context of design process. He described the idea of setting of the problem as a crucial component that unites the whole process. Schon advocated the mysterious and intuitive aspect of design, instead of trying to solve the problem he prioritized framing the issue.

In addition to the works of these authors, Di Russo (2012) considers the Participatory Design as a great reference of design model that originated the design thinking. According to her, during the development of design methods, participatory design was gaining momentum. According to Paizan and Mellar (cited by Macedo, 2014), this model emerged in the Scandinavian countries in the 1960s, in discussions about how democratic design practices could be introduced in the industrial sector. Technological developments during the end of this decade witnessed the participatory design change from social methods to technology methods.

As participatory design progressed in the 1980s, it eventually became part of interaction design. Many techniques used in participatory design were sought in science, such as usability testing, mock-ups, prototypes, among others. However, a

disadvantage of participatory design is that it was concerned with usability, but neglected emotional response from users.

According to Macedo (2014) as in design thinking, participatory design seeks to integrate all parts involved in the life cycle of a product in the development of new solutions and transformations of it, but still fails to consider intentions and desires of people in the process.

It was the search for the inclusion of these users' wishes and desires in the process, according to Di Russo analysis, that the User-Centered Design has emerged, whose most significant contribution was presented by Donald Norman[41]. In Norman's work, the end user was at the center of the development process. Usability tests have become less about usability and more about interests and needs. He also highlighted the benefits of understanding user experience throughout the process.

In the early 2000s, a new practice became current in design discipline: the service design. One prominent name is Lucy Kimbell that together with other researchers, rather than thinking about end user experience with a product or service, sought to understand the use, interaction and the journey of this product (Di Russo, 2012). Kimbell argues that the distinction between a product and a service is irrelevant because everything is a type of service that plays a role in creating value.

It was with this new approach to product/services systems that the idea of a holistic mindset was evident. Hence, the concept of meta-design, bringing into light the works of Ezio Manzini and Dijon de Moraes[42]. In the same way came the Human-Centered Design, which only began to evolve in the late 1990s, a point in which the design methods started to have further human focus.

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[41] The book "The Design of Everyday Things" was first published in 1986. In this book, Donald A. Norman uses the term "user-centred design" to describe design based on the needs of the user, leaving aside what he considers secondary issues like aesthetics. User-centered design involves simplifying the structure of tasks, making things visible, getting the mapping right, exploiting the powers of constraint, and designing for error.

[42] In Brazil we can also highlight the work of Rafael Cardoso in "*Design para um Mundo Complexo*" (2012) and the work of Caio Vassão, "Metadesign: *Ferramentas, Estratégias e Ética para a Complexidade*" (2010). The work of Dijon de Moraes will be presented in the Chapter 3. In Italy at the Polythecnic of Milan, the works of Silvia Pizzocaro, Flaviano Celaschi and Alessandro Deserti are worth of note.

According to Di Russo (2012), Human-Centered Design offers, as a characteristic, the use of collaborative and multidisciplinary methods and social systems, allowing for the development of holistic communities, focusing on empathy, using methods that have direct understanding of audience and the empowerment instead of improvement. The design focused on the human being has become a method for a mindset in order to humanize the design process and empathize with stakeholders. The humanistic approach re-introduced design thinking, but this time with a mentality to use a method for interpreting complex problems.

The figure below, adapted from Di Russo's work, shows a summary of the lines of thought and projective methodologies that reached Design Thinking. The author presented a circular shape where the outer circle are the changes in design theory along the timeline. The inner circle are the methodological changes in the practice of design over time.

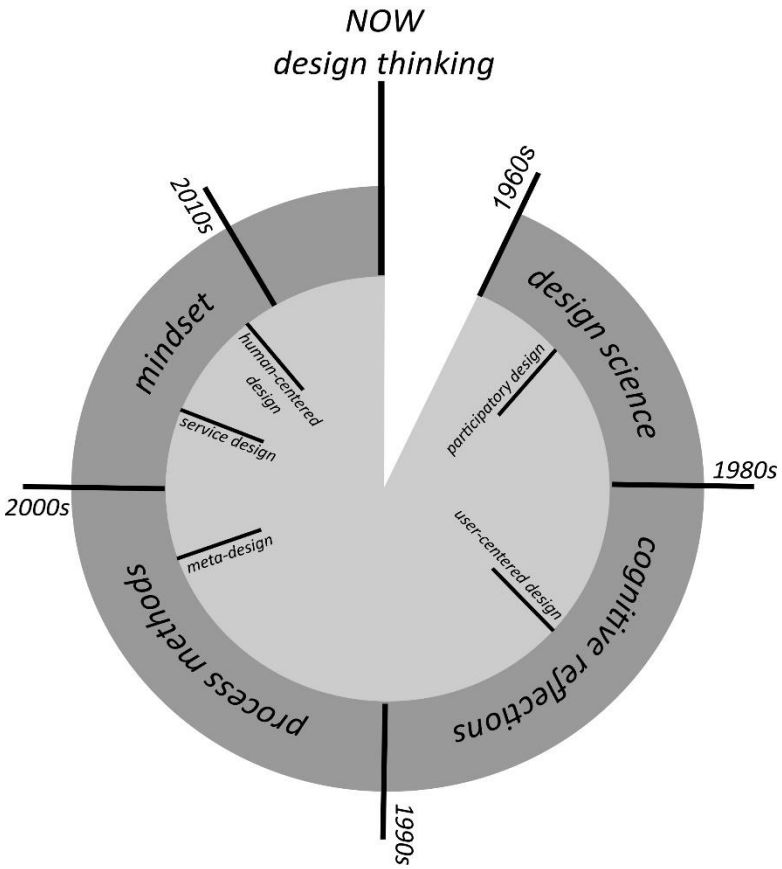

Figure 12: Evolution of design methods. Source: Adapted from Di Russo (2014)

Tim Brown[43] began to popularize the methods of design thinking as a way to solve problems and create innovations that could change the world. He says it was an approach that could integrate economy and technology, but always starts with a human need, or something that might come to be (Macedo, 2014).

According to Gomes (2013), Tim Brown considers design thinking as an important tool used by people seeking to transform innovation into value. For the author, design thinking is a discipline that uses the sensitivity and design methods to meet people's needs with what is technologically possible and what a viable business strategy can convert into customer value and market opportunity.

According to Brown (2010), design thinking initiates with skills that designers have learned over several decades in the search for establishing the correspondence between human needs with available technical resources considering the practical constraints of business.

For him, it is not just a proposal centered on the human being; it is a profoundly human activity. The design thinking is based on the ability to be intuitive, recognize patterns, develop ideas that have emotional significance beyond the functional, express ourselves in media beyond words or symbols. Brown's book represents a kind of manual containing a set of principles that can be applied by different people onto a wide variety of problems.

Vianna et al. (2012) published the book: "Design Thinking - Innovation in business" in order to present a Brazilian version of the theme, since, until then, only translated works were used in Brazil. According to the authors, Design Thinking introduces a holistic approach to innovation.

Like Brown, the authors present the work as a kind of manual for design thinking, dividing the process steps in **Immersion**, in order to promote a deep knowledge regarding the context. Then there is an **Analysis and Synthesis** stage, in order to organize the data collected into a visual way and point out patterns that help understanding the whole and identifying opportunities and challenges. **Ideation** is the third phase. In this phase, a generation of innovative ideas occurs through collaborative activities that encourage creativity. The ideas created are selected – according to the business objectives, technological feasibility and the user's needs - to be validated in the **Prototyping** stage.

[43] Tim Brown is CEO of IDEA, one of the most successful design companies of all time. He wrote the book Change by Design in 2009, published by Harper Collins Publishers.

The process is developed by multidisciplinary teams with the aim to understand consumers, employees and suppliers in the context where they are, co-creating with experts to generate new solutions.

Vianna et al. (2012) make it clear that despite the process steps being presented linearly, these steps can be assembled and configured so that suit in the project or problem at hand. In the figure below, there is an outline of the process presented by Vianna et al. (2012).

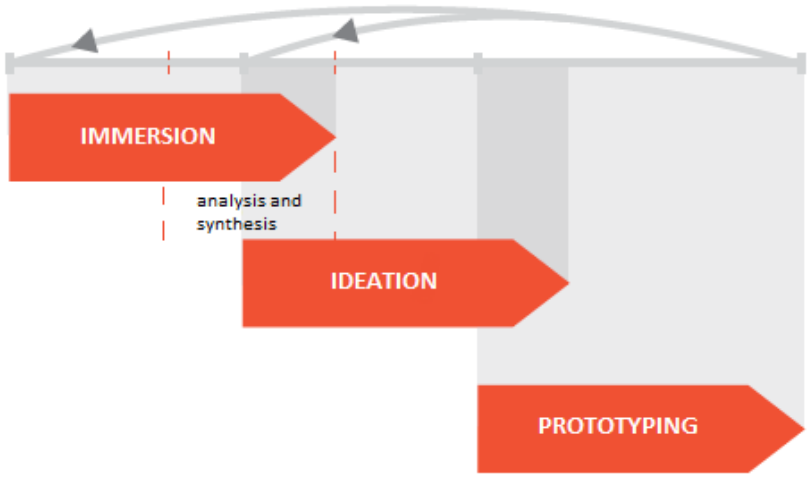

Figure 13: Phases of Design Thinking Process. Adapted from Vianna et al. (2012).

The immersion step is divided into the preliminary immersion and depth immersion. In the preliminary immersion, a reframing is realized first, in which the problems or unresolved issues in the company are examined from different perspectives, allowing, in this way, to deconstruct beliefs and assumptions of the stakeholders, breaking their thought patterns and taking the first step to achieve innovative solutions. The reframing process happens in cycles of capture, processing and preparation repeated until achieved the aim of encouraging those involved to see themselves the problem of different perspectives, creating a new understanding of the context to lead to the identification of innovative ways.

Then, still in the preliminary immersion, exploratory research and desk research were conducted. Exploratory research is a field research that leads the team into understanding the context to be worked and provides inputs for the definition of user profiles, actors and environments or moments of the product/service life

cycle that will be explored in depth immersion. It also helps in the preparation of the topics to be investigated in the desk research. Exploratory research is done through participant observation, a qualitative research technique originated in social anthropology.

The Desk research is a search for information about the theme from different sources (websites, books, magazines, blogs, articles, etc.). It is used to obtain information from other sources than the users and the actors directly involved with the project, especially identifying trends around the theme or similar issues.

Depth immersion consists in an extensive research in the context of actors' life and in the subject to be worked. To this end, members of the design team go closer to the users, to observe or interact with them, aiming to raise the following kind of information:

- What do people say?
- How do they act?
- What do people think?
- How do they feel?

The objective is to identify behaviors and to map patterns and latent needs. The research is qualitative and does not intend to exhaust the knowledge of consumer segments and behaviors, but to raise opportunities from different profiles, allowing creation of specific solutions.

Time is spent knowing their lives to gain empathy, enhance the understanding of their perspectives and, thus, identify their beliefs, desires and needs. Several techniques for conducting these surveys are available, including among them: interviews, photographic records, participant observation, indirect observation, awareness booklets, etc.

After data collection, the next steps are analysis and synthesis of the information collected. To this end, insights[44] are arranged to obtain patterns that help the understanding of the problem.

The step of analysis and synthesis aims to organize the data in a visual way, pointing out standards that help the understanding of the whole and identifying

[44] For Vianna et al. *insights* are discoveries from the immersion phase, in other words, they are the identification of an opportunity. *Idea*, in turn, is a solution generated to meet one or more insights.

opportunities and challenges. For this step, aid tools were developed such as those described below:

Insights Cards: are reflections from real data from the exploratory, desk and depth research, turned into cards that facilitate fast reference and handling.

Affinity diagram: is the organization and grouping of Insights Cards based on affinity, similarity, proximity or dependence, creating a diagram that contains large areas bordering the theme of the project, its subdivisions and interdependencies. Used when the volume of data from the research (desk and field) requires sorting, aiming to identify connections between themes and areas of opportunity to the project.

Conceptual map: is a graphical view, built to simplify and organize visually complex field data at different levels of depth and abstraction. It aims to illustrate the links between the data and to allow the emergence of new meanings from the information gathered in the initial stages of the immersion phase, mainly from the associations between them.

The graphical representation of a conceptual map allows for the visualization of data into a faster and holistic manner, making it easy to understand complex information at uneven levels. So it can also be used to communicate the synthesis of the research, enabling others to contribute to developments. In addition, the conceptual map can be used as the basis for generating ideas.

Guiding criteria: are guidelines for the project, highlighting aspects that should not be lost during the development. The scope of the project and the direction suggested by the client rises from the analysis of the data collected. They serve as basis for determining the limits of the project and its purpose.

Personas: are archetypes and fictional characters designed from the synthesis of behaviors observed among consumers with extreme profiles. They represent the motivations, desires, expectations and needs, gathering significant features of a larger group.

Map of empathy: is an information synthesis tool regarding the client in view of knowing what he says, does, thinks and feels. Thus, it enables the organization of the immersion phase data in order to provide context for understanding situations, behaviors, concerns and aspirations to the user (or other actors studied). The empathy map serves as a basis for identifying customer needs and opportunities for the project, and can be used as inputs in the ideation phase.

User journey: is a graphical representation of customer relationship stages with a product or service, which describe the key steps covered before, during and after the purchase and use.

Figure 14: Example of User Journey. Adapted from Vianna et al. (2012)

Blueprint: is a visual matrix that represents, schematically and simply, the complex system of interactions that characterizes a provision of services. In this representation, the different points of the service are mapped, i.e., the elements which the customer interacts, the client's actions and all interaction with the company from the visible operations to those that occur in the background.

The next phase, ideation, has the intention to generate innovative ideas and, therefore, use the synthesis tools created in the analysis phase to stimulate creativity and create solutions according to the context worked.

In addition to the tools, it reveals important to possess a variety of profiles of people involved in the idea generation process and, therefore, to include in the process those who will take advantage of the solutions that are being developed, as well as experts of their experience. Thus, beyond the multidisciplinary project team, other members are selected, like users and professionals of areas that are convenient to the topic under study, usually through co-creation workshops.

The objective of bringing together different expertise is to contribute with different perspectives, which consequently makes the result more rich and assertive.

The ideation phase usually starts with the project team conducting **brainstorming sessions** (one of the best-known techniques to generate ideas) around the theme to be explored. Then, one or more sessions of **co-creation** with users or staff of the company, depending on the necessity of the project. The ideas generated during this process are captured in **menus ideas** that are constantly

validated in meetings with customers, using, for example, a **positioning matrix** or prototyping (next phase).

The prototyping phase is the moment in which physical presentation of an idea is manifested in order to represent reality - even if simplified - and to provide validations. It is a learning tool to the design team, because to give shape to an idea is needed to formulate it in more details and to increase the wealth of the solution throughout the process. In addition, much stands to be gained by the user's participation, valuating the prototype and give suggestions to its evolution and improvement.

Prototypes reduce the uncertainty of the project, since it means an expeditious avenue for better selecting alternatives and identifying a more assertive final solution. The prototyping process begins with a formulation of questions to be answered about the idealized solution. From this, the team create models as testable alternatives.

The results are analyzed and the cycle can be repeated many times until the design team reaches a final solution meeting the user needs and the interest of the company. Thus, the more tests are done and earlier the process is started, greater is the learning and the chances of success of the final solution.

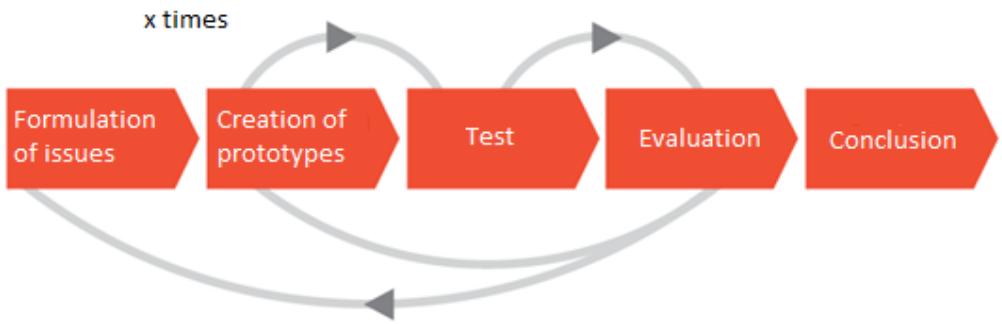

Figure 15: Prototyping cycles. Adapted from Vianna et al. (2012)

Prototypes can be made in paper, by graphical representations; volume models; scenarios (improvised simulation of a situation); storyboards to communicate an idea to others or even to display the thread of a solution.

There is also the prototype of a service, which is the simulation of material artifacts, environments, or interpersonal relationships representing one or more

aspects of a service in order to engage the user and simulate the performance of the proposed solution.

According to the authors, design thinking have been used by modern companies for gathering information, for knowledge analysis and for proposing solutions in a creative fashion, utilizing abductive thinking.

Such endeavor represents an approach that puts the man in the center of the process, as much during the search for better understanding the user as in the involvement of experts as constant collaborators. This allows a wide vision of the theme to be explored, through different points of view, bringing innovative and contextualized solutions. The authors emphasize that teamwork between interested parties is one of the fundamental keys for success in this approach.

2.2.3 Systemic Thinking

According to Docci (2008), the roots of systemic thinking own their origin to the ancient Greek word “synhistanai”, which means to “synthetize” or to “put together”. Aristotle believed that matter itself contained the essential nature of all things, in a way that the essence could only become real through form. This fluid and organic view dominated the western thought during the Middle Ages (Capra, 2006).

With the scientific revolution of the sixteenth and seventeenth centuries, the former medieval vision started to be ruled by mathematical and exact thought, understanding the world as a machine. This is a moment ruled by the Cartesian Mechanism and the analytical method put forth by Descartes. In the eighteenth and nineteenth centuries, the European continent witnessed the emergence of the Romantic Movement, which rescued Aristotelian ideas based in nature and organic forms. However, in the second half of the nineteenth century, the advances of Biology permitted by the perfecting of the microscope propitiated a return to the mechanism thought. At this point, Biology managed to comprehend the structures and functions of cellular subunits, but failed to explain the coordinating activities that integrated functional operations of the cell as a whole.

This comprehension arrived at the twentieth century with the organismic biology, a movement of opposition to the mechanism that had great influence in the construction of the systemic thought. The organismic conception defends that the priorities of an organism belong to the whole, in a manner that none of the parts possesses them, for such properties emerge from the interaction between the parts. Therefore, the properties of the parts can only be understood from the whole. Organismic biology puts the focus in the understanding of relations having the concept of organization itself later on perfected by the concept of self-organization (Gomes et al. 2014).

According to Luisi (2015), along with the organismic biology, in the decade of 1920 other two fields originated the systemic thought, the Gestalt psychology and the ecology. In all those fields, exploration of live systems has led researchers to think in a new manner, in terms of connection, relations and context.

In the decade of 1940, the real formulation of systems theory emerged. The objective of the General Theory of Systems was to study the universal principles

systems in general. Its author, Ludwig Von Bertalanffy[45], defined systems as a complexity of elements in a state of interaction. The relation between the components of a whole makes the elements mutually dependent and characterizes the system, different from the sum of independent parts (Vasconcellos, 2010).

Bertalanffy was dedicated to investigate the basic principles that could constitute an interdiciplinary theory. According to the author, a General Theory of Systems could offer a conceptual base capable of unifying several scientific disciplines that, at that moment, were isolated and fragmented. Such interaction is bound to generate feedback, which guarantees circulation of information between elements in the system. This can either be a positive or negative feedback, creating in this manner a regenerative self-regulation and new properties, which can be beneficial or hindering for the whole, regardless of the parts (Gomes et al. 2014).

In the decade of 1940, other two theories United to the General Systems Theory: Cybernetics and Communication Theory.

According to Wiener[46] (1961, apud Dolci, 2008), cybernetics is the Science of control and communication in animals and machines. The basic concepts of cybernetics are time, information and its transmission in time and space, the feedback and the control mechanism. The search for stable behaviors and stability zones in a system, as well as themes related to self-organization, learning and self-reproduction are questions addressed by cybernetics.

The Cybernetic Theory is divided in 1st order cybernetics and 2nd order cybernetics, being the first order further divided into 1st and 2nd cybernetics. The first cybernetics addresses the capacity of self-stabilization of the system, presenting concepts of input and output, emphasizing the presence of an observer out of the system as an expert (objectively), and the comprehension of the

[45] Since the decade of 1920, when he initiates his career as a biologist in Vienna, Ludwig Von Bertalanffy criticizes the predominance of a solely mechanism focus in theory and in scientific research. In 1925, he publishes his ideas in German, and in 1930, publishes a few articles in England. In the following decade, the author presents his theory of the organism considered as an open system. Amidst the context of the Second World War, the ideas of Bertalanffy were not well received at a first moment. The biologist then meets the Cybernetics theory that flourishes in the United States and starts to be influenced by it. In 1960, Bertalanffy starts to teach conferences in the United States and in 1967 and 1968 publishes his General Theory of Systems through a Canadian editor and, due to higher propagation of his ideas, that become available in the English language, his theory gains visibility (Vasconcellos, 2010).

[46] Norbert Wiener (1894-1964) is a mathematician, with a PhD in Logic by Harvard. He was a professor at the Massachusetts Institute of Technology (MIT) from 1932 to 1960. He was the founder of Cybernetic Theory and had great importance in research in many areas of control systems and systems that work with information. More of him at Tipografos. Available at: <http://www.tipografos.net/internet/norbert-wiener.html>. Accessed in Nov. 2015.

phenomena still connected to linear causality (stability). Thus, the first Cybernetics reaches the hypothesis of complexity, which in turn recognizes that the simplification obscures the inter-relations and, therefore, searches to contextualize the phenomena and explore the systems of systems, understanding that there is not a linear causality, but, instead, circular. Subsequently, the second cybernetics addresses the capacity of self-changing of the system. The notion of world as a process of constant transformation emerges, in which some phenomena of the world are unpredictable and irreversible and, therefore, uncontrollable (Vasconcellos, 2010 apud Gomes et al, 2014).

According to Vasconcellos (2010), second order cybernetics or Si-Cybernetics[47] has as main precursor the physicist Heinzs Von Foster. Foster is responsible for the notion of observant systems, according to which the observer, included in the system, observes herself observing. The 2nd order Cybernetics is also called constructivism or constructivist vision.

To Weiner, the purpose of Cybernetics had been to develop a language and technique that allowed for an approach to the problem in communication and control in general. Therefore, he considered the message to be the central element, just in communication as in control. To put it differently, to communicate is to send a message, in the same likelihood as to command (Vasconcellos, 2010). For this reason, the anthropologist Gregory Bateson, who also participated in the Macy Conferences[48], developed the Theory of Communication that contributed significantly to Cybernetics.

Bateson conceived a new and radical concept of mind, capable or surpassing the Carthesian view. Mind is a systemic phenomena of living things, a relational characteristic. Mind is not in the brain, but in the relations (Vasconcellos, 2010).

Bateson employed the use of analogies, metaphors and history by believing that these resources were a way to the study of relations. (Osório, 2002 apud Gomes et al, 2014).

[47] The Cybernetics of 2nd order is also called Si-Cybernetics because Edgar Morin proposed a movement that would overtake cybernetics: Si-Cybernetics. The prefix Si is the element of the Greek preposition SUN which means “to be together” which marks the mutual obligation between parts (Gomes et al, 2014).

[48] In 1946, the 1st Macy Conference takes place in New York, which has as a “Feedback” theme and had the participation of researchers, psychologists, anthropologists, economists and specialists in Game Theory. The encounter meant to reunite scientists that could help in comprehending the nervous system, social communities and means of communication. In the subsequent years, there have been several Macy Conferences and it could be affirmed that the theoretical framework of Cybernetics was construed in these encounters (Gomes et al, 2014).

The communication process covers a complexity of factors, such as content, form and language all of which are always present in the inter-relational processes. According to Watzlawick et al. (1973), invariably people send and receive a diversity of messages, be them through verbal or non-verbal channels, and the same necessarily modify or affect one another (Gomes et al, 2014).

In the decade of 1970, a new set of concepts and techniques was developed to manage the complexity of systems, known as the theory of complexity, characterized by non-linear math (Luisi, 2015).

Edgar Morin is the main theorist of the complexity theory. According to Morin, a simplistic and fragmented thought does not express the idea of unity and diversity present at the whole. According to his theory, the whole is complex, much like the parts, and it´s what justifies the principles of order, disorder and organization of the systems (Petraglia, 2008).

Also in the years of 1970, Maturana[49], in partnership with his then pupil, Francisco Varela, initiated the development of the concept of autopoiesis. Autopoiesis relates to the capacity of living beings to produce themselves. Living beings are structured from an organized system, which continually produces its own organization by means of the production of its own components, under the condition of continuous distress and compensating such distress (Moreira, 2004).

Other author relevant to the systemic thinking is Peter Senge, who in 1990 published "The fifth discipline". According to him, it is necessary to see the world as a system of intertwined strengths related between each other. In this way, conditions of forming the organizations of apprenticeship are created where people will learn continuously in group (Senge, 1990).

According to Dolci (2008), systemic reasoning is the fifth discipline, considered the conceptual structure that has the objective of making clear the vision of a whole from which the alterations necessary to improvement of organization are identified.

The theories presented above served as base to the construction of systemic thought as it is known today. Systemic thinking addresses complex systems, considering every part that sum up to a whole, working the relations and context.

[49] Humberto Maturana, Chilean biologist born in 1928, obtained his doctorate in Biology at Harvard, worked in neurophysics at the M.I.T. and has been a professor at Chile University since 1960. Besides Biology, Maturana was interested in Philosophy, Anthropology, Anathomy, Genetics, Cardiology, Autopoiesis Theory, or Biology of the Knowing, is the name given to the ideas of Maturana (Moreira, 2004).

And furthermore it promotes the ability to change attention to the front and back between levels of the system.

Ryan (2014) defines the systemic thinking as a way of looking, modeling and intervening in the world, assuming that it is composed of open sets, proportional and complex. These groups contain parts that are independent and open to change of matter, energy and information with its environment. Thus, its actions have effects beyond those intended.

The systemic thinking can contribute a lot to the design; from its approach, design can develop a great ability to work with complex situations promoting the change from linear to holistic and interactive dynamic thinking.

At the Polytechnic Institute of Turin, systemic design has been worked as a discipline that relates the study of agricole and industrial processes aiming the transformation of output from a process in a chain of mechanisms that seeks the total elimination of residues of manufacture. The model is inspired in the foundation of generative Science and has roots in the cybernetic and complexity of systems[50].

According to Bistagnino (2011), systemic design is based in five guidelines. These guidelines are the methodological base for the Project to be developed, considered an essential tool for the understanding of the system and for the understanding of relations between its parts. These guidelines are:

Output - input: The outputs (waste) of a system become inputs (resources) to another system, generating increased economic flow and new job opportunities.

Relationships: Relations generating the same system, all elements in the system are strategic and interfaces can be internal or external.

Auto-Generation: Self-producing systems sustain themselves by reproducing automatically, thus allowing them to define their own paths of action and jointly coevolve.

Act locally: valuing local resources including labor, material culture and solving local problems, creating new opportunities.

The man at the center of the project: the man related to the environmental context itself, social, cultural and ethical.

[50] Definition obtained from the lectures of Pier Paolo Peruccio in the discipline Theory and History of Systemic Design, taught in 2013 at the Polytechnic Institute of Turin.

Systemic design brings into focus the activity and not the product. Thus, focuses on action and not on the object itself and then relates it with all the other objects and the environment that are inserted in the general system of other activities related to that.

Thus, from interrelated actions between products and activities that occur, it generates a completely different scenario that is able to manage the outputs of a process and to make them inputs of others with large environmental advantages and new relationships that can not only reshape or propitiate new products, but also involves a dialogue between different sectors.

The figure below shows the difference between the current linear system and the systemic system. The main objective is to create an open web of relations, in a way that values the territory and the local producers, generating economic benefits from the system.

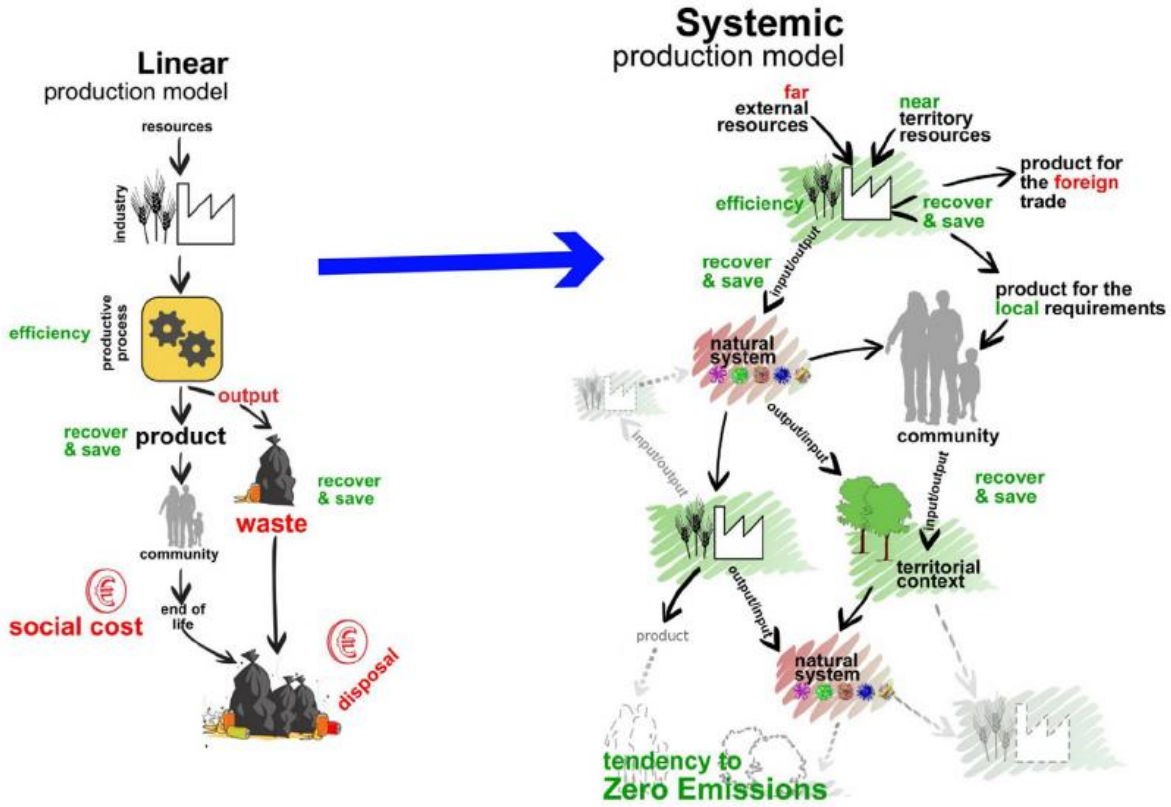

Figure 16: Systemic production model (Bistagnino, 2011).

According to Bistagnino (2009) each project developed with this approach is analyzed following its own methodology. Nevertheless, they have common steps.

First, the object is contextualized in the territory or productive system. To this aim, it is necessary to have a very detailed picture of the situation to be intervened on. This picture should present:

- The involved actors, their nature, knowledge and technology available at their disposal and employed daily, its origins and its relationship with the territory in which they produce, where the transformation and marketing occurs.
- A clear definition of all the movements and actions generated on the system.
- Description of what enters in the system (input), where it comes from, its quantity and quality.
- Description of what comes out of the system (output), quality, quantity, destination, and any application.

As a result, we have an accurate picture with the necessary resources, their characteristics and origins, and the quantity of waste generated, its quantity and final destination. In addition, it is possible to know what happens internally in the process, comparing the specific difference of how much comes in and how much goes out.

Designers, when focus only on realization of the product, or to solve a specific problem, do not realize the relationship that exist between the various actors, which does not have the capacity of intervening to manage the consequences of what they generate, acting only on the partial or final result and not on the overall process.

To understand this complex framework, it is necessary to construct a graphical model that shows the flows of matter and energy, their application, the knowledge, the relations between the actors and the contextualization of the system considered. The cause of a problem can be identified at the exact instant that it is presented. Each problem is analyzed with different parameters, such as convenience and economic value, environmental sustainability, relationship with the land and production flexibility. Each parameter is expressed in qualitative and quantitative evaluation (Bistagnino, 2011).

First, the problems are to be identified, only then to seek understanding them, which means to study the phenomena that determined them. The next step is to think about possible connections based on the coherence between the available outputs and the required inputs. The designer should be inspired by nature itself, trying to maximize the quality of outputs, suggesting connections and advantageous interactions, new uses of matter that yield possible new productions, and new forms

of power generation. Thusly, such action will develop flexible new economic models that embrace multiple actors in a specific territory.

According to Bistagnino (2011), it is only from the connection that arises between these various fields that new areas of research may emerge and can innovate. The systemic design opens up new scenarios of possible innovative and virtuous economic models on which the disposal that today constitutes an expense can become resources for new industrial systems, thereby offering the possibility of development of the territory, of the production environments and services related to this.

The chart below demonstrates the phases of the systemic design approach, the actions required for each phase and the expected results.

Table 1: Actions and results present in Bistagnino approach.

Phases	Actions	Expected results
Research	• Choose of the territory • Description of present activities, local resources and flows of inputs and outputs	• Frame with resources and waste present on the system • Identification of processes
Analysis	• Individuation of the actors involved • Identification and analysis of the existing problems in the system	• Identifying opportunities for intervention • Analysis of the system in accordance with: convenience and economic value, sustainability, relationship with the territory and production flexibility.
Connections	• Establishment of possible connections between the available outputs and required inputs.	• New economic models • New fields of research • Development of the territory, productive environments and services.

2.3 Design Education around the World

2.3.1 Design Education for Complex Situations

Pourdehnad et al. (2011) affirms that the way in which people act at problematic conditions depends on the quality of the approaches employed. These approaches depend much more on philosophy and world vision rather than science and technology. The design practices have obtained consistent results in integrating the systemic world vision in its methodologies.

According to Krippendorff (2006) since the mid-twentieth century, design has increased in abstraction, shifting from product design to service design, design of identities, interfaces, networks, projects and speeches. Today, some systemic approaches have emerged in design practice. Most of those approaches are working into an interactive way, taking systemic thinking to practical situations to improve them and learn about it simultaneously. This union of systems and design contains enormous creative potential that can better connect theory and practice to produce knowledge (Ryan, 2014).

Jones (2014) affirms that cycles of convergence and divergence between systems theory methods and the creative design disciplines have been occurring for decades. Some authors consider systems thinking as a design process, while others see design as a systemic discipline (Ackoff, 1993, Nelson, 1994, apud Jones, 2014).

According to Mugadza (2015), once the design thinking entered the domain of management, it faced complex issues and realized the necessity of a systemic approach. System thinking begins the comprehension of a problem by amplifying the surrounding context beyond the apparent limits, including other factors not so evident at first glance, but that by being connected to the problem, are able to cast influence over it. Thus, the relations are identified and developed in a way that the desired results can be found. Design thinking, in its turn, reveals itself more human centered while demanding the designer to experiment the problem further through the point of view of those affected. This empathy from design thinking enhances the holistic attitude that systemic design seeks.

Currently, there is a need to focus on the relationships between different actions and their consequences, between stakeholders, politics and consumption, democracy and production. The new approaches that are emerging are working these issues through a systemic perspective. Theorists and researchers are recognizing these approaches as sets of abilities to manage and design for complex situations (Mugadza, 2015).

This discussion is not a new debate, having started in the decade of 1960, when Alexander (1964) demonstrated the difficulties that designers face when all aspects of a design task along with its inter-relations are mapped out.

Ryan (2014) presents, through his studies, a framework to systemic design that integrates systems thinking and design thinking. According to him, when systemic thinking and design are mixed, the result is a potent synthesis that can be called systemic design. Systemic design permits facing situations from different perspectives. Designers work alongside with stakeholders in building a broader context in which the challenge is situated. This way, they amplify the alternatives pursuing a solution and aligning actions to improve messy situations. To the author, Systemic design is an approach to work together in acting, reflecting, and learning while doing.

According to Ryan (2014), systemic approaches and design are highly complementary, and can compensate for one another's weaknesses. Systemic thinking provides a broader perspective of a problematic situation from which many areas for intervention can be recognized. Design provides a humanistic perspective of the needs of real users, and craft skills for giving tangible form to abstract ideas. According to Goh (2014), the link between design and system thinking can bring a truly holistic understanding of a current system, generating ideas that will transform the system into a sustainable way.

Pourdehnad et al. (2011) have identified the core differences in the Systems Thinking and the Design Thinking approaches to problem resolution. They believe that System Thinking approaches consider primarily social systems into a context in which the stakeholders mainly play the role of the designers. In this process, design is a creative act that tries to estimate a set of behaviors for a determined objective. In turn, Design Thinking approaches consider that the product and the stakeholders are observed and studied by the design team. Thus, design means the application of the sensibility and methods of the designer to the solution of any problem.

As one can see, the union between design thinking and system thinking collaborates to solve challenging problems in complex situations. However, an effective action requires increased research and a broader and deeper involvement of design education.

Pourdehnad et al. (2011), affirms that traditional methodologies are inadequate for addressing complex problems, which becomes even more evident when applied to new conditions with increased rate of change, increased complexity and increased uncertainty.

According to Sevaldson (2008), exposing students to complex situations is considerably challenging. It requires skills that need to be learned in practice. However, a systemic exploration for the development of these skills have been neglected by design education. A typical school of design prefers to work with idealized and framed tasks than to expose students to complex problems where they could train the skills required to act. There already exists design practices geared towards dealing with complexity. However, such practices need to be systematized and developed further.

Each school of systems and design practice tends to promote their own methodology with points of differentiation. Despite this variance, VanPatter and Pastor (2013) have mapped a large number of innovation methodologies into a generic cycle with four main sequential activities: Discover and orient; Define and conceptualize; Optimize and plan; and Execute and measure (Ryan 2014).

Through this research, it was possible to observe some initiatives that pursue the practice of system thinking in design education; they are developed by postgraduate courses, research and extension centers or independent courses.

The system thinking exploration by universities in design courses is a recent development and just a few institutions are actively working in this field. However, there is a considerable network of researchers and activists developing activities towards an ecological approach concerning sustainable growth in a global and local scale. In addition, there are some institutions that are promoting an educational systemic approach in primary and secondary levels, magazines on future studies, research centers and studies groups.

2.3.2 Cases of Innovation in Design Education

This work highlights significant institutions from different parts of the world that employ teaching practices that emphasize the use of system thinking in their approaches. This study was conducted with the objective of identifying the main institutions that are actively working to spread the systemic knowledge. More specifically the study also aims to identify the schools that are practicing the systemic thinking plus design thinking in design education, as well as the methods and tools used by these institutions, and the results obtained. These institutions can be seen in the figure below:

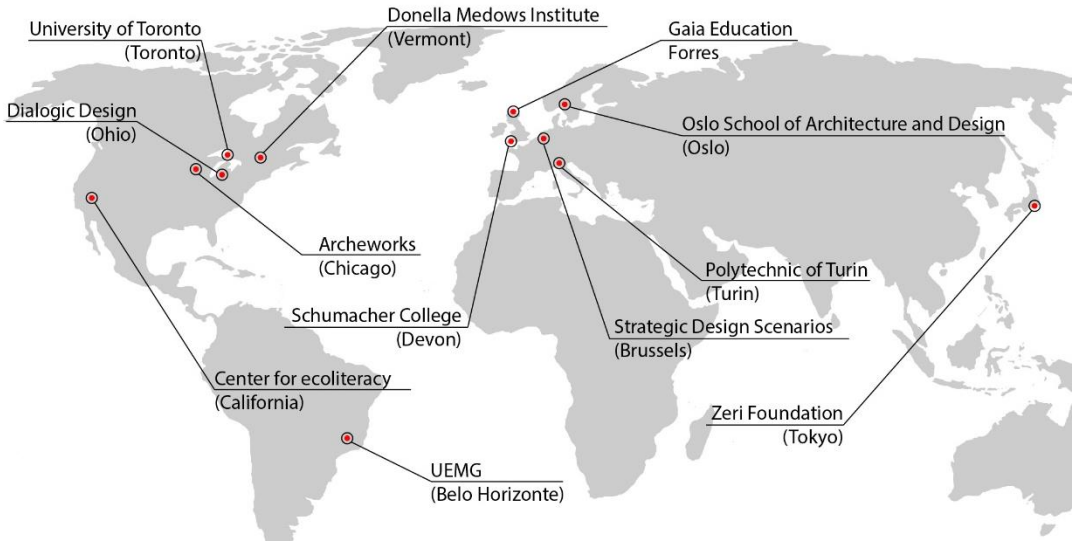

Figure 17: Practice of system thinking in institutions around the world

Regarding the systemic thinking in its learning and approaches that intended to conduce a holistic and ecological education, we highlight the Donella Meadows Institute, the Shumacher College, and the CEL - Center of Ecoliteracy.

The Donella Meadows Institute works in Vermont (USA), since 1996, with the objective of using system thinking disciplines through sustainable strategies to spread its practice and better manage economic, social and environmental systems. They conduct research, demonstrations and education of systems.

Another objective of the institution is to preserve the legacy of Donella Meadows[51]. To this purpose, free access to Donella Meadow's work is granted, accompanied by resources to leave her ideas to new audiences, making them available to students, practitioners and leaders in sustainability. The institution also implements initiatives in education, training and with publications with the aim to change mindsets and have more people mastering the skills necessaries to a sustainable approach.

The institute have been developing materials and co-taught graduate-levels courses, also presenting lectures to undergraduate courses. In those lectures, they introduce the system thinking using case studies, games and activities, with the aim to leave students to apply system approaches in their class projects (Orientation Guide, 2016 – Donella Meadows Institute).

Another institution is the CEL – Center of Ecoliteracy in California, which promotes ecological education in primary and secondary schools. It was co-founded in 1995 by Fritjof Capra[52] one of the most important system thinker. They act promoting systemic initiatives, releasing books and publications, promoting conferences and professional development and providing strategic consulting. They defend the concept of Ecoliteracy to educate children through teaching strategies as hands-on activities, both indoors and outdoors; reflective discussions; and participations on interdisciplinary projects.

One example of a successful program is the participation of students in real situations together with their local communities. They use for this learning process mapping technics, where they create a visual representation of the system related to their own environment. The participants are encouraged to develop collaborative activities with local citizens, organizations, agencies, businesses, and government to improve the quality of life in their communities.

[51] Donella Meadows (1941-2001) was an American environment scientist, teacher and writer, co-author of the book The Limits to Growth (1972), a best-seller on the importance of the dynamics of human and economical expansion measured against the capacity of the Earth to support it. Donella was a member of the research group about dynamic systems of the MIT (MIT System Dynamics), founded by Jay Forrester. More of her work can be seen at: <http://donellameadows.org/donella-meadows-legacy/donella-dana-meadows/>. Accessed in Dec. 2016.

[52] Fritjof Capra is an Austrian born in 1939, PhD in Theoretical Physics. He is a writer involved with ecological education. His book, The Turning Point (1982), is a reference to the Systemic Thinking. His main works are: The Tao of the Physics (1975), The Turning Point (1982), The Web of life (1996) and The Hidden Connections (2002). Capra's books have been published in more than 25 languages. More about his work can be seen in: <http://www.fritjofcapra.net>. Accessed in Dec. 2016.

The center bases its didactics on the works of John Dewey and Jean Piaget, by the experimental learning, where the hierarchical relation professor-student is broken, and the teacher is seen as a facilitator of the learning process. Also, interdisciplinary learning and constructivist approach are used by the center in their educational process (Sly, 2015).

Fritjof Capra is also a professor at Schumacher College, in Devon (UK), working in postgraduate programs and short courses. They promote courses for sustainable living to people from different places, ages and backgrounds. Lessons happen in alternative environments such as gardens and kitchen, including activities as diverse as cleaning, cooking or gardening. The focus is on the interactivity, experiential and participatory learning. They defend group work and co-creation, and are against the passiveness by the students, stimulating an active learning.

Regarding the global network, it is important to point out the Gaia Education, the work of Gunter Pauli in the Zeri Foundation and the work of John Thackara.

Gaia Education[53] is a British organization founded in 1998 by 55 educators from different profiles and backgrounds with the aim to develop a transdisciplinary ecovillage design curriculum, which was launched in October of 2005. Today, they promote educational programs for sustainable development across the world. They have an online program about "Design for sustainability" in which they provide an understanding about systems design, work on analytical abilities, design thinking skills and methods and practical tools for designers. The program is separated in four dimensions: social, ecological, economic and worldview. The program is available in three languages, representing an opportunity for students to connect with different profiles.

Another program from Gaia Education is the EDE – Ecovillage Design Education. In this program, students work in communities, institutions and neighborhoods as agents of change and sustainable designers. This program is present in 43 countries, reaching over 12,100 students. They present theoretical and practical activities adapted to the local context in the same dimensions of the online course.

The Zero Emissions Research and Initiatives (ZERI) is a Global Network seeking sustainable solutions to complex problems in the world, making use of

[53] Data from Gaia Education website. Available at: <https://gaiaeducation.org/index.php/en/>. Accessed in Dec. 2016.

nature's principles. It was launched in 1994 by the economist Gunter Pauli[54]. In 2004, at the occasion of ZERI's 10th Anniversary World Congress at UNU International Conference Hall in Tokyo, it was discussed with participants from different parts of the world the concept of zero emissions. In this conference, between other topics, the role of the product design and its principles were presented and inspired Luigi Bistagnino to create the Graduated School for Systems Design[55]. Using the concept of input-output, where the waste of one become resource for another. This work will be further explored in the following pages.

John Thackara[56] is a designer theorist, author of twelve books, between then the best-selling "In the bubble: designing in a complex world" (2005), which is one of the primary books about systemic thinking and design. He is founder and director of "The Doors of Perception", a conference that put together grassroots innovators and designers to imagine sustainable futures and work on projects to reach those futures.

Still two important research groups are the Systemic Design Research Network[57] (SDRN) and the Dialogic Design[58]. The SDRN was founded in 2011, by Birger Sevaldson, Peter Jones, Harold Nelson, and Alex Ryan at AHO, Oslo School of Architectural and Design, in partnership with OCAD University, Toronto.

This group works on systemic design as an integrated discipline of systems thinking and systems-oriented design. They promote workshops, publishing and symposium events on topics related to systems theory, strategic design, social systems, methods and system thinking. The founders have been releasing recent and important publications concerning the theory and practice of systemic design and methods. In addition, they are working together with the universities of Oslo and Toronto putting in practice the inclusion of systemic thinking in design education. In the next topic, case studies on their methodology will be presented.

[54] The economist Gunter Pauli was born in Belgium in 1956. He has published 20 books in more than 30 languages. He is a Fellow of the World Academy of Arts and Sciences (USA), a creative Member of the Club of Budapest (Hungary), Member of the Club of Rome, and obtained a Doctorate from the Italian Government in systems design. More of him at: < http://www.gunterpauli.com>. Accessed in Dec. 2016.

[55] Data from Zeri website. Available at: <http://www.zeri.org/ZERI/History.html>. Accessed in Dec. 2016.

[56] Data from John Thackara website. Available at: <http://wp.doorsofperception.com/>. Accessed in Dec. 2016.

[57] Available at: <http://systemic-design.net/sdrn/>. Accessed in Dec. 2016.

[58] Available at: <http://designdialogues.com/>. Accessed in Dec. 2016.

Peter Jones also have released the Design Dialogues, and the Redesign Network (2001), developing advanced practices in systemic design and social innovation. He is also a managing partner of a US boutique firm, Dialogic Design International, a consulting firm directed to design solutions to complex problems. They work with stakeholders spreading their understanding of interconnected problem systems to solve intricate issues.

Other cases concerning innovative approaches on design education are the Strategic Design Scenarios in Brussels (Belgic), the Archeworks in Chicago (USA) and the CEDTEC in Belo Horizonte (Brazil). Their approaches are more connected with design thinking, but they also present the same aims of systemic strategies, looking towards a sustainable development, a contextualized and local based project and using participatory design, working in a collaborative way with stakeholders.

The Strategic Design Scenarios[59] is a lab and a research group from Brussels with focus in social innovation, sustainable living, collaborative services, design for behavioral change, local development and regional/urban planning. The designer François Jégou created it in 2002.

One of their projects is the Product - service systems (PSS), which has the objective of reaching new sustainable business opportunities in the urban local context by combining products and services-systems. They developed a Tool Kit PSS, with the aim of presenting their methodology, which will be further detailed in the following pages.

The key factors in the success of the methodology, which have been tested and present notable results are, first, the combination of a territorial and individualized approach, the use of a multidisciplinary team, the involvement with stakeholders, an openness to new participants and new ideas, and a preference for solutions directed to local sustainable development.

Archeworks is a multidisciplinary design school with a humanistic approach. It was founded in 1994 in Chicago (USA) by architect Stanley Tigerman and the designer Eva Maddox[60]. Its educational programs are based on partnerships

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[59] Available at: <http://www.strategicdesignscenarios.net/>. Accessed in Dec. 2016.

[60] Stanley Tigerman is an architect and designer, author of six books; he has been a visiting professor at numerous institutions. He was winner of over 125 awards and represented the US at Venice Biennale in 1976 and 1980. Eva Maddox is the Principal of Perkins & Will | Eva Maddox Branded Environments a research-based design practice she created to identify & integrate a client's DNA into tangible experiences. She is the recipient of Chicago Magazine's 2002 Chicagoan of the

and public forums proposing sustainable and socially responsible design solutions. They assume that *"Design shapes the way we live. The fewer resources communities and individuals have, the more they need great design solutions to enhance their quality of life"*.

The school offers a one year postgraduate course in Public Interest Design, which develops local social projects using design thinking, design doing and participation design tools. The program gives emphasis to the multidisciplinary, by accepting students from different areas, promoting exchange of knowledge and culture between them.

One of the most striking and rich features of the school is the formation of partnerships, present in all projects. These partnerships are made between students and experts, civic leaders, business people, community members. Professional workshops and seminars are made, which adopt critical thinking, generating new proposals and working models, what they believe to be essential, not only to direct solutions to community but also to generate visionary answers to the more complex society challenges. The collaborative design projects work on topics ranging from universal design and accessibility to the health of the community, local food systems and sustainable land uses.

Students arrive at Archeworks with baggage that includes from architecture and interior design, political science, art history and public administration. They work in teams with other students with experience in different areas. Here the premise is that the domain knowledge that each student brings to the program contributes to form a shared knowledge that is in the background, the basis of all successful projects.

In Brazil, there remains bureaucratic barriers that slow down the implementation of new disciplines in formal curriculum of design courses. However, some initiatives have been taken to promote a design practice more related to the national reality, albeit experimentally and in parallel to mainstream education. One of these institutions is the CEDTec, the Center for Design and Technology, of School of Design at the Minas Gerais State University - UEMG.

Year; and 2000 Star Award from the International Interior Design Association (IIDA) honoring her outstanding leadership and contribution to design. In 1999, Eva was elected to IIDA's College of Fellows and in 1992, she was inducted into the Interior Design Hall of Fame. Available at: < http://archeworks.org/about/mission-history/>. Accessed in Jul. 2015.

CEDTec, coordinated by Rita Engler, works since 2010 acting from undergraduate to graduate courses with projects focused on research of new products, services and technologies. The goal is technical training for design professionals, to work on different projects through sustainable practices, technologically developed, toward improving the quality of life and income generation in poverty-stricken communities where it operates with projects in Social Innovation and Inclusion.

CEDTec promotes continued education and elective courses as "Arts and Environmental Education" inserted in the course of visual arts; "Social Innovation and Technology" as elective course; "Sustainability Reports" and "Fundamentals of Social Technology". These disciplines raise awareness and instruct students about the theory involving the current environmental requirements. This way creates an involvement between art-technology-innovation.

These courses encourage and motivate students to develop research projects, always guided by teachers who seek financial incentives to carry out such projects. An important fact to be noted is that some of the projects are based by initiative of the students, which reaches one of the main objectives of the center, which is to promote the transition in thinking from young designers to become conscious professionals in the New World.

CEDTec projects reach different areas, as examples we can mention the project *"A Casa da Gente"* (Our House), which acts in the rearrangement and functional improvement of the space of a shelter for children benefiting residents, staff and students. The project *"Agenda Socioambiental"* (Environmental Calendar) promoted waste management at the School of Design. The project *"Design Digital para Inclusão de Deficientes Auditivos"* (Digital Design for Deaf Insertion) develops communication activities and playful intervention for deaf and hearing people, enabling learning and strengthening ties between the community. The project includes participation of students, interpreters, the deaf and project supervisors. This project is being led to various communities and the goal is the inclusion of the deaf through the dissemination of Brazilian language of signs, the "Libras".

The project *"Comunidades Criativas das Gerais"* has carried out a series of actions intended to promote integration and benefaction of individuals within its territory by means of experiences, exchanges and cultural dynamics understanding creativity as a catalyst for sustainable development of communities. This project have benefited directly 40 local producers and indirectly all community of the town of São Sebastião das Águas Claras (Macacos) in 2012.

Acting in a way that transcends disciplinary boundaries of traditional classrooms, the CEDTec involves the community, students and teachers towards a more humane design, consistent with the context in which it appears, promoting inclusion and social innovation and benefiting all.

Next, some of the methodologies developed by those institutions will be presented, aiming to identify common tools and phases, as well as the key success factors in them.

These methodologies were founded in academic papers as in the case of Toronto University and the Oslo School of Architecture and Design, in the websites, as in the case of Strategic Design Scenarios and Archeworks or by the field research, as in the Polytechnic of Turin and CEDTec.

2.3.3 Rotman´s Design Thinking Methodology –Toronto University

Alex Ryan and Mark Leung (2014) present case studies where systemic design was applied. The work offers a contribution to knowledge on how systems plus design thinking might be synthesized to create an approach to systemic design. To the authors, systemic design integrates systems thinking and design thinking.

Design Works, the innovation research team at the Joseph L. Rotman School of Management of the University of Toronto, developed the first methodology presented.

This was a design approach based on design thinking tools and using system concepts. It used a methodology divided in three steps: Empathy and Need Finding, Ideation and Prototyping, and Business Strategy (See figure below).

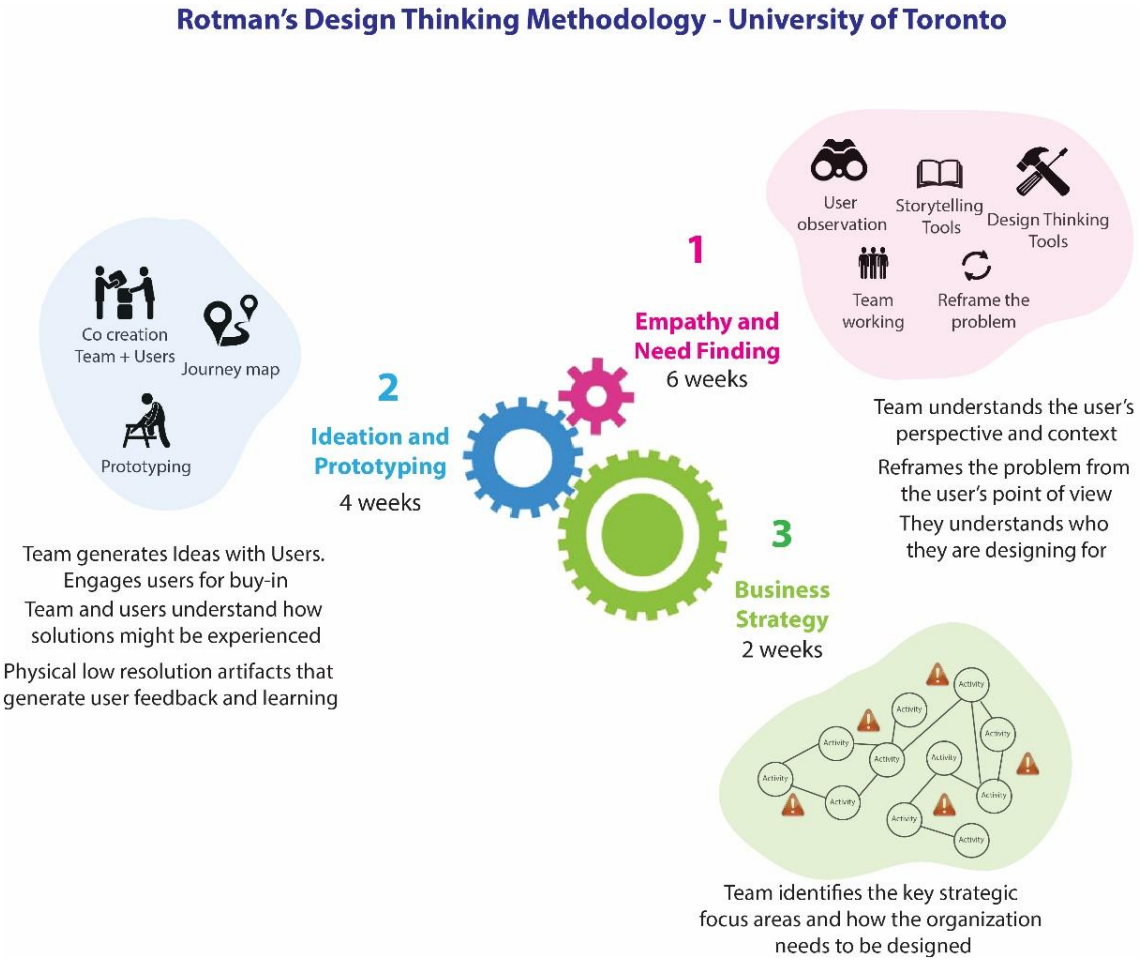


Figure 18: Phases of Rotman's Design Thinking Methodology

The first phase, denominated “Empathy and Need Finding”, constitutes the research phase. It is considered the most important phase, lasting about 6 weeks, and the aim is to deeply understand the users and the context, then reframe the problem. To this purpose, the team works with stakeholders, in their context, following their everyday and listening to their stories in an unbiased way. It is done not just with the people directly involved in the problem, but also with stakeholders as business officers and suppliers to better understand the broader picture and how the players interact and influence one another. The use of design thinking tools like Personas, Need Finder and Storytelling in the research phase lead to a rich reframe of the context and lead the team to having insights for unexpected improvements.

The second phase, "Ideation and Prototyping", is the creative step, including co-creation with stakeholders to find solutions to their needs. The dynamic occurs in the lab and the team performs sections using various brainstorming and prototyping techniques as journey mapping, storytelling and craft building. This process, by presenting a physical and tangible nature gets all participants engaged in the design process and turns vague ideas into real ideas.

Furthermore, it empathizes the importance of the use of images and physical representation to facilitate the understanding of the problem by all the participants.

In sequence, the team tests these new ideas with users in workshops and in the field. Thus promoting a valuable feedback, unveiling what works and what could be changed or improved.

In the third phase, "Business Strategy", the Activity System is developed, which is a kind of map that allows the team to identify strategic points in the context to be worked on to better meet the needs of the end users.

One of the best results of this methodology is the transfer of thinking and skills to the stakeholders involved. The participants realize the need to understand the user’s perspective from a holistic approach, and take this as company’s strategy.

2.3.4 Systems Oriented Design

This case presents an approach for designers to better deal with very complex situations through Systems Oriented Design. It was developed at Oslo School of Architecture and Design and was based in modern practices of systems thinking and generative diagramming (Sevaldson, 2013).

It consists not in a structured method, but a flexible tool kit for designing. They believe that the design process should be built for each project, this being a main strategy to work with complex issues. The process is represented in the picture below:

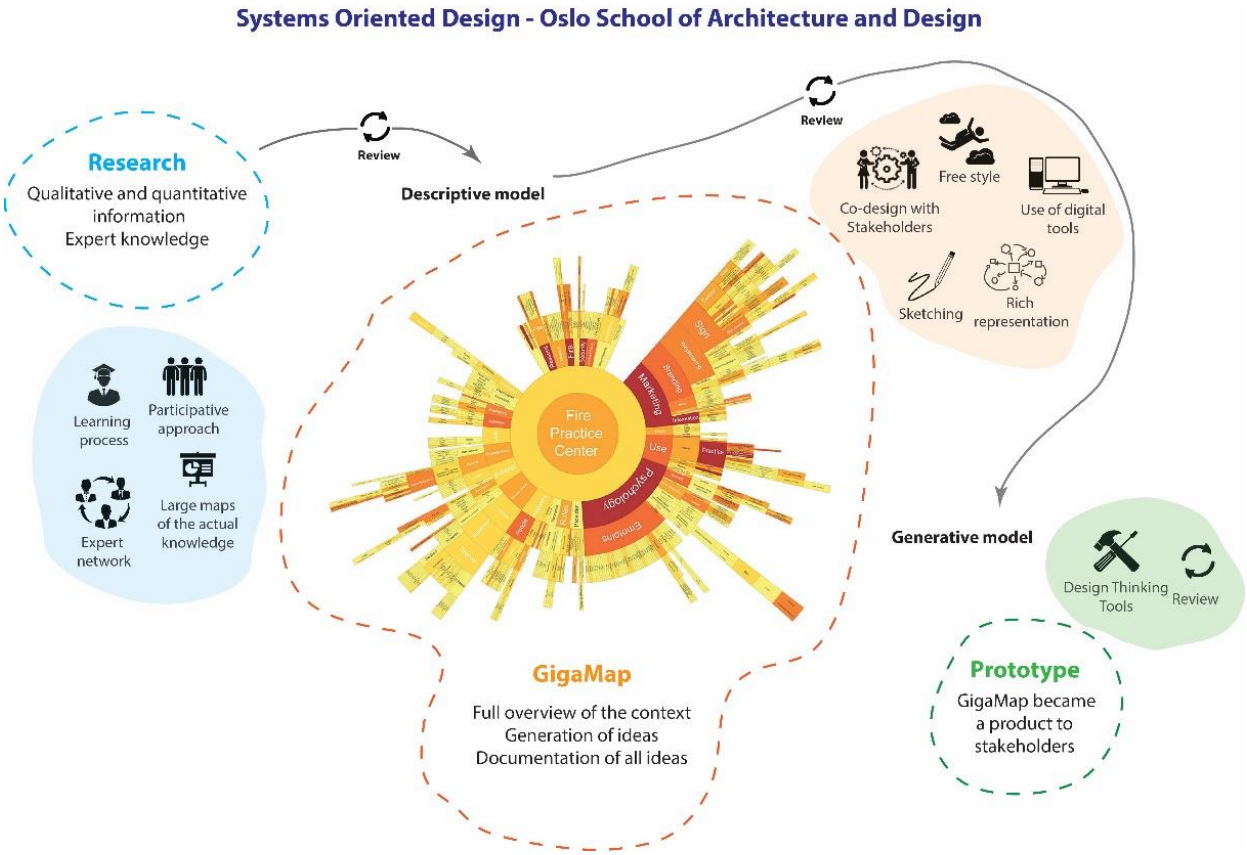


Figure 19: Phases of Systems Oriented Design Methodology

The first step consists in developing an extensive research to collect quantitative and qualitative information. This research is developed in field with intensive participation of stakeholders and through consultations with experts.

With the data in hands, the team go to the design studio, which should be a rich design space. According to Sevaldson (2008), a rich design space is a "system-oriented approach to creating a specific design environment". This space should have an amount of materials for representation and interaction that allows students to work from a messy state of complexity to a synthetized and organized plan.

There, they will be immersed in the information collected in order to define the design interventions. It is done by the construction of a Giga Map[61], which consists in large and dense diagrams with a visual representation of the actual context and process involved.

To build this map, different manual and digital design tools are employed. Large paper formats are used, hanging in the walls to make that large amount of information immediately accessible at any time.

The process starts with sketching the existing knowledge through networking mapping or timeline mapping, with special attention to the relations. After that, they return to the research into the literature or the material available. In this phase, expert knowledge is also employed to check the information. Then, the participants continue to develop the map with the information gathered.

The map then passes from being merely descriptive to a generative tool, and solutions start to emerge along with design outputs. In addition, design-thinking tools are used to reconfigure and generate new information. The maps are building with stakeholders' participation in a co-creation process.

After the initial sketching phase, the map is redesigned using digital media, this way the information is re-organized and becomes clearer. This reflexive process allows to organize and to internalize the large amounts of information. Free styling is emphasized, once that each case is different and demands individual attention and adequacy. Each map is done in the style that best attend to the needs of the actual case (Figure 20).

The students who participate in this process have control over their ideas and can better synthetize it. Ideas come from context and students gain a great quantity of knowledge through contact with experts.

[61] To more information about gigamapping read: Sevaldson, B. Giga-mapping: Visualization for Complexity and Systems Thinking in Design. In. Nordic Design Research Conference. Helsinki, 2011.

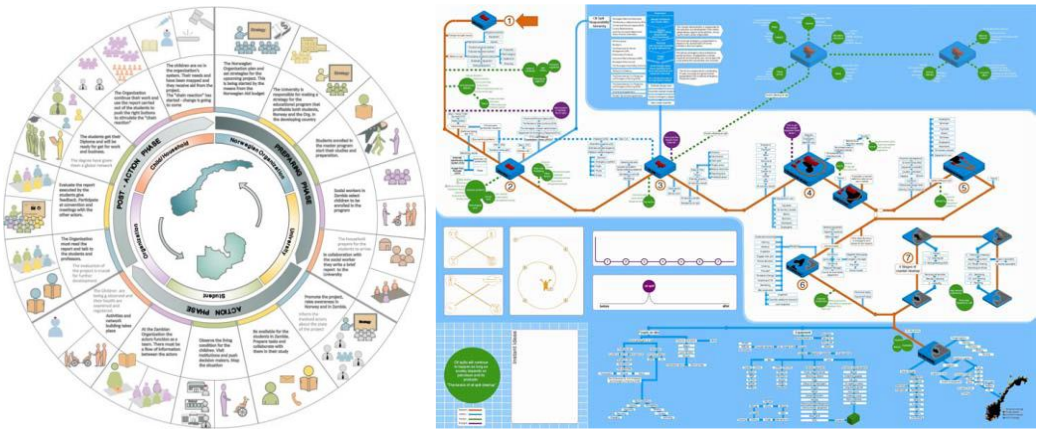


Figure 20: Different styles of giga-map. Sevaldson (2011).

Benefits of the program include that the map allows better understanding of the contexts and easy opportunity finding. In addition, it creates dialogues and shared images between participants, making possible to synchronize the same overview. Mapping in groups fosters dialogues and collaboration.

The map in some cases becomes a tool for stakeholders, through it, they are able to build an overview of their own work and services and how the whole system operates.

According to Sevaldson (2013), in education, this approach has proved to be very well suited for master level students, and has brought good results. The students are capable to develop the approach when graduated, but ideally need more deep instruction and training.

2.3.5 Strategic Design Scenarios – Product-Service System

This methodology, developed by the SDS – Strategic Design Scenarios group is available in the PSS[62] Tool Kit. It aims to present a direct approach to solving complex social, economic and environmental urban problems, by developing innovative business models.

The approach proposes five main steps, the fourth step being further subdivided into five more steps (Figure 21). The first phase is the territorial assessment. It constitutes a research with the objective of identifying the factors that influence the territorial development, and what should be done to turn the territory into a sustainable place. This assessment is done both from the point of view of the public authorities (top-down) as by the point of view of the city's users (bottom-up).

The second phase, "transformation" aims to transform the identified challenges into opportunities. The team conducts this phase by using tools like cards and charts displaying the challenge and the opportunity suggested. This opportunity usually is a new service or system that meets the territory needs.

Following the second phase, the third phase, "monitoring", starts and it lasts until the end of the project. In this monitoring, there is a review of the challenges and opportunities founded in phase two in order to inspire the next phase, when the new ideas will be mixed and re-elaborated. This is done in a form of exhibition of the cards or pictures.

[62] Available in: <https://issuu.com/strategicdesignscenarios/docs/pss_v3_english_full_quality_interac/1?ff=true&e=1860131/7392948>. Accessed in Dec. 2016.

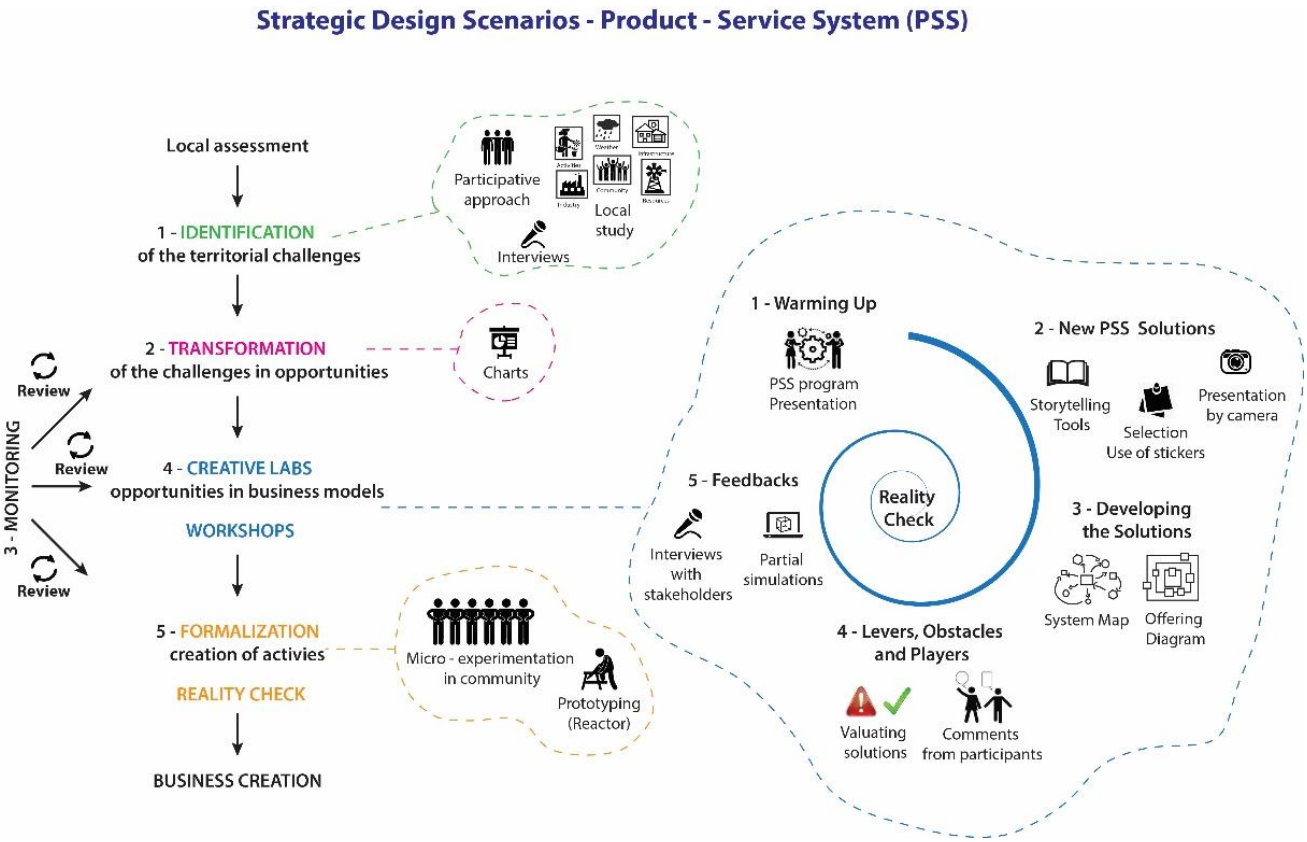


Figure 21: Summary of the PSS process.

In the fourth phase, the creative step occurs. The team develops thematic workshops in lab and organizes them by key topic. Fifteen participants with different profiles configure the team for each workshop and stakeholders such as residents, representatives of public authorities, businesses, etc., are included among them.

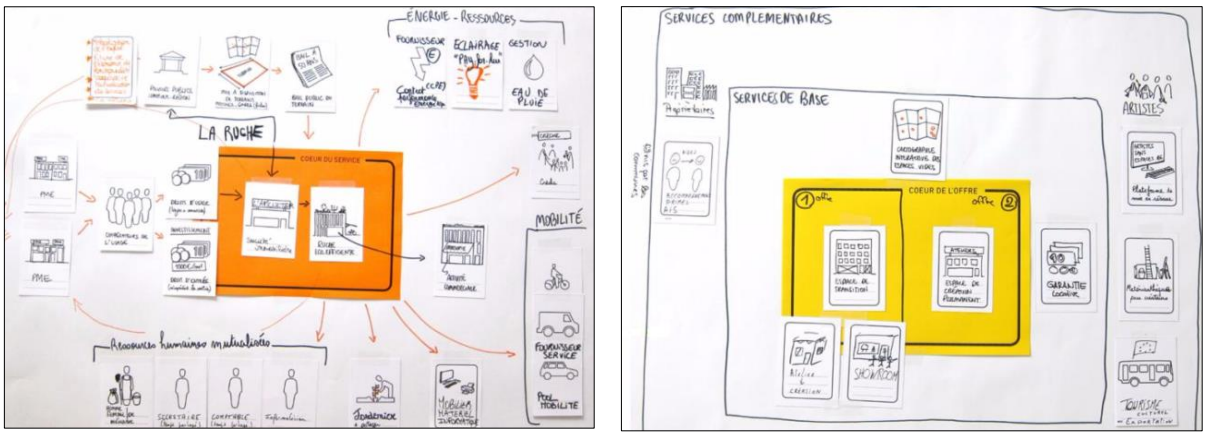
The workshop is subdivided in five steps:

(1) Warming up, which is the program presentation;

(2) Generation of new solutions, a practical approach, done by subgroups of a maximum of five participants. They use Story-telling tools, and the solutions proposed are presented by camera. They have a prioritization exercise and a selective process (with use of stickers) to choose the best proposals to be developed.

(3) Development of the solutions, the team choose a solution to work on. Them, they analyze what is needed to put this in practice. Two tools are used, the

System Map, which is similar to the GigaMap, but smaller. It represents graphically the interaction between stakeholders, the materials, flows and the coherence between flows. Other tool is the Offering Diagram, to analyze the offer to the market.



(a) (b)

Figure 22: (a) System Map; (b) Offering Diagram. Source: PSS Tool Kit.

(4) Identification of levers, obstacles and players, to evaluate each solution developed. The ideas are explained and commented by all the participants by using colored stickers (red, green and neutral).

(5) The final solutions are summarized in form of a business plan.

The last phase, reality check, happens when the new ideas and solutions are tested. It is done by partial simulations, interviews with stakeholders or a review or the service process. The objective, besides to test, is to understand what is necessary to the implementation.

The business models developed is further analyzed using three tools, Creative Debugging, Micro-experimentation and Reactors.

In the Creative Debugging, participants co-create with stakeholders during all process, as a way to check the solutions in development with the reality. Microexperimentation is the simulation of the solution in the real context, with the participation of the final users. Reactor, in turn, is a visual presentation of the process developed, which can be in a charge, video, object, etc. It is a finalized form to represent the solution and still make necessary adjustments.

2.3.6 Archeworks

The Archeworks's Public Interest Design program offers a postgraduate certificate that develop the student's skills and techniques and promote the implementation of the projects on the local context. It works inside the Chicago Complex, a campus for national and international universities in Chicago (USA). The program lasts 12 weeks and it is divided in four steps, Identify, Engage, Convince and Make.

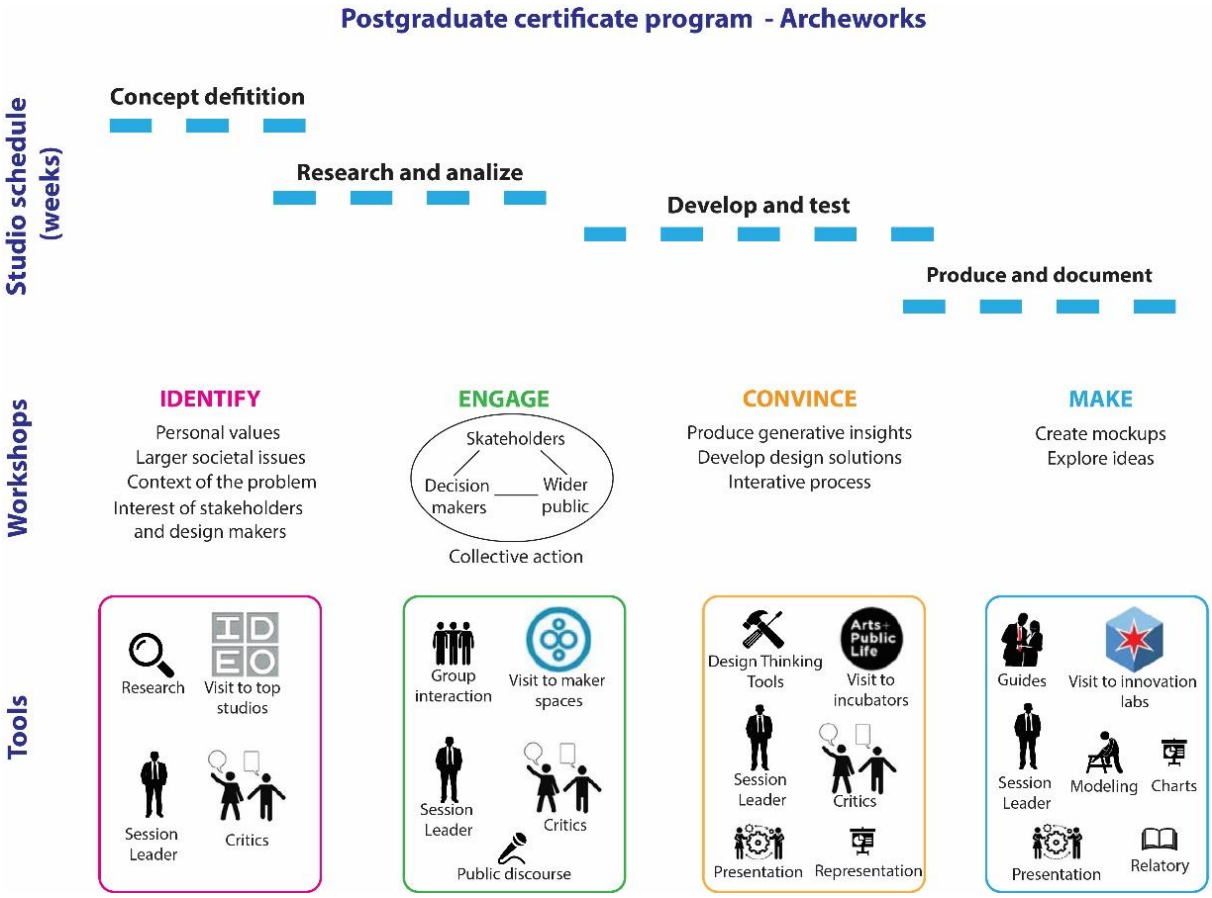


Figure 23: Postgraduate certificate program - Archeworks

During the "Identify" step, the comprehension and definition of the problem or opportunity are declared. It starts with studio lectures that explore models of research and design problems and goes to the identification of the problem, the stakeholder's needs, of societal issues and personal values.

In the “Engage” step, there happens a collective action, where the design team, the stakeholders and broad public are engaged to better know the issues involved, and promote interaction between them with the aim to start a collaborative relation, benefic to all.

“Convince”, is the step in which the ideas are developed and tested. They work in an interactive process using design thinking tools to find a solution to the problem. This solution is evaluated and it is realized a rich presentation of the proposal to convey partners, stakeholders and allies.

In the “Make” step, ideas are explored by prototypes and mockups. Creative strategies and methods are used to develop the design concept and translate it in an interactive material process.

The course comprehend study sections, workshops and lectures. In the studio, mentors and leaders from different areas such as architecture, design, planning, policy making, follow and advise the team during the entire process.

In the workshops, students have the opportunity to visit local studios as the IDEO, maker spacers, as BuiltWords, incubators and innovation labs. Each visit occurs in the most appropriate step, for example, the IDEO visit is in the "Identify" step, in which concepts and strategies are introduced. In the same way, leaders lectures are provided, each one selected in the appropriated phase.

All phases include these visits, session lectures with successful leaders and also the contribution of two critics that validate the evolution of the project, except in the "Make" step, when the critics are replaced by guides, to help the team to better implement the solution. At the end of the program, there is a design review with the participation of community members, experts and professional designers.

The results are published in print and digitally, and they include documentation, drawings, photographs and video; transcripts from interviews; and visual presentations, besides the work performed on studio.

2.3.7 CEDTec

The projects developed in CEDTec – Study Center in Design and Technology, the research center in UEMG – Brazil, are directed to social and technological innovation. The basic methodology follows the five steps showed in the picture below and the core of it is the participatory design.

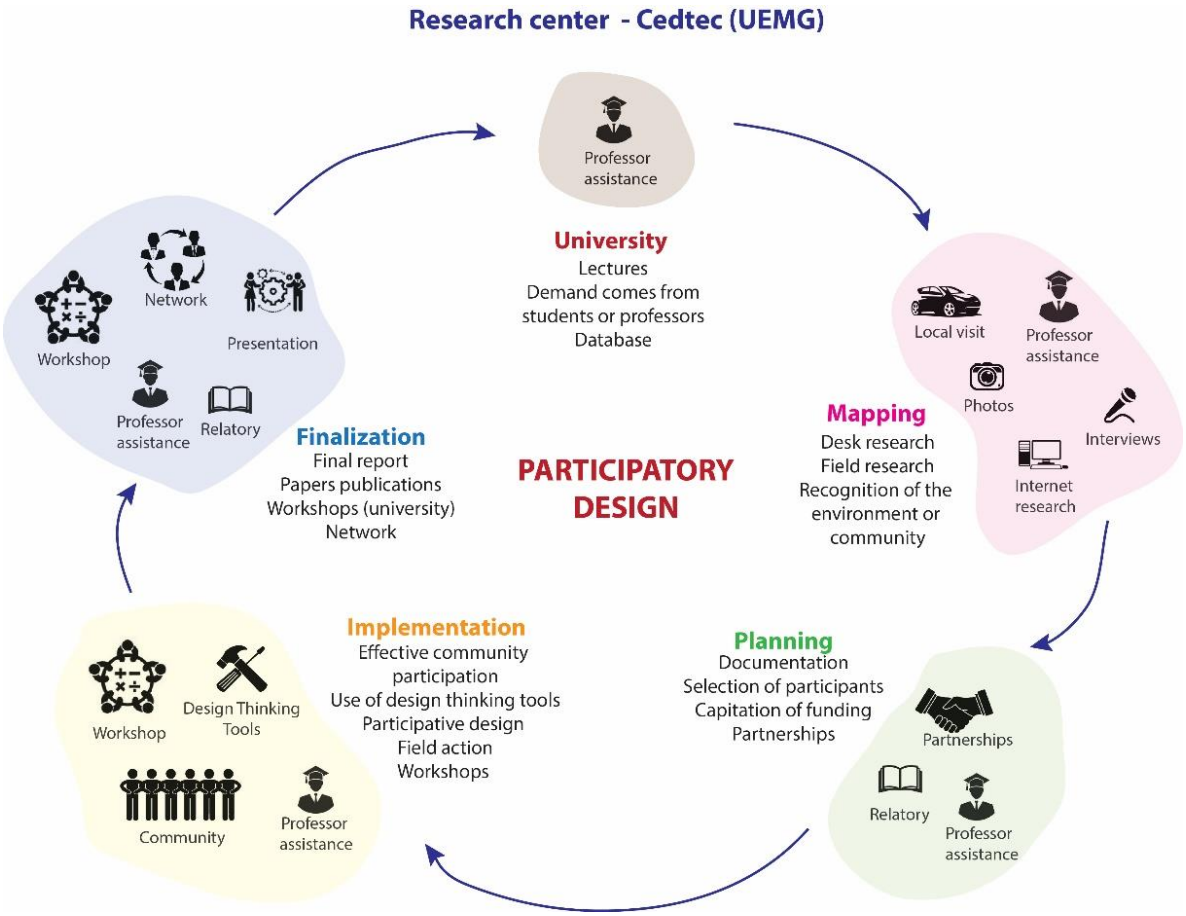


Figure 24: CEDTec methodology.

The projects usually are proposed by students that receive incentive from the university lectures in specific disciplines, as mentioned before; or by their own professors, according to the perceived need that they found through research, other projects or by knowledge of the local community. Nowadays as some communities are getting to know the group work, they come to CEDTec and ask for assistance with local issues. People who got to know previous work, and some communities

who have already worked with the team call for new projects to solve different questions.

Once the project is accepted, the students and professors involved start the mapping in the research center.

In the “Mapping” phase research involving the project is conducted, both theoretical and field research. The theoretical research includes the use of internet and available material related to the issue to be explored. In the field research, the team goes to visit the context and collect material, as pictures and videos, and perform interviews with the local community or stakeholders. The aim is the recognition of the problem, the environment and data collection.

The next phase, “Planning”, involves, beyond formal documentation of the whole project to be executed, the pickup of human resources through the selection of people who are involved in the project (community members, professionals, and business people). In addition, in this phase the funding capitation occurs, through the formation of partnerships, resources coming from government programs or donations.

In the “Implementation”, the practical approach initiates. In this step, the project is no longer only academic and starts to have an effective participation of the community. Design thinking and participatory design tools are explored and workshops with the community are performed.

In every project, this involvement brings benefits to all sides. The academic community enriches once that students are working on a real project, experiencing all difficulties presents, such as lack of resources, political barriers, and others. Students often become spreaders of knowledge in the communities by teaching participants a new way of acting (design thinking) which reinforces their learning process. It is also important to emphasize the advantages that fall on community that receive this benefit. The work is developed with participative design techniques. Students go to the field to teach what they have learned in workshops to the community. This provoke a cascading effect of knowledge dissemination.

The “Finalization” phase brings results in form of a final report, publications and articles, which means a return to the university, with increasing academic production. This publicity also evokes an incentive to new projects, social awareness of students, teachers and community. Some projects inspire the creation of workshops, lectures, buildings of blogs and communities on the Internet, which is an incentive to the continuity of projects.

2.3.8 Open System – Polytechnic of Turin

Open System is a discipline from the Polytechnic of Turin of the master design course. It is a multidisciplinary laboratory, which includes four disciplines, “Theory and history of systemic design”, “Procedures for environmental sustainability”, “Economic evaluation of the projects” and “Systemic Design”. It is performed during six months in classes with around a hundred students.

It is the more complete and systemic approached methodology present in this work. All students work in one territory and develop the project splinted in groups of students by one territorial activity. The aim is to configure a new economic and social model, in which the output of one system becomes resource to another, developing open relations between production, community and territory going increasingly closer as possible to zero emissions.

In the beginning, the students receive lectures about the system theory and there is an explanation about the project. The territory is choose by the professors and presented to the students. The entire group perform a research, both fields and desk research with the aim to construct a holistic overview of the territory.

The aim of this phase is to collect quantitative and qualitative data about the territory to construct a frame of the current situation, to know the actors involved and to identify possible problems. This data should contain information about the history, physical aspects, activities, resources, community, infrastructure, etc.

Bearing the data, students go to the classroom and are split into small groups per activity. Then, they work by building a charge with the linear system of that activity, containing a description of the resources (input) and waste (output) present on the system and the flow of matter and energy present in the process.

The graphic representation is very important since it allows students to deal more easily with the amount of information. They develop a map of this linear system unveiling negative points, the potential of the material and immaterial local resources. With use of symbols, they point in the charge, the key features of the process that should be addressed.

Together, the groups analyze the necessary inputs of their activities in contrast with the outputs of the other systems and they work in one new system with benefic flows of matter and energy where the waste of one becomes resource for another. This flow originates several new activities and products.

An economic analysis is conducted and the students compare the linear system (existing) and the systemic system (proposed), in quantitative and

qualitative data. Them, they develop and present a new, open and fluid economic system.

The professors giving support and guiding the project follow all this process alongside with the students. At the end, they have a final presentation involving all disciplines in one evaluation.

The figure in the following page presents a summary of the process.

This approach has presented good qualitative and quantitative results, as the increase of new products, activities and business, generates new job opportunities and, subsequently, new sources of income in the community. In addition, there is the enhancement of local know-how and culture; the sustainable management of natural resources and improvement of the quality of life for local inhabitants.

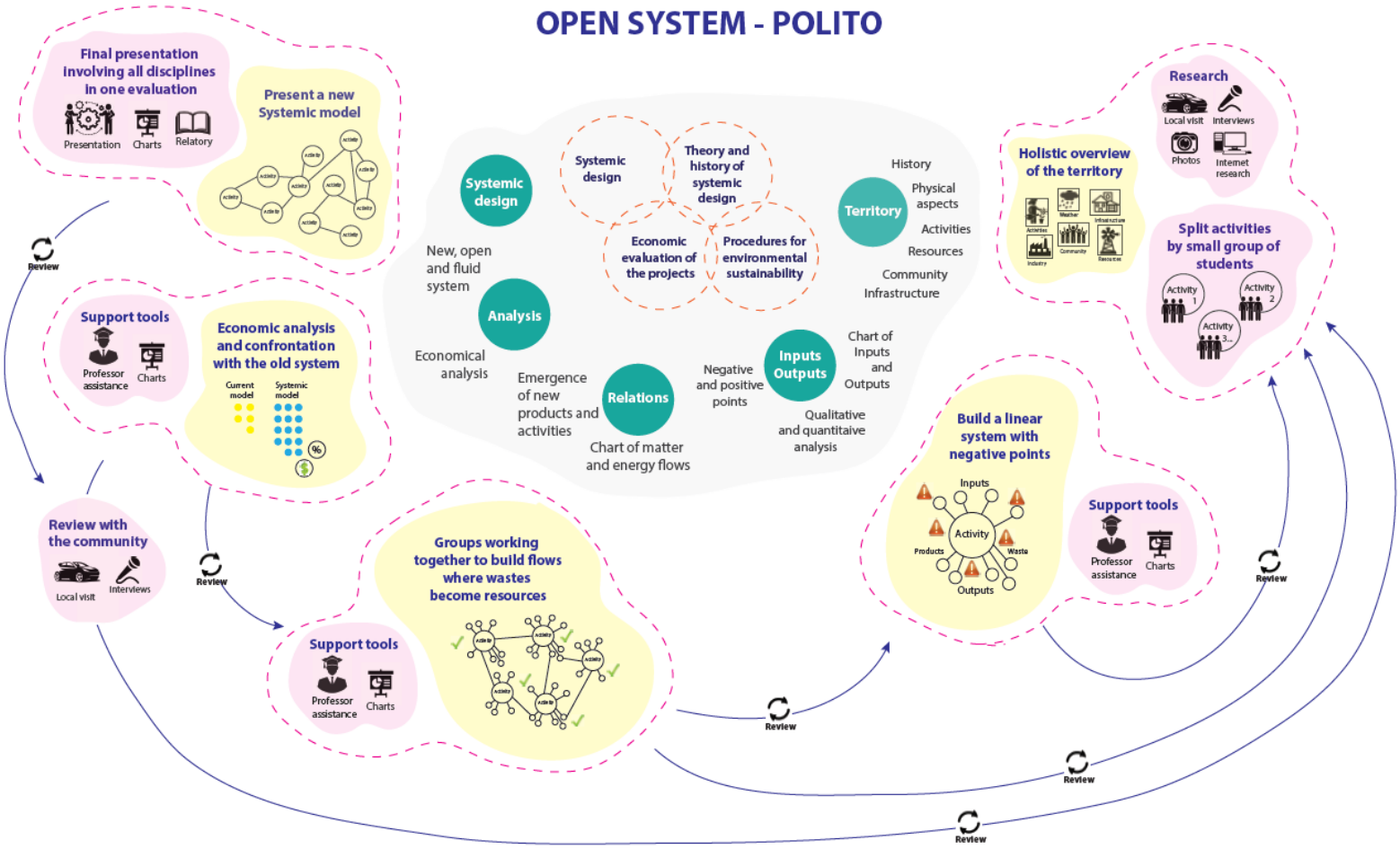


Figure 25: Open System - POLITO

2.3.9 Discussion

The methodologies or approaches studied have common phases and characteristics. These phases, as well as the main tools employed, were identified and synthesized.

The common characteristics, pointed out in the institutions as factors of success are, mainly, group work with multidisciplinary teams, focus on the territory, individualized approaches, use of design thinking tools, use of participatory design and work with real situations.

According to the constructivism, group work provides the construction of new knowledge through negotiation between the participants and not through an individual elaboration. Each individual structures knowledge from their own experience, interpreted through their own mental schemas (Carletti and Varani, 2005). Working in groups with teams made up of individuals with different profiles, allows the constructed image of the context to be closer to reality.

Multidisciplinary teams were pointed as a success factor. Archeworks, as well as CEDTec for example, accept students of different areas, from design related subjects and others. Each class is structured to include a diversity of knowledge, skills and abilities. Thus, the students come to school with different cultures and experiences enabling the exchange of knowledge. According to them, the domain knowledge that students bring to the program contributes to form a shared knowledge that is in the background, the basis of all successful projects.

A territorial and individualized approach creates solutions that meet the needs and expectations of the territory's users. The employment of design thinking tools is present in almost all approaches researched, highlighting storytelling, personas, story-board, it means tools that allow a better visualization of the context.

We can split the process in three steps, understanding the context, working data and delivery the ultimate benefit, be it a product, service or system. Each step has approaches and tools, which are synthetized in the figure below and will be explained next.

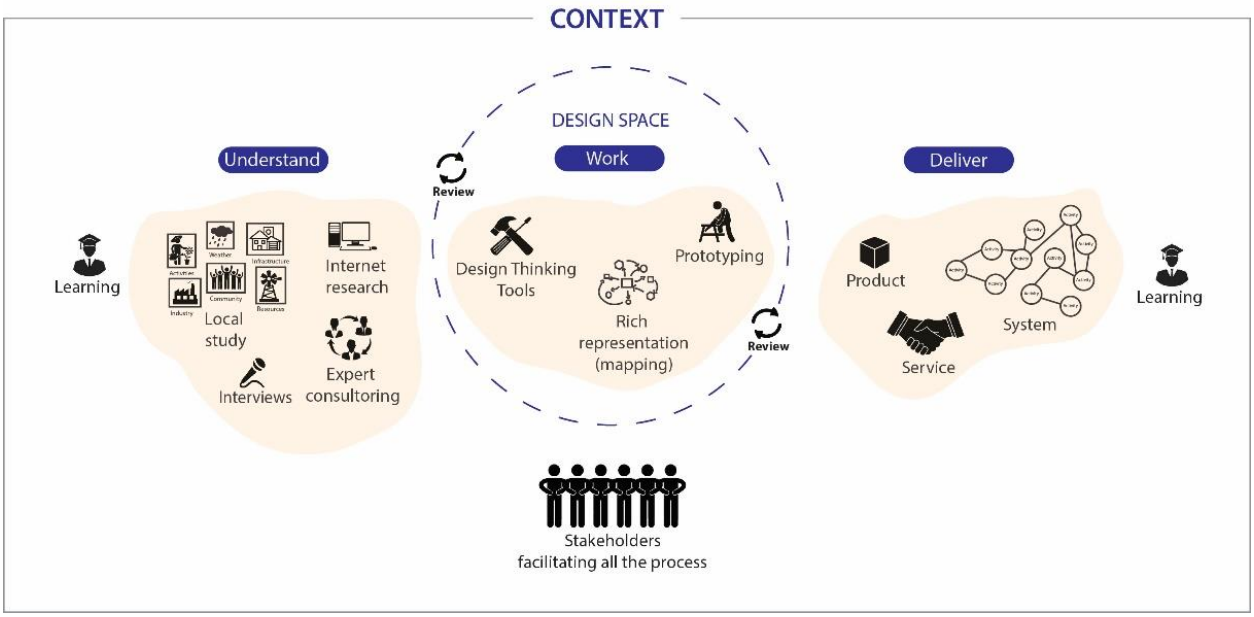


Figure 26: Common system thinking approaches

All processes start with a research phase, which proposes understanding the context or problem that will be working, getting to know the stakeholders' point of view, experiencing the environment, collecting quantitative and qualitative data. At this phase, the designer should attempt to fully understand the tasks and its implications. The participatory design is fundamental, enriched with the stakeholder’s involvement in providing information and, when possible, it is important the coexistence of the designer with those involved, so that he can really understand that reality.

This moment is also conducive to the formation of partnerships through a cooperative methodology. These partnerships can happen between students and experts, civic leaders, business people, community members. These partners should participate in the entire design process as co-creators and facilitators of the process.

With all information in hand, starts the second step in the design space to work the data collected. According to Sevaldson (2008), a design space should promote a wealth of media, materials to representation, creating an environment where students will learn to act quickly within a context and will train the ability to maintain a quantity of issues that are constantly changing during the process.

The objective is to make a richer visual representation of the context. The use of mind maps allows a holistic view of the problem and enhances the designer's ability to work with complexity. The more complex and difficult the project, the

greater is the need to keep many aspects, ideas and representations handy over time and between a large numbers of individuals.

Maps are not only to represent the context, but also through the analysis of these maps new ideas or solutions arise. In addition, during this process, new issues, problems or opportunities emerge, making the new proposals even richer.

The team with the constant participation of stakeholders and specialists should do this process of analysis and discussion. The analysis is done into a visual way, using as tools, large paper formats, markers, stickers, sketches, cards, different visual materials, texts and all manners of digital representation. It is at this stage that design thinking tools are most commonly used. Prototyping is also a practice at this stage and should be executed in the most realistic way possible.

In the delivery stage, the benefit is applied. Here we use the term benefit to promote a break from traditional thinking where the project starts from a specific product, and revolves around this product and around the direct user. The project starts from analysis of a context and its needs, and the result is a new proposal or improvement for an environment, a company, a group of people or a certain context, that is, what can benefit something or someone. This benefit can come in the form of a product, a service or a system.

During all phases, there is always a feedback process of the previous phase. During the research phase, the literature and the concepts acquired in the learning phase are analyzed. When working in the design environment the context is constantly re-analyzed, and new research is often required. In the delivery phase, context and analysis are constantly being reviewed.

At the end, the entire process is documented. In case of projects developed in universities, in either research centers or postgraduate courses, there is a profit to universities in the form of articles, theses, reports, which serve as knowledge bases for future work. In the case of independent centers, it was observed the elaboration of toolkits, best practice books and articles for dissemination of knowledge.

2.4 Brazilian Design Context

2.4.1 Brazilian Context

Brazil ranks among the nations with the largest territories of the world, spamming across 8.5 million km^2 (Campanili, 2010). Brazilian numbers are significant, not just in extension terms, but also in regard of its immense natural resources and productive capacity. Sadly, numbers related to social inequality, poverty and violence have reached considerable heights.

Nevertheless, Brazil is considered the primary mega-diversity holder on the planet, having between 15-20% of the 1.5 million species described on Earth. It also possesses the richest flora and fauna of the world, with approximately 55 thousand species of plants, 524 species of mammals, 1677 of birds, 517 amphibians and 2,657 fish (Ministry of the Environment - Brazil, 2015).

Because of its vast territory, Brazil extends itself through different climate zones, such as the humid tropics in the north or the semi-arid region in the northeast and south temperate zones. This leads to the formation of distinct biogeographical zones such as the Amazon rainforest, the most humid tropical forest in the world; *Pantanal*, with the largest floodplain; *Cerrado* presenting savannas and woodlands; *Caatinga* with semi-arid forests; fields of *Pampas*; and tropical rainforest in *Mata Atlântica*. In addition, Brazil has a marine coast of 3.5 million km², which includes ecosystems such as coral reefs, dunes, mangroves, lagoons and marshes.

Figure 27: Respectively: Amazon, Pantanal and Cerrado – Different Brazilian Biomes. Source: Ministry of the Environment – Brazil.

The Amazon Basin is the largest basin in the world, with 6 million km^2 and 1100 tributaries. Its main river, the Amazon, flows into the Atlantic Ocean,

throwing overboard about 175 million liters of water every second. This places Brazil as a holder of 12% of drinking water of the world[63].

Moreover, the largest mineral reserve of the earth also lies in the Amazon, in the *Serra de Carajás*, where large concentrations of iron, gold, silver, manganese, nickel, and other elements are found. Today, the company *Vale S.A.* extract these minerals and produces up to 240 million tons of iron ore per year[64].

Biodiversity occupies an important place in the national economy: the agribusiness sector accounts for roughly 40% of Brazil's GDP. In agriculture, Brazil stands out in the international scenario on the development of biotechnologies that generate wealth through proper use of biodiversity components. Biodiversity products measure up to 31% of Brazilian exports, especially coffee, soybeans and orange. The forest extraction and fishing activities employ more than three million people (Ministry of the Environment - Brazil, 2015).

In addition, the discovery of the pre-salt in 2006 puts Brazil among the largest oil producers in the world, reaching in 2015, the production of 800 thousand barrels per day[65].

Beyond that, the wealth of Brazil originates from more than its natural resources and commodities. Brazil holds a significant industrial base, with a large automobile and aviation industry. The company Embraer, for example, is the third largest aircraft manufacturer in the world, surpassed only by Boeing and Airbus.

However, despite all of these natural resources, there was a time in which Brazil seemed to squander its vast potential. Social inequality and government corruption have always been alarming factors in the country.

The origin of social inequality in Brazil dates back to the time of colonial Brazil, when the Portuguese crown accumulated capital by exploiting Indians and blacks. These populations, even after becoming free, continued to live on the margins of society, therefore, without finding work, ended up forming slums (denominated *favelas*) on the outskirts of large cities (Ribeiro, 1995).

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[63] Available in: Portal Vital. <https://www.portalvital.com/saude/saude/a-agua-no-brasil> Accessed in May 2015.

[64] Vale S.A. Is a Brazilian multinational corporation operating on five continents and one of the world's largest producer of iron ore. In addition to being the third-largest mining company in the world, Vale is also second largest producer of nickel. Available in <http://www.vale.com/> Access in May 2015.

[65] According to the journalistic channel Globo - one of the most important in Brazil.

Over several years, the country was plunged into many structural crises, with large rates of poverty, unemployment and unequal concentration of income.

Even with the emergence of public policies and legislation that would improve the situation of Brazilians, such as the introduction of a minimum wage, public retirement funds, protective labor laws, and many other situations, nothing resolved definitively the problem of social inequality.

In the early years of the decade of 1990, the situation was unsustainable. With the intensification of privatization, and increased instability in the labor market, followed by increased unemployment, poverty and social exclusion. During this period, interest rates increased in an extraordinary way, reaching a rate of 2000% per year, and hindering the lives of millions of Brazilians.

With the advent of the Real Plan, a Brazilian program that aimed to stabilize the economy in the middle of the 90's and later with new government programs in the early 2000s, this situation began to change. Programs like "*Bolsa Familia"*[66], *"Fome Zero"*[67] alongside the raise of the minimum wage, took thousands of Brazilians who were below the poverty line to a better situation, reducing social inequality and increasing access to health and education.

This improvement in Brazilians quality of life also generated a new and untapped consumer market, which provided a significant advance in the economy. This increase was so significant that it elevated Brazil to be considered "the country of the future".

Despite of all euphoria with the growth rates, some factors should have been taken into account. Even with the reduction in the number of people living below the poverty line, 16 million Brazilians still live on less than US$2 a day, which is considered extreme poverty (Estadão Journal, 2014)[68].

[66] The *Bolsa Família* Program, which has technical and financial support from the World Bank, is a social initiative taken by the Brazilian Government. It reaches 11 million families, more than 46 million people, a major portion of the country's low-income population. Poor families with children receive an average of R$70.00 (about US$35) in direct transfers. In return, they commit to keeping their children in school and taking them for regular health checks.

[67] *Fome Zero* is a Brazilian government program introduced by the President Luiz Inácio Lula da Silva in 2003, with the goal to eradicate hunger and extreme poverty in Brazil.

[68] Reported by Brazilian newspaper *Estadão,* published in September 16 2014, available at: <http://noticias.uol.com.br/ultimas-noticias/agencia-estado/2014/09/16/brasil-reduz-a-pobreza-extrema-em-75-diz-fao.htm>. Accessed in November 2015.

In Brazil, there are more than 12 million of people living in slums, under poor living conditions. Most of them are in large cities, especially in the Southeast, where almost 50% of the slums across the country are concentrated (Meirelles, 2014). However, it is not only there where poverty lies.

Figure 28: Brazilian Favela – Source: <http://www.terra.com.br/noticias/infograficos/favelas-brasileiras/>. Accessed in May 2015.

According to data from FAO-Brazil[69], 47% of the population in extreme poverty inhabits rural areas, mainly in the North and Northeast regions. One in four Brazilians that live in those areas live in extreme poverty, which represents a rate of 25.5%, while the incidence rate in urban areas is 5.4%.

Nevertheless, it is important to highlight that these communities do not represent only a poor and poorly structured portion of the Brazilian population, but also a strong branch of economy. According to a report of the *Globo* web portal, in

[69] FAO – Food and Agriculture Organization of the Unite Nations. Available in: <https://www.fao.org.br/download%5C042013ConsDesRAFRA.pdf> Accessed in May 2015.

2014, slums moved up to 68 billion *Reais*. Also in rural areas, according to IBGE[70] data, smallholders, areas of owners with less than 100 hectares, account for 80% of food production and 80% of the labor contracts.

[70] IBGE – Brazilian Institute of Geography and Statistics. Available at: <http://www.ibge.gov.br/> Accessed in May 20 2015.

2.4.2 Brazilian People

Brazil is also one of the most multicultural and ethnically varied nation in the world, having an estimated population of 202,768,562 people (IBGE, 2014). The official language is Portuguese[71], but over 200 languages are spoken. Prior to the Portuguese colonization, approximately existed in Brazil 1400 indigenous peoples, which meant a population of between three to four million. Each of these peoples had their own culture, religion and customs. Today in Brazil, there are about 890,000 Indians. Of those, 530,000 live in indigenous territories and about 360,000 have migrated to the cities. Among them 180 different languages are spoken (Gomes, 2012).

Brazil also received immigrants from different regions of the world, especially Germany, Italy and Japan. There are colonies of these people throughout Brazil that retain their native language. The Germans who settled in the south for example, made a fusion of culture with Brazilian culture, creating a new one, the culture of the Pampas.

Darcy Ribeiro in his book, "The Brazilian People - The Formation and Meaning of Brazil" (1995), rustically distinguishes the Brazilian people for differences due to regional location or functional abilities which according to him, characterize some segments of the population. They are the Sertanejos of Northeast, the Caboclos of Amazon, the Crioulos of the Coast, the Caipiras of Southeast and center of the country and the Southern Gauchos.

In the following pages, a brief description of each of those groups will be presented, based on Darcy Ribeiro's book, as well as in the documentary "*O Povo Brasileiro"* (The Brazilian People) available at: <https://www.youtube.com/watch?v=wfCpd4ibH3c&list=PLyz4LUAInoJJgiAJBM-fA69gClLt1uz>.

[71] Besides Portuguese, Brazilian portuguese recognises *Libras* (Brazilian sign language) as an oficial national language. *Libras* was only officialy recognized in 2002, through the law n. 10436 and regulated in 2005 by the decrete n. 5.626, in which it also became mandatory as a curricular discipline in teacher formation courses. Available at: <http://www.camara.gov.br/sileg/integras/821803.pdf>. Accessed in December 2016.

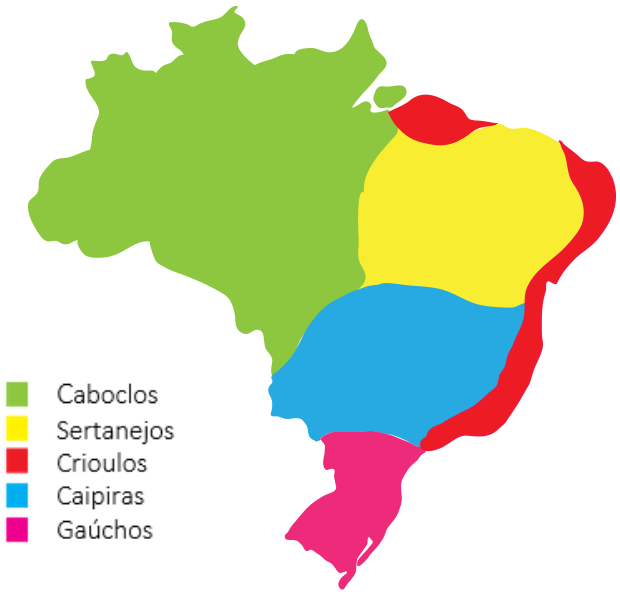

Figure 29: Brazilian People

Crioulos

Crioulos are the population inhabiting the coastal regions from the states of Pernambuco to Rio de Janeiro and part of the state of Minas Gerais. Its origin is described as the first Brazilian way of life: the civilization of sugar.

This because those regions, amid Atlantic forest, were where colonists developed the first form of Brazilian industry, when the Portuguese installed sugar factories exploring slave labor. Until today, those areas still host the largest black population of Brazil and are where their culture is present the most.

When slavery was abolished, Africans stayed away from the patriarchy of the Europeans and they had no choice besides going to the cities and marginalized themselves, creating a very different world. There arose the first form of social discrimination of the country.

African culture left a very strong feature in those regions, which turned out to be a form of culture most unique to Brazil. Examples are rhythmic patterns of music and dance, well represented with instruments like the *berimbau*[72] and the gourd. In

[72] The Berimbau is a percussion instrument with an African origin. It is the main instrument that is used in the Capoeira music. It consists of a flexible wooden rod, a steel string and gourd. The Berimbau is played with the help of a small thin stick called *vareta*, a coin called *dobrao* and an accessory named *caxixi*. Available at: <http://www.capoeira-world.com/capoeira-music/capoeira-instruments/berimbau/>. Access in 16.09.15.

the cooking, ingredients such as palm oil, okra and banana are used to form very characteristic dishes.

Figure 30: Crioula holding a tipical dishe from Bahia. Figure of Iemanjá at the back. Source: <http://boletim.museus.gov.br/?p=7187>. Accessed in May 2015.

African culture also played an important role in the country's religion. The *Umbanda*, genuinely a Brazilian religion, originates from the *Candomble* and today is part of life of a significant portion of the population, mainly in the states of Bahia, Recife, Maranhão and Rio de Janeiro.

It was also from this cultural matrix that came the Carnival of Rio de Janeiro, the deities of Bahia and the worship of *Iemanjá*[73], all strong features of Brazilian current culture.

Sertanejos

Sertanejos are people living in the region of *Caatinga*, mainly characterized by long periods of drought and large natural rangelands. At the time of the sugar mills,

[73] Yemanja is a goddess of African origin, the name meaning "mother whose children are fish" and is very revered in Brazil. Throughout all of Brazilian coast, at the New Year celebrations, thousands of people go into the ocean and deposit offerings to her. More about it in: < http://www.raizesespirituais.com.br/orixas/iemanja/>. Access in May 2015.

the Portuguese needed to keep away the cattle from the sugar cane fields, and then led the cattle to this region. The *Caatinga* then became a region supplier of meat, leather and service oxen. Livestock farmers have been multiplying and forming the *Sertanejos*. It was always a poor and dependent economy.

Because of the excessive livestock, leather was present in everything, as in the doors of the houses, in the furniture or in the clothing. A cultural parallel to medieval Europe was the norm, with strong religious traits, especially Catholicism, inherited from Portugal. This similarity with the medieval age manifests itself in popular poetry, with the *Cordel*[74], the landowner system and colonelism.

The colonelism was a system in which the colonel was the absolute master, and attended to everything with violence, forming a *de facto* government upholding its own laws. To combat this regime, the *Cangaceiro* (members of the *Cangaço* way of life) emerged as an important figure in the history of the country. *Cangaço* is a form of banditry typical of the pastoral country, and is structured in rustic men dressed as cowboys, well-armed, who roamed the hinterland on horseback, making the law with their own hands.

The inner country presents a very creative and retrograde culture. Among the important elements of this culture, there is the *Vaquejada*, a tournament that tested the ability of the Cowboys.

[74] *Cordel* is a popular literary genre often written in rhyming form, originated from oral reports and then printed in brochures. It dates back to the sixteenth century, when the Renaissance popularized the impression of oral reports, and remains a popular literary form in Brazil. The name comes from the way flyers traditionally were displayed for sale, hanging in rope (corda, in Portuguese language) in Portugal. More about it in: <http://cordeldobrasil.com.br>. Accessed in May. 2015.

Figure 31: Cangaceiros. Source: <https://fabiomota1977.files.wordpress.com/2015/06/image8.jpg>. Accessed in May 2015.

The country music, characterized by lyrics that resemble typical stories of backwoods and full of hopeful lines like "the hinterland will become sea". The typical cuisine includes ingredients like bottled butter (also called cattle butter), the corned beef (backwoods meat), goat meat, brown sugar, green beans and *cassava* flour. All cooking was developed from hostile climatic conditions, where the food had to be very strong, with great use of salt.

Caipiras

Caipiras are represented by Brazilian regions of the states of São Paulo, Minas Gerais, Goias, Mato Grosso, Paraná and with less force in the Espírito Santo and Rio de Janeiro. The typical Brazilian rural man represents it.

At the time of colonization, the Portuguese found tons of gold in the lands and rivers. Immigrants from all sides of Brazil and Portugal appeared because of this. Churches were built and culturally important cities like Ouro Preto were developed.

Figure 32: Caipira. Source: <http://educador.brasilescola.uol.com.br/estrategias-ensino/mundo-caipira-no-filme-tapete-vermelho.htm>. Access in May, 2015.

With the end of the golden rush era, the population spread mainly through the interior of the state of Minas Gerais, beginning to raise pigs, make cheese and to build a new culture. Thusly, the rustic man became an independent producer, marked by the presence of a stunted economy formed by a self-sustaining society that produced its own consumables, organizing fairs and living by crafting activities. The end of gold rush era also allowed for the development of coffee plantations, and at the same time, Italian immigrants settled mainly in the region of São Paulo.

Caipiras are those who are the closest to Portuguese culture. As an example, we have the "traditional family of Minas Gerais" with conservative characteristics. They also have a strong culture of community, where they unite through so-called "*multirões*" to do activities together as building houses or organizing traditional festivals.

Gaúchos

Belonging to south of the country, the *Gauchos* are the result of the São Paulo expansion that migrated to south seeking the cattle and mules. Due to the Pampa biome, characterized by vast open fields, pastoral activities were developed.

Figure 33: Gaúcho. Source: <http://mapadomundo.org/gramado/parque-gaucho/>. Accessed in May, 2015.

The southern region also received a large mass of European immigrants, mainly from Germany, followed by Italy, Poland and Ukraine. The Germans formed the largest cultural influence in the region, which can be perceive by the architecture, the popular festivals such as Oktoberfest and even the German language, present today in Brazilian communities, with an estimated population of one million speakers.

In cooking there is the strong presence of meat, with the traditional *gaucho* barbecue, *arroz de carreteiro* (a type of rice with specialties), wine produced in the region and the famous *Chimarrão*, a tea with special preparation served in a gourd. *Gauchos* traditionally drink this tea daily.

Caboclos

Formed by the inhabitants of the Amazon region, *Caboclos* live by the banks of the Amazon River and its tributaries.

They lived of the exploitation of rubber for a considerable time. In fact, the rubber industry attracted to the region several people from the state of Ceará who later went on to being tappers. The exploitation of rubber, a valuable export product, was what provided the expansion of some urban centers like Manaus and Santarem.

The indigenous cultures are predominant in the region. The Indians have infinite knowledge about living in the forest. They know how to build, to cultivate and to produce everything they need. They have medicinal knowledge, and know the forest and its secrets. There is also a strong presence of popular beliefs, featuring stories about the beginning of the world and the origin of everything. They developed the so-called "culture of rainforest"[75].

Today in the area, the most striking features are the houses, with adaptive buildings in respect to the cycles of nature, like the houseboats. In the crafts, there are works with golden grass, weaving, ceramics. In cooking, the highlights are the presence of varied flavors, regional fruits like cupuaçu, graviola, cajá. In addition, there is a presence of hunting and fishing.

Figure 34: Caboclos. Source: <http://jovemz.blogspot.com.br/2015/06/tupi.html/>. Accessed in May, 2015.

[75] A work that portrays accurately the history and characteristics of the Brazilian Indians is Gomes, M. P. *Os Índios e o Brasil – Passado, Presente e Futuro*. Petrópolis: Vozes, 2012.

According to Silva (2012 *apud* Oliveira, 2013), Brazil is called mega-diverse for its biodiversity and variety of ecosystems, but it should be because of their social diversity. The way in which society was formed is a symbol of diversity, i.e. the large number of factors regarding to the man, the heritage of other cultures, climate, language, and their survival to the environment, have created a relationship that results now an intrinsic feature of the territory.

Moraes (2006) points out that, in Brazil, the acquaintanceship between different folks generated a new phenomenon that we can see in all Brazilian cultural issues, as art, architecture, literature, music, culinary, etc. In the particular case of the Brazilian design, this phenomenon do not provoke symbolic and statics values, but fluids and renewable values.

2.4.3 Traditional Design in Brazil

According to Niemeyer (2007), it is possible to say that the history of products in Brazil starts before colonization, when Indians already worked weaving, doing pottery, body painting and using wood for few applications. When Portuguese and Africans arrived at the sixteenth century, other kinds of knowledge such sculptor, carpenter, weaver, the craft of lace and embroidery appeared (Ferreira and Souza, 2008).

We can see since the beginning of Brazilian history, the influence of other cultures in material production; however, this does not means a fusion of cultures, but an overlap prevailing the expression of the strongest. According to Branzi[76] (2006), Indians' ancient monuments became archeology even before the end of this civilization and what remained are scattered in their villages amid forests. Blacks kidnapped from Africa could no longer build their models villages. Finally, the only Brazilian historical monuments are Baroque buildings of Portuguese power.

A name that illustrates the colonial Baroque is the brilliant architect Antonio Francisco Lisboa, known as *Aleijadinho*. According to Moraes (2006), *Aleijadinho* was a mulatto (son of a Portuguese with a black slave), who carried typically Brazilian characteristics that can be seen in his works scattered in baroque cities of Minas Gerais. The Brazilian Baroque is characterized by the presence of typical national aspects such as use of soapstone and *Jacaranda* wood.

Figure 35: Santo Antonio Church – Tiradentes/MG, designed in 1810 by Aleijadinho, is one of the most significant works of the eighteenth century. Inside, intense and rapturous, approximately 482 kg of gold were used.

[76] Branzi, Andrea; *O Brasil como modelo do mundo*. Preface in Moraes, Dijon. *Analise do povo brasileiro, entre a mimese e a mestiçagem.* 2006.

During Brazil colonial times, manufacturing and craft production were restricted to internal market both in countryside as in urban centers. This system worked like feudalism, which regulated professions and punished offenders. Portugal had an agreement with England[77] that allowed external marketing only between them, leaving Brazil with a dependent economy, in which industrialized products were accessible only by the rich elite. Material production on this time was rude and rough and the main activities were the tanneries, rope making, pottery and shipbuilding (Niemeyer, 2007).

In the mid-nineteenth century began, still even poorly, the Brazilian industrialization process, based on a range of processed or semi-processed products, ranging from printing presses to shipbuilding. With the end of World War I and especially with the crisis suffered by coffee economy in 1930[78], Brazil begins to receive investments and develop its industrialization process; despite its still precarious infrastructure (Razza et. al. 2007).

Also in the decade of 1930, a notable progress in arts and architecture occur, influenced by the modernism that began in the previous decade. Moraes (2006) argues that the "Modern Art Week"[79] that happened in 1922, marked the beginning of modernism in Brazil and aimed to turn the European culture in something Brazilian. The results of this movement is witnessed through architecture. Some examples include the Airport Santos Dumont, in Rio de Janeiro, designed by Marcelo e Milton Roberto, the Pedregulho Housing Development, by Affonso Reydi and Pampulha's Church, designed by Oscar Niemeyer (Soares, N/D).

Oscar Niemeyer (1907-2012) was surely the most important Brazilian architect. In the beginning of his work, Niemeyer received a big influence from Le Corbusier, following his design stile. One example of that is the building that holds the ministry of health and education of Rio de Janeiro, built in 1936, known as the first modern public building of all Latin America. It is only in the decade of 1940, that Niemeyer starts to insert symbols of Brazilian culture in his projects, what became even more expressive in the next years (Moraes, 2006).

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[77] The Treaty of Methuen, also known as treated of cloths and wines, was an agreement between Portugal and England that lasted from 1703 to 1836 when Portugal opened its economy to import British goods in exchange for the marketing of Portuguese wines in England. This treaty was extremely unfavorable to Portugal, since it also included its colonies, such as Brazil (Freitas, 2016).

[78] Until 1929, Brazilian economy was virtually based solely on coffee exportation. Due to the global crisis of 1930, the sales of coffee fell by almost half and the government burned all production remains (Freitas, 2016).

[79] The Modern Art Week (or *Semana de Arte Moderna*, in Portuguese) was an arts festival in São Paulo, Brazil, that ran from February 11 to February 18, 1922, and marked the start of Brazilian Modernism.

(a) (b)

Figure 36: (a) Ministry of health and education, L. Costa, O. Niemeyer, A. Reidy, J. Moreira, E. Vasconcelos and C. Leão. Rio de Janeiro (1936-1943), considered the first milestone of modern architecture in Brazil. Source: <https://larissaandreaarq.wordpress .com/2013/06/06/lanccamento-livro-ministerio-da-educacao-e-saude-de-roberto-segre/> (b) Cathedral of Brasilia (1958-1970), example of Niemeyer's Brazilian style. Source: <https://commons.wikimedia.org/wiki/File:Catedral_metropol .jpg>. Access in Jan. 2016.

Before 1950, Brazilian industry did not show very significant results, besides having a growing consumer market (Razza et. al., 2007). Most of the authors considers there was not design activity until the 60s, when the first school of design in the country[80] was created. However, according to Razza, Brazil held a traditional material culture that searched for the consolidation of a national identity.

In the decade of 1950, Brazil suffered a modernization fever, between the governments of Getúlio Vargas and Juscelino Kubitschek who spread the slogan "50 years in 5". This government program had a plan that provided 50 years of progress in five years of accomplishments. Denis (2000) claims that with this movement a diversity of designs surfaced, which built a unique scenario in the history of Brazilian design. From this generation we highlight the work of Joaquin Tenreiro, maybe the most important furniture designer of this time. Tenreiro furniture used local wood, such as *Jacarandá* and *Palinha*, which are materials used in the most antique Brazilian furniture tradition[81].

[80] ESDI – *Escola Superior de Desenho Industrial*, founded in 1962 in Rio de Janeiro, its history and features will be addressed in the next chapter of this work.

[81] For more details it is recommend the reading of: Santos, Maria Cecilia Loschiavo dos. *Móvel Moderno no Brasil*. São Paulo: Studio Nobel: FAPESP, 1995.

Another prominent designer was Sergio Rodrigues, with his chair Mole, made from *Jacarandá* wood and leather, with a shape reminding a hammock in reference to the informal and light Brazilian manners. In addition, graphic designers Alexandre Wollner, Geraldo Barros and Rubens Martins deserve to be mentioned as paramount of their time.

Figure 37: Sergio Rodrigues and Mole chair (1957). Source: < http://g1.globo.com/rio-de-janeiro/noticia/2014/09/designer-sergio-rodrigues-morre-no-rio-aos-87-anos.html>. Access in Jan. 2016.

Also in the decade of 1950, Lina Bo Bardi and her husband Pietro Maria Bardi promote impacting actions. Together, they founded the MASP – Museum of Art of Sao Paulo, where they presented their work and created the first course of Design in Brazil[82]. In the late 50's, Lina moved to Bahia, and there she founded the bases of Brazilian art, which were less influenced by external culture. Lina conducted there an extensive research on popular art. Upon her return to São Paulo, Lina presented projects that showed accurately her experience and that, according to Cosulich (2007), held a unique simple design and a strong visual sense. During the rest of her work, Lina pursued the insertion of the Brazilian culture in national design.

[82] Lina Bo Bardi and Pietro Maria Bardi created in MASP the Institute of Contemporary Art (IAC), which included a design course of two years. The course worked only for three years and closed because of lack of resources. The next chapter will treat this subject in further detail.

Figure 38: Chair Frei Egídio (1987). By Lina Bo Bardi, Marcelo Suzuki e Marcelo Ferraz. Source: < http://casadaidea.com.br/arquitetura/lina-bo-bardi-arquitetura/>. Access in Jan. 2016.

In 1964, the military took the power in Brazilian government and established a growth plan that aimed economic, industrial and social development. Thus, from these years forward, Brazil began to receive industries and economic investments from different parts of the world, especially USA and Germany. This program was adamant in its purpose and in less than five years, Brazil had the biggest industrial development of all Latin America (Moraes, 2006).

Consequently, Brazil suffered a culture deterioration; the military *coup d'état* established a program that facilitated a lot the entrance of multinationals[83]. This multinationals could produce industrial goods at low cost to exportation to central countries and the possibility to commercialize inside the country, for a new medium class formed by the government.

This process caused a deep change in the Brazilians habits and way of life, being a truly sociocultural revolution. This changes bring positives and negatives results. Industrialization caused increase of suburbs and slums like a new urban phenomena.

[83] The Strategic Development Program (*Programa Estratégico de Desenvolvimento – PED*) was announced in 1967 and had as objectives economic growth, industrial and social development, aiming at a strong and rapid industrialization of Brazil. In Moraes (2006), p. 81-88.

Such economic growth affect also private companies, that start to direct their production solely for the internal market. This way, companies were competitive only between themselves, direct to consumers that accept everything on offer. These consumers strongly valorize price in detriment of design and other values.

This scenario remains during all of the decade of 1970, when on the other hand design education starts to develop, in opposition to what had been happening in industry. Despite advances in industry and technology, local design did little contributions.

In the meanwhile, the Occident sees the start of a movement known as the "green imperative". In the decade of 1970, this became a symbol against the industrial system and the capitalist model. Victor Papanek published in 1971 his book, *"Design for the Real World: Human Ecology and Social Change"*[84], in which defends social and sustainable design. Among Papanek's concepts, he opposes industry and its placing on the process of technological development and design in Third World countries.

According to Moraes (2006), at that time, not only Papanek but also all thinkers were against the transference of the productive capitalist model to third world countries, such as Brazil. Meanwhile, Brazilian design was between not being accepted by small producers and neither absorbed by multinationals. Thus, Brazilian design found in Papanek discussion a possible path, and alternative technology had space in Brazil.

An example of alternative technology use is CETEC - Technological Foundation Center of Minas Gerais, founded 1972, one of the first research centers in Brazil. Between 1977 and 1985, CETEC implemented in the city of Juramento/MG, a research on the technologic model based on the theories of Papanek[85]. One example was the use of bamboo to transport water to the village, but after many months of trials, the experiment failed.

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[84] *Design to the Real World*, is one of the most read design books in the world. In this work, Papanek puts design as a powerful weapon to change the world. Defending the social and environmentally friendly design, and abhorred any harm manufactured, dangerous or simply useless product.

[85] The *Juramento* project represented an important milestone in the history of Alternative Technology in Brazil. The intention was to investigate, in practice, the adoption of alternative technology in rural areas, putting into practice ideas, which had not been valorized in the Universities. The work of Brandão (2001), "*Programa de Apoio às Tecnologias Apropriadas - PTA: Avaliação de um Programa de Desenvolvimento Tecnológico Induzido pelo CNPq*", presented to the University of Brasilia, presents details of this project.

Figure 39: Construction of water supply system having bamboo as raw material - Juramento Project of Alternative Technology. In Moraes (2006).

This form of alternative technology was not welcome in Brazil, and perceived as poor design. It presented products of low quality, without design characteristics. Moraes (2006) says that these products were not crafts and neither popular culture, without symbolic values that bring a modern sense and technological value, and they are not industrial products.

This proved that alternative technology did not work well for design in Brazil. This technology remained in the schools for ten years, between the decades of 1970 and 1980. However, according to Moraes (2006), young designers left university and found a country increasingly industrialized to act. Thus, the rational functionalist[86] experience with practical results was much more successful than the experience related to alternative technology.

At this time, Brazil was dependent on multinationals in manufacturing, industrial and technological fields. Given this situation, Brazilian government

[86] ESDI, the first design school in Brazil, had as reference the rational functionalist methodology used in the German school, Hochschule Fur Gestaltung - Ulm. As the first school, ESDI's curriculum became a benchmark for design education in Brazil and the schools that emerged followed the same teaching style. This subject will be better addressed in the next chapter.

adopted a series of actions[87] aiming to minimize the gap in production capacity of local producers in the international context. Among the objectives of these actions was the support to Brazilian companies to add value in their products by using design. An important milestone for this development was the arrival of Gui Bonsiepe in Brazil in 1981. Bonsiepe worked at the National Council for Scientific and Technological Development (CNPq) and promoted strong incentive to technological orientation of design in Brazil (Burdek, 2006).

The economic scenario in the early 80s was not as favorable to the country as in the previous decades, in consequence of the global oil crisis that had started in 1983. Brazilian economists call the 80s "the lost decade"[88], because Brazil suffered losses in production, export and domestic consumption, which began after a recognized period of great economic growth and industrial development (Marangoni, 2012).

At this time, the postmodern movement arrived in Brazil, which Brazilian designers assumed as a protest against the multinational indifferences and contempt regarding local design. Moraes (2006) says that this postmodern design failed to produce much, but surely started a new process for the recognition of a multicultural Brazilian aesthetic.

According to Denis (2000), the hallmark of postmodernism is pluralism, i.e., the openness to new attitudes and tolerance to divergent positions, starting in Brazil a new way to design. An example that illustrates this new design is the work of the Campana brothers, who worked using everyday materials and Brazilian culture meanings. The Campana brothers joining experimentation and technology, presenting products directed to series production with handcrafted features.

Some examples of Campana's work include the iconic Red Armchair (1993-1998), made from rope (purchased at a local market) which is rolled in a metal structure. The Italian brand Edra now commercializes the Red Armchair. Brazilian identity elements are always present in the work of the brothers, as in Favela chair (1991), inspired by the favelas of São Paulo, built by reusing wood battens, or in the Crowd chair (2002), made from dolls from local crafts. This chair intends to portray the migration from the Northeast to the Southeast of Brazil. Both in the

[87] II Strategic Development Program (Plano Nacional de Desenvolvimento – II PND) (1975-1979). Period characterized by high growth rates, when the structure of Brazilian industry was consolidated through an expansionary macroeconomic policy (Cara, 2008).

[88] The "lost decade", characterized by decline in investments and GDP growth, increase of public deficit, growth of external and domestic debt and inflation rise. The crisis of this decade was so strong that in 1989 the currency decreased at a value of 80% per month (Marangoni, 2012).

choice of raw material, the use of vibrant colors or reuse of traditional objects (such as the dolls), the work of Humberto and Fernando are full of Brazilian culture, raising elements of national daily to the category of design objects (Vale, 2012).

(a) (b) (c)

Figure 40: (a) Red Armchair. (1993). (b) Favela chair (1991). (c) Crowd chair (2002), design by Campana´s brothers. Source: < http://www.georochha.com/irmaos-campana-e-o-design-brasileiro-e-irreverente-de-mobiliario-que-conquistou-o-mundo/>. Accessed in Jan. 2016.

Thus, in this time between the postmodernity and globalization, Brazilian design begins to have as reference the richness and expressiveness of its own culture. Takes the carnival as a collective fantasy, recognizes the kitsch as popular taste and telenovelas as ethical and aesthetics reference (Moraes, 2006).

At the same time, Brazil was recognized as a Newly Industrialized Country - NIC and with great potential for domestic consumption growth, called attention of global investors and transnational companies, being among the most promising markets in the world along with China and South Korea. Once again, the government was quite benevolent and favored new establishments of global companies in our territory.

Nevertheless, the government continued with the support of design programs. Such programs afforded approximation between designers and artisanship with the goal of creating design consulting for artisans to begin to sell objects to large urban centers. The Brazilian Service of Support for Micro and Small Enterprises (Sebrae), a government agency, has created a program like this, which has become source of employment for designers. However, according to Leon and Montore (2008), this ends up being harmful because it turns designers into simple marketing consultants and does not create conditions to give artisans autonomy.

2.4.4 From Products to Crafts

Design development in Brazil has been linked to political and economic development of the country. Moraes (2006) points out that in Brazil, design development did not happen spontaneously as in developed countries, where industry and design appear as consequence of local crafts. In Brazil, due to the late process of industrialization, its design was established by transferring models and solutions from abroad.

Denis (2000), proposes that, in addition of designs imported from the headquarters of multinationals, a reactive posture of national industries to invest in own designs still existed. The author also points out the lack of design influence as a professional field in Brazil during its history.

In the last decade, Brazil has seen an extraordinary growth in its design, and this again can be understood as consequence of political and economic changes in the country. Costa (2012) developed a historical research about contemporary design in Brazil, highlighting the years between 1980 and 2010, turning around the following questions:

> *How could Brazil, in the last 30 years, go through the lost decade and became one of the greatest promising economies; and how this context change contributed to the national Design Market?*

As seen previously, the 80's were marked as a major economic crisis that affected the lives of all Brazilians and culminated in the early 90s when the newly elected President Fernando Collor de Mello[89] caused one of the worst moments in country, involving corruption, fraud and confiscation of public money. His presidency ended with an impeachment process 1992, the first in Latin America.

Color's successor, then Vice President Itamar Franco (1992-1995), in two years was capable to establish a plan of action that was continued by the next president

[89] In 1989, Fernando Collor de Mello was elected by a small difference of votes over the candidate Luiz Inácio Lula da Silva, in a campaign that opposed two models of action: one guided in reducing the State's role (Collor) and other defending strong presence of State in economy (Lula). Early in his first days ruling, Collor putted in practice an economic plan and that blocked the money deposited in banks (savings and current accounts) of individuals and legal entities (confiscation). Among the first measures for the economy, there was an administrative reform, which abolished public agencies and enterprises and promoted the first privatizations, opened Brazilian market to imports, freezing prices and wages. Although initially this plan reduced inflation, it brought the deepest recession in Brazilian history, resulting in unemployment rising and business failures.

Fernando Henrique Cardoso (1995 – 2003). This plan implemented a new currency[90] that allow the beginning of Brazil's economic stability.

Costa (2012), points out that this economic stabilization along with the privatization of public companies allowed the formation of a large consumer market. Brazilian companies start to feel safer to invest in innovation and small entrepreneurs began to grow.

The next president of Brazil, as mentioned in the first part of this chapter[91], Luiz Inacio Lula da Silva (2003 – 2011), developed plans aiming hunger eradication and plans to give credit to the poorest people. These plans caused the enlargement of the middle class in Brazil, and as a consequence, the growth of the consumer market. Such approaches allowed the country to pass almost unscathed by the world crisis in 2008 and further strengthened its image in the international market.

At this time, the country's situation began to change. External debt was paid, the country became self-sufficient in oil production, the low risk for investments attracted foreign capital and incentives directed to the micro and small businesses were expanded (Costa, 2012).

According to the Diagnostic Review of Design in Brazil (2014), several government programs have emerged to give financial support to Companies that aim to invest in innovation. Between them, are FINEP (Studies and Projects Funding Agency), CNPq (National Council for Science and Technology Development) and BNDES (National Bank for Economic and Social Development), which are linked to the Ministry of Development,

Industry and Foreign Trade (MDIC). They can also have access to free or subsidized consultancies and programs through private entities acting in public interest, such as SEBRAE (Brazilian Service of Support to Micro and Small Businesses) or SENAI (National Service for Industrial Learning).

In this context, national design begins to have its best time. Entrepreneurs of the country were not afraid to invest in innovation and small entrepreneurs had

[90] Real Plan (Plano Real in Portuguese) was a Brazilian program that aimed stabilization and economic reforms, which began in 1994 with the provisional measure 434. This provisional measure established the Real Value Unit (URV), together with conversion and usage rules for monetary values, initiated the de-indexation of the economy, and launched a new currency, the Real. The Real Plan appears as the most effective economic stabilization plan in history, reducing inflation (main objective), expanding the population's purchasing power, and reshaping national economic sectors. More details can be viewed in: Sayad, João. *Observações sobre o Plano Real*. Est. Econ. São Paulo. Vol. 25, No. Special, pp. 7-24, 1995-6.

[91] Can be seen in Brazilian context, pp. 93

conditions to become small business owners. Additionally, according to Costa (2012), there was a new consumer market with purchasing power to ensure business of traditional or new companies.

According to Moraes (2004), this postmodern period allowed Brazilian design go through a new path, decoding its ethnic pluralism and its local aesthetic, popping up a new design culture. Brazilian designers start inserting strong signs of local culture in their project, through a new work model that also opened space for enhancement of regional handicrafts.

Brazilian local design becomes a creative strategy. Frederico Duarte (*apud* Silva, 2010), develops a work called *Alvorada* project - The Exploration of Brazilian Design[92], which explores the identification of networks and communities of Brazilian designers, discovering what moves and concerns them. His work reveals a significant identity in Brazilian contemporary design that goes beyond the fame of Havaianas brand and Campana Brothers. Duarte demonstrates that designers are reflecting, through their work, Brazilian values such as identity, regional folklore, collective memory, celebrities, style and surprise. Brazilian designers have shown a work involved in transforming ideas and values both in industrial as handmade products.

One example pointed by Duarte is the work of Marcelo Rosenbaum. Designer and architect for performance, Rosenbaum acts as a designer since the decade of 1980, when he worked for major brands. He passed through the Brazilian crisis and lived the design boom in the decade of 1990, when he became a national reference in design. Rosenbaum was invited by the broadcaster Globo to participate in a TV show called Home Sweet Home (*Lar Doce Lar*), a television show similar to extreme makeover in poor houses. From this TV show, Rosenbaum became strongly interested in social design, and began to develop several projects with poor communities in Brazil.

A good example is the project "*A Gente Transforma"* (We Transform), which works in communities in order to discover and explore people's potential and knowledge and turn them into opportunities, inside and outside the communities. Opportunity consists in opening markets, income generation by recognizing the

[92] *Alvorada*, Portuguese for "dawn", looks at this rising nation through the lives and works of its product and furniture designers. According to the author, Frederico Duarte, this exploration concentrates on how the thinking and making of consumer goods reflect a country in social transition. By addressing the role that class, values, scale and human resources play in the work of Brazilian designers, *Alvorada* shows how design is shaping and being shaped by radical social changes. More details can be seen at: <http://www.alvorada.org/> Accessed in Feb. 2016.

traditions, keeping their culture, generating self-esteem and dignity. According to the project website, "*A Gente Transforma"* uses design to expose the Brazilian soul.

Another Rosenbaum's project worth of mention is the *Jalapa* project developed with artisans from the Jalapão region. This community works with golden grass, and from this project, they could add in their pieces concepts connected with the daily life of artisans and the region's beauty, adding value to the final product. This project was carried out under local SEBRAE support, and resulted in beautiful pieces, improvement of craft production, retaining tradition and still promoting competitive participation in national and international markets[93].

Figure 41: *Jalapa* products. Photo by Fábio Del Ré. Available at: <http://www. rosenbaum.com.br/> Accessed in Feb. 2016.

Adélia Borges[94] (2011) affirms that this insertion of design in communities and the insertion of crafts in design is a silent evolution that is happening. It is a

[93] More information about Rosenbaum projects in <http://www.rosenbaum.com.br/> Accessed in Feb. 2016.

[94] This is part of Adelia's speech in *Forming Ideas*, a professional development program that ran from October 2008 until April 2011. The program aimed to broaden and strengthen the debate around contemporary craft practice and to build national and international networks. Available at:

relationship that brings advantages to both sides. Artisans inspire designers that lead them to new skills and, simultaneously, designers end up making direct use of these references in their work.

In this speech, Borges quotes some contemporary designers who are doing full use of Brazilian references in their works. An example is the work of Flavia Amadeu, a jewelry designer who uses rubber sheets produced by micro latex processing plants installed in the Amazonian forests of Brazil and operated by rubber tappers and their families, using techniques simple and inexpensive equipment. The technology, called Tecbor (technology for the production of rubber and artifacts in the Amazon), was developed by the Chemical Technology Laboratory of the University of Brasilia, and allows the preparation of colored sheets. As this goes without processing stage, the rubber tappers in the Amazon can have a bigger profit. The design takes advantage of the flexibility and lightness of the material. Bracelets and necklaces are to become three-dimensional when placed on the body and create different and innovative shapes.

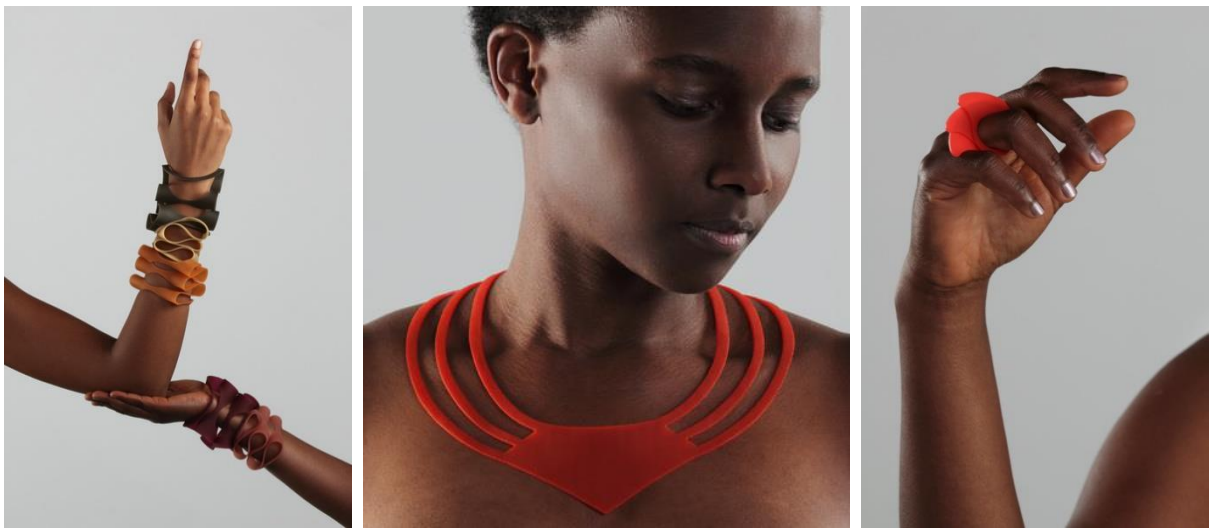

Figure 42: Jewelry by Flavia Amadeu. Photos by Nick Kane. Available at: <http://www.flaviaamadeu.com/>. Accessed in Feb. 2016.

<http://www.formingideas.co.uk/content/craft-design-and-social-change-ad%C3%A9lia-borges-brazil>. Accessed in Feb. 2016.

Other work cited by Borges (2011) is the Solo bench by Domingos Tótora. He created a recycled material from discarded cardboard and empty bags of cement mixed with water and glue. This new material looks like wood and has its characteristics of strength and behavior. Tótora developed the material after seeing the large amount of cardboard discarded by a company in the small village where he lives (Maria da Fé – Minas Gerais). The material and the resulting pieces of furniture, objects and sculptures are handmade by artisans who Tótora has trained. Domingos Tótora recalls the nature in his projects; with cardboard he mimics the shape of stones and woods. Like this bench, which has its seat formed by stone imitations.

Figure 43: Solo bench by Domingos Tótora. Available in: <http://www.domingos totora.com.br/>. Accessed in Feb. 2016.

Adelia Borges also states that Brazilians have been using sustainable techniques even before the popularization of ecology and sustainability concepts. Driven by poverty, Brazilians always recycled and created from what was available, and this attitude now migrated to the industrial design.

According to Costa (2012), creativity and improvisation skills are strongest features of Brazilian design and it is due to the precariousness of technologies and

materials suffered by the country. Since the times Brazil was not allowed to develop manufacture, and industrial products imported were almost exclusive for the elite, popular classes needed to develop solutions in artifacts, inventions or gadgets that solve unmet needs by objects that could not be produced in the country.

Costa also quotes the testimony of Frank Zierenberg, one of the coordinators of the IF Design award in an interview for the Brazilian magazine Casa Cláudia[95] about Brazilian design:

> *"The Brazilian Design, from my personal point of view, is based on manual work and improvisation. Here in Europe you have technical and very high standards that you may not yet have in Brazil on a large scale. But Brazilians are masters of improvisation and take full advantage, do the best with what's available in the market and combining craftsmanship with industrial production. For example, companies like Lumini, who has participated in the IF Design Awards for a long time, started with manual products and is now switching to automated production facilities of its works. I think this is a very interesting development. Again, Brazil has much to offer to the world, many crafts, manufactures and interesting techniques that can really bring something new to design community."*
>
> Interview from 15 Mar 2012. Available at: < http://casa.abril.com.br/?casa_materias_marcas=entrevista-com-frank-zierenberg-coordenador-do-if-design-awards>. Accessed in Feb. 2016.

About the technical aspect, Moraes (2004) states it important to realize that new Brazilian design, with all its power, still brings references of a rational-functionalist model which it has always been part of. These rationalist characteristics are manifested by the use of few constructive elements and a model that indicates the ease of manufacturing. According to the author, the rational aspect, still present in the new Brazilian design, is as a form of local awareness of the country's reality in which the Brazilian dilemma of social inequality has not yet been resolved.

Still, in this new national scenario, Brazilian design and its industrial products begin to leave the mimesis process adopted with references from abroad and begin

[95] Casa Claudia is a Brazilian magazine and is one of the first design magazines in the country. *Abril* editor launched it in 1977. Casa Claudia is also the creator of the national award "*Planeta Casa*", which incentives sustainable actions in architecture and design. Available at: <casa.abril.com.br> Accessed in Feb. 2016.

to use local culture as its own reference model. Thus, Brazilian features, values and identity begin to be recognized internationally as genuine and present themselves as a great differential in the globalization model (Moraes, 2004).

2.4.5 Brazilian dilemma

As we can see, Brazil is a huge country full of natural and cultural riches. It is also a country of contrasts, with high levels of social inequality, widespread poverty and violence. Its history is marked by ups and downs. The delay in industrialization process, the long period of military dictatorship, the crises in politics and economics in the country were very harmful to development of national design.

Two important moments can be visualized in the history of Brazilian design. The first between the decades of 1950 and 1960, when we had the important role of designers like Sergio Rodrigues and Lina Bo Bardi, who developed projects related to local culture and wealth, with strong identity traits. This time spurred the emergence of design as a profession in Brazil, with the instalment of the first design school.

Unfortunately, it was a fleeting moment in history, and because of political reasons, for 30 years Brazilian design has remained virtually expressionless. In the 90s, we saw a resurgence of design, and from there a steady growth. Brazilian culture and identity returned to being part of industrial design and design became increasingly connected to its territory and people.

Denis (2000) defends that, in countries with late industrializing like Brazil, some consequences are evident. Such as having most of designs imported from the headquarters of multinationals for products to be produced and marketed in the peripheral countries; the lack of interest of local industries in investing in design and the lack of influence of design as a professional field.

However, contemporary Brazilian design has achieved impressive results and is reaching a situation of greater autonomy with growth prospects. The presence of Latin designers in European and North American awards is proof that the ability to generate innovation will inevitably be affected, but not necessarily victimized by historical fatalities (Costa, 2010).

Some features can be observed in relation to Brazilian design, as pointed out by Costa (2010). One is the influence of the crafts and popular culture, from the first major design time these were two important aspects, as we see in Lina Bo Bardi' works, among others. Also now, in contemporary design, those are strong characteristics, which are giving Brazilian design a unique substance.

Moraes (2006) calls the complex path of Brazilian design by *Brazilian Design theorem*, and explains it like this:

> *This complex phenomenon of multiculturalism and miscegenation present in Brazil brought, into design practice, paradoxical elements of different providences, several sources, contrasts and large divergences, which, interacting with each other through a constantly changing phenomenon, made it possible, as we could ascertain, building a character and multiple meanings to local design. (Moraes, 2006, pg. 255)*

Despite all this change in the practice of Brazilian design, within universities the reality is different. Today in Brazil, design schools continue to prepare their students for industrial market, related to mass production, having as a model, the functionalism of German schools. This is a point that deserves further attention and will be discussed in next chapter. The German educational model was established at the beginning of Brazilian design education and remains today in most schools.

Moraes (2014) proposes that traditional schools are experiencing a dilemma between innovating and staying with Cartesian and rational methods to the practice in design. Nevertheless, he highlights the reality that we are living where design practice is aligned with the new forms of innovation, sometimes approaching high technology, sometimes approaching craft and art.

2.5 Brazilian Design Education

2.5.1 History of Brazilian Design Education

As previously discussed, the government of President Juscelino Kubitschek marked the beginning of the Brazilian industrial development. With its action plan "Fifty years in five", Kubitschek attracted foreign capital, encouraged implementation of the first consumer durable industries, especially appliances and vehicles. The diversification of national economy was stimulated by increasing the production of raw materials, machinery and equipment, implementation of rail transport and shipbuilding. In the early 60s, the industrial sector exceeded the average growth of other sectors in Brazilian economy (Dias, 2004).

It was this industrialization, along with a modernization policy, that caused the need for qualified professionals able to draw objects for the industry. Thus, in 1950 began the first attempts for formal education in design. Niemeyer (1998) points out that, since the beginning of Brazilian industrialization, there had been a non-formalized process in industrial activities that could determine the Brazilian standard for new products. However, some professionals in São Paulo saw the need to train professionals with appropriate qualifications to meet the demands of product designing and communication (Tissiani, 2014).

It was at MASP (Art Museum of Sao Paulo) that emerged the first practical actions through educational activities related to design. The Italian Pietro Maria Bardi, along with Assis Chateubriand, created in 1947 the museum MASP, designed by Lina Bo Bardi[96]. At that time, Lina Bo Bardi and her husband Pietro Maria Bardi realized that, in São Paulo, an industrial city, nobody spoke about design. With that in mind, they opened in 1951 the Institute of Contemporary Art (IAC). At IAC, which functioned inside of the MASP, was created the first industrial design course in Latin America and its structure was based on the New Bauhaus, the Chicago Art Institute, founded in 1937, under the direction of Monoly-Nagy, a former professor of Bauhaus (Dias, 2004).

[96] The Italian Lina Bo Bardi (1914-1992) studied architecture in the University of Rome. In 1946, she moved to Brazil with her husband, the journalist Pedro Maria Bardi, where they set permanent residence. Besides MASP, Lina Bo Bardi is responsible for the creation of important works in the country, such as *SESC Pompeia, Solár do Unhão, A Casa de Vidro*, among others.

Figure 44: MASP - Eduardo Bajzek illustration. Available in: <http://zaznu. wordpress.com/2010/08/30/o-masp-segundo-eduardo-bajzek/>.

The course stimulated a discussion between design, arts, crafts and industry, creating an openness to design in the productive sector. According to Couto (2008, *apud* Tissiani 2014) the original course presented a strong influence of the rationalist aesthetic of architecture and modern design. The goal was to train students to be able to draw objects to industrial production in accordance with the tendencies and characteristic of the time.

The intention of the course creators was, moreover, to train professionals that would attend to market demands, consolidating the Brazilian Design so that they could produce artifacts from local projects, avoiding imported projects and valuing local identity. They also pursued to design functional objects, aesthetically enhanced, made to the local population and not only to the elite (Razza, 2007).

The IAC lasted only three years and ended in 1953 due to lack of financial resources. However, for its pioneer nature, the IAC served as an important inaugural mark of the formal design education in Brazil.

The experience lived by the IAC students, counted with the influence of Max Bill[97], who had finished performing a significant exposition in Sao Paulo, influencing young designers to go to Germany to continue their studies. Important names of Brazilian design were among them, such as Mary Vieira, Almir Mavignier, Geraldo de Barros and Alexandre Wollner.

As a consequence of this movement, the first Brazilian design school was created, the School of Industrial Design - ESDI and in sequence the College of

[97] The Swiss designer and architect, Max Bill came from Ulm to perform a series of lectures about Bauhaus actions. Simultaneously with the opening of the IAC, an exhibition dedicated to his work was held, which was considered as a marking moment in the dissemination of concrete art in Brazil.

Architecture and Urbanism at the University of São Paulo – FAU-USP (Leite, 2007).

The ESDI was founded in 1962 in Rio de Janeiro[98]. The first ESDI Dean was the architect Maurício Roberto. His main objective was to establish a model of an experimental and free education; to create an institutional space capable of producing products and visual media; and to legitimize the design profession. In addition, to introduce design on the agenda of public debate (Niemeyer, 1998).

In its initial phase, ESDI sought to maintain the balance between humanities and technological knowledge. However, the establishment of the school occurred in the midst of a transition government in 1960 and the military coup of 1964, what made significant influence in the school didactics structure.

In 1968, the military government established a set of development policies, which discouraged courses in arts and humanities. Thus, ESDI was pressed to have a technological education direction, which according Couto (2008, *apud* Tissiani, 2014), "*Help make Brazil a country that would go forward*."

Being design a new field of knowledge, at the time of ESDI creation there were no professors trained to take on the course subjects in Brazil. Much of the professors chosen to form the first faculty, were indicated by local political directors[99] because of occupational ties or friendship (Freitas, 1999).

[98] ESDI was created outside of the University and only in 1975 was incorporated into the UERJ - Rio de Janeiro State University. However "those responsible for ESDI academic activity (principals, department heads and professors) favored their isolation and independence, valuing the preservation of internal models at the expense of integration into university dynamics" (Niemeyer, 1998).

[99] More specifically, these statements were made by the Governor Carlos Lacerda, the education secretary Flexa Ribeiro and Lamartine Oberg, director of the Institute of Fine Arts of the State of Guanabara.

Figure 45: Signing of the ESDI Foundation Act by the Governor Carlos Lacerda, on 05/12/1962 (Hatadani, 2010).

Another alternative adopted was to bring professionals qualified abroad, or even foreigners[100]. Consequently, these professors used as reference the methodology of the German school, Hochschule Fur Gestaltung of Ulm (HfG – Ulm), which kept a rationalist aesthetics and was restrictive to the development of new methodologies (Niemeyer, 1998).

Some ESDI professors, as Alexandre Wollner, Karl Heinz Bergmiller and Aloisio Magalhães, who are considered responsible for defining what it meant to be a designer in those times, had great influence and approximation to students, often coming to offer them internships in their offices. This connection with the

[100] To compose the faculty of ESDI and to coordinate sectors where the school course would be organized, were invited: Flavio d'Aquino - architect, professor of art history, art critic, art history assistant at the Faculty National Architecture. Aloisio Magalhães - painter, graphic designer, a visiting professor at the Philadelphia College of Art. Alexandre Wollner - graphic designer, attended Hochschüle für Gestaltung, Ulm. Euryalo Cannabrava - professor of the College Pedro II, a visiting professor at Columbia University. Antonio Gomes Penna - psychologist, Psychology full professor of the Faculty of Philosophy, Sciences and Letters of the State of Guanabara, assistant of psychology chair of the National School of Philosophy. Zuenir Carlos Ventura - in technical writing, assistant chair of Literature and Portuguese Language of the National Philosophy College of journalism. Karl Heinz Bergmiller -designer industrial, formed by Hochschüle für Gestaltung, Ulm, and former member of Max Bill's office in Germany. Orlando Luiz de Souza Costa - industrial designer, graduate in Industrial Design from the Parsons School of Design, New York (Farias, 1995 aoud Freitas, 1999).

students resulted in an endogenous process in which ex-students became new professors (Hatadani, 2010).

According to Niemeyer (2007), this procedure ended in the establishment of traditional patterns, as in most of the time the ex-students repeated as teachers, the practices and procedures learned.

The first group of professors formed by former students began teaching without going through any kind of academic improvement, exercising usually some kind of liberal profession in synchrony with the didactic function. This event echoed through school development and, until 1994, ESDI still had one of the lowest averages of scientific production by professor.

ESDI intended to establish itself as the school of modern design in the country, and chose to follow Ulm's model, which used a formal language, rationalistic and scientism. It ended causing a distance from the Brazilian context. The teaching practices were disconnected with the specific characteristics of production and consumption in Brazil, disregarding specific Brazilian problems as its social inequality. This way, according to Leite (2007), ESDI presented an institutionalized design, attempted by the growing industrialization, avoiding any reflections in regard of the national context. The author states, "*This was the error of the ESDI, to turn its back to reality and work only in the field of idealization".*

Despite all controversy, ESDI curriculum has become a model for the other design schools that emerged. From its foundation, design schools in Brazil have multiplied in the approximate ratio of one for every nine months in the 35 years that followed. Without postgraduate courses available in the country, the majority of professors of those schools were graduated students with little or no real experience. Most of them started to teach because they could not enter in the market as designers, so they found in teaching the only possibility to work in the sector (Landim, 2010).

The first stage of expansion of the courses, which took place in the 70s, came from the need to replace the bachelor degrees in fine arts, which were in crisis mainly because of the military governance, as explained before. The solution found required to turn those courses into design courses. The professors, which were not prepared to perform these lectures, being from other areas, found themselves forced to follow the minimum centralizing curriculum established by the Ministry of Education (MEC) and the only didactics format, in the absence of other options, took ESDI curriculum as a model (Lima, 2003).

Initially, the courses were limited to Visual Communication and Industrial Design, in four-year-long courses. From 1987, the reformulation of the minimum curriculum consolidated both into one unique course named Industrial Design, with two qualifications, Visual Programming and Product Design, remaining as a bachelor's degree obtainable in four years. Up to that time, there were few variants, as in the FAU-USP[101], which kept an Industrial Design course as an extension of the Architecture course.

This system increased the distance between the university and the reality of companies in the country. Professors ended up teaching a design for a market that did not match the reality, directed at large and modern companies, while in fact the possible customers would be micro and small entrepreneurs with little capital seeking a differential for their survival.

The design education in Brazil, following the Ulm School model was oblivious to the social reality in which it was inserted. According to Freitas (1999), the low-income consumer, as the vast majority of the Brazilian people, was rated as having poor taste, and was abandoned under the pretext of being unable to give value to the "design product".

The lack of post-graduate courses and the lack of literature available in the national language meant that professors had no other alternative than to continue to repeat behaviors and speeches. Without scientific and technological claims, the course began to revolve around the design practice, with oral transmission of knowledge and without any critical reflection on the production itself.

Starting at the decade of 1990, this situation began to change. The end of the military government in 1985 followed by the economic improvement with the establishing of the new coin in 1992 brought new attention and value to national products of the design. The approval of new regulation in the form of the Law of National Education Bases and Guidelines (LDB – Law n. 9.394) in 1996 brought the creation of new undergraduate and technological courses. In addition, the segments Industrial Design and Visual Communication started to be called Product Design and Graphic Design (Toledo, 2010).

With the first edition of the Brazilian Research and Development Conference in Design - P&D Design in 1994 and the opening of the first graduate program in

[101] ESDI is the first school, but the first class in a college of design in Brazil occurred in 1957 at FAU-USP, when disciplines of Industrial Design and Visual Programming were introduced in the curriculum. From 1962, it became new training area, been characterized as a sequence within the architecture course (Freitas, 1999).

Design at PUC-Rio in 1997, the academic production in the area truly began (Paschoarelli, 2014). The design schools started to take interest in research and incubators, laboratories and research groups started to emerge. As an example, there were six research groups in design in the country in 1993, but by 2010, this number rose to 121.

As we saw, the design education in Brazil started from political and economic needs, amid a period of change on the national scene. The initial idea was to make a design geared to local context, highlighting Brazilian culture and characteristics. However, with the lack of experience and professionals prepared to lead in this direction, what happened was just the opposite. Design in Brazil for many years remained a decontextualized copy of German design from the 50's. The figure below presents a summary of the path of Brazilian design education.

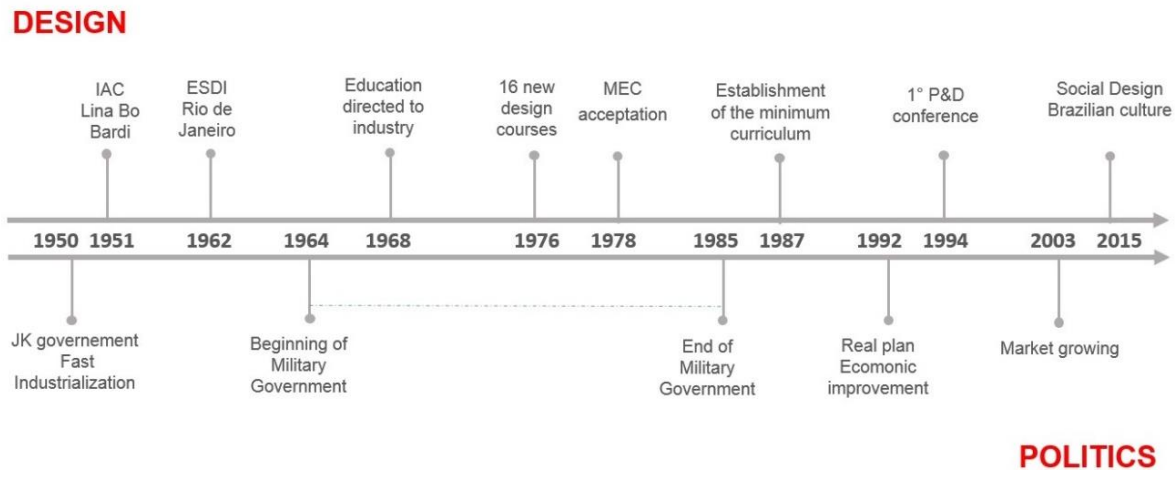

Figure 46: Timeline of Brazilian design education.

During the next 30 years after the opening of the first school of design and with creation of new schools, all following the same methodology, the design education in Brazil suffered a fall in its quality and had one of the worst grades in the classification of the Brazilian Ministry of Education. In the 90's, with the introduction of graduate courses and the encouragement of academic research, this frame started to change.

Students and professors began to react by building a generation of professionals who think about design as opposed to simply reproducing it. Along with the increase in academic production, the critical and reflective capacity of the design

community in the country increased as well, which promoted a change of posture in order to bring the university closer to society.

Besides the improvement in terms of education, there was also a growth in the labor market and the quality of the Brazilian design production. According to the Diagnostic Review of Design in Brazil (2014), the design sector in Brazil shows great growth from the 2000s. Such growth is observed not only in education, but also in the market, technology and knowledge production.

The government is also increasingly raising the incentive to the profession by funding programs, scholarships and awards. Companies that have interest in investing in design can obtain financial support from public institutions such as FINEP (Studies and Projects Funding Agency), the CNPq (National Council for Science and Technology Development) and the BNDES (National Bank for Economic and Social Development).

Beyond that, in Brazil different types of scholarships are offered to students interested in scientific research, in all levels, in the country or abroad, by national agencies as CNPq and CAPES (Brazilian Federal Agency for the Support and Evaluation of Graduate Education) or by local government agencies.

2.5.2 Didactics

As previously mentioned, ESDI was the first design college in Brazil and its curriculum and way of teaching influenced the principles for design pedagogy in Brazil.

In the beginning, the ESDI's course had the goal of training students to meet the demands of the new industrial society by planning products through a technical, scientific, artistic and cultural education. Its didactical plan was adopted from a Maldonado proposal made in 1955 to the School of Ulm, which was discussed and analyzed by a commission[102] and resulted in a curriculum ordered in sectors such as the organizational model of HfG (Oliveira, 2010).

The teaching model of Ulm, when implemented in Brazil, did not suffer many changes in its educational structure. The course's fundamental principles were built under a base structured by practical exercises combined with systematic investigations, divided into four areas of work. [1] Visual Introduction, experimentation and training on the phenomena of visual perception; [2] Means of Representation, practice and analysis of elementary representation methods; [3] Practical Work, introduction to manual and analysis of design means; [4] Cultural Integration, lectures and seminars on contemporary history, art, philosophy, cultural anthropology, morphology, psychology, sociology, economics and political science (Lindinger, 1991: 41 cited Leite, 2007).

ESDI's course of Industrial Design had four years of duration of which, in the first year, students would attend to the Fundamental Course while for the remaining three years they would attend specific disciplines directed to specific qualifications. The subjects, which were formulated originally from ESDI, would be divided into three departments: Instrumental Education, Vocational Training and Information.

An issue pointed by Niemeyer (2000) was the discussion about qualification, which had been always present, not only in ESDI, but also in numerous other colleges. Some institutions advocated general education, objecting that super-specialization of knowledge results in a superficial and impoverished professional practice with greater difficulty in adjusting to the market, without mastery of a specific field of knowledge.

[102] The commission: Mauricio Roberto, Wladimir Alves de Souza, Karl Heinz Bergmiller, Alexandre Wollner, Aloisio Magalhães, Orlando Luiz de Souza Costa, Jose Simeon Leal, Flávio de Aquino, Euyalo Canabrava (Oliveira, 2010).

According to Oliveira (2010), the implementation of the course was experimental and several professors held reservations against the didactics implemented. The fundaments of teaching were not clearly defined and despite having internally a democratic environment, open to critic, the actions seeking change were isolated and disconnected. There was a significant difference in the methods and behaviors practiced by professors. Many theorists' professors coming from other educational institutions did not understand the school's goals, having a simple conception of design, which caused a delay in the treatment of subjects and a distance of theory and practice, making it difficult to adopt interdisciplinary attitudes and actions (Oliveira, 2010).

Consequently, a teaching pattern rose without theoretical basis, even for the methodological procedures. The activities were based on projective practice as a type of workshop, which dictated the pedagogical rule, avoiding theory, and virtually separated from the art, naturally leading the design to drift from the context.

The great emphasis given to the projective practice was due to the desire of the designer to put their knowledge in favor of production processes, as it was believed that this was the closest way for the profession to gain social respectability. However, the course of ESDI never achieved their goals of forming a professional trained to meet the demands of industry. The disciplines that should elucidate manufacturing processes and materials technologies were very forward to the technological innovation of the time and the practice continued to attempt to conciliate the artisanship with the industry.

According to Freitas (1999), beyond its educational objectives, ESDI was more concerned about the participation of designers in a developmental process than in their functional and technological development. The theoretical objectives were neglected and replaced by an empirical-discursive behavior, making the school even more distant from a critical reflection.

In 1964, the ESDI director in office, Flávio de Aquino, presented a proposal of reformulation of ESDI's program. He presented a document with proposed measures such as the concept of the designer integrated to a team and the use of a logical reasoning and methodologically structured to solve complex problems. He supported the idea of design practice as a fundamental core of the course, where it should converge with other disciplines. It was also noted that there should be a multidisciplinary or interdisciplinary correlation, but there had been no mention of how it would be applied didactically (Oliveira, 2010).

The new ESDI curriculum was accepted by the National Education Council (CFE), and was the first minimum curriculum for the bachelor's degree in industrial design in the country, which contemplated two modules. One was directed to basic disciplines as Aesthetics, History of Arts and Techniques, Communication Sciences, Plastic and Design. The second module involved professional disciplines, including the following: Expressive Materials and Techniques of Use, Expression, Social and Economic Studies, Theory of Production, Project and its practices (Tissiani, 2014). Following the Bauhaus model, design practice was the foundations of course, on which other disciplines sought to support it.

Niemeyer (1998 *apud* Oliveira, 2010) conducted an analysis based on subjects taught in ESDI between 1963 and 1992 indicating changes between the opening curriculum and its subsequent developments. According to Oliveira (2010) observations, there was a reduction in some disciplines like Cultural Integration, Introduction to Logic and Information Theory. This indicated a change regarding the enhancement of knowledge and consolidation of a national identity, which suffered a decline, as well as the identity of the designer, with the loss of scientific foundations that aimed the formation of a professional planner, with multidisciplinary vision.

Still, the weight of design practice disciplines remained unchanged throughout the studied period, although, according to Niemeyer (1998), the reduction of technological and scientific disciplines of the course resulted in making the design approach based on the learning of the practice by practice, originating the notion that design is learning by doing.

The professors, according to Moraes (1999), used to bring to the classroom cases of successful active professionals with more work experience, using them as a reference for students. This is reflected in the design limitation of teaching, instead of providing the necessary diversification and scope.

These references proved prejudicial to the learning process of students. To have their projects compared against success cases of active professionals caused anxiety, along with feelings of inferiority (Ladim, 2010).

Moraes (1999) understands that during a design process of teaching, the most important aspect would be, rather than obvious issues such as aesthetics or technical and ergonomic factors, the synthesis of design culture through cultural, critical and analytical values explored during the design process.

According to Ponds (2011), design education tends to follow the design methodology and professional experience of its professors. The problem is that the

methodologies applied in design education in the main institutions of higher education in Brazil fail to meet the contemporary needs, making the graduates leave school unprepared for the development of design activities in front of the complexity of contemporary issues.

In 1996, the new National Curriculum Guidelines (LDB 9.394 / 96) was published with a scope conducive to the development of more in depth and effective evaluations in the field of design pedagogy.

These directives determined, along other demands, that institutions of higher learning should be responsible for the social, scientific and technologic demands of the country. Beyond that, the institutions would have the autonomy to implement and define the curriculum of their courses, following the orientation within the directives. These resolutions were reformulated and approved in 2004, as demonstrated in Annex 1.

Within its definitions is the contextualization of the pedagogical project in relation to its institutional, political, geographical and social insertion. As well as the interdisciplinary practice of integration between theory and practice, along with incentive to research, including the insertion of lines of specific modality aiming to address the local market and region.

These new guidelines also listed skills that the graduate should have. These skills included, among others, the ability to interact with experts from other areas in order to utilize diverse knowledge and to work with interdisciplinary teams in research and projects. As well as the systemic view of design, demonstrating the ability to conceptualize it from the combination of various material and immaterial components, manufacturing processes, economic, psychological and sociological aspects of the product. This systemic view remained focused on the process and the product, not including the design of systems or services.

In light of these resolutions launched in 2004, Ponds (2011) conducted a PhD research in 2010 in which the author made an identification of the universe of design courses in Brazil, making a cut in product design courses, which had methodology of design, design and product development disciplines or similar with the same goal.

One issue addressed the bibliography used in Product Design Methodology. According to the aforementioned research, the main bibliographies used were the books “Product Design” by Mike Baxter (88%); followed by “Things are born from Things” by Bruno Munari (75%) and at last, “Design for Environmental Sustainability” by Ezio Manzini and Carlo Vezzoli (63%).

According to the analysis of Ponds (2011) concerning these books, Munari presents a rational and simplified method, centered on production viability and problem solving; Baxter presents a highly market-oriented vision, committed to large-scale production and maintenance of the business market. Manzini and Vezzoli developed a technical approach, focused on addressing the environmental problems using as a fundamental tool the analysis of the product life cycle.

Most professors (88%) affirmed to develop activities having the primary objective of sustainability in their disciplines. Although, when questioned about how well prepared graduates were to face complex issues, most replied that only between 60% and 70% were prepared, which shows that professors do not consider all students to be fully prepared graduates to work in projects related to major problems, such as sustainability.

This leads to conclude that in spite of the new guidelines and that in fact some schools have made changes; most of the country's product design courses still follow the scheme of backbone in design practice discipline, where students follow a rigid methodology for their projects, making use of a rationalistic bibliography, directed to mass production. Most initiatives that seek a different direction to meet the new guidelines are out of the main line of teaching.

The design framework in Brazil took a very significant step forward, but there remains plenty to do. Moraes (2014) highlights that both in the field of graduation and specialization as in the master's and doctoral design programs in Brazil, there is an accentuated emphasis in technologic objectives and linear areas instead of humane social and immaterial content.

2.5.3 Design Schools in Brazil

As previously mentioned, since the creation of the first undergraduate degree in design in Brazil (ESDI), a series of new courses and design schools have emerged. According to Moraes (2014), in Brazil there are currently 538 design courses, distributed in 267 higher education institutions, almost 80% of them belonging to private institutions. Altogether, they offer about 55,000 vacancies divided in curses such as product design; graphic design; interior design; fashion design; digital design; multimedia design, among other variations.

In 2010, the Brazilian Education Ministry published a document entitled "National Curricular Reference Points for Bachelor Degrees"[103]. According to the document, graduate designers should be involved in the *"creation, development and execution of projects and systems that involve visual information".* It describes how the activity requires knowledge in products and materials, as well as knowledge in historical aspects, in cultural traits, and in production technology. Graduate designers can develop new products, just as they can redesign existing products and adapt them to new situations or needs. A specific characteristic of their work is interdisciplinarity, which means interacting with experts from other areas who supply the complementary knowledge necessary to develop a new project. They coordinate and supervise work teams and respects the ethical, safety and environmental issues.

Among the topics covered in this education stream are: design; computer graphics; art history and the history of design; theories of design; project methods and techniques; representation means; communication and information; ergonomics; materials and manufacturing processes; management; visual communication; semiotics; psychology; photography; illustration; interfaces; information and communication technology; ethics and the environment; relationships between science, technology and society.

According to Toledo et al. (2010), there is a high concentration of design schools in the southeast and south of the country with few courses available in the North, Northeast and Central West. This fact is justified primarily because those are more industrialized regions, which means greater market demand in these regions.

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[103] The entire document is available at <http://www.ufsj.edu.br/portal2repositorio/File /ReferenciaisGraduacao.pdf> page. 28. Accessed in Sep. 2015.

The state of São Paulo possesses the highest number, having 131 courses, according to data published in 2013 by the Ministry of Education of Brazil. Other states with significant numbers are Rio Grande do Sul (52), Santa Catarina (49), Minas Gerais (39), Paraná (37) and Rio de Janeiro (25). It is important to stress that every state in Brazil offers courses in the area of design (Selau, 2014).

As previously mentioned, it took a long time before the first graduate design program was implemented in Brazil, which only occurred 32 years after the creation of the first undergraduate design program. Moraes (2014) shows that beyond this delay to the arrival of the first course of graduate school, there was also a lack of academic support, such as scientific publications or research groups to increase and keep quality of the courses.

In Brazil, graduate courses are separated into *lato sensu*[104], comprising expertise courses and programs designated as MBA (Master Business Administration) and *stricto sensu*[105], comprising of master's and doctoral programs open to candidates from undergraduate courses that meet the requirements of educational institutions.

According to Moraes (2014), in the 90s, the first *stricto sensu* design course in Brazil emerged in the South and Southeast Brazilian areas, especially in São Paulo and Rio de Janeiro. As they were dynamic courses, free of rigorous evaluation criteria they prospered in Brazil.

In an estimation presented in the *Diagnostic Review of Design in Brazil* (2014), it was observed that Brazil has 110 education institutions that offer *lato sensu* graduate design programs, and 274 specialization courses were in operation in 2013. Out of these, 23% are in fashion, 18% interior design, 15% graphic design and only 10% in the product area. Sectors such as eco-design are between 4% listed in the category "General". Of these, 50% are in the Southeast area with 77 of them in São Paulo.

Stricto sensu programs are regularly evaluated by the Brazilian Federal Agency for the Support and Evaluation of Graduate Education (CAPES), under Brazilian Education Ministry (MEC) supervision. Furthermore, according to data from the *Diagnostic Review of Design in Brazil* (2014), in 2013, Brazil had 17 education institutions offering *stricto sensu* graduate degrees in the field of design with 27

[104] *Lato sensu* is a Latin expression that means "broadly sense". In Brazil, this expression is used to distinguish graduate courses of shorter duration as opposed to "*stricto sensu*".

[105] *Stricto sensu* is also a Latin expression and means “strict sense”, and is used to graduate courses of larger duration.

programs in operation. On the map below, we can see the geographical distribution of *stricto sensu* graduate programs of design in Brazil.

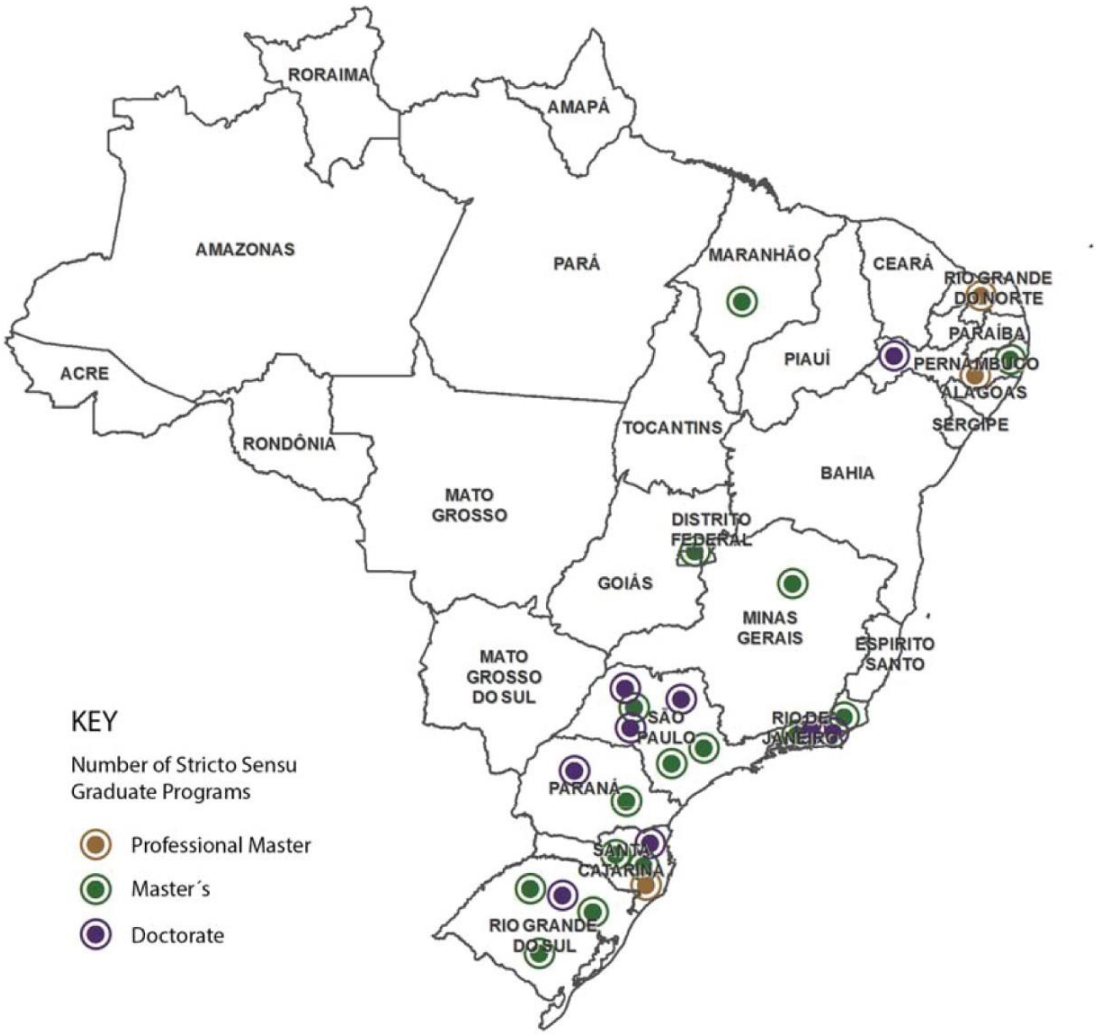

Figure 47: Distribution of *Stricto sensu* graduate design programs. Source: Diagnostic Review of Design in Brazil (2014).

In addition, Moraes (2014) notes that the firsts master programs in design in Brazil emerged to compensate for a lack in this area. Before that, graduate designers sought other alternatives to obtain their qualifications in related courses such as production engineering, media, education, history and others, which related to the design activity, or even sought training programs abroad, preferably in countries such as England or the United States.

This practice extended the interaction of design with other disciplines and areas of knowledge, which, on the one hand enriched its content, but on the other tended to disperse their possibilities of action as its own area and set within the applied social sciences.

The subjects researched in *Stricto sensu* in Brazil are design and technology, digital design, informational system, ergonomics, theory, history, strategic design, fashion and innovation. The mandatory courses in masters are mostly focused on methodological areas, technology, sustainability and ergonomics. The optional subjects offer additional choices in the areas of materials, production system, ergonomics and technologies applied to design. In the doctorate, subjects are presented more as a critical analysis with a reflective nature than as a productive and technological context (Moraes, 2014).

Moraes (2014) highlights that both in the field of graduation and specialization as in the master's and doctoral design programs in Brazil, there is an accentuated emphasis (in different layers) in technologic areas, objectives and lines instead of humane, social and immaterial content.

Another point that deserves to be mentioned concerns the academic production. The scientific and technological production in Brazil in design had a very significant increase. When analyzing the evolution of different indicators in the subject, it is observed that the bibliographic production in the area grew by approximately 1,900% in the period between 2000-2010 and the authors of publications in the area increased by 2,459% in the last ten years, affecting directly on the generated content on the subject.

Based on data from the Brazilian National Council of Scientific and Technological Development (CNPq), regarding the academic production of Industrial Design and technology of the years 2000-2010, it is possible to observe this growth in the charge below:

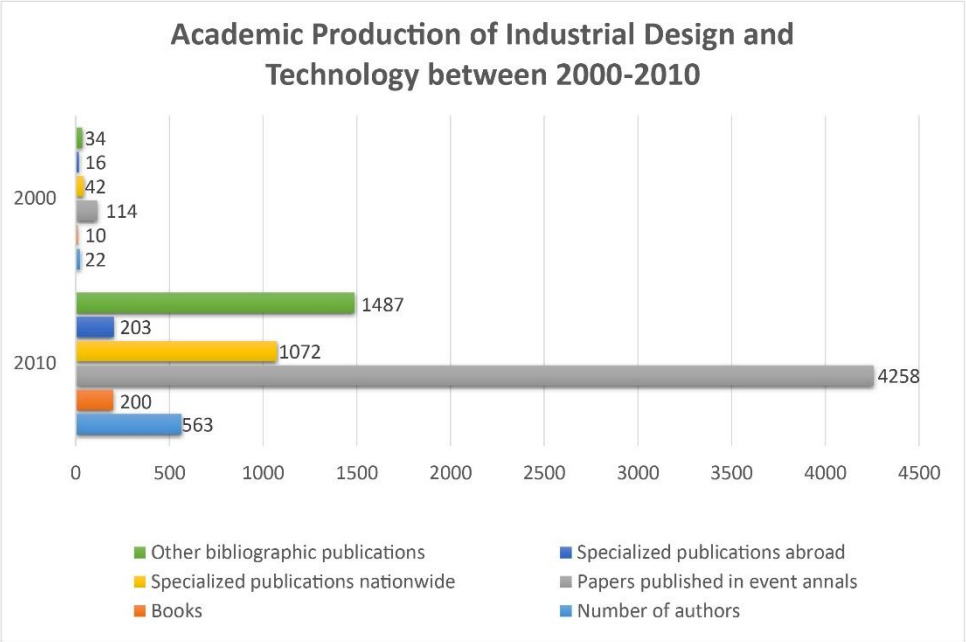

Figure 48: Academic Production of Industrial Design and Technology between 2000-2010.

It is important to observe that this growth is significant, but does not mean that the Brazilian academic production is sufficient. As we can see, in 2000 there were only 10 Brazilian books published in the area. Moraes (2014) remember that in the 90s, the time of the emergence of the first programs, this number would be much less significant.

Regarding the research in Brazil, there are 42 higher education institutions in design that maintain approximately 121 research groups in Brazil, representing 0.5% of Research Groups registered in the CNPq. These groups focus on: Project 36%, Technology 7% and the remaining percentage is divided between History, Media, structure / shape, etc. We can perceive that a large emphasis on productive and technological factors, as well as materials and ergonomics, dominates research design groups, much like in graduate programs (Moraes, 2014).

Chapter 3

Case Study: UEMG – Brazil

3.1 Contextualization: Minas Gerais State

3.1.1 Characteristics

The state of Minas Gerais is one of the 27 federal units of Brazil. It is located in the Southeast and its territorial area is the fourth largest in the country. This territory, with 586.522,122 km^2 is further subdivided into 853 cities. According to data from the Brazilian Institute of Geography and Statistics (IBGE) published in July 1st, 2016, Minas Gerais hosts a population of 20.991.560 people, being one of the most populous area in the country, second only to the state of São Paulo.

Minas Gerais is also the third most important economic pole in Brazil, after the states of Rio de Janeiro and São Paulo. According to data from the Ministry of Foreign Affairs (2016)[106], the state presents an important industry, especially in the areas of vehicles, steel, iron ore and cement. In the agricultural production, Minas Gerais holds the largest cattle herd in the country, with around 22 million heads; it is the largest national producer of milk (32%) and coffee (50%). In addition, the state stands out among the main producers of pineapples (34%), potatoes (27%), garlic (21%) beans (12%) and Maize (10%), among many other agricultural products.

The State, divided in ten areas, is characterized by acute social inequality and concentration of income, as the rest of the country. The *Central* area holds 46,6% of the state GDP, and the poorest areas as *Jequitinhonha/Mucuri* and *Rio Doce* holding together 12% (AMM portal, 2016).

Minas Gerais is also the biggest mineral producer in Brazil and has one of the most important mining industries in the world; the company *Vale do Rio Doce*[107].

[106] Magazine *Textos do Brasil* n. 4. Available at: <http://dc.itamaraty.gov.br/imagens-e-textos/revista4-mat8.pdf>. Accessed in December 2016.

[107] As explained in Chapter 2, page 92.

Their mines hold the widest range of minerals and semiprecious stones such as diamond, emerald, amethyst, topaz, quartz, tourmaline, hematite crystal, aquamarine, opal and more (Implicities, 2016)

The state of Minas Gerais possesses the most important hydro-mineral sites in the country, famous for their healing effects and beneficial nature to health in general. The city of *São Lourenço*, for instance, possesses reserves having six different sources of mineral water containing magnesium, carbonic acid, alcaline salts, iron and sulfonamide. Other mineral sites of relevant importance in the state are in the cities of *São Cambuquira*, *Lambari*, *Caldas*, *Jacutinga*, *Passa Quatro*, *Fervedouro*, *Patrocínio* and *Andradas* (Ministry of International Affairs, 2016).

The biggest hydrographic basins of the country have its origin in the state of Minas Gerais, as the *São Francisco* River, considered as the national integration river, the *Paraná* River and the *Leste* River basin.

The *São Francisco* River, borne in the Canastra Range and flowing bound to the Northeast of the country, constitutes a strategic hydric resource fundamental to the development of the region. It runs for a total extension of 3.160 km, in a basin of 631.133 km^2, before flowing into the Atlantic Ocean (Ministry of Foreign Affairs, 2016). Alongside its course in the State of Minas Gerais are, in the town of *Barreira Grande*, the hydrelectric plant of *Três Marias*, which supplies energy to most of the state. Its generating capacity amounts to 520.000 kW, while the barrier of the dam measures 2,700 meters in extension (Senac Minas, 2016).

Figure 49: *São Francisco* River. Source: <http://www.fortenanoticia.com.br/noticias /8848/governo-lanca-pla no-par a-revitalizacao-da-bacia-do-rio-sao-francisco.html>, Accessed in Dec. 2016.

Rivers and lakes occupy around 30% of the territory and 1.252 km^2 are environmental protection areas which consist of state and federal parks (Senac Minas, 2016). Among these, the most important ones deserve noting. The State Forest Park of *Rio Doce* has the biggest continuous forest of the Brazilian southeast with 42 lagoons. Followed in importance by the Forest Park of *Ibitiboca*, which is located in the South of Minas Gerais; and the State Park of *Itacolomi*, in the central region. Next, the National Park of the *Canastra* Range, where lies the source of the river *São Francisco*, is in the Southwest of the state. Finally, the National Park of the *Cipó* Range is in the outskirts of the capital, Belo Horizonte (Ministry of Foreign Affairs, 2016).

According to the Ministry of Culture (2006), over 60% points of touristic interest in the state consist in rivers, waterfalls, lakes, etc. In addition, the cultural heritage attracts the tourists. Currently, it is possible to find monuments, bridges, ruins, districts, trails stone-paved by slaves; and settlements that conserve the importance of such natural, historic, artistic and cultural heritage.

3.1.2 History and Culture

The history of the state of Minas Gerais has its beginning in the sixteenth century, with the arrival of colonists from Portugal. These, coming in search of natural riches and resources, would venture in expeditions through the interior of the country in order to gain personal profit.

The work in search of precious stores and gold in the middle of the sixteenth century unleashed the discovery of the territory that now comprehends the state of Minas Gerais. Due to its prestigious riches in mineral resources, the year 1709 saw the creation of the Captaincy of Gold Mines, which caused the first village of the country to be created in 1711, in the city of *Mariana*. Quickly populated, in the beginning of the eighteenth century, the region became an important economic center for the colony (Sales, 1999).

Figure 50: Minas Gerais Square – municipality of Mariana. Source: <http://www.jornaloliberal.net/workspace/uploads/imagens/mariana-eduardo-972-praca-de-1321665026.jpg> Accessed in Dec. 2016.

Approximately in 1759, the production of gold began to fall. Portugal then, increased the taxes and curbed the development of other activities, such as exportation of food, sugar, cotton and tobacco. What unveiled one of the main anti-colonial movements in the eighteenth century, the *Inconfidência Mineira*. Inspired by the French Revolution of 1789, such conflict was an attempt of liberating the state from Portuguese domain (Government of Minas Gerais, 2016).

With all the investment in mining, the state economy only returned to grow in the first years of the nineteenth century, with the production and exportation of coffee. Coffee opened the doors to industrialization of the state, reinforced later by the protectionist politic implemented after the proclamation of the Republic. In the beginning of the twentieth century, coffee became the main product of the country, elevating Minas Gerais to being one the leading national potencies (Freitas, 2016).

According to Freitas (2016), the predominance of coffee cultivation in the state began to lose value in 1930 with the start of steelwork production largely applying the mineral resources. Once again, in the decade of 1950, the industry amplified notably its participation in the country's economy.

However, in the decade of 1970, with the advent of a military regime, industrialized capitals (including the capital of Minas Gerais, Belo Horizonte) received considerable investments, becoming independent from industrial zones, making it so that inner-state cities were unstructured. There was also a considerable investment in diversification of the industry, as well as the widening of national and international inclusion of the economy of the state, along with the consolidation of new industrial sectors (Freitas, 2016).

Currently, with Brazil being a federative Republic, Minas Gerais is one the richest states in the country.

The *Mineiro* People

The people native to the state of Minas Gerais have received the demonyn (or gentilic) *Mineiro,* which in the Portuguese language translates to *miner,* a reference to the main activity of the state in its historical consolidation.

As demonstrated above, the state of Minas Gerais is the second most populous state in Brazil. Its flag bears the inscription "*Libertas quae sera tamem*" (latin for "liberty, however late"), which demonstrates the plight for freedom and justice which lingers to this day in the customs and habits of the people. Among such habits, it is important to highlight the hardworking way and dedication to the family (IBGE, 2016; Government of Minas Gerais, 2016).

When the Portuguese started to relate to the natives in the time of the discovery of Brazil, the Europeans sought to catechize the Indians native to the region. Such propagation of catholic religion had a significant influence all over Brazil. Even today, mainly in the state of Minas Gerais, which still cultivates countless religious traditions, among them, religious celebrations such as the *Congado* and the *Folia de Reis.* In several towns of the state, people designated for the organization of the church celebrations are considered local leaders by the population. This faith provokes a relation with the costume of hospitality, like the habit of receiving at home the image of a saint to pray with the neighbors (Government of Minas Gerais, 2016).

Figure 51: Celebration of *Folia de Reis*. Source: <http://www.barbacena.mg.gov.br /noticias.php?id=3173> Accessed in Dec. 2016.

According to Moraes (2010), the *mineiro* people presents some marking imaterial caracteristics. Among them is the mistrust of strangers, inherited from the past of working with precious stones; the involvement in politics, due to the history of the *Inconfidência,* the religiousness and introvert nature, which, according to the author, is related to the mountain topography surrounding the territory.

Gastronomy

The cuisine of Minas Gerais is a marking point in the region culture, which shows their richness and diversity, deeply connected to its history. It emerged from the encounter of different groups of people that occupied the region between the sixteenth and seventeenth centuries. The colonists from Portugal, the slaves from Africa and the native Indians merged their gastronomic culture creating the typical *mineiro* cuisine, still in practice to this day (Senac Minas, 2016).

The taxes charged in the time of the gold cycle barred the access of miners to food products. Therefore, they had to encounter different ways to create meals utilizing the food available to them. Consequently, the *mineiro* food is formed from simple ingredients, readily available, such as, for example, corn, pork, manioc

roots, beans, chicken and vegetables, which together formed a rich meal, appreciated for its flavor, aroma and color (Food Magazine, 2016).

Today, the typical *mineiro* food presentes rich and diversified dishes, typical in accord to each region and each occasion, for example the rice with *pequi*, a fruit native to the north of the state; chicken with okra, prepared in the central region; and the guava sweet from the westwards *mineiro* triangle region.

Figure 52: Typical mineiro dishes. (a) Rice with pequi. Source: <http://blog.turismodeminas.com.br/6-pratos-tipicos-de-minas-gerais-que-voce-precisa-provar/> (b) Chicken with okra. Source: <http://megareceitas.com.br/receita-de-frango-com-quiabo/> (c) Guava sweet. Source: <http://g1.globo.com/sao-paulo/sorocaba-jundiai/nosso-campo/noticia/2015/03/goiaba-e-fruta-coringa-na-plantacao-das-pequenas-propriedades.html>. Accessed in Dec. 2016.

The combination of several gastronomic cultures resulted as well in the creation of countless festivals in all the state. Among them, the International Culture and Gastronomy Festival of the city of *Tiradentes;* the Free Range Chicken Festival of the city of *São Gonçalo do Rio das Pedras;* The Good Table Festival in the city of *Caxambu,* The Coffee and Music Festival of the city of *Cristina,* the *Comida di Buteco* Festival in Belo Horizonte, the Gastronomic and Cultural Festival in the city of *Carrancas,* the *Ora-pro-nóbis* Festival in the city of *Sabará,* among others.

The abundance of *mineiro* festivals and typical regional dishes was the way of enrichment in several cities, as for example the liquors of the city of *Sabará,* or the olive oil producers in the city of *Maria da Fé.* Even the *Serro* Cheese and the *jabuticaba* wine in the city of *Caeté* are examples of such phenomenon. Those cities and municipalities of the state are recognized for their gastronomy, improving the economy of Minas Gerais (Instituto Estrada Real, 2016).

Artisanship

According to SEBRAE, the artisanship production includes popular art, manual labor, food products, semi-industrial products, cultural reference artisanship, traditional artisanship, indigenous and conceptual artisanship (SEBRAE, 2010).

Coming from different people and diverse locations, the *mineiro* artisanship, much like the cuisine, constitutes a historic inheritance of the state. This artisanship originally used the materials available at the region, such as, for example, the ceramics. Several forms of the *mineiro* artisanship are rooted in indigenous customs such as the use of ceramics obtained from the mud present in the vales of the *São Francisco* River and *Jequitinhonha* vale, or the works in soapstone, common to the regions of *Caminho dos Diamantes* (Government of Minas Gerais, 2016).

Figure 53: Artisanship from the *Jequitinhonha* Vale, in the north of Minas Gerais. Source: <http://www.50emais.com.br/artista-plastica-vai-ajudar-ceramistas-mineiros/>. Accessed in Dec. 2016.

Other expressions of artisanship include materials such as wood, bamboo, leather and textile fibers, that are worked in all of the state of Minas Gerais to produce, typically, images of saints, garments, hammocks, historical figures and

others. There is also an immeasurable production of embroilments, knitting and works in weaving, copper, Flanders sheet, funneling and silver.

Formed by family traditions, the artisanship is an important source of income for the state of Minas Gerais, which is developed in cultural and economic sectors (PUIG, 2014).

Architecture

The state of Minas Gerais possesses the most important set of architectonic and artistic heritage sites of the sixteenth and nineteenth centuries. In the state, countless preserved constructions, primarily in the cities of *Diamantina*, *Ouro Preto* and *Mariana*, are due of note for their richness in the baroque style.

The baroque style arrived in Minas Gerais along with the Company of Jesus. In this manner, this art is found mostly in chapels, oratories, sanctuaries and churches. Its objective was to affirm the divine splendor and conquer faith. Therefore, the constructions were portrayed with luxury and wealth. In this way, the interior of these structures were filled in detail, as it can be seen in the photo of the church *Matriz Nossa Senhora do Pilar*, in the city of Ouro Preto (Pinto, 2006).

Figure 54: Church *Matriz Nossa Senhora do Pilar*, in the city of Ouro Preto. Source: <http://www.agenciaminas.noticiasantigas.mg.gov.br/noticias/dia-do-barroco-resgata-a-memoria-do-patrimonio-historico-de-minas-gerais >. Accessed in Dec. 2016.

The modern architecture has its main expression in Minas Gerais in the works of the architect Oscar Niemeyer. In the beginning of the decade of 1940, Niemeyer was invited by the then mayor Juscelino Kubitschek to the city of Belo Horizonte, capital of Minas Gerais, to structure buildings based on the baroque style. They would form the complex of *Pampulha*. The intention of Kubitschek was to turn Belo Horizonte into a city of worldly vanguard. The buildings of the Museum of Modern Art, the *Casa do Baile*, the *Iate Tenis Clube* and the church of Saint Francis of Assisi are all part of the *Pampulha* complex. The later further counts with the actions of landscaper Burle Marx and painter Cândido Portinari (Portal Belo Horizonte, 2016).

Constructing several works in all of the state along the years, Niemeyer became the most prominent and recognized architect of Minas Gerais. However, throughout the years, other architects have dedicated themselves to the modern architecture of Minas Gerais, such as Shakespeare Gomes, Eduardo Mendes Guimarães, Raphael Hardy and Sylvio de Vasconcelos (Braga, n.d.).

Niemeyer continued to work in projects in the state of Minas Gerais until short before his demise, realizing even what today stands as an icon of modern architecture, the Palace *Tiradentes* in the complex of the Administrative City, a 21,000m^2 building entirely suspended above the ground.

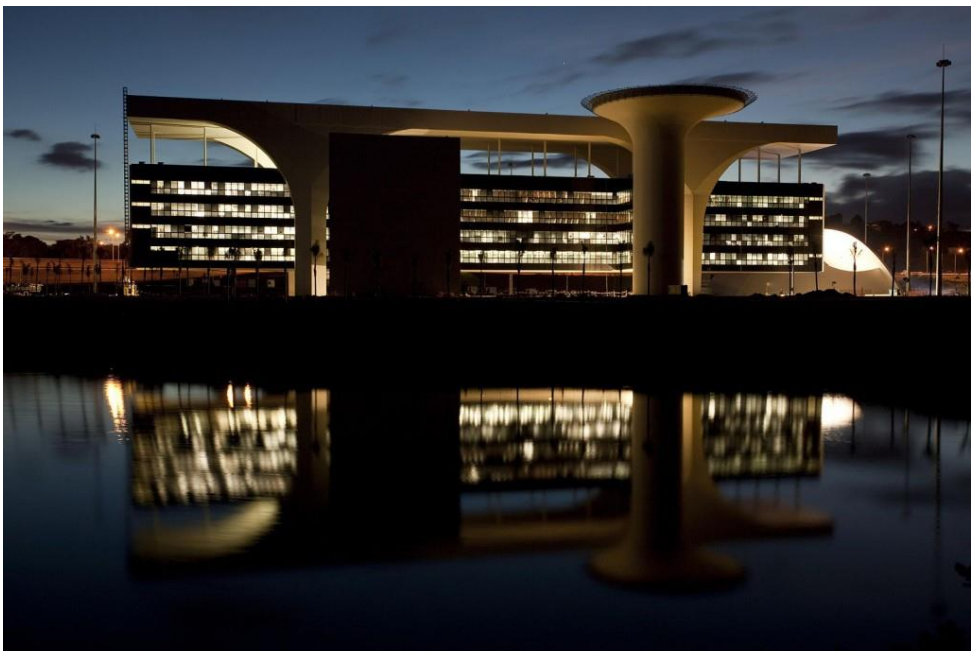

Figure 55: Palacio *Tiradentes*. Source: <http://implicities.com/pt-br/os-recursos-naturais>. Accessed in Dec. 2016.

3.1.3 Design in Minas Gerais

The sector of Design in the state of Minas Gerais has demonstrated an expansion, through the increase in interest and incentives from the government, as well as the increase in the offer of formation and specialization courses, placing professionals in the Market and heightening the demand for design services.

Today, local design counts with great support from Sebrae and Sebraetec. Sebrae is an acronym that, translated from the Portuguese language, stands for "service of support to micro and small companies. It is a non-profitable private association attending to every municipality in the state offering orientation to entrepreneurs, developing projects and promoting the creation and dissemination of public policies to the growth of small businesses (SEBRAE, 2016). Currently, Sebrae is one the institutions that invest the most in support to the Brazilian design.

Sebraetec is a program from Sebrae that supplies subsidies to technological consulting to micro and small companies. In this way, it provides opportunity for micro-entrepreneurs to have access to design programs, as well as offering an opportunity for designers to obtain their first clients.

The program also promotes the necessary interaction for the development of local businesses, at the length that it attends to demands of small entrepreneurs, of communities and start-up companies, with the action of young designers, including participants of incubated companies from research institutions and Universities (Vieira, 2014).

Minas Gerais also counts with the *Center Minas Design.* This being a proposition of the state government with the objective of "*invigorating and integrating different strands and agents of demand and offer of design in Minas Gerais"* (ED-UEMG).

The incentive to design in Minas happens also through awards such as the *Sebrae Minas Design* Award that has as main objective to spread and recognize the practice of design in small businesses. To this purpose, it awards projects that promote cost reduction, improves productive processes and efficient use of natural resources.

Another highlight is the Minas Trend, which is an event organized by the fashion industry of Minas Gerais. It gathers the main names and labels in fashion desing of Minas Gerais, becoming a significant platform for generation of business in the sector in Brazil.

Regarding education, there are today thirty-five design courses in Minas Gerais, seventeen of them being higher education of design technology and eighteen bachelor courses. The state also counts with seven graduate courses, one master's degree and one doctoral, both offered by the School of Design of UEMG (Sebrae's Report of Design in Brazil, 2014).

According to Sebrae's report of Design in Brazil (2014), the research in design in Minas Gerais counts primarily with the actions of the federal university (UFMG) and the state university (UEMG). At UFMG, through the ADAPTSE laboratory, linked to the department of projects of the school of architecture, the university acts in a didactic form, offering courses, events and presentations, beyond the publishing of reports and technical articles and the development of projects.

At UEMG, the research is conducted primarily through the program of post-graduation in design (PPGD) and is directed to the areas of design, innovation and sustainability, with two lines of research, Design in Culture and Society; and Design in Materials, Technologies and Processes.

The Brazilian association of design companies (Abedesing)[108], the most important entity in the sector in the country, conducted in December of 2015, a diagnosis of design in the state of Minas Gerais called "Perception of Design in Minas Gerais"[109], in partnership with FIEMG.

To this purpose, a qualitative research was conducted through personal interviews with designers and design companies of different modalities practiced in the state of Minas Gerais. The research also consulted companies of different sizes and different segments relevant to the economy of Minas Gerais.

The objective was to characterize on one side the demand of the company seeking design services and, on the other, the professionals available. Then the research sought to understand the points of divergence and convergence between the former and the later as to establish a dialogue. It also had the objective of supplying information to stimulate a better capacitation of designers and strengthen their relations with the companies.

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[108] ABEDESIGN – Brazilian Association of Design Companies – was founded in 2005, in São Paulo, with the objective of increasing the Market of design services, communicating to the market, institutions and government branches, the importance and the results that design propiciate to the Brazilian society and for the development of the country.

[109] The presentation of this research can be seen at: <http://abedesign.org.br/percepcao-do-design-abedesign-minas-gerais/>. Accessed in Dec. 2016.

In regard of characterization of design services offered in Minas Gerais, the vast majority of such services are offered by autonomous professionals, who either offer freelance services or work out of small offices. They are followed by medium or small sized companies, with up to forty employees. In the state, a configuration of large sized design company, with over one hundred employees, does not exist.

The main modalities of design practiced are graphic design and interior design. Product design, in spite of being less expressive, stands in third place. At the bottom of the list are social design and strategic design.

When the designers were asked which sectors seek for professionals the most, the answers pointed to the sales and shopping centers sectors, followed by the food industry, health, automotive and others. In the last place were the sectors of technology, start-ups and franchises, which are new segments in the demand for the offices.

This was a point of divergence between the answers of the companies and the answers of the designers. The companies that affirm to seek professionals the most were from the areas of the food industry, construction and steelworks industry. In the last place were the sectors of sales and shopping centers, followed by technology.

According to business owners, services of design are hired from out of the state of Minas Gerais. This type of service is bought alongside with services of communication, for local providers of design services are considered to be inadequate or below expectations.

Business owners complain that designers in Minas Gerais work focused on the final part of product conception. That is to say the aesthetics, the communication and publicity parts. Few designers act in the inside process of the company, in the development of the product. Thus, the designer fails to work with the intelligent, innovative and organizational parts of the process.

Furthermore, business owners complain of a lack of approximation from the designer to the productive process, to the internal functioning of the company and to the people working on it. They affirm this approximation could contribute to more organic and strategic design solutions. Business owners are seeing the necessity of acting in design in different phases of development of the product. They expect a more systemic action integrated with internal processes of the company.

The conception of design for the designers in Minas Gerais is further connected to the concept of visual communication, of the expression of a certain product, service or company. To business owners, design has a more pragmatic and rational meaning, seen as a tool of sales in the first place and, at a lower level, it is seen as a tool of efficiency for company processes, as a solution of intelligence.

According to interviewed designers, the market in the state of Minas Gerais remains in development. The support from Sebrae and Sebraetec is of paramount importance to the growth of the sector. Although there still is a shortage of big projects and big labels, there is a growing demand from start-ups and from the governmental sector.

Companies, on their turn, complain about the qualification of designers, affirming it often to be limited and too specialized. Some designers acting, for instance, solely in the area of product, refraining from any graphical work, or vice-versa. The companies also complain from the difficulties in hiring locally. Therefore, as mentioned previously, they resort to hiring out of state professionals.

The cost of service design was also a subject of complaints. It drives business owners, often, to hire visual communication companies, rather than design, for offering a wider service. Some companies opt for having an entire in-house team, arguing it to be more viable from the financial point of view, as well as for a matter of agility.

Designers act much more in an autonomous form, through indication from former clients, displaying a passive attitude towards business. Few designers seek partnerships or the development of a commercial area for selling their products.

According to the conclusion of Abedesign, the design practiced in Minas Gerais tends towards a tactical character, connected to matters of aesthetics and functionality, passing through an organizational design in search for a strategic design, in a way that it would act in a systemic way in all stages of the company. It is needed to address this way further in a strategic form to increase the influence of design and conquer the trust from the companies.

Among the companies interviewed, only 8% would hire organizational and strategic design. The vast majority resorted to hiring tactical level isolated services. However, the professionals providing such services are already being hired continuously, having thus, an opportunity to attempt to work in a strategic level while attending to a demand.

The recommendations presented as conclusion of the research are that once the designers desire to work on strategic level and companies want them to act on development, there should be a stronger immersion within the company.

There is also the necessity of sharing challenges and results. Companies often refrain from presenting the designer the challenges to be faced, debilitating their scope of action. In their turn, designers fail to clarify the results they can offer, hindering their credibility.

It is visible, on one side, a demand by companies for the improvement of the efficiency of processes and development; and on the other side, the desire from designers to act with strategic design and innovation. Thus, it is critical to heighten the dialogue with administrators regarding management and processes, as to have contributions in efficiency increase as well as in intelligence.

3.2 Design School - Minas Gerais State University (UEMG)

The history of UEMG Design School dates its origins back to 1955, when it was founded as the School of Fine Arts (UMA), though it only became fully operational in 1957. Subsequently, in 1963, The UMA was transformed into FUMA - Foundation Art University of Minas Gerais, and in 1965, it was certificated and recognized as University[110]. According to Dias (2012), the first courses offered were in Fine Arts, Industrial Design, Visual Communication, Decoration and Illustration Teaching.

Its first pedagogical plan was idealized following the principles of Bauhaus: the balance between theory and practice, the direction towards reality of work and the presence of creative professors. According to Osvaldo Amaral (*apud* Aguiar, 2006), in spite of following Bauhaus, FUMA was in its own merit an innovative endeavor for the time, presenting a more scientific and rational pedagogical line based on mathematical principles.

The inaugural curriculum of the school privileged technical subjects. At first, all the courses of the school had a common set of disciplines and the students would opt for a specialization to follow.

In the decade of 1970, the school underwent great influence of teachings from the Ulm and ESDI schools. In this period, the state of Minas Gerais developed from an economy based on agriculture and cattle raising into an industrial economy. With the installation of the automobile factory of FIAT and other 700 industries, there came the need to adequate teaching and mass production (Aguiar, 2006).

It was also in the decade of 1970 that the foundation of Cetec occurred – Technological Center of Minas Gerais[111], connected to the university through its design sector. Despite all of this movement, in that time, design still wasn't recognized in the state by the local businessmen. The design work was realized only in the university, isolated from local reality.

[110] The UEMG school of design (named FUMA at the time) is not acknowledged as the first school of design in Brazil because it was only certified as a University in 1964. Such recognition goes to ESDI, as previously noted.

[111] Cetec was the first institution in the country responsible for research in technology related to industrial design. To this day, Cetec is still considered the main technological base in the state of Minas Gerais.

In 1970, the curriculum of the school suffered significant alterations with the adding of new disciplines. These included Expression I II and III, Expressive Materials and Perspective and Shadow. This addition occurred mainly to approximate the course to the Industrial Design and the Plastic Arts Graduate courses. At that time, most of the professionals graduated in Plastic Arts occupied teaching positions in the course of Industrial Design (Aguiar, 2006).

Figure 56: Former headquarters of Design School, where FUMA functioned. Available at: <http://www.ed.uemg.br/sobre-ed/historia>. Accessed in Dec. 2016.

The country lived a military dictatorship, which restrained the action of designers. One example is the case of Professor Ricardo Mineiro: from a progressive and libertarian vision, back in 1973, he started a project of interaction, through a participative approach, within an artisanship community. This developed ecological solutions for the labor of artisans.

However, the same Professor was persecuted by the military dictatorship, hindering the project. The Professor, according to Dijon de Moraes (*apud* Aguiar, 2006), had an extreme sensitivity to the social problems of Brazil. When incorporated to the teaching body of the design school, he brought a rich theoretical debate around the social function of design.

According to former Professor Mário Generoso, the students of that time were knowledgeable, sensible, with immense spatial vision, what allowed to unite technical efficiency and design.

At that time, similarly to what occurred in ESDI, most of the Professors were either from architecture and plastic arts, or recently graduated designers with little to no experience in teaching the knowledge of design.

In the decade of 1980, with the end of the military dictatorship, the post-modernist movement arrived in Brazil, making teaching more flexible and contextualized with contemporaneity. The idea of rationalism as a single model and as a precise answer to all human questions was surpassed (Moraes, a*pud* Aguiar, 2006).

The courses offered by the school began to be called Industrial Design with habilitations in Product Project and Visual Programming; Interior Design; and graduation in Illustration and Plastic.

In 1981, the discipline Design Practice started in the school. It demanded a comprehension of the process methods, with focus in creation. The course stimulated the integration of product, technology, life style and economy. This brought a great development for the students in their projects.

The Industrial Design course started to have a scientific and technological character, approximate to engineering, heightening invention, perfecting and utilization of industrial technique. According to Aguiar (2006), the higher weight of disciplines was in the department of technology and science, with thirty disciplines, followed by planning and project with twenty-two. The department of arts and culture, in the last position, had seventeen disciplines. All of this was in accordance to the curricular matrix approved by the State Council of Education in 1988.

In the same year, the center of extension was installed in the school with the purpose of developing short term courses, design projects and also exhibit showcases of the student`s productions. This propitiated visibility for the school, through receiving awards of quality in design and forming importing partnerships.

In the decade of 1990, along with the new modernity and globalization, a new phase for the school of design started. Investment in research grew as well as the search for new partnerships and the beginning of the formation of doctors. The focus shifted from science towards research. According to Moraes (*apud* Aguiar,

2006), in this phase the subjective aspects, such as aesthetics and intuition, began to add value to the design.

Still in the decade of 1990, FUMA was absorbed by UEMG (Pedagogical Project, 2003). There was the creation of centers, laboratories and research cores. The first laboratory was of visual programming, with the purchase of modern computers through a partnership with FUNDEP – Foundation of Support to Research of Minas Gerais.

At that time, the school also received its first doctor in administration and production engineering, Professor Jairo Câmara. He was the winner of the first edition of the French award *Defi-Alu* 90 – an international contest of design for perfume flasks. Such recognition added visibility to the school. Consequently, Câmara was invited to be on the *juri* of the "Shell Marathon" in the years of 1992 and 1993. In sequence, he started the *Sabiá* project in the school, which is a program for developing experimental ecological race cars to compete in Shell`s Eco-Marathon.

In 1994, the *Sabiá I* won the *"Prinx d'Honneur du Design"*, in France. It was also awarded in the editions of 2000, 2004 and 2005. The *Sabiá* IV became a symbol of the competition in 2002, being part of all the publicity material. The objective of *Sabiá* in the competitions, according to Jairo Câmara, was to cause visual and functional impact, above the speed records, confirming the interests of the UEMG design school (UEMG, 2016).

Figure 57: Sabiá IV. Available at: <http://www.lexicarbrasil.com.br/universidades>. Accessed in Dec. 2016.

Jairo Câmara was also responsible for the creation of CPqD – from the Portuguese, Center of Research and Development in Design and Ergonomics. To this day, it remains an important center of research that supplies scholarships to professors and students. The CPqD has also been fundamental in the creation of the master`s and doctoral programs in Materials Engineering in partnership with UFOP – Federal University of *Ouro Preto*, and the CETEC, becoming the only credentialed center in UEMG to receive master`s candidates.

The CPqD is a multiple center, aggregating several research lines, such as Design; Ecodesign; Arts and Design; Applied Ergonomics; Material Selection; Fashion Design; Automotive Design; Alternative Woods; and Memory Reflection and Teaching. The center has obtained notoriety primarily in the sector of Transportation Design, having ten professionals admitted by the automotive sector and twenty masters and doctors in the same field (Aguiar, 2006).

Another paramount is Dijon de Moraes, who perfected his knowledge in Milan with a masters and doctoral degree. Upon returning to Brazil, he received awards in nearly all of the national design contests along with a number of international contests. Moraes wrote sereval books, including notably works such as "*Limites do Design"* (Limits of Design, 1997); "*Análise do Design Brasileiro"* (Analisys of Brazilian Design, 2006); "*Metaprojeto, o Design do Design"* (Metaproject, the Design of Design, 2010).

In the decade of 1990, there were strong advances in the extension and post-graduation of the school, with the support of its diverse cores and through partnerships. There was also the beginning of active student participation in projects of social, cultural and economic importance for the state of Minas Gerais and Brazil.

Despite all advances in research and structure of the University, there remained a failure in the content of teaching. According to Moraes (*apud* Aguiar, 2006), the teaching plan was exceedingly focused in objective disciplines, applied in detriment of subjects that would stimulate conceptual reflective thought. All of this in order to obtain technical professionals, rather than critical.

The research centers would act autonomously approximating to the community and the productive reality. In parallel, the curriculum continued to present a rational and technical character.

Other research center were created in the university, such as the Center for Design Project Development, formerly the design laboratory; the Center for Surface Design; Artisanship Design; Typography; among others. In total, twelve centers were created.

In 1997, the FUMA was officially renamed to *Escola de Design* (from the Portuguese, Design School), in a strategy to satisfy the national design teaching association – ANED-BR, thus ensuring the school's participation in the Brazilian design program, in order to obtain subsidies for research and formation.

In the beginning of the new millennium, with the globalization, the design started to be understood as a complex subject, which required a systemic vision from the designers. According to Moraes (*apud* Aguiar, 2006), it was necessary to consider a triple aspect: design, culture and territory. Questions such as environmental issues, consumerism and social demands started to be accounted for. A shift occurred in the design values, aesthetics, for instance, started to follow ethics and the behavioral method of social groups. The activity of designing phases to the intellectual level with the existence of a project culture.

In 2003, the then government of the state of Minas Gerais, Aécio Neves, published the delegated law nº 91, which allowed didactic-scientific, administrative, finance and disciplinary autonomy to the University.

Several alterations were approved in the courses offered by the school, with a new curriculum approved in 2004 by CEP – from the Portuguese, Superior Council of UEMG. The new curriculum followed the orientations of the report Cesu-CNE n.0146, of April, 2002, which approved the national curricular directives of the graduation course in Design.

The new curriculum sought to measure the disciplines in 28.7% of theory, 35% of practice and 36.3% of theoretical practice. It also altered the length of courses to be four years long[112].

Beyond the alterations in the curriculum, there was a fierce advance in the activities of the centers of research and extension, as well as in the laboratories. The management of such facilities was divided among the study centers, what lead to increased support in complementary actions for teaching design (Aguiar, 2006).

Currently, the aforementioned centers are what maintain the University in contact with the external context. They work through partnerships with public and private institutions as well as the community. Today, they represent the primary form of maintaining the courses in consonance with the productive reality. Presently, the school counts with the action of ten research centers and laboratories, as shown in the figure below.

[112] Previously, the courses had a total lenght of five years, with the antecedent curriculum being in use from 1989 until 2003.

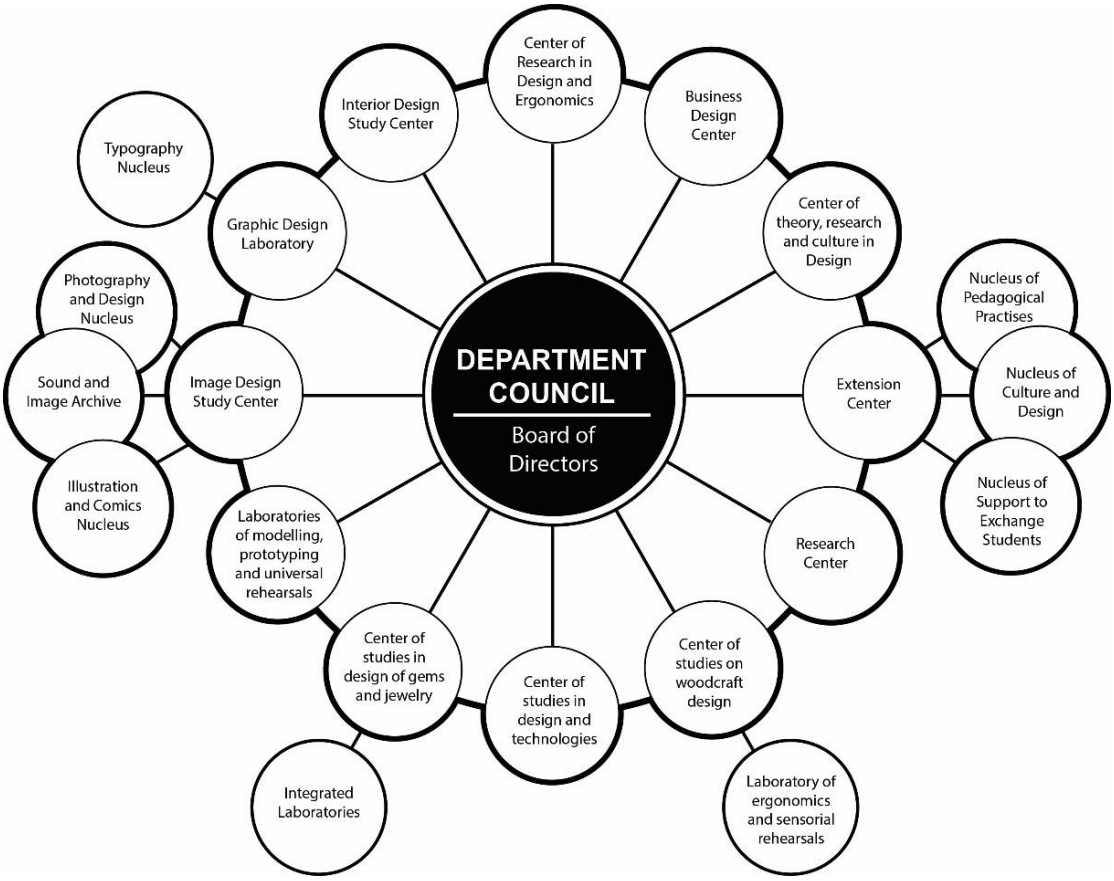


Figure 58: Organogram of the research centers of the Design School. Adapted from UEMG (2015).

The sector of post-graduation in the School underwent considerable progress as well. Currently, it offers three *Lato Sensu* post-graduation in the specialties “Design Management”, “Gems and Jewelry Design”; and “Furniture Design”. Furthermore, it counts with the *Strictu Sensu* courses of masters and doctoral degrees.

The masters course presents two research lines, “Design, Culture and Society”; and “Design, Materials, Technology and Processes”. In addition, the doctoral course offers the research lines in “Technology, Materials and Ergonomics”; and “Culture and Design Process Management”.

In the graduation course, today, the courses are “Product Design”, “Graphic Design”, “Interior Design” and “Graduation on Visual Arts”.

3.2.1 Product Design Course

The Product Design course, which will be the focus of this study, has a total lenght of four years distributed in eight periods, averaging forty students per class. The selective process is held once a year by a system of classification. According to the pedagogical project of the course, created in 2003 and still in use, the course has the objective of:

> *To form human resources capable of delineating the general structure of the design process, both in regard of the aspects of the Project activity, as well as in identifying and anticipating design problems related to the universal orientation of the discipline that promote the balance of nature with physical, economic and social well-being of the individual.*
>
> (Pedagogical Project, 2003)

Moreover, the specific objectives foresee a professional formation in syntony with the local development plans, handling of the holistic process of problem solutions in design; critical reflection on the context dynamics; partnership and reciprocity with the society to provoke intervention and improvement in the surrounding environment.

In addition, according to the document, the course possesses a generalist character. Among the requirements dedicated to the professional profile intended, the following are due of note:

- Capacity to articulate systemic, methodology and creatively elements of human culture;

- Ability to dialogue with other areas and act in multidisciplinary teams;

The systemic approach in the pedagogical project (2003) is seen as a way of understanding all aspects involved in a design problem from the organization of the whole. To this purpose, an integrated and transdisciplinary approach is proposed. Thus, the contents of other areas should be addressed in regard of the process of design.

The pedagogical process is divided in three levels. The first level targets the basic specific content, such as theory of design, general methodology and development of potential creative thought. The second level addresses analysis and development of concepts, with an exploration of different design problems,

building expertise and project laboratories. The third and last level is dedicated to the perfecting and domain, through application of the methods studied in the management of product development in projects connected to the professional practice. The primary idea is for content to pass through approach levels in a way that the level of complexity is increased.

The disciplines in the course relate to the project practice, attempting to establish a balance between exact and human sciences. In the figure below, one can see the distribution of subjects addressed during the four years in the course. In green, the disciplines of the humanities, whereas in purple are the exact sciences. The ones in orange belong to the group of practical disciplines.

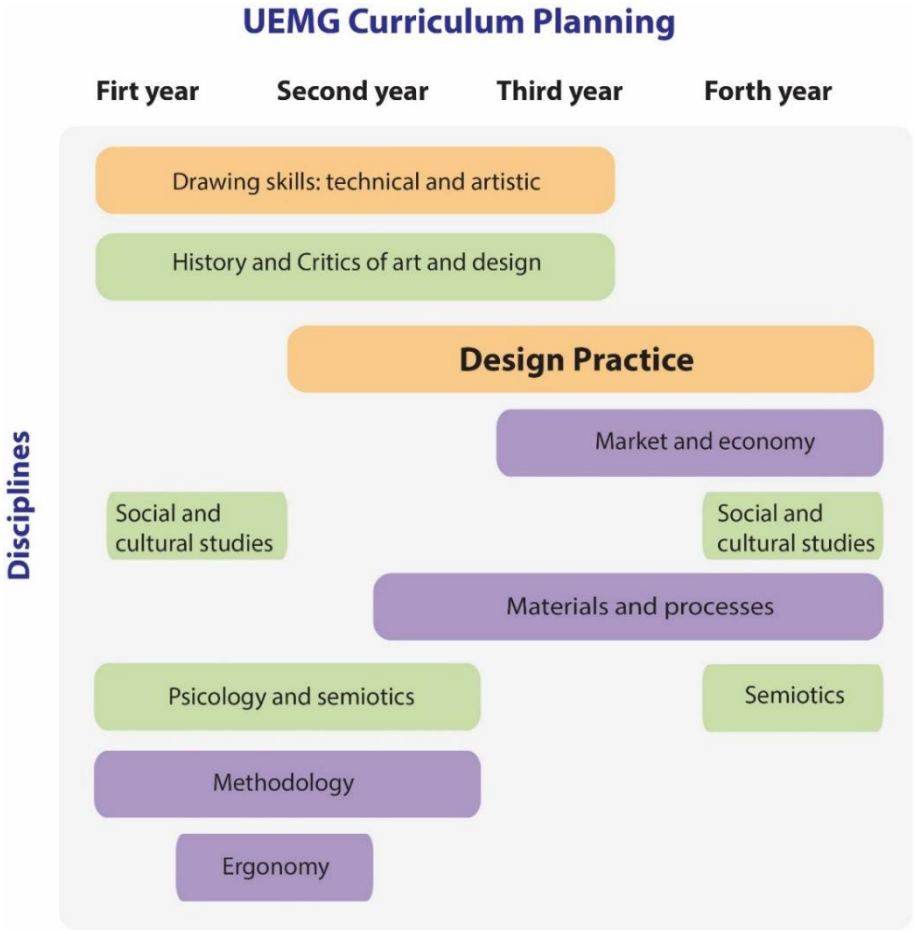


Figure 59: Design School curriculum planning.

Considering the project practice discipline, this study analyzed the syllabus, available at the website of UEMG's design school. In regard of the contents and methodology, it is possible to observe that the basic bibliography suggested by all Professors, from the second to the eighth period, used as primary reference the book by Mike Baxter[113], *Product Design - Practical methods for the systematic development of new products* (1998). According to Ponds (2010), the same occurs in most of design schools in Brazil.

Other highly recommended bibliography include the works of Bernhard E. Burdek, *Design: History, Theory and Practice of Product Design* (2005); and Bernard Lobach's *Industrial Design* (2001). *The Art of Innovation* (2002) by Tom Kelley and Jonathan Littman is another work often used, this being the single one with an innovative character. Only one Professor recommends as complementary bibliography the book by Tim Brown, *Design Thinking* (2010), the most prominent work published on this theme.

Mike Baxter describes the methodology for development of new products as tools and strategies to be followed during the project process. The techniques in the book are geared towards mass production and for the interests of large companies with little ecological concern. The book covers the entire process of development of new products, based on analysis and market research, conceptual design, development and manufacturing specifications. The focus is on the systematic control and well management of the entire process using a series of techniques that aim to prevent failure and ensure success of the new product. Innovation appears as keyword and is presented in a systematic and rational manner.

Baxter (1998) argues that new products are developed for the consumer; the designer must interpret their needs, dreams, desires, values and expectations. Development must be solved in stages and with very clear specifications involving planning, related to the technical and economic viability into a structured process. It is marked by advances and withdraws, in which earlier stages are revised constantly, analyzing the implications of new ideas. Each step represents a cycle of idea generation, followed by a selection of those.

[113] Mike Baxter is director of the Design Research Center at Brunel University (England), where he also teaches product design. The author is also a teacher in practical courses for professionals in England, the United States and in Denmark.

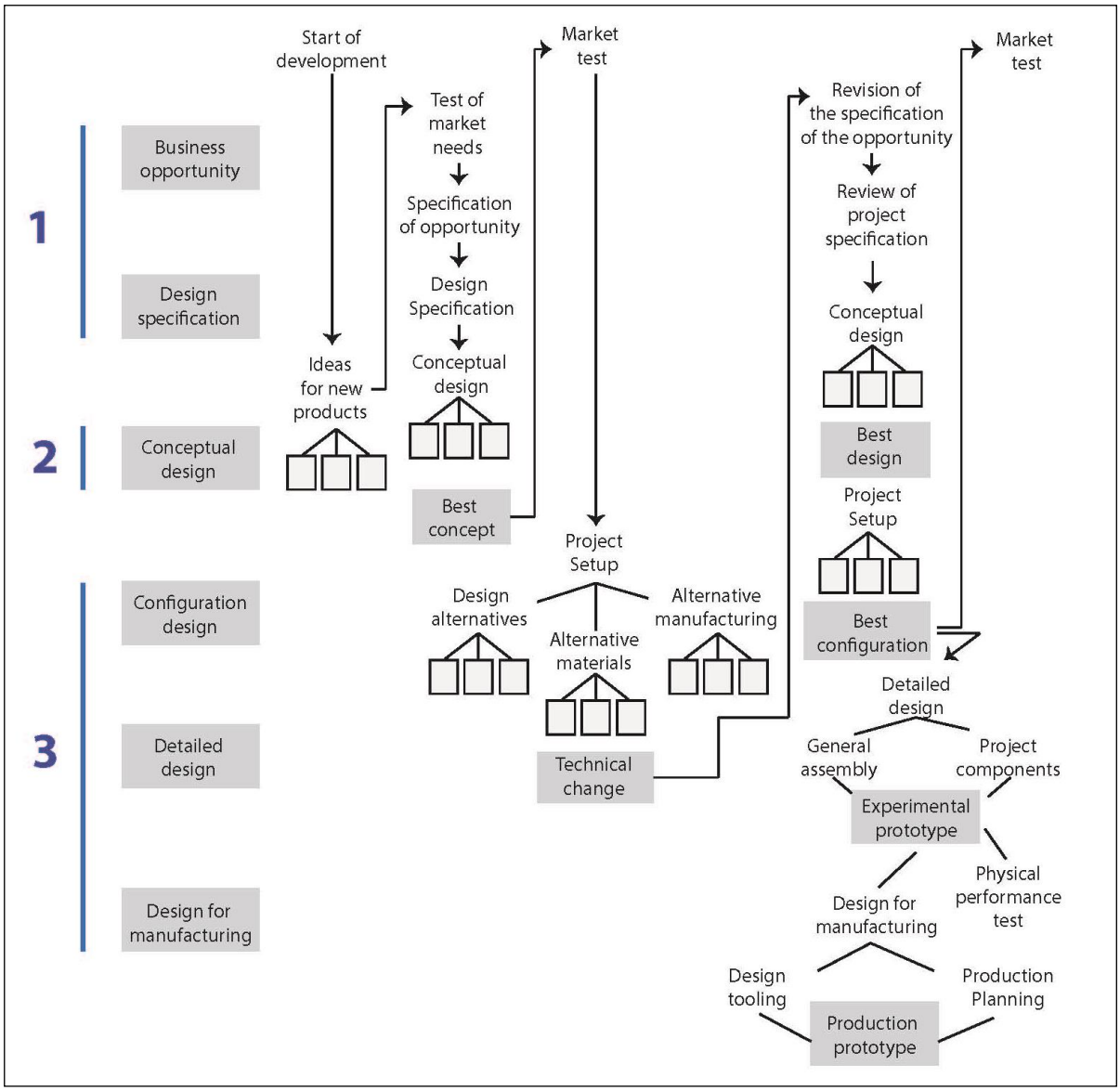


Figure 60: Design activities in different stages of product development – Adapted from Baxter (2000)

The method of Baxter can be divided into three basic steps, (1) Product Planning, (2) Conceptual Design and (3) Configuration and detailing.

The first phase, Product Planning includes: identification of an opportunity, marketing research, analysis of competing products, new product proposal, drafting the specification of opportunity and design specification. The author considers this phase of extreme importance, because the product is more likely to have success when based on a clear and precise specification. At this stage, the important decisions are made, before the beginning of development. Furthermore, this is the

moment that costs are lower, thus decreasing the risk. The process of product planning focuses on better market orientation, in order to determine the specific qualities to be incorporated in the product.

In the second phase, the conceptual design begins, when the principles for the new product will be determined. The key of the conceptual design is to make it possible to generate the greatest number of concepts and select the best out of them. With this aim, the conceptual design is divided into stages, for the problem to be analyzed and defined. Consequently, ideas are generated for a possible concept and there is a final selection.

Baxter affirms that the generation of concepts requires intuition, imagination and logical thinking. To this purpose, the author presents methods of concept generation that help reduce the problem of conceptual design to its basic elements (abstraction) and use structured techniques of thought (tools) to analyze different aspects of the conceptual design and generate a large number of possible alternatives for problem solution.

The project configuration works on the selected concept and determines how it will be done. It decides not only the product architecture and the design of their components, but also the general outline of materials and manufacturing processes. The project configuration goes as far as the product prototype. The detailed design produces a set of technical drawings and manufacturing specifications, sufficient for the industrial production of the product.

Table 2**:** Actions and results present in Baxter's approach

Phases	Actions	Expected results
Planning	Research involving: • Market Opportunity • Demand and consumer desire • Competing products • Technological Opportunities	• Identification and specification of opportunity • Design Specification (specific qualities to be incorporated in the product)
Concept	• Use of incentive tools of creativity • Analysis of the product universe involving ergonomics, function, life cycle and value analysis.	• Set of functional principles and style to the product which meet the specifications of opportunity.
Detailing	• Technical drawings • Construction of prototype	• Product architecture • Design of components • Determination of materials and manufacturing process

Baxter´s methodology, geared for mass production and technological innovation, envisions a business-oriented context, aiming for competitive, profitable and innovative products. The methodology starts from a deep research, passing by a development of the greatest number of ideas, finally arriving at an ideal solution, i.e. an innovative product.

This methodology, presented by Baxter, is old, however solid, and has been many times proven. This credibility induces Professors to continue employing it. However, this method fits less and less in today's world, not attending to the concerns with environment, with the territory and the system around the problem to be solved.

In interviews with the Professors of the Design School[114], it was possible to perceive that they recognize the necessity of innovation in the methodology used by the school. However, a number of barriers, especially in regard of the work market, can be pointed.

One of the Professors affirmed that it is necessary to have an awareness from the local businessmen in the first place, for they already offer resistance in accepting the "traditional" design, not holding much regard for the designer as a professional.

In pertinence to the students, Professors believe that they are not prepared for a complex thought, in which systemic issues would be addressed. There remains a tradition of focusing the project solely in the product, what represents for students and teachers a difficult barrier to surpass. Some Professors go as far as to display degrees of prejudice against approaches such as the Design Thinking, which in practice is not addressed in any discipline.

Professors also complain of the difficulty in introducing new disciplines and in proposing changes to the syllabus. These are bureaucratic matters, which depend on the approval of different levels in the managing structure of the school. Consequently, the methodology is often held back from innovation.

Some Professors have taken the initiative to try to introduce new approaches in their disciplines. One of these initiatives, while still in post-graduation, came from Dijon de Moraes, who in the years of 2004 and 2005, taught a module about metaproject in the REDEMAT[115] master's degree course, as well as in the

[114] Interviews realized in October of 2016, with all current Professors of the Project Practice disciplines of the UEMG Design School.

[115] REDEMAT, from the Portuguese, Thematic Network in Materials Engineering, is an association between UEMG, CETEC and the Federal University of *Ouro Preto* – UFOP, offering

specialization (*Lato Sensu* graduation course) in Design Management for micro and small companies.

Another initiative came from Paulo Miranda e Pedro Nascimento, who in 2014, applied the systemic design methodology for students in the Product Design graduation course.

These two experiences, with the positive and negative points of each, will be addressed in the following pages.

courses of master's and doctoral degrees in the field of Materials Engineering. Available at:< http://www.redemat.ufop.br/>. Accessed in December 2016.

3.3 New Approaches Experience

3.3.1 Experience of Metaproject Approach Application

The metaproject model presented by Dijon de Moraes (Moraes, 2010), constitutes a support to conventional methodology, as well as a support for reflection in the elaboration of the project research.

Its objective is to propitiate an existing or future scenario from a platform of knowledge, in which an analysis is presented about the industrial products or services. In this analysis, verifications are conducted concerning the cycle of life, the productive technology and the applicable raw materials; social and market factors; as well as the formal aesthetic coherence and the factors of usability.

The approach occurs before the project phase, elaborating different possibilities through new conceptual propositions. Thus, it explores the potencies of design, by means of mapping the previous knowledge regarding the product, evaluating its positive and negative points in relation to its development.

Far from a static and traditional projective method, it is a support for reflection to the organization and elaboration of the reach of the project research.

Dijon de Moraes realized an experiment with the application of the metaproject in different graduate classes and in different levels of complexity.

The following examples will presented: the application of the metaproject in a *Lato Sensu* graduate class, its application in a master's class and its application in a system, in this case, a local productive arrangement in the state of Minas Gerais.

The experimental application in the *Lato Sensu* specialization course occurred in the course of Design Management for micro and small companies in the school of Design of UEMG, realized in the year 2005.

The application module had the duration of 16 hours and counted with the participation of 40 students in one multidisciplinary class with different origins in areas beyond design, such as engineering, architecture, communication, administration and others. According to Moraes (2010), this diversity served also to evaluate the resourcefulness and understanding of the approach by actors from diverse culture and backgrounds.

The course was divided in two parts, the first of them being theoretical, for the introduction of the metaproject and levelling of knowledge of the students. This phase had the duration of eight hours. The second part, of practical application,

occurred in the eight following hours. The class was divided in groups and products previously chosen from different industrial segments were distributed[116].

These products were evaluated in relation to a number of different aspects including the market's scenario, strategic positioning, sociocultural influences, the design-product relation, the formal and ergonomic typology, the productive technology, the materials employed and the environmental sustainability.

Through the analysis of these factors, it was possible to construct a scenario around the product and thus point out possible flaws, which could also be perceived as project opportunities. Beyond that, success factors of the products were identified, contributing further to its improvement.

In the year of 2004, a master's degree module was developed in the course of Materials Engineering at REDEMAT. This module, being an elective discipline, was recipient of great interest from the students. The module had an average length of forty hours allowing the course to go into further depths.

It was observed that beyond a richer and more consistent development of the research that involves the metaproject model, the students also developed the critical and discursive capacity. During the course, questions and theoretical discussions were raised concerning the solution of basic questions presented by the analyzed products. Yet another point of discussion came from the student's perception of the lack of design approaches presenting environmental awareness.

To exemplify, in this experience, one of the groups conducted an analysis of the Nike "Shox Cog" sport shoes. This took the form of a hypothetical analysis, based on the deductive method. With the objective of measuring the product against the requirements of the metaproject, students sought to discover possible points where designers could act in order to make the project the most resolved as possible (Moraes, 2010).

The product was analyzed under the same scrutiny of the products in the *Lato Sensu* course. Within the market factors, the analysis considered the local and global scenarios; its historic acting in a still static context; and its acting in the contemporary dynamic scenario. The positioning of the product in regard of design and environmental sustainability was also analyzed, as well as the design system, in what refers to the whole strategy of communication and coherence to the product.

[116] The products were: mineral water plastic bottle for the practice of sports, shampoo and conditioner recipients, vodka bottles, disposable shaving kit, gardening tools.

Finally, the productive technology and materials employed, along with their formal typological factors were considered, including aspects of use and ergonomics.

Thus, through the metaproject, a reflective analysis was carried out regarding the objective and subjective aspects of the products, building a scenario complete of information that conducts to the comprehension of the real necessities surrounding it.

The metaproject, with its characteristic systemic analysis, lead to an even more complex project, this time outside the scope of the university. Dijon de Moraes was invited to manage the territorial marketing of *Arranjo Produtivo Moveleiro* (from the portuguese, "furniture productive arrangement"), in the city of Ubá, in the state of *Minas Gerais*[117]. This center of furniture makers presents, according to Moraes (2010), a great domain and technological potency. However, it presents flaws in relation to their communication system, including marketing, distribution and also design.

The objective was to apply the metaproject to construct the territorial marketing for the local scenario. It was also intended to establish short, mid and long-term goals to increase the productive and market possibilities.

The project counted with the involvement of several stakeholders and collaborators, such as businessmen, unions and governmental branches. It took approximately four hundred hours of work, including workshops, thematic encounters, meetings with research institutes and publicity agencies.

These actions were divided in three stages. The first stage was the construction of a work plan in which the initial proposals were discussed. In turn, the second stage propitiated a series of debates on the results of the researches realized. These debates counted with the participation of managers and stakeholders, seeking to verify the compatibility of the proposed actions with the possible actions. Finally, the third phase ensured the final construction of the strategic actions.

These meetings determined the profile of the furniture center, its mission, identity, strategic positioning and market segmentation. This was conducted, primarily through research and discussion with the parts involved. Finally, twelve

[117] The furniture center of the city of Ubá, in the state of Minas Gerais is the largest center of the state and the third largest in the country. The center hosts over three hundred and fifty furniture companies, generating sixteen thousand direct jobs and twenty thousand indirect jobs. Available at: <http://www.femur.com.br/?modulo=uba>. Accessed on Dec. 2016.

indicators were conceived to integrate the strategic planning of the furniture center of Ubá.

The brief application experience of UEMG`s metaproject, in the scopes of post-graduation, served as an introductory base for a systemic thinking by the students. In addressing the initial phases of the project, specifically the research phase, the metaproject amplified the student`s vision of the product or system in question, allowing for the construction of a scenario rich in information.

The involvement with stakeholders during the analysis, the opening for multidisciplinary teams and the participative design during the process allowed for a rich exchange of information, leading the project to a more realistic and dynamic scope. Besides that, as previously noted, the work increased the critical and discursive capacity of the students.

The studied metaproject experience within the university, albeit short and limited to post-graduate classes, was highly noted in the academic environment.

Therefore, it has continued to be utilized as a tool preceding the project, facilitating for students and Professors to work with complex and dynamic issues.

3.3.2 Experience of Systemic Approach Application

In 2015, an experiment was conducted at the UEMG Design School, in which Paulo Miranda and Pedro Nascimento[118], both with experience in Systemic Design by the Polytechnic University of Turin, worked with undergraduate students applying a methodology that followed the principles of systemic thinking.

The main objective was to introduce the systemic thinking and show the students a new way of designing, with focus in the context and in people, not solely in the product. The meetings took place once a week for sixteen weeks, lasting 4 hours each. The participating classes were of the fifth and sixth period in the Disciplines of Project Practice III and IV. The figure below represents a synthesis of the process followed in the experience:

[118] Paulo Miranda was a professor at ED-UEMG with a PhD in Systemic Design from the Polytechnic University of Turin. Pedro Nascimento was also a professor at ED-UEMG and participated in the program "Youth Citizens of the World" in 2008 at the Polytechnic of Turin, attending an intensive course of Systemic Design with a duration of one month.

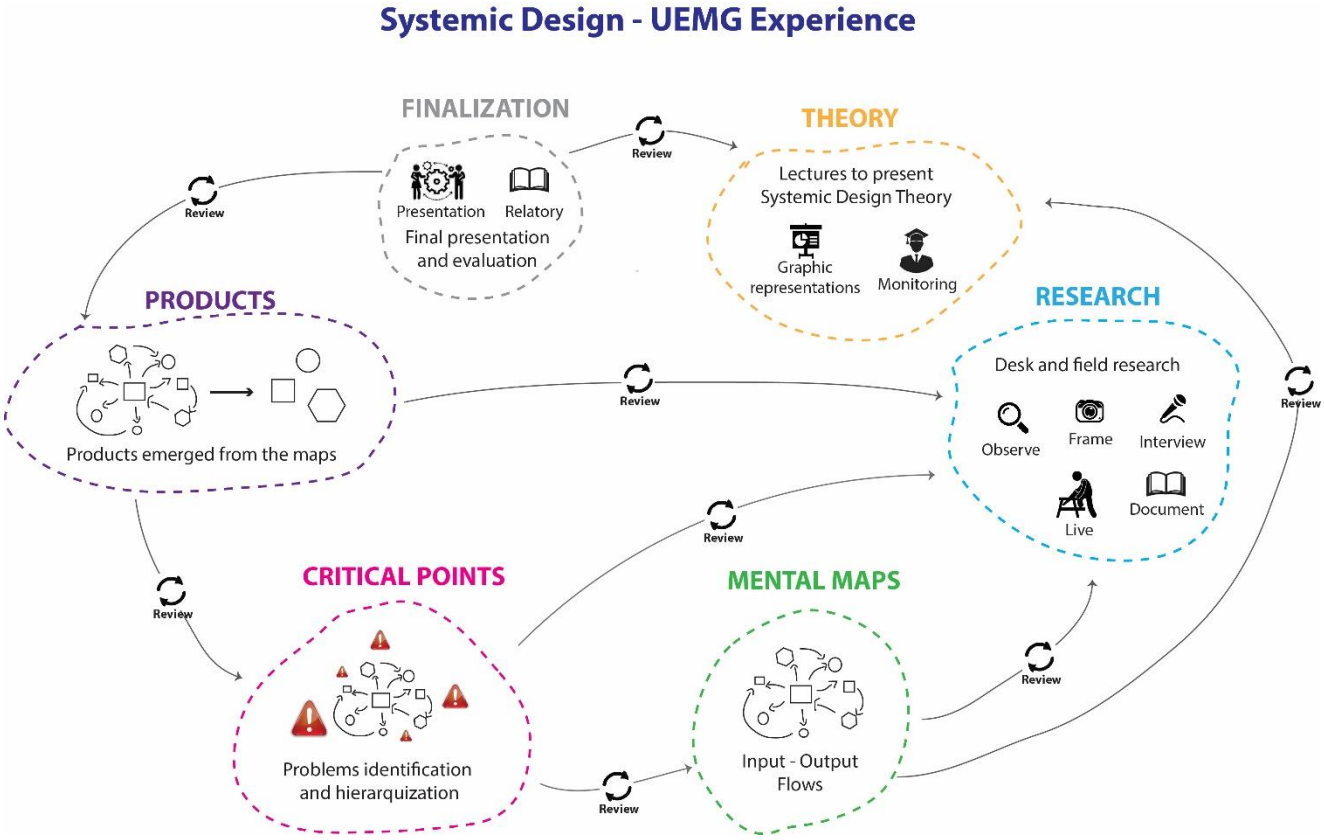


Figure 61: Application of systemic design experience - School of Design (UEMG)

In the first lectures, the systemic design theory was presented to the students, as well as the project and the methodology that would be developed. Professors used as primary reference a number of academic articles and materials from researchers of the Polytechnic of Turim[119]. The students were divided into free-choice groups to develop the project.

The students were then induced to choose a scenario to analyze and identify opportunities of intervention. From the start, professors considered the difficulty that students could have with the complexity and they proposed to choose not a

[119] The main references mentioned were the article "*Systemic Design - An interdisciplinary approach to innovation"*, by Luigi Bistagnino, published in *Collection of Advanced Studies in Design* (2009). And the book "*Man at the center of the project*", developed by professors and members of the Department of Architectural Design and Industrial Design of the Polytechnic of Turin (2008).

wide territory, but an indoor environments such as a bussiness system, a house or a service provider.

The first stage of the methodology consisted of an extensive theoretical and field research, in which students were directed to fulfill five stages:

- Observe – the context, the elements involved and their relationships;
- Register – the dynamics of the context, through photographs, videos, notes;
- Experience – to live within the context and experiment the dynamics involved;
- Interviewing – people living in this context, assuming different points of view;
- Document – through a report, what has been observed, perceived and experienced.

The research was carried out by the students through an imersion in the chosen environment, along with the users and other people involved. The purpose was for them to collect qualitative and quantitative data about the inputs and outputs of the system, information about the flows of matter and energy and the relationships between the actors involved, directly and indirectly.

From this research students used the collected material to construct a map of the context. In this map, the inputs and outputs of the system, as well as the relations flows, had already been placed. Large paper formats, sketches, image cutouts, post-its, lines and pins were used as work tools in the beginning of the project to make sketches by hand. With the information better organized in the initial sketches, students would remake the map in a computer.

Figure 62: Example of students working on the initial mapping in group. Photo: Miranda, Paulo (2015).

To construct the map of the entire linear process with all aspects, students divided the process in areas, and then the areas were put together to built the system and estabilish the relations between them.

To illustrate this process, the work of the student Barbara Rabelo serves as an example. She worked in the context of a hair styling business. The business was analysed in relation to the external local context, i.e. the Brazilian and Minas Gerais context, in a generalist way; and a deep analysis in the internal environment was conducted.

To this purpose, the internal activities inside the business were divided as shown in the pictures below. The picture illustrates the architectural plan in the areas of hair treatment, nails treatment, reception and bathroom, in the first flloor, with the kitchen and waxing area in the second floor.

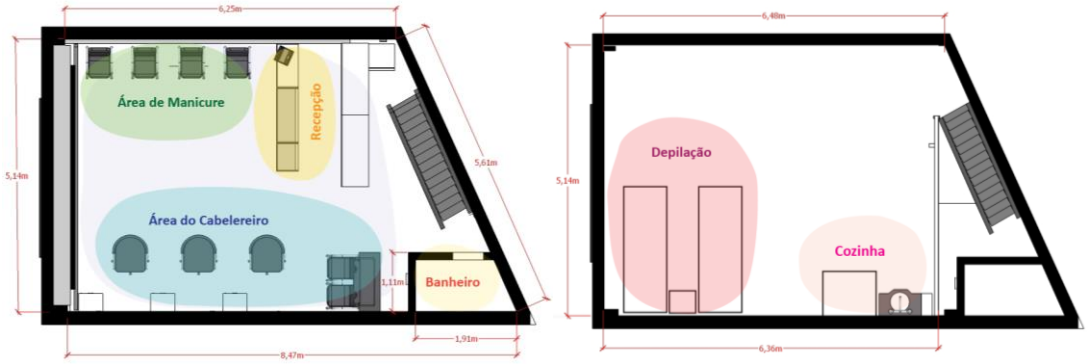
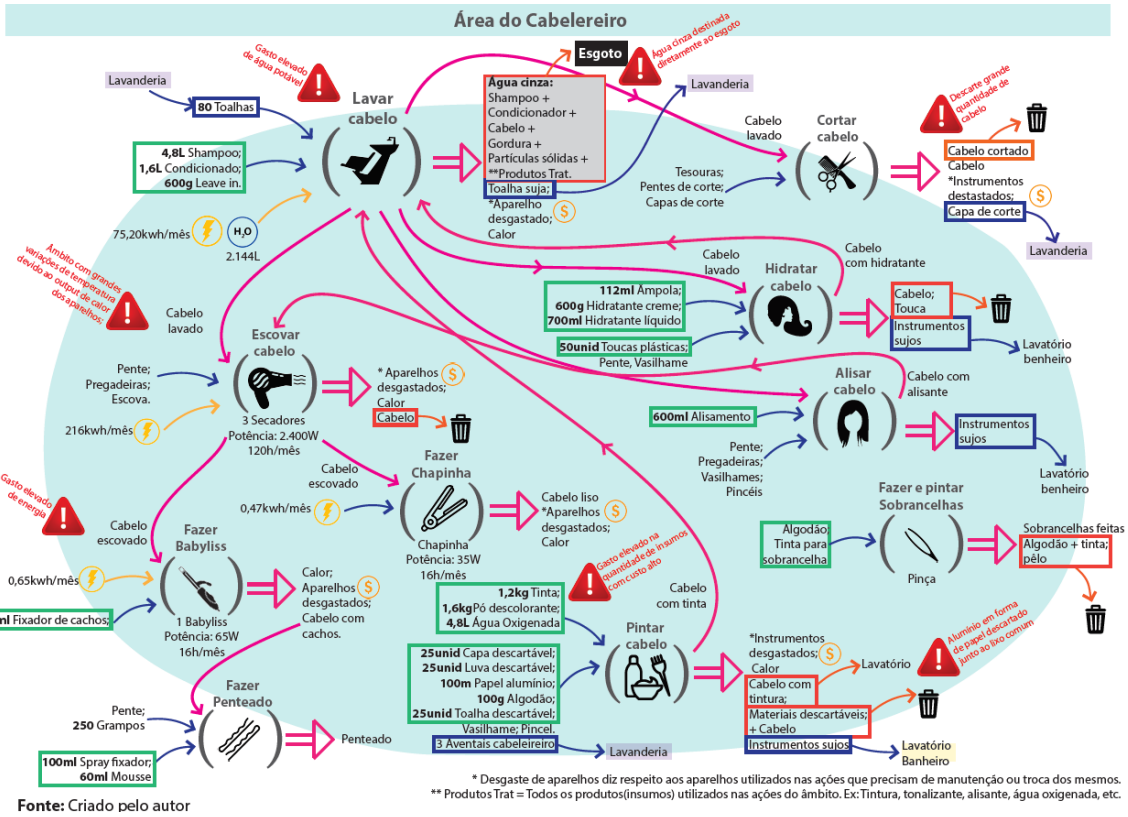


Figure 63: Areas of analysis of a hairstyle business. Source: Rabelo, 2015.

Each of those areas was analysed separately and a map was constructed pointing the inputs and outputs considering the quantity of matter and energy of each action inside that activity and the monetary cost. The picture below (Figure 64) shows an example of the linear system of the hair treatment area.



Fonte: Criado pelo autor

Figure 64: Linear system of the hair treatment area. Source: Rabelo, 2015.

During this stage, revisions of the research and the theory were made. With the map ready, the students were able to identify critical points that needed to be worked on. These points were identified with symbols and were hierarchized according to the need for intervention.

In sequence, all the activities anlysed were put toghether and the relationship between them was established. By analysing the flows, the waste and the needs of the system, students constructed the systemic map where the outputs of one activity become a resource for another:

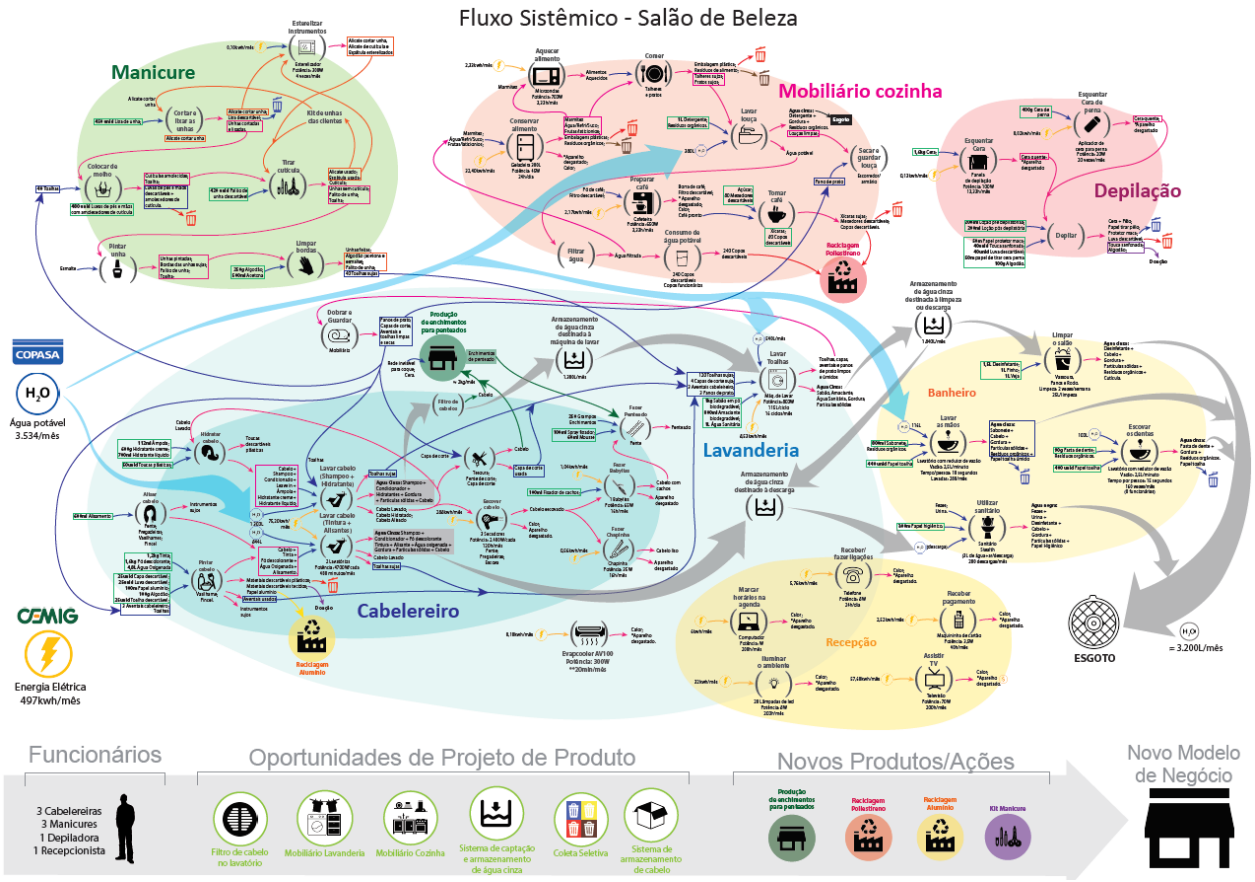


Figure 65: Systemic map of the hairstyle business. Rabelo (2015).

From this map, students could identify new opportunities of products and actions, in order to elaborate a new business model at the end. In addition, an ecomonic analysis was conducted comparing the new system to the old linear system. For example, in the project of Barbara Rabelo, the systemic approach application resulted in a 50% reduction in water expenditure and 6% in energy. In

addition, the project raised six opportunities of innovative products and four actions of material reuse to generate new products or business.

Besides the development of the systemic process, the experience caused the development of products that solved the mentioned problems. At this stage, the students could decide whether to continue working as a group or if each student would separately conduct their own product project. In the final presentation, besides the developed product, the students presented a report of the whole process.

The experience allowed for a systemic analysis to be carried out. As a consequence of that, several opportunities were identified, which generated a number of projects. Among them, the work of Camila Leão and Barbara Rabelo is due of note. These students developed a drying rack capable of drying clothes up to 30% faster. The rack stored hot air from the sun light through a thermal blanket forming a green house effect. This product was envisioned and developed in consonance with the local Brazilian context, where the majority of apartments have little to none laundry room. Therefore, it was thought to employ the sun light, abundant in the country, in a simple way to optimize the drying of clothes.

Figure 66: Thermal drying rack by Camila Leão and Barbara Rabelo. Photo: Miranda, Paulo (2015).

Another example comes from the student Carolina Balbino, who developed a modern and versatile shelf for small ambients utilizing pallet boxes, a commonly discarded item in local fruit and vegetables markets. In addition to an artificial

leather bag, developed from discarded syntetic latex from a rubber extraction cooperative.

Figure 67: Pallet shelf by Carolina Balbino. Photo: Miranda, Paulo (2015).

Also worth of note is the work of student Junia Barone. Walking through the streets of Belo Horizonte, the student noticed a large number of jeans itens sold by second hand stores at very low prices. This occurred due to a high discard rate fueled by the consumerism of the local fashion industry. With that in mind, the student developed a collection of pieces created utilizing those discarded materials, transforming them into new pieces. Taking one step further, the student developed a manual for people to create by themselves clothing itens from used pieces.

Figure 68: Jeans collection by Junia Barone. Photo: Miranda, Paulo (2015).

From the experience some difficulties were reported by the professors. The first of these was about breaking with the old *modus operandi*. Students had difficulty getting out of the traditional method of product development, and could not see the process into a non-linearly way.

Another difficulty was to start the project from the study of a context and its needs and not from a product. This made the students lose themselves in the research phase and at the beginning of the construction of the map because, according to them, it seemed as if they did not know where they would arrive.

The map construction also presented some challenges, mainly regarding to students dealing with the amount of information generated. This problem was solved with professors guidance constructing the map step by step, working first with large groups, then inserting details at each point.

Once the map was built, some students were enthusiastic and wanted to solve all the problems at the same time. Other students were concerned about the quantity of new problems that emerge. From there came the need to prioritize the problems so that they were all worked, but with different emphasis for each project.

The positive points presented by the students were that after they had overcome the first difficulties, when they finally managed to see the context in a systemic way and build the map, it was much easier to conduct the rest of the project. According to students' reports, the products emerged more easily and the perception of the importance of these products to solve the problems within the context was greater.

The students began to focus on the benefit to be acquired and not the product. The end product became a consequence of a necessity and not the goal in itself.

Another point is that after learning about the systemic method of thinking, students could no longer return to linearity. They began to think first about the context and in the relationships around the universe to be worked, focusing on the benefit, even in projects that used different methodologies.

The figure below shows the main positive and negative points of the experience:

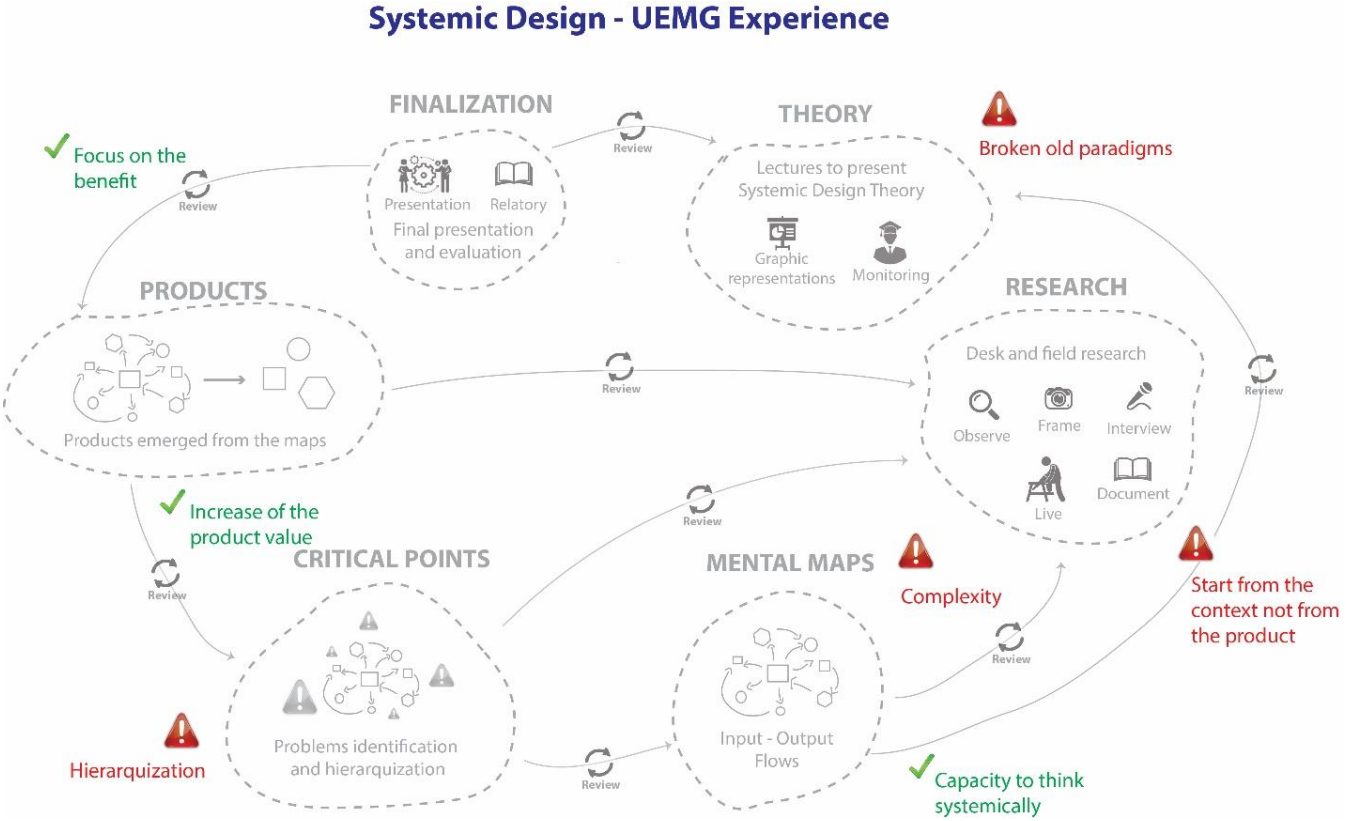


Figure 69: Positive and negative points of systemic design experience.

As result of this project, quality products were developed with high value, contextualized and with innovative characteristics. Students showed extreme satisfaction with their projects, affirming that the connection with the context made clear the product importance and its link with the reality.

The experience prooved that despite the complexity of the approach, when adequate orientation is received in the right time, ungraduated students can show

good results. According to students declarations, the discipline brought a new way to solve problems and improved their capacity of designing.

Chapter 4
Analysis and Discussion

4.1 New Design Approaches

As previously discussed, we live in a complex world in constant mutation. Designers face the challenge of having to act in a dynamic scenario with fluid and humanistic values, which are no longer predictable or static. This requires a change of posture by the designers in their way of designing and a widening in their field of performance. Currently, designers do more than simply envisioning products or graphic pieces. They also work in services, systems, social areas, digital media, among others.

Formerly, designers needed to be concerned only with developing a product that would meet the demands of the market, production, and user needs. Today, human needs go further and designers are also concerned with social, ecological and psychological issues. A holistic attitude is needed, which concerns the internal needs of each individual involved in the problem in question (including the designer himself), going through concerns with production, local development, relationships among actors, etc., until they reach global and sustainability issues.

This chain of development results in a complex scenario that designers are not prepared to address. According to Moraes (2010), the current design practice relies heavily on the methodology for the development of products or even services. However, given the current complex scenario, relying on a pre-established method is insufficient for a fluid, contemporary, and contextualized project. Thus, according to the author, the methodology must cease to have a specific role in the project and shift to a flexible and adaptable relationship. In turn, designers should broaden their range of knowledge and approaches, considering the whole scenario in its psychological and semantic factors, as well as factors regarding interface and human feeling.

Margolin (2014) says that today's design has a different meaning from what it had before, which described a creative process for product planning and began to mean the process of visualizing an activity that leads to a specific and useful result.

The presented research demonstrated that new approaches are emerging, which seek to work with new and complex scenarios. At times, the new approaches work with a mix of methodologies such as design thinking, metaproject, systemic design. Alternatively, other times they address a few points of each of these methodologies more freely, albeit always pursuing to meet the current needs and requirements.

The current scenario requires designers, mainly, to:

- Learn to deal with complexity;

- Be aware that the scenario is constantly changing, requiring an adaptive attitude;

- Show ecological concern, being an ecoliterate professional;

- Look closely at the local context, promoting its development;

- Have a sense of community, in a broad sense.

To possess this kind of awareness and attitude, designers must be trained and such is the role of the school. However, we must take into account that the educational system is part of a context, which establishes relationships of dependence and obligations. Therefore, for an effective holistic and contextualized teaching, one must consider the whole that surrounds the school-design-society system. The professional training of the designer must count on internal and external actions by the teachers and the institution, by the local government and community; as well as global actions, through networks and partnerships.

4.2 Didactic Tools

As stated before, dealing with complexity is one of the primary challenges that designers need to face. When these issues are presented to undergraduate students who are still in the beginning of their academic training, it is even more challenging.

According to Sevaldson (2009), the new approaches find in complexity a great potential for innovation. When designers stop trying to synthesize complexity to arrive at a solution, they begin to see the interrelationships of objects and their surroundings and come to solutions that consider ethical, sustainable, ecological, technological, social, and commercial issues.

In order to embrace complexity, and to be able to work in this dynamic scenario, considering the local, global, social, and economic context, it is necessary for designers to develop human, psychological, conceptual, and social skills, rather than technical and linear skills.

Such skills are synthesized as **empathy**, the ability to see the other and their needs; **Flexibility** to accept new ideas and other perspectives; **Holistic vision and systemic thinking** to understand the context and be able to work in a complex and dynamic scenario. In addition, the **capacity for negotiation and communication**, for the development of a participatory project, in partnership with the parties involved. Furthermore, there is a need for designers to be **ecoliterated**, which means to consider the environment and promoting sustainable attitudes.

Teachers can work on the development of these skills during design activities, by using didactic tools. This study compiled the main tools that can be used by teachers, sought from constructivist practices and the most current methodologies used. The objective here is not to present a definitive model of project practice, but rather a set of tools to help teachers and students work in an open and adaptive design practice.

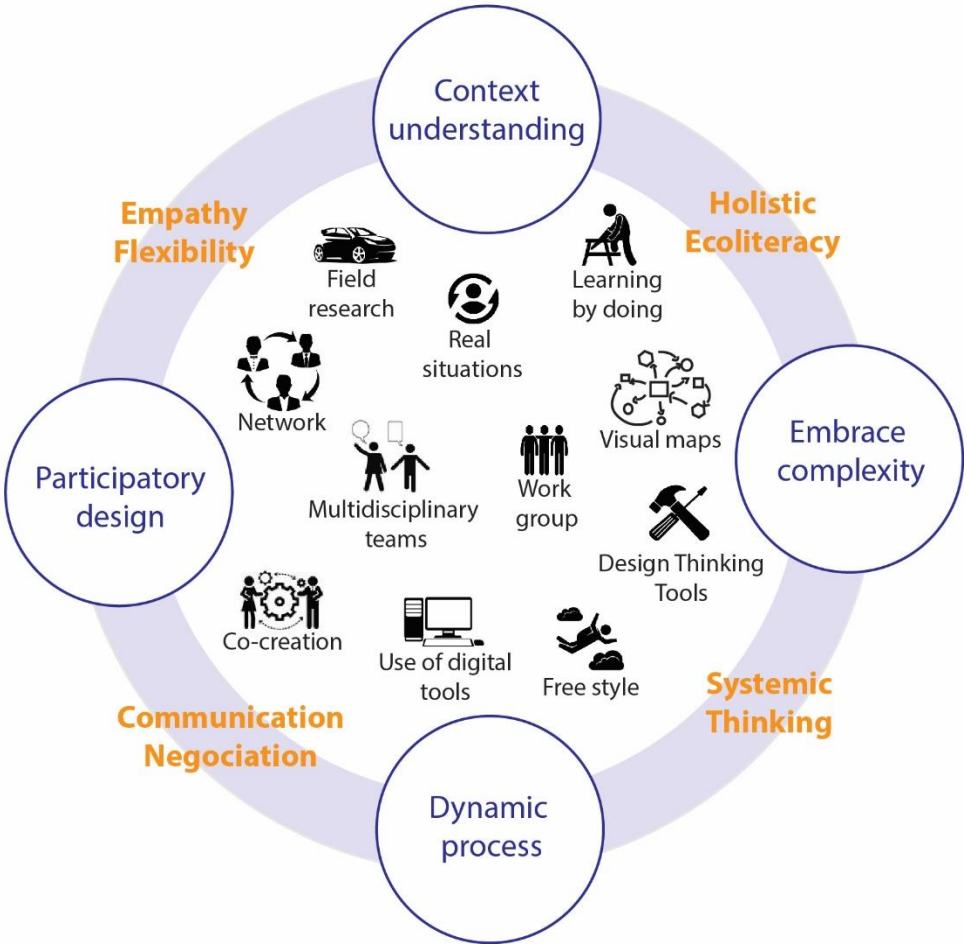


Figure 70: Systemic features, skills and didactic tools.

The figure sintetizes prominent features that those new approaches should present, which are the use of participatory design, which leads to a social dialog with stakeholders and community; context understanting, through a holistic and imparcial vision of the whole; embracing complexity, which means that all data should be addressed, not sintetized; and dynamic process, assuming that the context is constantly changing Additionally, the figure represents in orange the necessary skills aforementined. Finally, in the center of the figure are the main tools that can be used by professors to reach this skills.

4.2.1 Dealing with Complexity

According to the research, one common point between the new design methodologies is a depth of research, with a collection of the biggest quantity of data possible, including expert consultoring, field research, visual data, etc. All this generating a huge net of information.

During this research, it was possible to realize that when the systemic design methodology is presented to the teachers of the current design courses, they affirm that this part of in-depth research is always done and that the students deal very well with this. While talking with students and observing how they work, it has been found that students often do in-depth research, but when they need to work on the data they collect, they often choose some data that they find more promising and neglect others. Thus they end up not seeing some aspects and losing potential opportunities or solutions.

Visual mapping of information has proven to be a useful tool to help students cope with complexity. Designers have great facility in handling and creating visual information. And this is usually taught from the beginning of graduation. According to Sevaldson (2009), the mapping is a way to think through, ordering and internalizing a picture of the information collected and induces a creative process.

Conceptual maps are a graphical tool for organizing and representing knowledge. They are used in pedagogy as a language to describe and communicate concepts and their relationships. Its origins came from the meaningful learning theories developed by David Ausubel and disseminated by Joseph Novak in the decade of 1970[120].

In new design methodologies, visual mapping has been used not only to represent a situation, but also as a way of dealing with an amount of information, organizing it and visualizing it in a way that all aspects involved in the situation are considered.

According to Sevaldson (2011), in the context of design, mapping is not intended to simplify issues, but to take on complexity and deal with it, making a better interpretation of reality. The author states that projects often lose the holistic

[120] To know more: Novak, J. D. and Cañas, A. J. (2008). "The Theory Underlying Concept Maps and How to Contruct and Use Then". Technical Report IHMC CmapTools 2006-01 Rev 2008-01. Available at: < http://cmap.ihmc.us/docs/theory-of-concept-maps >. Accessed in Feb. 2017.

perspective because they lack the ability to maintain complexity in thought during the design process.

Bistagnino (2011) affirms that in order to have a complete view of a process it is necessary to make a graphic representation in which one can "go with the eyes and not only with the mind" into the dynamics and relationships involved in the system to be considered. Thus, according to the author, the cause of a problem can be easily identified at the moment that it is presented, and can be analyzed according to different parameters, such as economy, sustainability, territory, production, etc.

Field research at UEMG has shown that one of the greatest difficulties for students is the construction of the maps. Sevaldson (2011) in his work presents some useful guidelines to mapping.

According to the author, maps should begin with sketches in large paper formats, by means of disorderly attempts. It is possible to organize this beggining by orienting the project in two ways, which can be chosen according to the situation in question, leading to the network mapping or the timeline mapping.

Maps should always start with the current knowledge, preferably prior to the research phase, to form an initial structure and then add other information. These other information must be acquired through literary research, conversation with experts, coexistence with stakeholders, field research, etc.

After this initial phase, the redesign of the maps through digital means is recommended. This provides a mental process of choice and ordering, as well as the internalization of information. By visually working the information to order it in way to present an easily readable schema, one gains a holistic view of the problem.

This organized map is not a final version, but a built schema that must be improved to identify problems and solutions. Some approaches are recommended during map development:

. Maps should contain quantitative and qualitative information of the system.

. All of the actors and stakeholders involved must be shown.

. Must be open systems, always with the possibility of adding information.

. Impartial onstruction, based on dialogue and research.

. Maps must highlight and emphasize relations rather than objects.

These are recommendations drawn through the case studies and the works of Sevaldson (2009, 2011, 2013), Bistagnino (2011) and Ryan (2014). It is important

to emphasize that according to Sevaldson (2013), there are no fixed rules for the construction of the maps. Free style is recommended, as each case requires a different and appropriate approach. These are just suggestions to help students overcome the initial difficulties in building maps.

In addition to mapping, the use of design thinking tools has proven to be helpful in coping with complexity, such as, for example, the use of insight cards, guinding criteria, personas and user journey[121].

[121] These tools are presented in this study on pages 50-51.

4.2.2 Context Understanding

The employment of mental maps are a key point. Mapping increases the capacity to work with complexity and allows for a full context understanding. In order to reach this, it is important to know the context that will be represented.

Field research is fundamental and presented in all new approaches. To have a full context understanding, the context should be observed and lived closely. Standing next to the final users is a way to understand how they live, what they think, what are their needs and desires. To observe the context allows to know the system and its dynamics.

In addition, knowing the way of life of the people leads to respecting their culture and traditions, which represent an important role in the proposal of sustainable solutions, considering that every design project must meet human demands for well being (Souza, 2014).

According to Sevaldson (2008), most of the universities prefers to work on idealised and framed projects than to expose the students to a real design work. This is done to avoid problems with complexity and dynamism. However, working in real situations, students can train the skills needed to act, negotiate and interact.

Students working on a real project and experiencing all difficulties present, such as shortage of resources, political barriers, and others, enrich the academic community. Students need to learn in order to apply their knowledge to solve real problems.

The activities from CEDTec for example, occur mainly in the local context. This promotes the integration and benefit of the individuals in their territory by exchanging experiences, knowledge and culture. One example was in the action in the project "*A Casa da Gente*" (Our House)[122] in which students, by acting in loco, could perceive financial difficulties in regard to the project application, problems related to user priorities, and technical difficulties to execute the final project.

The “Learning by doing” approach, in which the learning comes from experimental activities, have been used not just in new design educational initiatives, but also in primary and secondary schools and independent courses.

As previously seen in the case studies, some institutions, such as The Center for Ecoliteracy and the Shumacher College, make use of this kind of approach to lead to a sustainable way of acting and living. According to them, students learn the

[122] As mentioned in the page 71.

best when they practice hands-on activities, participating in indoors and outdoors environments. In these courses, students are encouraged to view their communities as ecosystems and to understand the relationships and processes necessary to support healthy living.

This form of approach leads students to become ecoliterated. According to Dominici (2016), the main purpose of ecoliteracy is to understand the living systems and learn from them. The practice of activities together with the local community, in the local environment propitiates a deep knowledge about the present flows and dynamics, and consequently about their preservation.

4.2.3 Dynamic Process

As we have seen, we are currently living in a dynamic context, with fast-paced changes, where it is necessary to anticipate not only of the consumer needs but also environmental, economic and social needs.

Working in a dynamic process, which is in constant change is a significant challenge. This reinforces the concept that static methodologies, such as those practised in the past, no longer work. The changes are fast and designers should adapt their approaches for each situation.

According to Maldonado (1991), the design should adequate itself in the context in which it is involved, being able to reflect the diversities and conflicts of such context. Thus, the designer should have flexibility and adaptability, recognizing the values that are intrinsic to each social, economic and cultural structure in which it is found.

Margolin (2014) explains that societies do not develop through linear trajectories, but small and intense changes, such as those that occur in the fields of technology, science, war or arts. These changes are able to alter their course in order to construct completely different scenarios. Today, we are living at a time in which technology is changing our relationship with the material world, just as they are changing values and issues related to ethics.

Design as a discipline capable of transiting and dialoguing with different areas of knowledge must work in a transdisciplinary way, interacting with other fields of knowledge and including these during the development of the project.

It is necessary to think systematically, considering all the factors that involve the problem in question, not only the tangible factors, but one must consider and try to predict the future needs as well, constructing possible scenarios. To work with multidisiplinary teams, evolving different profiles, bringing an assertive picture of the reality, making it possible to build a future scenario.

One of the success factors presented in the previous cases was the adaptation of each approach to a certain context and a certain time, so it is very important that students work in real situations for them to know the needs of situations that ask for adaptations.

Besides, liberty of style allows to work fluently whithin a dynamic context and helps students to yield the linearity. Within rigid formatting patterns and pre-established methodologies, students restrict their ability to expand possibilities and

imagination of different scenarios. The freedom to build new scenarios and conduct the project allows students to work holistically and innovatively.

The constructivist approach presented by Carletti and Varani (2002) defended that the use of digital tools can be truly helpful to address this dynamism. It allows manipulating the information, making modifications and updates, besides controlling and exchanging data. The digital media promotes the communication between users and stakeholders, promoting the creation of networks, resulting in a collaborative and cooperative environment.

4.2.4 Participatory Skills

The use of participatory design techniques has proven to be very effective in encouraging holistic and contextualized performance. Thus, students can work in partnership with the parties involved in finding solutions.

Through dialogue with the community in question, or with future users, it increases the understanding of their needs, culture and yearnings. A deeper understanding of these realities promotes the exchange of knowledge. Designers before intervening in a reality, have the opportunity to know how the problem in question is already addressed, knowing alternative ways to deal with it.

In addition, before arriving at a solution, by including the parties involved in the project during decision making, it is possible to anticipate possible failures and points that need adjustments. Thus, feasible and suitable solutions are achieved more easily.

Working with others makes learning a cooperative practice, in which one learns not only through a teacher, but through the exchange of experiences, values, and cultures. It develops the ability to see other points of view and the ability to negotiate.

Carletti (2005) highlights the importante of group work in the learning process, where the construction of knowledge is a result of a negociation with others, not just an individual elaboration. Working in group, students develop the ability to negotiate and can enhance their empathy.

A network with a variety of professionals and the participation in multidisciplinary teams brings a broader culture, and along with the work group, brings the capacity to build a more realistic overview of the context. Moreover, it allows the creation of partnerships, already pointed as essencial to any project.

The experience at UEMG demonstrated that students struggle to negotiate and communicate with stakeholders. While this ability warrants practice, it has been observed that field research and the use of internet communication tools are paths that can facilitate this process.

4.3 Application in Brazilian Context

As previously stated, Brazil is a country with significant natural and cultural riches in one hand and, in the other, a country with alarming levels of social inequality, poverty and violence. Designers, by working on the conception of new products, systems or services, offer the possibility to interfere and change this scenario.

According to Souza (2014), in a country as Brazil, it is necessary to incorporate the designer's actions to the social reality, with the same importance that we incorporate them to environmental responsibilities. For this purpose, it is imperative for the schools to possess pedagogical strategies leading to a set of appropriate knowledge and skills.

The design teaching in the undergraduate level, since its implementation, has employed approaches inherited from the Ulm school, focused in industry and mass production. This meant that Brazilian design for a long period remained decontextualized from the reality in which it was inserted, being directed only to large companies and to the elite. Thus, during its development, the Brazilian design ignored not only the social and economic problems of the country, but also its large cultural diversity, failing to present its own fortified identity.

In the historical course of Brazilian schools, we observe many attempts to change, present since the decade of 1970 with performances such as that of Ricardo Mineiro[123], repressed at the time by the military government, as well as the attempt by CETEC[124] to implement a project using alternative technology, not well accepted by popular culture.

More recent experiences, such as the application of metaproject and the application of systemic design at the Design School, offer a great advance in relation to a change of posture and thought by the students. However, this kind of approach still suffer resistance by the professors, becoming isolated experiments, without continuity.

Graduation courses and research demonstrate great advances in relation to methodological innovations. In UEMG we see through the research centers the use of approaches as social design and participatory design, as well as the use of

[123] See page 159.
[124] See page 110.

techniques linked to the way systemic design works. However, these attitudes are not part of the main line of the education, relegated to secondary importance and optional disciplines, refraining from reaching all students. Therefore, it is necessary to promote the integration of the undergraduation with the research.

Despite the increase incentive from the government with the implementation of programs such as Sebrae and Sebraetec, which encourages design to work in line with micro and small enterprises and give more visibility to the profession, there is still great prejudice by the majority of entrepreneurs in accepting and valuing local design. These entrepreneurs often end up seeking out of state services, while still complaining about the lack of a more integrated participation of the designer acting with the company in the process as a whole.

For effective and innovative design change, a systemic action is required, starting in the internal environment of the university, and expanding to its external relations with society, government and the environment.

The didactic tools presented can contribute to a change in the way of teaching practiced today, especially in relation to the design practice, leading students to develop the skills necessary to deal with the complexity and dynamism of the contemporary world. Thus, students will become able to develop products, services or systems that meet the real needs of a given context in a certain time and space in an innovative way.

For this to happen, the focus of education cannot rely solely on students, but rather on the professors. It is imperative that they change their attitudes, to be open to new approaches, into a way that professors and students have a close relationship, becoming partners in the construction of knowledge, as elucidated in constructivist practices.

Transdisciplinarity also appears as a key point for systemic learning. According to Denis (2012), design dialogues with almost all other fields of knowledge in some level. These interfaces tend to expand as the system becomes more complex, increasing the inter-relationships between the parties.

Another important point, still in the internal scope of the university is the development of humanistic abilities. According to Dominici (2016), it is necessary to shift the focus from the professionalization of students to their social education, connecting them with concepts of exchange, relationships, flows and collaborations.

These actions also have an impact outside the university, where relationships with the community, government and the environment should be

addressed. The relationship with the community through participatory design, dialogue and collaboration leads to a beneficial exchange to all, increasing the range of knowledge and culture on the part of designers and delivering realistic and appropriate solutions for the community.

Government involvement and support are fundamental. The Brazilian government has already increased its incentives and efforts regarding design activities, but an action directing to increase the awareness and openness by the entrepreneurs and community may be even more effective.

Actions in favor of the environment, by using local resources and discarded materials, along with the management of the systems, lead to a sustainable approach as well as the economic development and valuing of the territory.

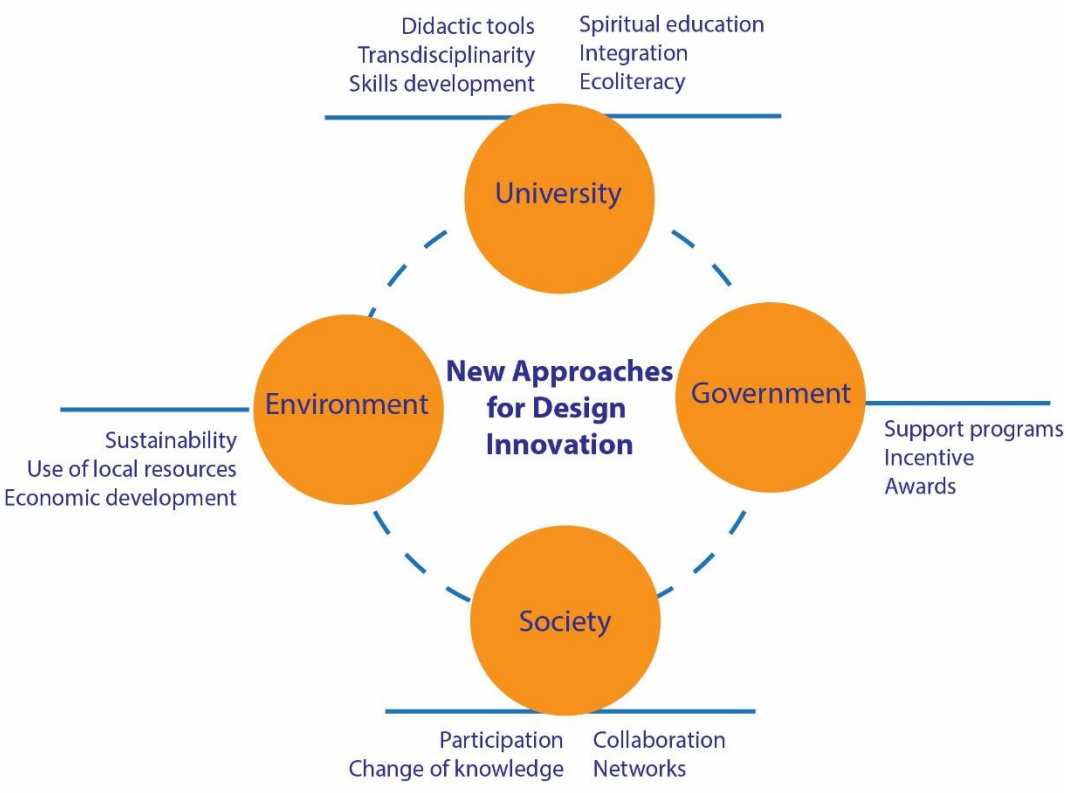


Figure 71: New approaches for design innovation.

As a consequence of these actions together, the design will be directed towards a systemic thinking, with humanistic focus, through dynamic and contextualized actions and with a sustainable character.

Chapter 5

Conclusion

The designer is no longer a professional who develops exclusively products or graphic pieces for industry or mass production. Today, these professionals have become recognized as capable of offering intelligent solutions both for the production of artifacts as well as for issues related to services, systems, society or environment.

The field of action of the designers is expanding, as well as the complexity they have to face when seeking complete and innovative solutions to meet the real needs of today's world. This requires training and knowledge, which warrants the school to play a fundamental role in directing the designers to assume this new posture.

The present work conducted an investigation concerning both the evolution of the didactic methods as well as the evolution and development of methods used in design practices. It was noticed that both didactic methods and design methodologies moved from a rationalist and linear posture to a more fluid and contextualized posture, with holistic values centered on the human being.

In the beginning, teaching practices were based in severe discipline with a painful learning process. With the study of the methods, education became increasingly more holistic and human based, connected to the individual and to the context. Studies about psychology, human nature and consciousness lead didactics to act through systemic practices, accounting for the entire context around education. Currently, the bases of education rely in values such as freedom, collectivity, relationships and active involvement.

The constructivism emphasizes on the importance of the surrounding that involves students and education, as well as the internal construction of the knowledge by the individual. Didactics ceased to rely merely on transmission of knowledge by professor to student, but instead it is about the sharing of knowledge, not just between professor and student, but also between the student and their colleagues, family and society.

In all likelihood, design methodologies have been changing the focus from the product and mass production, which attended to the demands of the past, to put the focus on the context, and the real needs of the society. The dynamism of the changes in today's society, the speediness of news and the increase in our capacity of communication and change have turned the design activity even more complex, so that old mathematical and linear methods fail to satisfy it. Today, designers seek solutions to improve quality of life, focusing on the benefit, regardless of it being a product, a system or a service.

Some design schools around the world are practicing new didactic approaches, moving from the old standardized linear way of the pre-established design methodologies to open and participatory methods. They are integrating the systemic thinking in their design activities promoting a new kind of practice. This new way of education is opening the doors of the classroom and embracing transdisciplinary, the practice in real situations, the contact with communities and the surroundings.

It has been provoking good results in a transcendental level, reaching not just designers students, preparing them to this holistic performance, but is reaching the society, the industry and the environment. These new approaches, by using participatory actions, are empowering communities, through the exchange of knowledge and skills, reinforcing the social fabric. In addition, by working close to stakeholders, through the co-working, partnerships and networks, these new practices are promoting a decentralized design, with a faster and dynamic feedback, saving time and resources.

Brazil presents a scenario full of natural resources and multiculturalism, which is well expressed through its costumes, music, gastronomy, architecture, industry and through its landscapes, fauna and flora. On the other hand, it is a country with high levels of social inequality, widespread poverty and violence. Despite all these problems, Brazilians are open, spontaneous and creative, with a deep-rooted sense of community and capacity to transform their reality by doing the best with what is available to them. In this scenario, designers could find many opportunities for intervention, along with the resources needed for action. In spite of this, Brazilian design still carry out references of the rational-functionalist model in which it was based on.

A case study was conducted in the state of Minas Gerais, one of the richest and most traditional states in Brazil. It possesses in a small scale all main characteristics of the country, presenting a scenario rich in natural, economic and cultural terms in one hand while, on the other, it also presents a great social inequality, high levels of poverty and waste of natural resources. The local design, despite being in

expansion, receiving increase incentives from the government, it not well absorbed by the local market.

This means that Minas Gerais presents a context in which the design could contribute significantly, since designers have the power to promote an effective change in the elaboration of new systems, services or products. However, this requires them to learn to address complexity while bearing the ability to view holistically all the factors involved. In order to do so, they must receive appropriate guidance and direction.

By investigating the Design School of UEMG, it showed that research centers and departments are already promoting this change, by proposing new approaches based on new technologies and participatory design. However, the undergraduate course, being the main line of education, still practices the rationalist and linear design of the past, valuing technical above human training. According to the professors, this happens because the students have difficulties in dealing with complex problems at the beginning of their formation, not being able to escape the old way of designing.

It was observed that, beyond the difficulties reported by the students, professors also offer resistance against changing their way of teaching, maintaining the repetition of outdated methods and patterns. Such behavior can been explained by the fear they have in facing the complexity of new approaches, since those professors themselves were not trained for it as well. This is in addition to the natural mistrust in the character of the *Mineiro* people, the inhabitants of the state of Minas Gerais. Such mistrust is a characteristic feature of the *Mineiro* since colonial times.

The experiences of new approaches applied to the undergraduate course have shown with success that there are techniques and tools capable of getting students to manage and deal with complexity from a fluid and holistic approach. As a result, innovative, contextualized products and systems that meet specific needs were presented. Still, the experience has led students to a change of posture and thought regarding the way of designing. As they stated, once they started to think systemically, they could not come back to the linearity.

This work presents approaches and tools that can be employed in the university to induce this desired change, not only by the students, but also by the professors and by the institution. These tools intend to develop the skills necessary to help the new professionals to better deal with the complexity, being able to act in the current dynamic scenario, considering the man, the context and the environment.

The objective was, beyond presenting a methodological model to be followed, to indicate a set of actions tested and approved that can naturally lead students and professors to this change. The change in design education should be systemic, starting in the university, first with students and professors and later expanding to the society, government and environment.

In the same way that each project should be adequate to the situation in which it intends to work, this study had a look at the characteristics and needs of the Design School from UEMG. It is hoped that a result from this research will indeed be the change in the undergraduate course of this institution, later to be extended in an appropriate way to other schools and universities.

The change that begins in education results in training professionals prepared to make a change in society and in the local environment. Effectively, a good work serves as an inspirational example, positively influencing other places and other professionals, creating a cascade effect. Thus, the search for a holistic attitude causes the start of an expected change, which is the pursuit of a fairer world, where products, services and systems are in favor of man, his community and his environment.

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Annexes

CONSELHO NACIONAL DE EDUCAÇÃO

CÂMARA DE EDUCAÇÃO SUPERIOR

RESOLUÇÃO Nº 5, DE 8 DE MARÇO DE 2004. (*) (**)

Aprova as Diretrizes Curriculares Nacionais do Curso de Graduação em Design e dá outras providências.

O PRESIDENTE DA CÂMARA DE EDUCAÇÃO SUPERIOR DO CONSELHO

NACIONAL DE EDUCAÇÃO, no uso de suas atribuições legais, com fundamento no Art. 9º, § 2º, alínea "c", da Lei 4.024, de 20 de dezembro de 1961, com a redação dada pela Lei 9.131, de 25 de novembro de 1995, tendo em vista as diretrizes e os princípios fixados pelos Pareceres CNE/CES 776/97, de 3/12/97 e 583/2001, de 4/4/2001, e as Diretrizes Curriculares Nacionais elaboradas pela Comissão de Especialistas de Ensino de Design, propostas ao CNE pela SESu/MEC, considerando o que consta dos Pareceres CNE/CES 67/2003 de 11/3/2003, e 195/2003, de 5/8/2003, homologados pelo Senhor Ministro de Estado da Educação, respectivamente, em 2 de junho de 2003 e 12 de fevereiro de 2004, resolve:

Art. 1º O curso de graduação em Design observará as Diretrizes Curriculares Nacionais aprovadas nos termos desta Resolução.

Art. 2º A organização do curso de que trata esta Resolução se expressa através do seu projeto pedagógico, abrangendo o perfil do formando, as competências e habilidades, os componentes curriculares, o estágio curricular supervisionado, as atividades complementares, o sistema de avaliação, a monografia, o projeto de iniciação científica ou o projeto de atividade, como trabalho de conclusão de curso – TCC, componente opcional da Instituição, além do regime acadêmico de oferta e de outros aspectos que tornem consistente o referido projeto pedagógico.

§ 1º O Projeto Pedagógico do curso, além da clara concepção do curso de graduação em Design, com suas peculiaridades, seu currículo pleno e sua operacionalização, abrangerá, sem prejuízo de outros, os seguintes elementos estruturais:

I - objetivos gerais do curso, contextualizados em relação às suas inserções institucional,política, geográfica e social;

II - condições objetivas de oferta e a vocação do curso;

III - cargas horárias das atividades didáticas e da integralização do curso;

IV - formas de realização da interdisciplinaridade;

V - modos de integração entre teoria e prática;

VI - formas de avaliação do ensino e da aprendizagem;

VII - modos da integração entre graduação e pós-graduação, quando houver;

VIII - cursos de pós-graduação *lato sensu*, nas modalidades especialização integrada e/ou subseqüente à graduação, de acordo com o surgimento das diferentes manifestações teórico-práticas e tecnológicas aplicadas à área da graduação, e de aperfeiçoamento, de acordo com as efetivas demandas do desempenho profissional;

IX - incentivo à pesquisa, como necessário prolongamento da atividade de ensino e como instrumento para a iniciação científica;

X - concepção e composição das atividades de estágio curricular supervisionado, suas diferentes formas e condições de realização, observado o respectivo regulamento;

XI - concepção e composição das atividades complementares;

XII – inclusão opcional de trabalho de conclusão de curso sob as modalidades

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(*) CNE. Resolução CNE/CES 5/2004. Diário Oficial da União, Brasília, 15 de março de 2004, Seção 1, p. 24

(**) Republicada no Diário Oficial da União, de 1° de abril de 2004, Seção 1, p. 19

monografia, projeto de iniciação científica ou projetos de atividades centrados em área teórico-prática ou de formação profissional, na forma como estabelecer o regulamento próprio.

§ 2º Os Projetos Pedagógicos do curso de graduação em Design poderão admitir modalidades e linhas de formação específica, para melhor atender às necessidades do perfil profissiográfico que o mercado ou a região assim exigirem.

Art. 3º O curso de graduação em Design deve ensejar, como perfil desejado do formando, capacitação para a apropriação do pensamento reflexivo e da sensibilidade artística, para que o designer seja apto a produzir projetos que envolvam sistemas de informações visuais, artísticas, estéticas culturais e tecnólogicas, observados o ajustamento histórico, os traços culturais e de desenvolvimento das comunidades bem como as características dos usuários e de seu contexto sócio-econômico e cultural.

Art. 4º O curso de graduação em Design deve possibilitar a formação profissional que revele competências e habilidades para:

I - capacidade criativa para propor soluções inovadoras, utilizando domínio de técnicas e de processo de criação;

II - capacidade para o domínio de linguagem própria expressando conceitos e soluções, em seus projetos, de acordo com as diversas técnicas de expressão e reprodução visual;

III – capacidade de interagir com especialistas de outras áreas de modo a utilizar conhecimentos diversos e atuar em equipes interdisciplinares na elaboração e execução de pesquisas e projetos;

IV - visão sistêmica de projeto, manifestando capacidade de conceituá-lo a partir da combinação adequada de diversos componentes materiais e imateriais, processos de fabricação, aspectos econômicos, psicológicos e sociológicos do produto;

V - domínio das diferentes etapas do desenvolvimento de um projeto, a saber: definição de objetivos, técnicas de coleta e de tratamento de dados, geração e avaliação de alternativas, configuração de solução e comunicação de resultados;

VI - conhecimento do setor produtivo de sua especialização, revelando sólida visão setorial, relacionado ao mercado, materiais, processos produtivos e tecnologias abrangendo mobiliário, confecção, calçados, jóias, cerâmicas, embalagens, artefatos de qualquer natureza, traços culturais da sociedade, softwares e outras manifestações regionais;

VII - domínio de gerência de produção, incluindo qualidade, produtividade, arranjo físico de fábrica, estoques, custos e investimentos, além da administração de recursos humanos para a produção;

VIII - visão histórica e prospectiva, centrada nos aspectos sócio-econômicos e culturais, revelando consciência das implicações econômicas, sociais, antropológicas, ambientais, estéticas e éticas de sua atividade.

Art. 5º O curso de graduação em Design deverá contemplar, em seus projetos pedagógicos e em sua organização curricular conteúdos e atividades que atendam aos seguintes eixos interligados de formação:

I - conteúdos básicos: estudo da história e das teorias do Design em seus contextos sociológicos, antropológicos, psicológicos e artísticos, abrangendo métodos e técnicas de projetos, meios de representação, comunicação e informação, estudos das relações usuário/objeto/meio ambiente, estudo de materiais, processos, gestão e outras relações com a produção e o mercado;

II - conteúdos específicos: estudos que envolvam produções artísticas, produção industrial, comunicação visual, interface, modas, vestuários, interiores, paisagismos, design e outras produções artísticas que revelem adequada utilização de espaços e correspondam a níveis de satisfação pessoal;

III - conteúdos teórico-práticos: domínios que integram a abordagem teórica e a prática profissional, além de peculiares desempenhos no estágio curricular supervisionado, inclusive com a execução de atividades complementares específicas, compatíveis com o perfil desejado do formando.

Art. 6º A organização curricular do curso de graduação em Design estabelecerá expressamente as condições para a sua efetiva conclusão e integralização curricular, de acordo com os seguintes regimes acadêmicos que as instituições de ensino superior adotarem: regime seriado anual; regime seriado semestral; sistema de créditos com matrícula por disciplina ou por módulos acadêmicos, com a adoção e pré-requisito, atendido o disposto nesta Resolução.

Art. 7º O Estágio Supervisionado é um componente curricular direcionado à consolidação dos desempenhos profissionais desejados, inerentes ao perfil do formando, devendo cada Instituição, por seus colegiados superiores acadêmicos, aprovar o correspondente regulamento de estágio, com suas diferentes modalidades de operacionalização.

§ 1º O estágio de que trata este artigo poderá ser realizado na própria Instituição de Ensino Superior, mediante laboratórios que congreguem as diversas ordens correspondentes às diferentes técnicas de produções artísticas, industriais e de comunicação visual, ou outras produções artísticas que revelem adequada utilização de espaços e correspondam a níveis de satisfação pessoal.

§ 2º As atividades de estágio poderão ser reprogramadas e reorientadas de acordo com os resultados teórico-práticos gradualmente revelados pelo aluno, até que os responsáveis pelo acompanhamento, supervisão e avaliação do estágio curricular possam considerá-lo concluído, resguardando, como padrão de qualidade, os domínios indispensáveis ao exercício da profissão.

§ 3º Optando a Instituição por incluir, no currículo do curso de graduação em Design, o estágio supervisionado de que trata este artigo, deverá emitir regulamentação própria, aprovada pelo seu Conselho Superior Acadêmico, contendo, obrigatoriamente, critérios, procedimentos e mecanismos de avaliação, observado o disposto no parágrafo precedente.

Art. 8º As Atividades Complementares são componentes curriculares que possibilitam o reconhecimento, por avaliação, de habilidades, conhecimentos e competências do aluno, inclusive adquiridas fora do ambiente escolar, incluindo a prática de estudos e atividades independentes, opcionais, de interdisciplinaridade, especialmente nas relações com o mundo do trabalho e com as diferentes manifestações e expressões culturais e artísticas, com as inovações tecnológicas, incluindo ações de extensão junto à comunidade.

Parágrafo único. As Atividades Complementares se constituem componentes curriculares enriquecedores e implementadores do próprio perfil do formando, sem que se confundam com estágio curricular supervisionado.

Art. 9º O Trabalho de Conclusão de Curso-TCC é um componente curricular opcional da Instituição de Ensino Superior que, se o adotar, poderá ser desenvolvido nas modalidades de monografia, projeto de iniciação científica ou projetos de

atividades centradas em áreas teórico-práticas e de formação profissional relacionadas com o curso, na forma disposta em regulamentação específica.

Parágrafo único. Optando a Instituição por incluir, no currículo do curso de graduação em Design, Trabalho de Conclusão de Curso-TCC, nas modalidades referidas no *caput* deste artigo, deverá emitir regulamentação própria, aprovado pelo seu Conselho Superior Acadêmico, contendo, obrigatoriamente, critérios, procedimentos e mecanismos de avaliação, além das diretrizes técnicas relacionadas com a sua elaboração.

Art. 10. As instituições de ensino superior deverão adotar formas específicas e alternativas de avaliação, internas e externas, sistemáticas, envolvendo todos quantos se contenham no processo do curso, observados em aspectos considerados fundamentais para a identificação do perfil do formando.

Parágrafo único. Os planos de ensino, a serem fornecidos aos alunos antes do início do período letivo, deverão conter, além dos conteúdos e das atividades, a metodologia do processo ensino-aprendizagem, os critérios de avaliação a que serão submetidos e bibliografia básica.

Art. 11. A duração do curso de graduação em Design será estabelecida em Resolução específica da Câmara de Educação Superior.

Art. 12. Os cursos de graduação em Design para formação de docentes, licenciatura plena, deverão observar as normas específicas relacionadas com essa modalidade de oferta.

Art. 13. Esta Resolução entrará em vigor na data de sua publicação, revogadas as disposições em contrário.

ÉFREM DE AGUIAR MARANHÃO

Presidente da Câmara de Educação Superior

Portaria Inep nº 235, de 10 de junho de 2015

Publicada no Diário Oficial de 12 de junho de 2015, Seção 1, pág. 24

O Presidente do Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira (Inep), no uso de suas atribuições, tendo em vista a Lei nº 10.861, de 14 de abril de 2004; a Portaria Normativa nº 40, de 12 de dezembro de 2007, em sua atual redação; a Portaria Normativa nº 3, de 6 de março de 2015, e considerando as definições estabelecidas pela Comissão Assessora de Área de Design, nomeada pela Portaria Inep n° 54, de 6 de março de 2015, resolve:

Art. 1º O Exame Nacional de Desempenho dos Estudantes (Enade), parte integrante do Sistema Nacional de Avaliação da Educação Superior (Sinaes), tem como objetivo geral avaliar o desempenho dos estudantes em relação aos conteúdos programáticos previstos nas diretrizes curriculares, às habilidades e competências para a atualização permanente e aos conhecimentos sobre a realidade brasileira e mundial, bem como sobre outras áreas do conhecimento.

Art. 2º A prova do Enade 2015, com duração total de 4 (quatro) horas, terá a avaliação do componente de Formação Geral comum aos cursos de todas as áreas e do componente específico da área de Design.

Art. 3º As diretrizes para avaliação do componente de Formação Geral são publicadas em Portaria específica.

Parágrafo único. A prova do Enade 2015 terá, no componente de Formação Geral, 10 (dez) questões, sendo 2 (duas) discursivas e 08 (oito) de múltipla escolha, envolvendo situações-problema e estudos de casos.

Art. 4º A prova do Enade 2015, no Componente Específico da área de Design, terá como subsídio as Diretrizes Curriculares Nacionais do Curso de Graduação em Design, Resolução CNE/CES nº 5, de 8 de março de 2004, as normativas posteriores associadas e a legislação profissional.

Parágrafo único. A prova do Enade 2015 terá, no componente específico da área de Design, 30 (trinta) questões, sendo 3 (três) discursivas e 27 (vinte e sete) de múltipla escolha, envolvendo situações-problema e estudos de casos.

Art. 5º A prova do Enade 2015, no componente específico da área de Design, tomará como referência o perfil do egresso que contemple o pensamento projetual ético, crítico e analítico, que resultará em produtos, sistemas e serviços para atender às demandas do indivíduo e da sociedade. Tais aspectos do perfil do egresso se articulam com:

I - a visão sistêmica e atuação multidisciplinar;

II - o conhecimento e uso de metodologias projetuais;

III - a análise histórica, estética e cultural;

IV - a ação prospectiva e criativa;

V - os fatores tecnológicos, funcionais, produtivos e materiais;

VI - a gestão do design com vistas à inovação.

Art. 6º A prova do Enade 2015, no componente específico da área de Design, avaliará se o estudante desenvolveu, no processo de formação, as competências e habilidades para:

I - dialogar com diferentes áreas de conhecimento e das atividades humanas;

II - sintetizar e configurar em projetos de design (produtos, sistemas e serviços) as informações obtidas em análise sistêmica e na atuação multidisciplinar;

III - diagnosticar, conceituar, gerar alternativas, desenvolver, implementar e avaliar resultados de projetos de design (produtos, sistemas e serviços);

IV - avaliar entre as diferentes metodologias projetuais a mais adequada para diferentes situação e contextos ;

V - promover conexões entre os conhecimentos históricos, estéticos e culturais expressando-os por meio de linguagens de representações;

VI - valorizar a estética e a forma como componente do processo de projeto de design (produtos, sistemas e serviços);

VII - produzir e implementar conhecimentos e/ou procedimentos para novas realidades considerando as especificidades locais;

VIII - saber especificar e implementar processos de produção e seus distintos componentes;

IX - adequar as diferentes tecnologias na produção de design respeitando a diversidade local ou as disponibilidades ambientais;

X - contemplar na ação projetual os aspectos sensoriais e perceptivos humanos e seus diversos significados;

XI - avaliar a viabilidade técnica, funcional, econômica e/ou mercadológica de projetos de design (produtos, sistemas e serviços);

XII - propor soluções de gestão em design, considerando simultaneamente conhecimentos, estratégias, pessoas, etapas de projeto e seus aportes.

Art. 7º A prova do Enade 2015, no componente específico da área de Design, tomará como referencial os seguintes conteúdos curriculares:

I - História e Teorias do Design e História da Arte;

II - Estudos das relações usuário/objeto/ambiente;

III - Estudos sociais, econômicos e culturais;

IV - Estudos da percepção, da estética, da comunicação e da semiótica;

V - Linguagem e expressão visual, representação gráfica e modelagem;

VI - Metodologia de projeto;

VII - Estudos em ergonomia aplicada ao design;

VIII - Materiais, processos e meios produtivos;

IX - Gestão do Design;

X - Linguagem e expressão verbal e documentação de projetos em design.

Art. 8º Esta portaria entra em vigor na data de sua publicação.

JOSÉ FRANCISCO SOARES