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The prevalence of the network paradigm in all sectors of human activity is connected not only to important changes in the ontology, the methodology and the design and construction tools, but also to changes in the relations between design and construction. Within the above frame, the present essay will attempt to describe the methodology and the learning environment to develop the skills of designers so that they can correspond to the new data shaped by the network paradigm. Firstly, the basic steps of the teaching plan will be described. This is a continuous process which includes modeling, construction analysis, interdisciplinary collaboration, standardization, control, production and assemblage. Next, the general frame of the teaching environment will be outlined. This involves Collective Innovation labs (CI labs), the combination of craft workshops and innovation and creative technology spaces. The presentation involves a holistic proposal of continuum design-construction teaching methodology that includes the ideological, methodological and spatial framework.

Key words: teaching, digital construction, design, labs, collective innovation, commons, autonomy

INTRODUCTION

The structural link between design and construction is central to the teaching of design (Papalexopoulos, 2008, 2014; Kolarevic, 2003). The information generated during the design process is inextricably linked to the manufacturing process. The digital files produced during the design phase control the operation of the production machines (machines for cutting formulating, three-dimensional printing, robotics etc.) while simultaneously they constitute a base for the management and organization of the project. Design information now entails construction information and production information (Papalexopoulos, 2006). At the same time, the design incorporates digital data of the production of structural elements. The construction analysis constitutes a suitable methodology for the structural correlation of design and construction as it contributes to the design of objects, on the one hand based on the properties, and on the other based on the relations of the individual parts of the construction. In this way, it is possible to face the changes arising so much during design as during the construction of the project. These changes may concern matters of geometry, material properties, organization and construction, project budget etc. The logic of construction analysis may be applied to the total project or the individual construction units and the structural elements of the construction. To be mentioned, among other, the research efforts of:
- Institute for computational design and Construction in Stuttgart Europe, especially the ICD/ITKE Research Pavilions,
- Abedian School of Architecture in Brisbane Australia, especially the “CELLULAR TESSELLATION” Pavilion,
- UC Berkley Environmental Design in California US, especially the Freestanding Pavilion “Bloom”

At the same moment, so much the design as the construction procedure are the result of an interdisciplinary collaboration that takes place in real time, remotely and on a global level. Interdisciplinary collaboration involves transverse
communication among the various scientific fields and the possibility for innovative approaches through these. Information networks connect designers, constructors and product producers. Interdisciplinarity requires the development of a common language of communication (terminology, standards, inter-operability etc.) among the parties involved, and it uses knowledge communities and collaborative environments as tools.

**Ontology of production – introduction to the digital construction**

The formation of a new framework of production is generally ascertained in the ontology of production, but more specifically a new framework of digitally controlled construction (digital construction), based on immaterial work (Hardt and Negri, 2005; Rylmon, 2017), throughout the networks paradigm (Castells, 1994, 1996, 2003; Dijk, 1999; Lessig, 2002; Sassien, 2002; Hardt and Negri, 2005; Thacker, 2004; Stalder, 2012) and the globo-local “Glocal” features of production (Swyngedouw, 2004).

The sovereignty of immaterial work results in:

- The appearances of “bridges” between design and construction. Design and construction are unified. The digital archives created by design are the same as those used by production machines. Also, new generation innovative construction tools are developed, directly linked to digital design.
- The development of collaborative, collective, common and, thus, open procedures, allowed by digitally controlled construction. Networking and the promotion of small-scale production units thus appears, as a model for the factory of the future.

Network production results in:

- The challenging of major capital-intensive interventions and the promotion of small production units which are well networked.
- The growing effort to produce products on a local level. Constructors are trying to move their production closer to markets.

Globo-local features of production result in:

- The constant emergence of knowledge and technology clusters, which constitute at the same time production units and research centers, operating supportively to production. At the same time, they are the “bridge” between the procedures of construction of the site and the operation procedures.

**METHODOLOGY OR PRODUCTION**

A hybrid dimension of production is ascertained in the methodology (Psychogyios, 2017; Hauschild, 2011; Kolarevic, 2003, 2005, 2017). There are procedures that require skills and techniques in digital processing services, while at the same time there are procedures that require manual skills and a deep knowledge of the materials and the machines of production. There are parts of the production identified locally (production machine sites) and parts of the production distributed (design, calculation, cloud procedures).

It is also noted that the 9-step methodology as described below (Modeling 1/ Construction analysis / Interdisciplinary collaboration / Modeling 2/ Standardization / Control / Production / Assemblage / Modeling 3) applies to all construction scales, from the building casing of large scale constructions to the manufacture of interior furniture and items of industrial design.

Also, the basic methodology applies to several materials, among which are aluminum alloys for facades, beech plywood for outer casings, black metal sheets and industrialized wood (MDF) for interior partitions, glass for openings, polyester and acrylic materials for supports, as well as combinations of the above, depending on the design of the production item.

Lastly, an important ascertainment is that this methodology is used in various project cases. We come across it in projects whose basic aim is to develop innovations and optimize procedures so as to reduce cost, research projects emphasizing the change in the construction model, innovation and the use of cutting edge technologies, research projects focusing on new forms of collaboration and a redefinition of worker roles, experimental projects focusing on the development of a new socio-economic structure with an emphasis on free and open exchange of files and information, but also in specialized closed scientific projects with limited information and research carried out almost in secret.
Production tools
As for production tools, the following are pinpointed:
- MPF machines with multi-point metal surface configuration
- Robotic machines
  - for welding
  - for assemblage
  - for the processing of the material (piercing / cutting)
  - for painting
- cutting and material removal machines
  - acrylic
  - aluminum
  - wood
  - glass
  - extruded polystyrene
- metal cutting machines
  - plasma
  - waterjet
- machines for the formation of metal
- three-dimensional printing machines
- machines for cutting and printing on paper
- machines for three-dimensional digitization (complementary role in the production process)
- geographical information systems machine (complementary role in the production process)

It is important to state that the above machines are used in different stages of the construction and they have different specifications, mainly related to the type of material being processed and the quantity of the product. At the same time, the machines are always supported by specialized control software, which in general determine the speed of production, the type of material, the processing method and the special tool to be used for each process (head). In general terms, control software is based on G-code and they come under the nesting software category.

Based on the above, we could briefly state the following general categories of digitally controlled production tools:
- Tools for cutting material
- Tools for removing material
- Robot tools
- Three-dimensional printing tools
- Digitization tools (complementary role in the production process)

The modern requests that production tools are called to meet (Globa, 2012; Gershenfeld, 2003; Fordyce, 2016; Guljajeye, 2012; Gwamuri, 2014) in the construction sector are:
- Fast and economic production of unique, different parts of the construction, which are then assembled
- Constructions of a particular morphology
- High level of precision in construction
- Elimination of mistakes and omissions related to manual construction
- Cross-sector collaboration
- Distributed production and remote control

Satisfying the above facts entails the development of the department of equipment and the department of digital control of the equipment. An analysis of the case studies revealed that the more developed the two departments, the more effective the machines. Usually, companies that place emphasis on both departments are those that have the most prominent positions in the marketplace. The two-fold component (local and network) of production tools is thus ascertained.

Teaching digital construction - Methodology
As the production framework has been described above, it arises that the general learning aim of the educational process of designers should be the understanding and the management of the relationship between information management (design – construction) and conceptual design process (Bradham, 2008; Butler, 2017), as well as the management of the relationship of digital technologies with the databases, the advanced building systems and CNC machine tool production (Barbosa, 2014; Agkathidis, 2013; Bijker, 1994). Another important factor is the practical introduction of additive / subtractive manufacturing to the cutting-edge sector, by standardizing with digital tools, composite small-scale structures, whether wooden, metal or glass.
By connecting construction to robotic technology, three-dimensional printing technology, CNC technology and three-dimensional scanning technology, it becomes possible to re-invent traditional production techniques as innovative processes for architecture.

In this sense, conventional tools acquire an increased level of preciseness and control when used by digitally controlled production machines, allowing users to perform functions with surgical precision. It is also important to carry out original design tactics which are gradually changing into production procedures of exceptional preciseness and flexibility, with the use of digitally controlled production machines. This is a critical approach to design through action (Eisenhardt, 2010) where construction is central to the design procedure.

More specific aims of the educational process are

- The definition, the classification and the correlation of the construction units of a project. Then, the drafting and the application of correlated digital catalogues where the parts of the construction information will be organized and correlated
- The search of valid online construction information by definition of key words and phrases and the use of optimized techniques in search engines. At the same time, the aim is to encourage the development of the knowledge community for construction information
- The recognition of the importance of interdisciplinary collaboration for the solution of design and construction problems and the application of digital design collaborative practices
- The application of an integrated procedure of modeling, control, production and assemblage of a project, under scale, with the use of standardization lab machines. The aim is for students to go through and adopt all stages from the initial conception to the final assemblage of the construction.
- The introduction to robotics, three-dimensional printing and CNC technology and the familiarization with robotic arms, three-dimensional printing machines, 4-axis CNC machine tools and three-dimensional scanning machines, while at the same time researching the control software which will help in the production of the suitable geometry and tool paths.
- The participation in advanced three-dimensional scanning technologies which will contribute to the initial design procedure, but also to the update and guidance of the production.
- The construction and assemblage of standardized constructions on a 1:1 scale.

The educational procedure is organized into two units. The first unit is focused on construction analysis, cooperation models and standardization of the construction. The second unit is focused on design adaptation to the control software data of the production machines, the production of parts of the construction and the assemblage procedure. The starting and ending point of the procedure is the modeling of the construction and it ranges from the initial concept stage to the final design following implementation (as built). In the first stage, students are asked to create an open knowledge community and cooperate on a common online platform, while for the second stage they will make use of the standardization labs.

The outline of the digital construction course (see Figure 1) may be defined as a continuous infinite procedure that includes the following steps:

- Modeling 1
- Construction analysis
- Interdisciplinary collaboration
- Modeling 2
- Standardization
- Control
- Production
- Assemblage
- Modeling 3
Modeling 1

Modeling 1 is about initial design (working sketches etc.) and the creation of digital construction models to be enriched throughout the stages of the design procedure. This is the primary design phase where the operational requirements, the morphological requirements, the building program, the relationship with the installation environment, the materiality and the structural behavior of the construction are taken into account. This step highlights the operational role of digital design applications based on automated, real-time multiple user solutions which offer data from common collaboration platforms (xref).
Construction analysis

Construction analysis is about the analysis of the construction into individual parts and the determination of the features and relations of these parts. At this point emphasis is put on the structure of the construction and its representation. Construction units are specially devised for the purposes of the study and they are not applied universally in all cases. An important element of construction analysis is the selection of standardized and non-standardized construction elements.
Interdisciplinary collaboration

Interdisciplinary collaboration is about transverse communications of scientific specializations. For example, the correlation of architecture with building technology, statics, engineering, informatics, ecology, material sciences, economy, critical theory etc. Interdisciplinary collaboration relates to all the steps in the procedure.

Figure 3: construction analysis

Figure 4: interdisciplinary collaboration
Standardization

Standardization is based on construction analysis and interdisciplinary collaboration. It includes elements of programming, systemization of industrial products, specifications, repetitive work and constant production of the same item. Standardization is approached operationally through the search of valid information on the web and the drafting of open digital catalogues. At the same time, an open educational community is gradually formed which is on the cutting edge of knowledge, its members respond to the rapid changes in the scientific subject, there is an attempt to interconnect with production bodies and a valid, dynamic, digital library is gradually formed.

Figure 5: standardization

Modeling 2

In this step a construction information model gradually arises which includes geometry information, correlation information, sequence information and specification information. For example, it is important to understand that external heat insulation

- has specific dimensions and positioning on the building (given with geometry information)
- has a specific relationship so much with the materials of the external coating as with the structural elements (given with correlation information – diagram)
- has specific installation techniques and a suitable installation time (given with sequence information – time schedule)
- has specific specifications and properties, life span etc. (given with specification information - text)
Control

The control is based on control software of the production machines. This stage defines the production machines (cnc router, cnc laser, cnc waterjet, 3D printer, robotic, drone etc.) and the method of processing materials. The digital files of the modeling determine the construction items, the cutting and processing tools and the cutting times. The way the materials are placed on the machines is also defined. Corrections are made in the geometry; the files are adapted to machine files and production is optimized to save materials. In this stage new work teams may arise, which will deal with the construction or the adaptation of the production machines.
Production

In this stage, the items of construction are produced by the production machines.

Assemblage

Assemblage is usually in two stages. First the whole construction or part of it is pre-assembled to examine the joints and the end result. If the production quantity is large, then one part is produced and assembled. Pre-assembly is also performed in cases where the material will be subjected to further processing (e.g. colouring). This procedure also allows the design of the method of transfer and final assembly of the construction. Final assembly is usually performed on site.
Figure 9: Assemblage

Assemblage
- pre-assembly, dimension control, node control, matters of worksite organization
- final assemblage

Figure 10: Modeling 3

Modeling 3
In Modeling 3 the collaborative information model is completed with construction information and implementation plans (as built). After this, it is possible to check the operation of the construction during its first use.

Modeling 3
- implementation plans (as built) for the jewelry exhibition space "Avlaia"
Notes concerning methodology steps

As far as the learning procedure is concerned, it is important to stress the following matters:

A. Continuous circular procedure. It is important to understand that from the moment modeling 3 is complete with the “as built” designs, the management body is able to control the functionality of the construction and at any time make improvements and changes that will arise from any non-determined operational needs. (See Figures 12-13)

![Schematic course diagram](image)

**Figure 11:** continuous circular production procedure

![Infinity symbol](image)

**Figure 12:** Leonhard Euler - Variae observationes circa series infinitas. Commentarii academiae scientiarum Petropolitanae 9, 1744, pp. 160-188.
B. Individual circular processes (redesign, design optimization, production optimization). It must be noted that in many cases the need arises for optimization of the construction design or the construction procedure. For example, when modeling 2 is complete, it may be deemed necessary for the procedure to return to construction analysis, interdisciplinary collaboration and new standardization in order to continue to phase b which includes control, production and assemblage. Another very common phenomenon is the completion of the first cycle (control / production / assemblage) followed by a return to construction analysis, interdisciplinary collaboration and standardization. At this point the linear internal relations between steps must be stressed, such as construction analysis with assemblage, standardization with control and interdisciplinary collaboration with production (see Figure 13).

![Figure 13: linear internal relations of production steps](image)

C. The use of common digital files in all steps. The interoperability of production machines has played a major role. This is the result of production computerization (Nagurnay, 2006; Pearce, 2015; Richardson, 2013; Ridgway, 2013; Rawn, 2015; Tenno, 2016). It does not mean that industrial production ceases exist or play an important role. Just as agricultural production increased in industrialization, in the same way computerization is changing industrial production, by redefining and renewing its procedures. Knowledge, communication and information acquire a central role in professions, which are becoming more flexible. At the same time, great emphasis is placed on the provision of services that an industrial product offers. To this respect, Castells and Aoyama (1994) identified two models of computerization: The English-Saxon model, based on service economies, and the Japan-German model, based on computerization of industrial production.

The greatly laboratorial character of the procedure and the development of collaborative practices. Several educational institutions (universities, schools, museums, libraries etc.) focus on practices of incorporating collective innovations, mainly within the frame of educational programs (Eisenhardt, 2010). These practices are based on social responsibility, participation of the local community, the diffusion of local sayings into the global community, the participation of various social groups in innovative laboratories, the democratization and open access to knowledge through content digitization as a form etc. According to Desi Gonzalez, (2015), in an age where in many public hearings the discriminations among art, the mass media and technology are not significant, production based on art is merged with that based on technology. Instead of these, practices of creative production -which converges the worlds of art and technology- are those that tend to be dominating.
Figure 14: presentation of a student project for the course composition 6A – NTUA. Students Megalemos - Papadopoulos - Pettemeridi, supervising prof. D. Psychogyios

Figure 15: presentation of student project for course composition 6A – NTUA. students Zografos - Miliaraki - Touros, supervising prof. D. Psychogyios
Teaching digital construction – Spatial framework- Collective Innovation Labs (CI-labs)

The suitable environment for the teaching of digital construction is Collective Innovation Labs (CI-labs) which combine features of creative manual labs (woodwork, metalwork, marblework labs etc.) and innovation labs (fablabs, living labs, co-working spaces, hacker spaces) (Capdevila, 2014; Cohen, 2011; Leforestier, 2017; Maxigas, 2012). These are usually places open to the public. Their members have specific targets, they exchange information and tools, and have a participational and inter-sectorial basis. They have an intensely local character, they are factors of local development and they are based on geographical and cognitive proximity. They place emphasis on access to knowledge, formal and informal learning, creative technology and a knowledge flow. Finally, they are intensely characterized by a return to materiality. CI labs emphasize participation of the local community, the diffusion of local sayings in the global community, the participation of various social groups in innovative labs, the democratization and open access to knowledge through content digitization as a form of informal learning and the participative culture of the web.

CI labs are based on “autonomy” and the “commons”. According to Kastoriadis, the autonomous society is the one that bears life and the adjustment of social relations itself. According to Boiler, the commons are the management of resources with the least possible or no dependence at all on the market or the state.

![Collective Innovation Labs (CI-labs) diagram](image)

**Figure 16:** Collective Innovation labs (CI-labs) diagram

**Autonomy**

The "other" society referred to by Kastoriadis (2010) is the “autonomous society”, the one that sets its own laws (autonomous = auto + nomos-law). According to Kastoriadis, autonomy is individual and social. Individual autonomy is reconciled with social autonomy with the existence of power, which bears life and regulates social relations itself. It comprehends human history and the society as a creation, not subject to undeniable historical laws. Autonomous society is self-imposed, the nucleus of the institutions is “imaginary meanings” that orient values and cannot be refuted. For example, according to Kastoriadis, the “imaginary meaning” in capitalist society is the increase of productive powers.

"Kastoriadis’ great contribution, not only to philosophical thought but more broadly to all humanities and more specifically to History, is undoubtedly the emergence of the dimension of imagination -which he himself reached after his decisive critical turn to psychoanalysis and the denial of Marxism- is the emergence of the primary meaning of what he himself called “social imaginary”, this magma of social imaginary meanings. Kastoriadis showed us how to think of society as something that makes, constantly creates itself. For Kastoriadis (2014), imagination was the driving force of History”.

Consequently, the features of autonomous society are the following:

- It is self-institutionalized
- It creates laws by itself, as it considers that there is no transcendent source of laws
- It comprehends history as a “creation” and not as subject to undeniable historical laws
● It approaches the ancient Greek (8th - 5th c.) and western-European (following the Middle Ages) society, where the phenomenon of the recreation of a “political society” is presented, which bears its life and adjusts its social relations, while having the ability to doubt tradition.

● Citizens of an autonomous society do not believe in afterlife.

According to Kastoriadis, autonomy has its roots in the class of the artisans and merchants, and it appears in the town-state in which this particular class developed.

Commons

In recent years, a large number of researchers from various fields have dealt with the concept of commons. In his book “Think like a commoner, a short introduction to the life of the commons”, David Bollier (2016) gives the following definition:

“A commons is:
A social system for the long-term benevolence of resources that preserves the common values and identity of the community.
A self-organized system with which communities manage sources with no or the least possible dependence on the markets or the state.
The wealth we inherit or create together and that we have to bequeath, as is or increased, to our children. Our collective wealth includes gifts of nature, urban infrastructures, cultural works and traditions and knowledge.
A sector of the economy (and of life!) which produces values in ways often considered de facto – and are often put in danger by the market-state dipole”.

In an interview, Franco Berardi (2017) talks about the contradictory role of new technologies. He claims that technology on the one hand is moving towards the monitoring and the control via global businesses, but at the same time within businesses there is an interesting conflict developing. He believes in the power of mental production, the power of knowledge and technology developed within a hegemonic model. He considers that change will come from the power of the machine producers, from the new type of “industrial workers”, from the pioneers of today, who he calls “productive nuclei”, “global Silicon Valley”, which, however, is not in California but everywhere. He also supports that “human feelings and communication are more and more at the forefront of production and consumer standards which support capital flow in meta-industrial society”. Thus, Berardi devises the conceptions “cognitariat” and “infolabour” to analyze these psycho-social procedures.

Berardi was a member of Radio Alice, the first pirate radio station in Italy. He was also co-founder of Telestreet, the Italian movement that installed free TV stations in various towns in Italy. This movement set out in Bologna, with Orfeo TV a small station, which would transmit for some hours at a radius of 200 meters. Then, the movement was supported by organizations, groups of people who wanted to make TV a free means of communication.

Autonomous Joint Cultural Networks have the technology and political maturity to move one step further than the Telestreet movement, basically aiming at free, unlimited open access to cultural content through distributed and strongly networked micro-architectures. Both the development of technological infrastructures and the strengthening of the role of “global production nuclei” make this project more mature so that it can be attained. “Global productive nuclei” are connected with the artisan and merchant classes described by Kastoriadis and the immaterial workers referred to by Hardt and Negri (2002, 2011) (and they constitute the critical mass that will participate in this paradigm change. Both cultural laboratories of collective innovation and urban cultural networks of collective innovation, as described below, constitute the new architectural paradigm that has a tendency to become hegemonic.

While the Telestreet movement is connected to the business part of the Autonomous Common Cultural Networks, the Commons and more specifically the Cultural Commons are connected to the power of knowledge and the methodology of the new architectural paradigm. Bollier (2016), one of the modern scholars of the Commons, believes that the economy of the Commons constitutes the other paradigm against the predatory markets and the bureaucratic state. We could maintain that the Commons constitute the continuation of Kastoriadis’ research on the autonomous society.

According to Bollier (2017):

The Commons are a social system for the creation and management of common wealth. They manifest in a variety of ways, from the self-management traditions of native people and the collective management of lands, fishing areas and forests, to Wikipedia and open source code. The commons can be found in community gardens, urban land trusts, cooperatives and alternative currencies. What brings them together is bottom-up self-management. Simple citizens control common resources themselves. They devise their own rules, traditions, rituals and moral codes to achieve this. And they pay particular attention to justice, conciseness and viability. The example of the commons is witnessing a revival today throughout the world, especially in Europe and global south, because it can
function more justly and responsibly than the markets and state bureaucracies. In contrast to the extracting market of the economy, which has a tendency to privatize profits and transfer costs to the environment and the communities, the systems which are based on the commons have the ability of production and reproduction. They strive to satisfy the basic needs of people in a stable, self-adjusting and holistic manner.

Bolier suggests the creation of a new type of institution based on the commons, which will be able to manage common resources directly and transparently, thus bypassing political manipulation of legislators and regulating authorities:

An attractive idea is to found “associations of those who have a legal interest” (stakeholder trusts) on the common wealth. Citizens must pressurize legislators to vote for the foundation of an independent authority for the management of common resources such as oil, fossil fuels, water and cultural heritage. Such an association may act as a supervisor of common goods and, in certain cases, generate income to be shared with the beneficiaries.

Innovation and creative technology spaces (Hacker spaces, Living Labs, Fab Labs, co-working spaces)

Hacker spaces, maker spaces, Living Labs, Fab Labs or co-working spaces are a common name for Localized spaces of collaborative innovation (LSCI) (this is the term used by Capdevila in the article “Typologies of localized spaces of collaborative innovation”, where knowledge communities meet to innovate collectively. According to Capdevila (2014), these spaces may be a key point in the innovative ecosystem in towns, thus bridging personal creativity with innovative businesses. However, the increasing importance of this phenomenon has been ignored by researchers in the field of innovation, both in organizations and in urban planning. In his research, Capdevila stresses the role these communities play in the promotion of knowledge and innovation both on a local and a global level, thus contributing to the innovative and creative capability of towns. Indicative examples of innovation and creative technology spaces are Fab lab – Athens, Co-working spaces – Cube, Maker spaces / Hacker spaces - [HSGR] and Living Labs - TNS LL

Creative industries (craft workshops / craft industries / local know-how)

According to Georgios Sykianakis (1964), the productive sector in processing is divided into three branches: cottage industry, craft industry and factory industry. Although these three forms co-exist in the economy, each one of them characterizes an era. The oldest historically is the cottage industry, where processing is located within. Craft industry characterizes the middle Ages to the spread of the industrial revolution. Craft workshops appear within homes and products are produced for the anonymous market or on order. Factory industry characterizes the more recent years and the discovery of the steam engine is a key point. The production method, capital accumulation and production spaces change dramatically. The size of the business, the degree of production mechanization, the role of the entrepreneur in the business, the workers’ skills, the business turnover, the method of product standardization and the livelihood of the business are factors that characterize a business as a craft industry or a factory industry.

Craft industry was an important factor in the development of the Greek economy, it created and still creates a significant number of job positions, it forms the consumer framework and it contributes to the export of local products. The installation place of craft industries contributes decisively to the employment and economic development of a region. Also, siting (center – regional) of craft industries is a determining factor in decentralization and the strengthening of regional areas.

Sofia Avgerinou-Kolonia and Irene Klabatsea (2006) both attempt to approach the relations of local craft industry “know-how” and activities with newer changes and transformations observed in the economic, social, operational and spatial setup of these historical urban areas. The writers claim that the protection, the revitalization and promotion of traditional craft professions on modern terms are an important local development factor. They directly and interactively connect craft professions with the creation and development of historical settlements and cities. As elements of intangible urban heritage, local craft know-how, production activities and techniques, are believed to be means of the identity and authenticity of these historical urban landscapes. So it is a continuous interaction of socio-economical and spatial data, of determining importance for transformations made in the field of historic cities and the formation of modern urban landscapes.

The writers connect the economic boom and the formation of physiognomy of historic cities with craft and early industrial activities, which were based on local raw materials. More specifically, activities per region are the following:

- traditional metallurgy, silversmithing and jewelry making in Ioannina, Serres, Stemnitsa in the mountains of Arkadia
- ceramics in Crete, Sifnos, Lesvos
- weaving in Pilio, Thessaly, western Macedonian towns
- sericulture in the Peloponnese, the Greek islands and Souflı
- wood carving in mountainous settlements in mainland Greece
● Cycladic marble carving
● stone construction art in mainland and island Greece
● leather tanning in Crete, Lesvos, the Peloponnese
● Fur production in Kastoria, Siatista etc.

Knowledge associated with this local know-how is formed and recreated within the frame of the local society. It characterizes the local socio-economic formation and the particular local culture stemming from this.

Along with the local level, developments and data on international and European level are making actions and development of craft structures important. The writers (Avgerinou and Klabatsea, 2006) state in particular that there are changes concerning the demands in modern societies, which are turning towards high-value products of non-mass production, they are approaching local cultures and placing emphasis on local societies. At the same time, local culture is included in the epicenter of the development procedure. Specifically, it is connected to strategies of financial support of these areas where there is local know-how (UNESCO, 1998). Within this frame, international state or other organizations are supporting and promoting local cultures which are supported by local traditions and know-how.

Indicative examples of training areas which have intense features of craft workshops and constitute key points in the craft character and development of an area are the following:

● Silversmithing School in Stemnitsa
● Center for the Study of Modern Ceramics
● Preparative and Vocational School of Fine Arts, Panormos, Tinos – Ministry of Culture
● Department of Wood and Furniture Design and Technology (TEI of Larissa - Karditsa)

SUMMARY – CONCLUSIONS

Summarizing, this project attempted to outline a proposal for a holistic teaching approach in construction design relating to the ideological, methodological and spatial framework. As for the methodological framework, it proposes a continuous procedure including modeling, construction analysis, interdisciplinary collaboration, standardization, control, production and assemblage. As for the spatial framework, it proposes CI-labs which are a combination of craft laboratories and spaces of innovation and creative technology.

The existing regime in production is based on the prevalence of intangible work, the hegemony of the network paradigm and global-localization. So it is important for the above features of production and, consequently, the teaching of digital construction, to be based on a social system of common use of resources and self-adjustment of social relations “autonomy”.
**Figure 17:** whole teaching diagram of digital construction

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