How the advanced technology affects the working environment?

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Emerging technology affects the working environment in many aspects, for instance, a design team can hold a meeting and show the ideas to investors in any place because a mini projector, an architect can bring the unfinished drawings in a memory card to home to continue work on them, a staff can use a headphone as a wall to obstruct the distraction from other colleagues, an employee can adjust the most comfortable microclimate for himself around his desk and seat via a program in his personal computer. Working environment is changing flexibly, efficiently and creatively since the appearance of office building in the beginning of the 19th century. We can not only replicate the former experiences to build a new office building in this moment, instead, we need to redefine the workspace in this context and applying emerging technology to explore new space for working. Looking back to these two decades, I am trying to integrate these developments and changes in four aspects: the personal workstation, the building shell, the material and detail, and the core.

A Focus on the workstation: The case in North America

The greatest developments in advanced office setting in North America center around the workstation[1]. More than ten years passed, each individual workstation now includes a vast range of electronic peripherals (smartphones, personal computers, printers, faxes), which are housed in newer ergonomic and computer-capable furnishing systems and supported by cable management floor systems. Also, for the first time in modern offices, workstations include systems for individual environmental control. The list of major design changes in the North American office building consistently includes the introduction of a three-dimensional cable network, involving both vertical and horizontal cable distribution plenums[2]. U.S. Manufacturers arid designers have developed a range of solutions for horizontal distribution, from cable trays overhead, trench systems, and raised floors below. Until now, a remarkable development in flexible and expandable horizontal cable management technologies and their effective connection with the work surface. In addition, the development of the multiple-zone heating, ventilation, and air conditioning system has instigated a renewed development in individual environmental control technologies for personally setting light, heat, fresh air, and air conditioning levels (see figure 1). The most significant product development in this area is the Personal Environments system by Johnson Controls, in which fresh air is ducted to each desk in an open office environment, with dimmer controls for cool air, radiant heat, task light, and even white noise. In addition, the American intelligent office is beginning to show the effects of the increased memory capability of personal computers, with mainframe rooms being replaced by minicomputers or laptops and microprocessors at every workstation, linked through local area networks[3]. However, the shift away from mainframes and dummy terminals has not diminished the number of shared facilities. Group spaces for printers, fax machines, copiers, electronic conferencing, and socializing have grown. Finally, there are some indications of a shift in the building design process in North America, toward team decision-making to ensure the creation of a truly intelligent office. Most notable is the TRW Headquarters project

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[1]. ABSIC 2000：32

[2] ABSIC 2000：32

[3] Brill and Margulis 1995

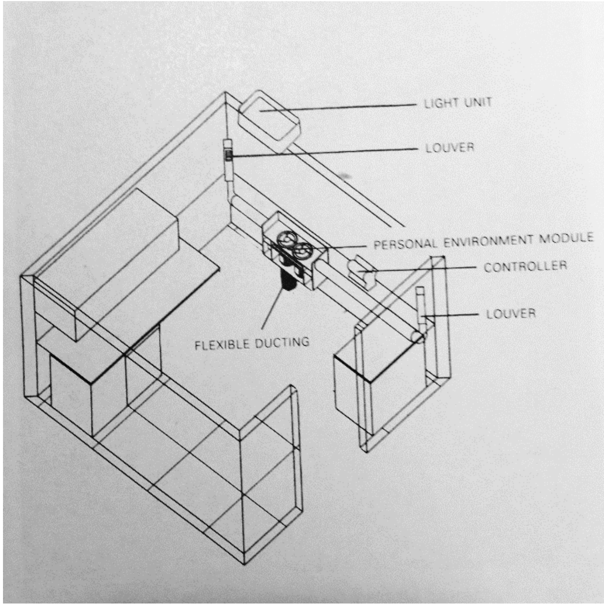

Fig.1 Personal Environments system by Johnson Controls.

Source: *North American Building Studies I*

Fig.2 the TRW Headquarters building in Cleveland.

Source: *Design the Office of the Future*

in Cleveland (see figure 2), where a full-time project manager coordinated a team of peer decision-makers including exterior architects, interior architects, mechanical engineers, telecommunications engineers, and the building constructor. This design team was fully involved from early conceptual design through one year of commissioning to ensure an office headquarters with the latest in technology and the physical and environmental setting needed to support the technology over time[4].

A Focus on the Shell : The case in Germany

Although the ABSIC team's intention was not to highlight polar differences in the international studies, they did find that the German intelligent office designs focused far more on the building shell[5] (see figure 3) than on either the core emphasized in Japan[6] or the workstation emphasized in North America. Many intelligent office buildings in Germany are shifting toward six-or seven-story buildings (rather than high-rises), with greatly in-creased exposure to the landscape through campus planning, green atria for social spaces and circulation, and much smaller floor plates. Design innovations explored in intelligent German office buildings include daylight and artificial light interfaces, also management systems such as exterior sun shading devices and distributed lighting controls. Gartner Industries, Siemens, and the Fachhochschule Koin are developing window “lenses” to eliminate glare and to evenly distribute daylight for working light levels deep into office[7]. Air flow windows and water-heated framing technologies use waste heat from the highly automated office to minimize energy loads, building degradation, and human discomfort at the envelope (see figure 4). The Germans have also explored the interface of mechanical ventilation and operable windows to allow natural ventilation at the workplace.

[4] ABSIC 2001：7
[5] ABSIC 1999：20
[6] ABSIC 1998：15-17
[7] Loftness, Hartkopf, and Mill 1999

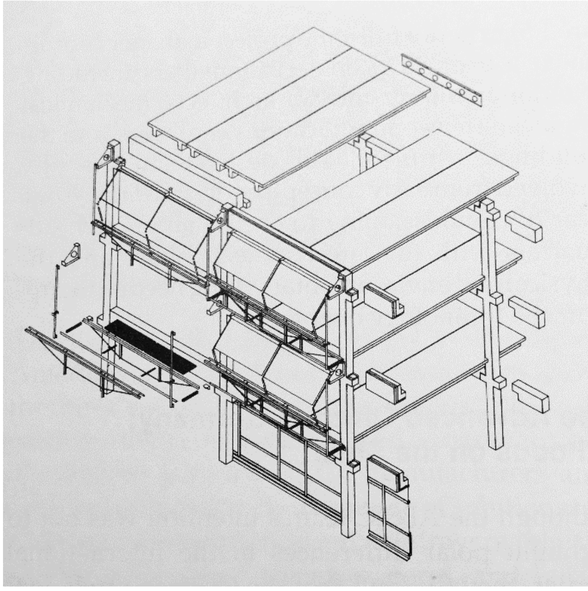

Fig.3 The IAM building in Braunschweig, Germany, shows the layered façade for sun control, daylight management, natural vegetation, fire egress, and maintenance. Source: *German Building Studies*

Fig.4 Water-heated framing technologies by Gartner Industries. Source: *German Building Studies*

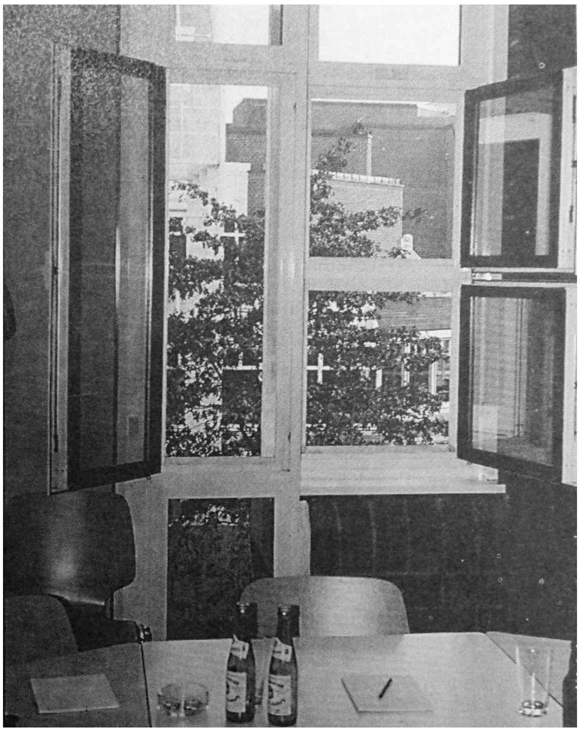

Fig.5 Colonia Insurance responded to occupant desires for operable windows by reducing building height and redesugnung HVAC controls to allow natural ventilation Industries. Source: *German Building Studies*

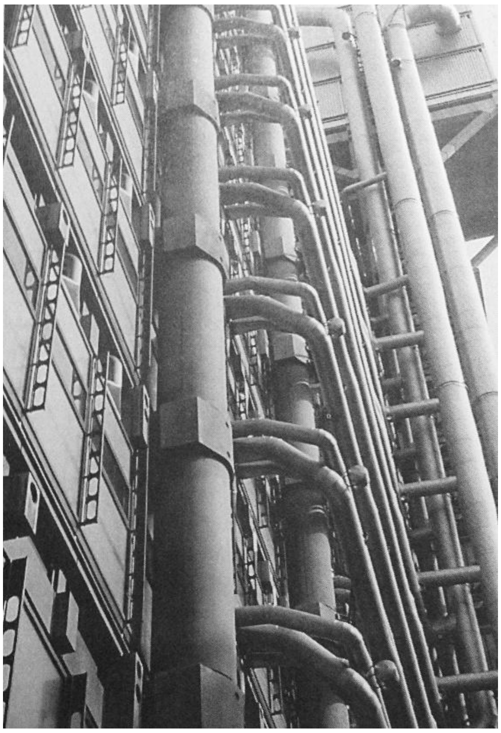

Fig.6 Lloyd's has the mechanical and telecommunications cores on the outside of the building. Source: *U. K. Building Studies*

Climate sensors inform the central system and the occupant about the timing for open windows (see figure 5)[8]. There is increasing interest in natural products, with heightened concern about the

[8] ABSIC 1999：29

use of "unhealthy" building products.This emphasis on environmental interface has led to a broad range of intelligent office technologies, including distributed lighting systems on movable tethers in the ceiling, and distributed air systems on movable tethers in the floor. The movable air supply ports are fed by central systems with distributed controls or by individual heat pumps. The interest in individual air supply has led to the simultaneous development of raised floor technologies for air and cable management. Early raised floors were acoustic failures (due to vibration, drum, and squeaking sounds). However, new technologies are emerging, including the Schmidt-Reuter "egg-crate" floor system, to provide structural soundness and adequate air and cable management space[9]. New cabling technologies, new computer technologies, and new desktop peripherals have been developing. Although German offices have advanced electronic support nowadays, however, at the beginning of 2000s, the German intelligent office focuses less on the rapid development of computer hardware and more on providing the vertical and horizontal plenum space and the environmental systems needed for the introduction of future hardware[10]. Indeed the intelligent office concept has fostered unique industry growth in quiet individual heat pumps, in lighting and shading systems, and in accessible and easily modifiable mechanical and electrical concepts. In contrast to Japan and the United States, the German building delivery process consistently involves the ultimate users of the building from the project outset. These long-term building users are responsible for directing the German intelligent office toward "fresh air architecture." As a result, a high-quality work environment for each individual is pursued, with more individual or small group offices, and direct access to daylight, fresh air, and landscaped gardens and courts[11]. Shell likes a skin of a building, it provides more comfortable interior space to people, if the shell of an office building become more ecological, more sophisticated, more environmental, informal meetings and other interactive activities will happen more frequently.

A Focus on Material and Detail for Aesthetic and Performance Qualities: The case in the U. K

The United Distillers, the Grianan, and the Lloyd's of London office buildings in the United Kingdom revealed a fascination with material and detail for their aesthetic qualities, justified through potentially higher performance qualities. In all three buildings, the designers selected a restricted number of high-integrity materials--lead for roofs, stone, stainless steel, aluminum, glass, and natural woods-to create an enduring modern aesthetic. Working with the manufacturers, the designers developed the material and component details critical to ensuring immediate high-performance quality and long-term integrity. Once details were resolved and appropriately integrated with other systems, the architects maximized the visibility of these select materials and details, through highly articulated building forms and interior cutouts (courts and atria), toward increasing overall surface exposure as well as daylight accessibility.

A very significant development in the United Kingdom is the engineering expressionism demonstrated in the Lloyd's of London building, designed to ensure accessibility and expandability of servicing systems in order to accommodate major changes in technology. Each subsystem--mechanical supply and return, electrical, telecommunication, and transportation--is run independently on the exterior of the building. These exposed service cores create the building

[9] Loftness, Hartkopf, and Mill 1999
[10] ABSIC 1999：31
[11] ABSIC 1999：31

aesthetic and its long-term adaptability (see figure 6), and are reminiscent of the large, accessible interior cores in Japan and Gemany, though far more expressive and expandable.

Interior design in LIoyd's also demonstrates the selected use of high-quality materials and well resolved details, with performance as a justification. Highly engineered ceiling insets provide glareless light and individual control in a heavily automated workplace, high acoustic absorption with modest sound reflection, and effective return air in a very high density workplace. Air flow windows were engineered for using waste heat to minimize poor mean radiant temperatures and condensation at the envelope. This technology was used to provide an aesthetic both inside and out, with supply and return ducts exposed on the facade. Finally, the significant cultural and political tradition in the U. K. In the form of "right-to-light" laws continues to positively affect the design of modern high-tech buildings (see figure 7)[12]· Workstations are designed with direct visual access to windows; building depths are controlled; and courts and atria are designed to maximize sunlight penetration (with "cones" of sunlight such as in the United Distillers Headquarters). Clear glass with overhangs continues to be the norm. The two-story Grianan building in the speculative Dundee High Technology Park effectively provides working daylight for deeper open office areas through the use of clear glass, sloped inward to the sill, and a corresponding upwardly sloped ceiling (see figure 8). These examples build on the tradition in the U. K. of using daylight as the primary source of working light in shallow-plan buildings[13]. The United Kingdom also continues to show interest in passive solar designs for heating, cooling, and lighting commercial buildings. There is some speculation that the

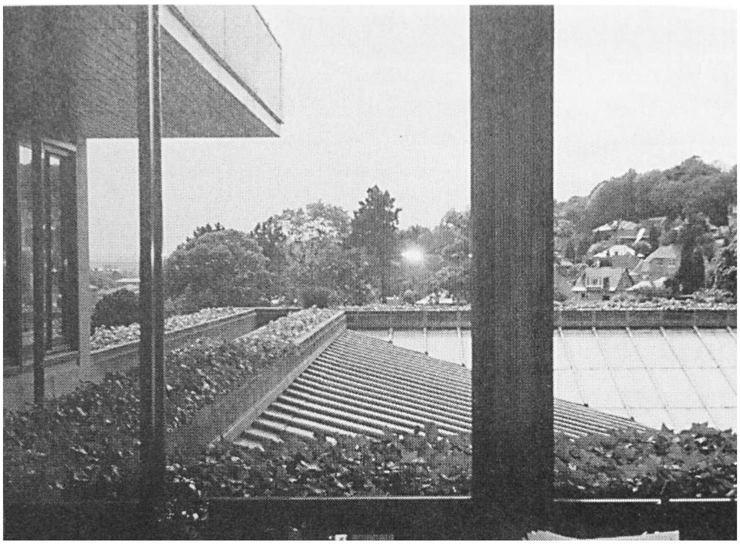

Fig.7 England has valued daylight access for the workplace, as shown in the United Distillers Headquarters. Source: *U. K. Building Studies*

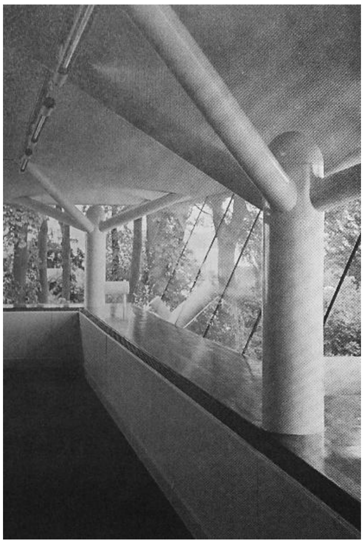

Fig.8 The Grianan building provides glare-free daylight with inwardly sloping glass and upwardly sloping ceilings. Source: *U. K. Building Studies*

U. K. will enter a period of sealed, air-conditioned buildings and reflective glass, in response to global warming trends and greatly increased internal heat gains. However, this trend is already being challenged by building research groups and by the office workers who presently benefit from access to windows, clear views, and sunshine. One can argue that "aesthetics" dominated the system design process at some point, leaving weaknesses in the independent or integrated

12 ABSIC 1999：19-22

13 Wilson and Hedge 1997

performance of components[14]. Nonetheless, major lessons can be learned from the careful and limited selection of materials (including daylight), as well as the careful resolution of details and integrations (with the support of industry), toward creating durable and flexible settings for increasing and ever-changing electronics[15].

A Focus on the Core: The case in Japan

When looking at Japanese intelligent office buildings (including the Toshiba Headquarters, the NTT Twins Regional Headquarters, the ARK Mori Building, and the Umeda Center Building), it is clear that the advanced design of the building core and its servicing systems has been emphasized rather than workstations or building enclosures[16]. One major intelligent design change in the Japanese office building is a rethinking of the 3-D cable network, as in the United States. However, the vertical distribution is far better resolved through distributed cores than the horizontal distribution, which is often excessively confined in trenches and thin raised floor plenums. The assumption appears to be that the workstation arrangement will remain static, while the workstation hardware will change[17].

The use of multiple-zone HVAC (heating, ventilating, and air conditioning) has also been embraced in the Japanese office, but through distributed mechanical systems rather than space-by-space mixing devices. The distribution of mechanical rooms varies from one every three floors, to four per floor, providing for more thermal variation and control in the constantly changing office setting. The Japanese have significantly developed technologies for resource conservation (energy, water, and air) including gray water management, thermoelectric cooling, load balancing, and off-peak storage[18]. There is also far-reaching development of systems for fire and earthquake management, and systems for vertical transportation (elevator and "communicating" fire stairs), all located in the carefully planned core. Most unprecedented are the developments in post occupancy robotics, ranging in use from continuous environmental testing of temperature, air quality, and noise, to unmanned window-washing systems[19].

A great mount of possibilities of working methods are hide in these technic developments. Basing on emerging technology, working are becoming more moveable, more effective and more comfortable. These four aspects reflect how advanced working environments looks like in different parts of the world, as remarkable references which can inspire us in the design process of a contemporary office building, technically, economically and aesthetically.

14 Wilson and Hedge 1997
15 ABSIC 1999：9
16 Davis, Becker, Duffy, and Sims 1995
17 ABSIC 1998: 40
18 ABSIC 1998: 42
19 ABSIC 1998: 42

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