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RESEARCH REGARDING MODULARITY, EFFICIENCY LAW OF GEOMETRICAL ORGANIZATION

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Abstract: *[**Efficiency Law of Geometrical Organization**] is a modular concept devoted to industry especially. It came from LEGO appeared in 1932 in Denmark like a kids game. The advantages using modular concept based on ergonomics, comfort and efficiency can be found in a lot of industry activity domains and others like biology, technology, mathematics, psychology, arts, where it was applied many years ago and it is still moving trying to do the relationship between operator-work-machine more pleasant..*

Key words: *ergonomics, efficiency, comfort, modularity.*

1. INTRODUCTION

EGO is a modular concept devoted to industry and derived from LEGO, a kids play started in Denmark in 1932 and it comes from the word "Leg Godt" which means "play well" but in the Latin language LEGO means "I assemble" and like the title says ego in Latin means "me". So, looking at the modularity at the title, ego-lego is another way of expressing the power of this concept the modularity/ combination at these words.

The concept is based on Ergonomics, Comfort, Efficiency and Modularity.

Ergonomics is the science of work. Its name is derived from two Greek words: ergon, meaning work, and nomoi, meaning natural laws. When combined, they create a word that means the science of work and a person's relationship to that work.

In applications, ergonomics is a discipline focused on making products and tasks comfortable and efficient for the use, comes into play.

Comfort is one of the greatest aspects of a design effectiveness. Comfort in the human-machine interface and the mental aspects of the product or service is a primary ergonomic design concern. Comfort in the human-machine interface is usually noticed first.

The utility of an item is the only true measure of the quality of its design. The job of any designer is to find innovative ways to increase the utility of a product. Making an item intuitive and comfortable to use will ensure its success in the marketplace. Physical comfort while using an item increases its utility.

Efficiency is quite simply making something easier to do. If something is easier to do you are more likely to do it. If you do it more, then it is more useful.

Modularity is the degree to which system components may be separated and recombined. The meaning of the word can vary somewhat by context:

- In biology, modularity refers to the concept that organisms or metabolic pathways are composed of modules.
- In industrial design, modularity refers to an engineering technique that builds larger systems by combining smaller subsystems.
- In manufacturing, modularity refers to the use of exchangeable parts or options in the fabrication of an object.

2. METHODS

Spiral of Archimedes

It is the locus of points corresponding to the locations over time of a point moving away from a fixed point with a constant speed along a line which rotates with constant angular velocity (Fig.1). Equivalently, in polar coordinates (r, θ) it can be described by the equation:

$$r = a + b\,\theta$$

with real numbers a and b. Changing the parameter a will turn the spiral, while b controls the distance between successive turnings. The polar coordinates r and θ can be converted to the Cartesian coordinates x and y (Fig. 2) by using the trigonometric functions *sine* and *cosine*:

$$x = r\cos\theta$$

$$y = r\sin\theta$$

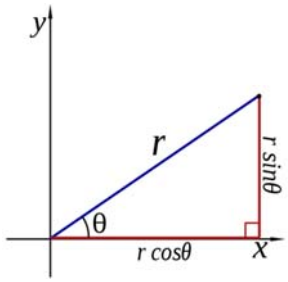

Fig. 1. The Rule

Table 1- Spiral coordinates

x	y	z
0	0	0
12.37	12.37	0
35	0	0
37.12	-37.12	0
0	-70	0
-61.87	-61.87	0
-105	0	0
-86.62	86.62	0
0	140	0
111.37	111.37	0
175	0	0
136.12	-136.12	0
0	-210	0

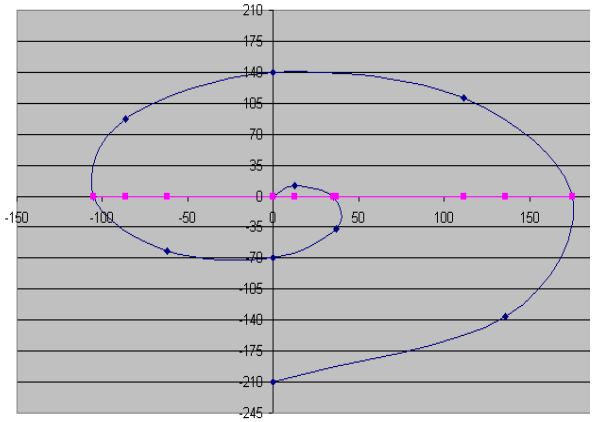

Fig. 2 Spiral of Archimedes generated by the coordinates from the table 1.

Using a professional design program, we can see that the theory is successfully in industry, as in the example of these two blocks (Figs. 3, 4) and is not only a theory which stay on paper.

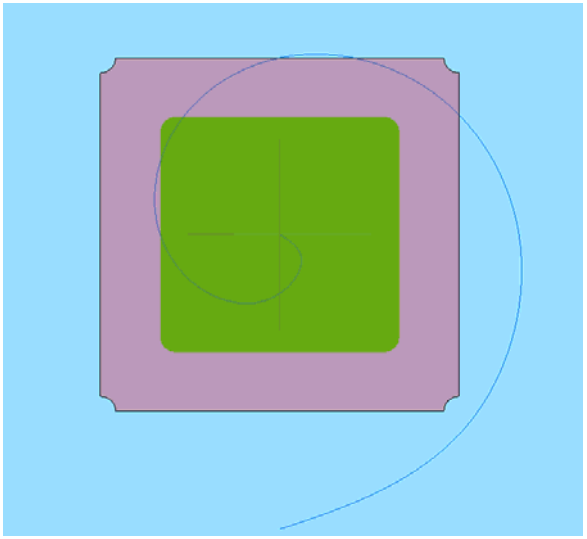

Fig. 3 Front view about modular blocks built with spiral of Archimedes

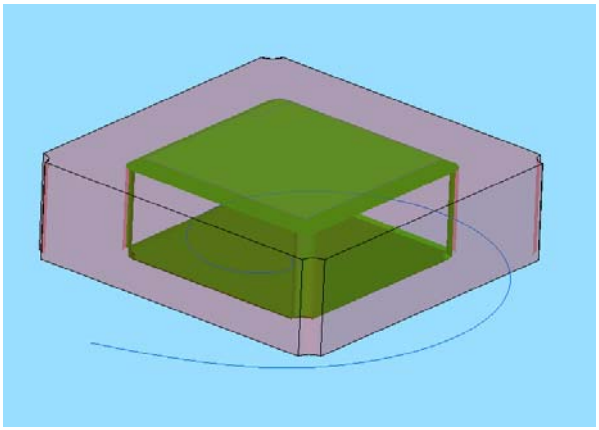

Fig. 4 Perspective view at the blocks built with the spiral of Archimedes

3. APPLICATION AND RESULTS

Research on modularity **in biology** is that of Gunter Wagner. Wagner's work[1] explores how natural selection may have resulted in modular organisms, and the roles that modularity plays in the evolution. Wagner's work suggests that modularity is both the result of the evolution, and facilitates the evolution—an idea that shares a marked resemblance to work on modularity in technological and organizational domains.

In the fine arts it has a long pedigree among diverse cultures. In the classical architecture of Greco-Roman antiquity, the module was utilized as a standardized unit of measurement for proportioning the elements of a building. Typically the module was established as one-half the diameter of the lower shaft of a classical column; all the other components in the syntax of the classical system were expressed as a fraction or multiple of that module. In traditional Japanese construction, room sizes were often determined by combinations of standard rice mats called tatami; the standard dimension of a mat was around 3 feet by 6 feet, which approximate the overall proportions of a reclining human figure. The module thus becomes not only a proportional device for use with three-dimensional vertical elements but a two-dimensional planning tool as well.

Modularity as a means of measurement is intrinsic to certain types of building; for example, brick construction is by its nature modular insofar as the fixed dimensions of a brick necessarily yield dimensions that are multiples of the original unit. Attaching bricks to one another to form walls and surfaces also reflects a second definition of modularity: namely, the use of standardized units that physically connect to each other to form larger compositions.

With the advent of modernism and advanced construction techniques in the 20th century this latter definition transforms modularity from a compositional attribute to a thematic concern in its own right. A school of Modular Constructivism developed in the 1950s among a circle of sculptors who created sculpture and architectural features out of repetitive units cast in concrete. A decade later modularity became an autonomous artistic concern of its own, as several important minimalist artists adopted it as their central theme. Modular building as both an industrial production model and an object of advanced architectural investigation developed in the same period.

Modularity has found renewed interest among proponents of ModulArt, a form of modular art in which the constituent parts can be physically reconfigured, removed and/or added to. After a few isolated experiments in ModulArt starting in the 1950s[2], several artists since the 1990s have explored this flexible, customizable and co-creative form of art[3].

The term modularity is widely used **in studies of technological and organizational systems.** Product systems are deemed "modular", for example, when they can be decomposed into a number of components that may be mixed and matched in a variety of configurations.[4] The components are able to connect, interact, or exchange resources (such as energy or data) in some way, by adhering to a standardized interface. Unlike a tightly integrated product whereby each component is designed to work specifically (and often exclusively) with other particular components in a tightly coupled system, modular products are systems of components that are "loosely coupled."[5]

Most noted work on **modularity in psychology** is Jerry Fodor's book, The Modularity of Mind (1996/1983).[6] In the book, Fodor does not argue that the entire mind is modular; rather he proposes that the central cognitive system responsible for complex cognitive activities (such as analogical reasoning) is not modular, but that input systems (which interpret the neural signals from physical stimuli, and are responsible for basic cognitive activities such as language and vision) are likely to be modular.[7]

4. CONCLUSIONS

In this paper the basic idea originates in LEGO, a children game started in Denmark in 1932. The advantages of using the modular concept based on ergonomics, comfort and

efficiency is encountered in many and different domains like technology, biology, psychology, mathematics (Table 2) where was applied many years ago and the development still moving trying to do the life for human beings much easier in the work area.

Table 2

Concept	Technology and organizations	Psychology	Biology	Mathematics
Domain specific	X	X	X	
Innately specified		X	X	
Hierarchically nested	X	X	X	X
More internal integration than external integration (localized processes and autonomy)	X	X	X	
Informationally encapsulated	X	X		
Near decomposability	X	X	X	X
Recombinability	X		X	X
Expandability	X		X	X
Module as homologue	X		X	X

5. REFERENCES

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[2] Schilling, M.A. 2000. Towards a general modular systems theory and its application to inter-firm product modularity. Academy of Management Review, Vol 25:312–334.

[3] See "Modulartists and Their Works" in ModulArt.

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Cercetări privitoare la modularitate, legile eficienței aranjării geometrice

Rezumat : ***[Legile eficientei aranjării geometrice]*** *este un concept modular destinat industriei în special. Este derivat din LEGO apărut 1932 în Danemarca ca un joc destinat copiilor. Avantajele folosirii conceptului modular bazat pe ergonomie, confort şi eficienţă se regăsesc în multe dintre domeniile de activitate industrială şi nu numai ca: biologie, tehnologie, psihologie, matematică, construcţii, arte ş.a.m.d. unde au fost aplicate cu succes cu mulţi ani în urmă şi care se află într-o continuă dezvoltare încercând să faciliteze relaţia om-maşină-muncă.*

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