ARCHITECTURE AS A KNOWLEDGE-BASED TOOL: THE ARCHITECTURAL TRANSFORMATION OF WORKSPACES

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1. Introduction: An Era of Technological Innovations

In these early days of the twenty-first century the pace of innovations in technological developments is phenomenal. A common example: the personal computers that we were using five years ago – which did not even exist about twenty five years ago – are now –for all intents and purposes useless today. The speed of technological innovations and product development has reached such an extent that almost every one of us has some outdated "technological" tool, which is yet to be "upgraded" to the latest technology.

While many disciplines are in constant state of inquiry – both for understanding the factors that necessitate these fast paced developments, and ways of supporting and utilizing the developments themselves, is architecture merely accommodating these technologies – i.e., is it simply a "spectator"? Or, can architecture be a discipline or realm to support these fast paced technological developments and innovations, - i.e., is it a "player"? Which role is more appropriate for architecture, or which positions for architects can highlight architecture as an important force of this era of constant and rapid technological change and development?

We can begin searching for the importance and place of technological innovations in today's world by acknowledging the three contemporary "revolutions", which are historically interrelated. First is the technological revolution, which is as significant as the industrial revolution. Second, there is the formation of a global economy – the continuity of economic processes on the planet scale – marking a worldwide interdependence among nations. Third, and the most important, is the formation of an "informational economy", where productivity and competitiveness are dependent on the creation of knowledge and flow of information, which clearly marks the importance of technological innovation (Castells and Hall 1994).

Obviously, the importance of knowledge is a more recent phenomenon, i.e., of the last decades of twentieth century. The last two centuries were marked with the shift from agrarian economies to industrial economies, through the Enlightenment and the Industrial Revolution, both of which had different focal points. However, the realm of architecture has responded to these changes in different ways, in order to support these changes in society. One important issue at this point is that, architects have attempted in various ways to employ their expertise as a knowledge-based tool to support either industrial, or recently, informational economies. In addition to the fundamentals of the profession of architecture, such knowledge-based attempts have formed a complementary 'paradigm' in architecture.

The main objective of this paper is to discuss these attempts, starting from the late nineteenth century, until today, through the development of workspaces. Design of workspaces, either as production facilities, or to house the service sector, have been a major area of search and research in architecture, for the utilization of a knowledge base. As scientific developments have taken place, different approaches to designing workspaces, i.e., typologies, have been developed, such as factories and office buildings. Today, research and development facilities have also been added to this repertoire of building types. This paper focuses on the mentioned paradigm, through a search on the development of office buildings, which in most cases also house research and development activities.

In doing so, attempts to exhibit the various ways in which architects have responded to the

changes in the conception and design of the workspace – economical, technological, or informational – through utilizing a knowledge base, thus utilizing architecture as a knowledge based tool: architecture as a form of technology. The paper concludes with informed speculations on the future practice and research opportunities on the architecture of workspace.

2. Initial Attempts

The attempts to employ architecture as a technology itself have their roots in the early stages of the Industrial Revolution. As in many other areas of human society, the Industrial Revolution, marking the transformation from agrarian to industrial economies, has had a significant impact on the evolution of the workspace.

The industrial revolution is hard to consider without the idea of enlightenment. 'Enlightenment', as an understanding, has yielded the notion of the 'autonomous man'. Within this understanding, a distancing of man from the nature and dark primeval forces, and a quest for control of nature and himself accompany each other. The idea of enlightenment, described as the great rationalization of the Western world, has cultivated modernity as a condition, sharing much with the Industrial Revolution of nineteenth century, which, consequently induced scientific and technical rationality (Muller 1991).

The scientific and technical rationality that began to be dominant for the first time in this period was supported by three factors. First, capitalism, as a system where effort is mainly geared towards obtaining maximum return from the least amount of investment, became an important goal. Moreover, the Protestant ethic, where moral values were attributed to non-moral activities, one of which is work, consequently had a significant impact on the understanding of work and the workspace. Hard work now, had a moral value, affecting the value systems and moral worlds of the "workers". Another important factor was that, this overall series of developments was encouraged with the technological and scientific successes (Brolin 1976). This era marks the beginnings of the entry of scientific and technical rationality in the realm of architecture.

The reflections of these developments on the formation and spatial organization of the workspace needs to be discussed through managerial science. It was the idea of managerial science that formed the concept of work organization, and therefore, induced the formation of specific spatial organizations of the workspace. This also marks the attempts to employ workspace architecture as a technology: a technology to be utilized for the purposes of maximum productivity in the workspace.

As a major contributor to the study of managerial science, Frederick Winslow Taylor was a pioneer to affect the spatial formation of the workspace.

Taylor's principles on work do not solely focus on the office, but is a contribution to the realm or idea of 'work' as a whole. Having its basis on the notion that "...people can be managed best when they are treated as unthinking automations...", Taylorism proposed some managerial ideas about work, such as the careful observation and ruthless control over work, treating people as if they were simple and many units of production, observing people with a stop-watch, punctuality and synchrony, and no expectation of intelligence and inventiveness from the 'worker', either in the office or the factory.

The waste of human effort through the ways which work was conducted was a main point for Taylor's approach. Depending on his own experience, he was convinced that the actual movements of men at work were wasteful and ill directed. Russell (1981) argues that Taylor was after training workers according to the system, instead of searching for competent men:

"All this was effected by minutely timing the work processes, the movements of the men and the positions of machines and tools. From this the movements and processes seen as being most economic of time and effort were set down as norms for the job with the result that production went up and the wages also went up... (Russell 1981: 86)"

These ideas clearly had much to do with the physical formation and spatial organization of the workspace, and the utilization of workspace architecture for the support of work.

When one focuses on the effects of Taylorist principles on the workspace, the results are somewhat similar on nearly all examples: one large space for the 'office-workers', or clerks to do clerical tasks in, mostly linearly organized, and higher status workers with their enclosed offices on the periphery, to supervise the clerks. It is argued that the crystallization of Taylorist principles is exhibited in Frank Lloyd Wright's Larkin Building (Duffy 1997) (Figures 1 and 2).

Figure 1. Larkin Building 1906. Interior, Architect: Frank Lloyd Wright (Source: Albtecht and Broikos, 2000: 48).

In order to cope with the Larkin Company's business of mail order, and to handle vast amounts of paper based information necessary for business, a large and disciplined group of clerks was needed. Wright's solution to the problem was a strictly ordered linear space, where the clerks were expected to work within a strictly ordered structure. *"It was probably ... the most perfect relationship between architectural invention and organizational innovation that has ever been achieved"* claims Duffy (1997), regarding this solution. Larkin Building was one of the first examples of utilizing architecture for the purposes of supporting work in the workspace: architecture was now a technology in and of itself. In other words, architecture was turning into a knowledge-based tool.

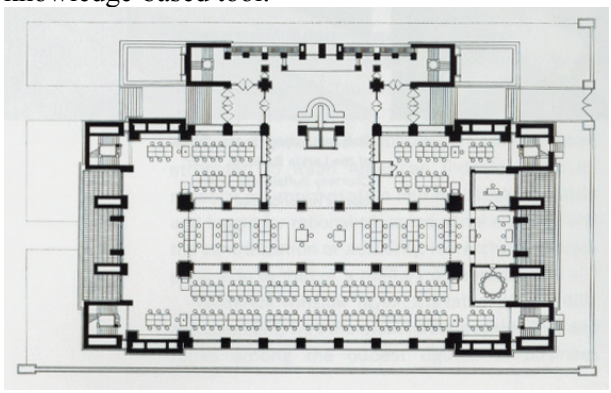

Figure 2. Larkin Building, 1906. Plan, Architect: Frank Lloyd Wright (Source: Albtecht and Broikos, 2000: 51).

3. Twentieth Century

There have been numerous changes and developments in the conception of workspace and the response of architecture to these, since the Industrial Revolution and principles of Taylorism. The post World War II developments in Europe and North America are worth considering in this respect.

Although the genesis of workspaces in the form of office buildings parallels the developments in "organization" in the United States, the two directions of development diverge in the post-war period. The custom designed office buildings such as Larkin Building gradually left the scene under the pressures of real estate development, forming a new type of office building, which was to be called "speculative offices".

The "speculative offices" were basically developers' speculations in the real estate market where offices had a mere "exchange value" (Worthington 1997). These were randomly built

office buildings on lots with a high real estate value, where the owner or the developer was able to either sell or rent a portion of office area. The "thin slab office tower" offered maximum profit with the highest number of floors. Partitions were placed on the slabs according to the request of the user, and renting or selling trends of the area (Laing 1997). Today, these speculative office buildings are ubiquitous in many North American cities.

Eventually, the speculative office industry turned into a building industry of "skin trade", where the architect was expected to provide maximum flexible area to be divided in a multi-floored block, leaving the interiors entirely to the interior designer. Such shiny glass covered rectangular prisms had a considerable effect on the silhouette of most North American cities. The glass office tower on a podium turned into a "fashion", where companies or organizations were able to rent or buy as much area as they needed (Laing 1997). Obviously, these speculative offices had not much in common with the idea of a knowledge-based response to the nature of work.

Meanwhile, the developments in Europe were more close to the idea of employing architecture as a knowledge-based tool. During the "invasion" of the speculative office buildings in the United States, reactions against the lack of link between work patterns and workspace design were forthcoming in Europe. The idea of relating design of office buildings to the work pattern to be housed was an "awakening" in the continent.

The concept of "burolandschaft" was introduced in Germany by Quickborner team in 1959. The basic concept of "burolandschaft" was an emphasis on the need for better communication in the workspace, supported by the design of the office, based on an analysis of the work patterns of office organizations. The routes of paper flow in the office, as well as the visual communication among office employees were the main factors determining the work setting design, i.e., spatial organization. Another argument in favor of the concept was that it eliminated segregation due to status differences; that is to say, it was an attempt to flatten hierarchy (Laing 1997). This understanding of the relationship between work patterns and work settings led to the creation of open workspaces in large, deep floor slabs, where clerks occupied large open spaces, whereas managers occupied private enclosed offices (Figure 3). The main difference of the concept of burolandschaft from speculative offices was that, whole layout was dependent on work pattern, instead of commercial restraints or opportunities. This was the introduction of a "use value" of an office building (Worthington 1997).

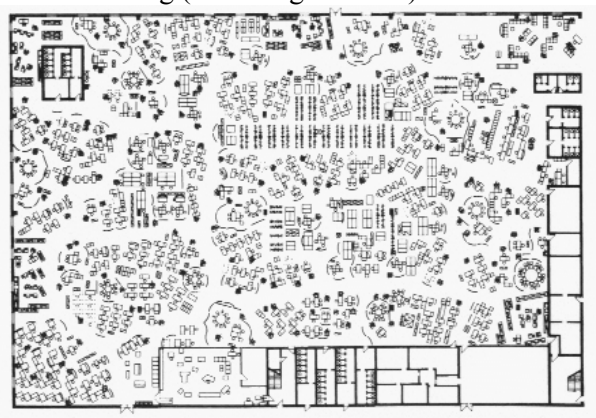

Figure 3. The concept of burolandschaft: GEG Versand Kamen building, floor plan (Source: Laing 1997: 28).

Despite the fact that the concept of burolandschaft remained within the concerns of interior design and work setting, it was an important awakening, in regards to the relationship between work pattern and design of the office workspace, thus, as a knowledge-based response to the nature of work by architects.

4. Changes: the Rise of Knowledge

The last two decades of the twentieth century have been significant for the vast amount of changes and developments that have been experienced. The introduction of new work patterns, high speed developments in information and communication technologies, flattening hierarchies, the introduction of knowledge as a commodity have all had great impacts on the evolution and developments of workspaces, through the responses of architecture (Duffy 1997).

In order to draw a clear picture of what has happened and is happening, a general framework can be proposed. The introduction of knowledge as a commodity by the end of twentieth century, which was a consequence of economic developments, has had enormous impacts on the workspace. The idea of "knowledge as a commodity" has reflections on many dimensions of the workspace environment, from new work patterns to new concepts of spatial organization. Additionally, one obviously has to consider the impact of the introduction of information and communication technologies on workspace environments, which are no less than those of "the idea of knowledge as a commodity". Thus, these two points, namely, *"the idea of knowledge as a commodity"* and *"the introduction of information and communication technologies in the workspace environment"* constitute the basis for the recent evolution of office environments, both in the scale of operation and design.

The attempts to employ architecture as a knowledge-based tool for workspaces have resulted in various research and design approaches. Among these, recent research by Duffy et al. (1998) looks at the changes in the work patterns, in order to build an empirical knowledge base to be utilized in workspace design. This research into the changes in work patterns can be summarized as in Table 1, where 'Conventional' vs. 'New' work patterns are compared. This comparison clearly exhibits the changes in the nature of work, and the need for architects to be informed about recent information about these changes.

Table 1. 'Conventional' versus 'new' work patterns.

'Conventional' work patterns	*'New' work patterns*
Routine processes	Creative knowledge work
Individual tasks	Groups, teams, projects
Work breakdown to small components	Collaborative and individual work
Work carried out by staff given precise instructions	Work process constantly redesigned
Precise timetable	Complex timetable
Full time occupancy of space	Task based occupancy of space
Individual space	Shared space
Alone or isolated work	Combined *interactive* and *autonomous* work

As a result of their research into the work patterns, Duffy et al. propose four optimized spatial configurations of workspace, where the main variables are interaction and autonomy: hive, cell, den and club. As interaction and autonomy increases, the workspace approaches today's innovative workspace. The authors summarize the spatial implications of these four types as shown in Figure 4 below.

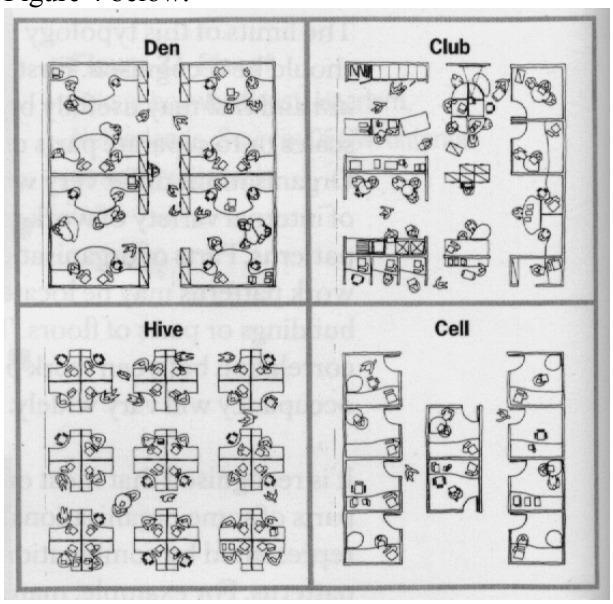

Figure 4. The four optimized spatial configurations (Source: Duffy et al, 1998: 26).

Duffy et al.'s work is an approach to the idea of utilizing architecture as a knowledge-based

tool (Figure 5), where some optimized spatial organizations are provided, to be used by designers.

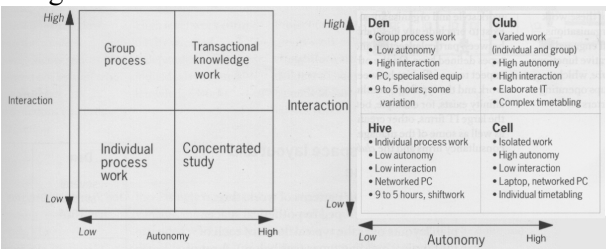

Figure 5. The four optimized spatial configurations and work patterns (Source: Duffy et al, 1998: 26).

Hillier and his colleagues, utilizing the space syntax method, pursue another point of departure in their research. The methodology used in this research searches for the interactive 'hot-spots' in the workspace, in order to find the tools and ways to support the innovation processes in today's workspace (Hillier 1996). Although Hillier and his colleagues' research does not yield some optimized spatial configurations, their studies evidently provide a quantitative approach, where the role of designers' intuition is potentially minimized.

5. Conclusions: Future Opportunities for Architecture and Architectural Research

Economical and technological advancement is an integral part of the objectives of contemporary societies. It is now evident that knowledge is a commodity, and the developments favor creation of knowledge and knowledge-based products and services. The question at this point is whether architecture will be able to contribute to the advancement of contemporary societies with the necessary means to support fast-paced technological developments, moreover, the creation of knowledge.

In a recent article, Gwendolyn Wright, while discussing "The Virtual Architecture of Silicon Valley", points out the fact that architects have not been able to intervene in the formation of this *"Mecca of digital technology"* to a large extent (2000: 88). Moreover, one of her statements reveal how critical this era is for the legitimization of architecture and its products:

"Most of the people who work here [Silicon Valley] *only notice architecture when it gets in the way (Wright 2000: 93)."*

It may be the time for architecture to admit that it **has** to contribute to the life of contemporary societies in ways different than it does today or has done in the past. By now, it seems evident that workspace design is an area that has a great potential for architects to contribute to the contemporary technological developments, and find new means of legitimization for the profession. For architects to provide the public with efficient 'tools' of development, and therefore support the innovation processes in such settings, knowledge-based contributions to the fundamentals of the profession is vital. In this respect, effective research by the scholars of architecture, as well as efficient means of communication to the practitioners of architecture has to be nurtured.

Introducing architecture to contemporary societies as a redefined technology among other technological advances will be a challenge for the realm of architecture in the twenty-first century. To cope with the pace of technological advances created by the 'innovative geniuses' of this century, a complementary knowledge base to the 'iconic gestures' (Figure 6) of architectural traditions is crucial.

Figure 6. Oracle Campus, Silicon Valley, CA (1989 – 1998, Architect: Mitchell Schwarze, Photo by Umut Toker).

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