Development of Intelligent Buildings and Their Impacts on Architecture in Turkey

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ABSTRACT

Related to every period’s life conditions the community’s needs show differences. Today’s people giving prior importance to business life and depending on this priority and the incoming intense, active life flow bring up the need of “facilitating life” and again one of the most main problems in today’s life described as energy loss is reduced by designing “energy conscious” buildings. At this point of view, developing technologic and construction sector take on the roles as two important inputs to help design concept.

Considerably the technological developments that took place with “Industrial Revolution” started the use of machine power, created new bazaars and new work areas, and brought up the creation of new life styles with itself. With these points, this process came across the new trends in architecture and construction. Spreading use of information technologies, make differences in expectations about daily life standards. As men can adapt the changing needs and obtain maximum suitability, need buildings with minimum cost for usage and upkeep. The main aim of the buildings described as “intelligent buildings” is use of minimum energy and besides to obtain system works and comfort at an optimal level. To be considered as intelligent, building must;

- give answers today’s and tomorrow’s users’ physical and psychological needs and offer flexible solutions for usage
- facilitate users’ lives
- provide energy-active use
- be sensitive about ecology
- be economical
- be composed of renewable building components
- use natural energy sources in an optimal way and
- first of all the building must be shaped with reference to these criteria.

With these points, besides the advantages that intelligent buildings bring up, they can cause important problems to take place. With their electrical infrastructure they may cause the inhabitants to be abstracted from the outer life, and with respect the people working in multi-storey buildings have health problems like “building syndrome” or because of the computer aided structure of these buildings "accessibility" problems can occur. These problems come in the first places on the problems rank.

In the solutions of the problems occurring by intensive use and by the way increasing demands, at the point architectural solutions become insufficient electro-mechanical systems join. For providing high life standards complete for today and tomorrow's life, the buildings which are designed bye using series of technological solutions, are composed of the integration of these systems. All these developments, different than the conventional design process, need the information flow with the other science branches -interdisciplinary approach-. A building to be formed as intelligent by "architectural concepts", with a large proportion is related to the "architect's intelligence". In these terms architect must be following all new developments in technology. In other ways, intelligent buildings will be the buildings designed by engineers.

Nearly in the past ten years, intelligent building applications are also seen in our country. But whether the lack of investigation about the abroad works or these buildings participated in our lives with the unnecessary ambition of consumption, so with these facts intelligent buildings cannot deserve their attribute. To state that a building is totally intelligent, from the design process, the project must be taken up as a total work with the sub-systems providing central supervision and administrating. But the approach in our country sees the sufficiency as a building that owns one of the named systems or any residence full of intelligent house products. Of course these terms are not enough for intelligence.

As a result, this work examines the approach to the subject in our country by evaluating sub-systems of intelligent building concept, design criteria, the advantages and disadvantages of these buildings, and the degree of intelligence.

Key words: intelligent building, building automation system, office automation system, telecommunications system, information technology, and energy conscious buildings

ÖZ

Her dönemin yaşam koşullarına bağlı olarak; insanların gereksinimleri de farklılıklar gösterir. Günümüz insanının iş yaşamına öncelik verdiği yoğun ve hareketli temposuna bağlı olarak, "hayatı kolaylaştırıcı" ve yine günümüzün temel sorunlarından olan enerji kaybına bir çözüm niteliğinde "enerji korunumlu" binalar tasarlamak artık bir gereklilik halini almıştır. İşte bu noktada, gelişen teknoloji ve inşaat sektörü, tasarıma yardımcı iki önemli girdi olarak rollerini üstlenmişlerdir.

Önemle "Endüstri Devrimi" ile oluşan teknolojik gelişmeler; makine gücünün kullanılmaya başlanmasını, yeni pazar ve iş kollarının yaratılmasını, yeni yaşam stillerinin oluşmasını beraberinde getirir. Bununla birlikte, bu süreç inşaat ve mimarlık alanında yeni mimari stillerin ve yeni malzemelerin doğuşuna sahne olmuştur. Bilgi teknolojisi kullanımının yaygınlaşması, günlük yaşam standartları konusundaki beklentilerin değişmesine yol açmıştır. İnsanoğlu değişen ihtiyaçlarına uyum sağlayabilen, bina kullanımında maximum elverişlilik sağlarken; minimum kullanım ve bakım masrafı yaratan yapılara ihtiyaç duymaktadır. Akıllı binalar olarak adlandırılan bu binaların temel amacı; enerjinin minimum kullanımının yanında, sistem işletimi ve konforun optimum düzeyde sağlanmasıdır. Bir binanın akıllı olabilmesi için;

- bugünün ve yarının kullanıcılarının fiziksel ve psikolojik gereksinimlerine cevap verebilmesi esnek kullanım çözümleri sağlaması
- kullanıcıların hayatını kolaylaştırması
- enerji etkin kullanım sağlaması
- ekolojik açıdan duyarlı olması
- ekonomik olması
- yenilenebilir yapı elemanlarından oluşması
- doğal enerji kaynaklarını optimumda kullanması ve
- binanın öncelikle bu kritere bağlı olarak şekillenmesi gerekmektedir.

Bununla birlikte, akıllı binalar sağladığı pek çok kazancın yanında bazı problemlerin doğmasına da neden olmaktadır. Tamamen elektronik altyapısı ile kullanıcılarını dış hayattan tamamen soyutlaması, önemle çok katlı binalarda çalışanların "hasta bina sendromu" olarak nitelendirdikleri sağlık sorunları ve

bilgisayar destekli yapısına bağlı olarak "erişilebilirlik" sorunu bunların başında gelmektedir.

Kullanım yoğunluğunun ve dolayısı ile taleplerin artması sonucunda oluşan sorunların çözümünde, mimari tasarımın yetersiz kalmaya başladığı noktada, elektromekanik sistemler devreye girer. Yüksek yaşam standartlarının bugün ve gelecekte eksiksiz olarak sunulabilmesi için bir dizi teknolojik çözüm kullanılarak tasarlanan bu yapılar, tüm bu sistemlerin entegrasyonundan oluşur. Tüm bu gelişmeler, konvansiyonel tasarım sürecinden farklı olarak, diğer bilim dalları ile olan bilgi akışını - interdisipliner yaklaşım – gerekli kılar. Bir yapının "mimarca" akıllı hale getirilmesi önemli oranda "mimarın akılılığına" bağlıdır. Bu anlamda mimar tüm teknolojik gelişmeleri takip eden bir yapıya sahip olmalıdır. Aksi takdirde akıllı binalar mühendisler tarafından tasarlanan yapılar olacaktır.

Yaklaşık olarak son on yıldır, akıllı bina uygulamalarını ülkemizde de görmekteyiz. Ancak gerek yurt dışı çalışmaların yeterince incelenmemiş olması, gerekse ülkemizdeki bilinçsiz tüketim hırsı ile hayatımıza dahil ettiğimiz bu yapılar, taşıdıkları sıfatı tam olarak hak etmemektedir. Bir yapının tam anlamı ile akıllı sayılabilmesi için onun, tasarım sürecinden itibaren, merkezi denetim ve işletmeyi sağlayan alt sistemler ile bir bütün olarak ele alınması gerekmektedir. Oysa ülkemizdeki yaklaşımla, yapıda söz edilen sistemlerden yalnız bir tanesinin bulunması yada akıllı ev ürünleri ile donatılmış olması maalesef akıllılık için yeterli görülmektedir.

Sonuç olarak bu çalışma; akıllı bina kavramı altsistemlerini, tasarım kriterlerini, bu binaların yarar ve zararlarını, akıllılık derecelerini incelemek suretiyle; ülkemizde bu konuya olan yaklaşımı irdelemektedir.

Anahtar kelimeler: akıllı bina, bina otomasyon sistemi, ofis otomasyon sistemi, iletişim teknolojileri, bilgi teknolojisi, enerji korumlu binalar.

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ABBREVIATIONS

ABSIC	Advanced Building Systems Integration Consortium
AI	Artificial Intelligence
BAS	Building Automation System
BMS	Building Management System
BREEAM	Building Research Establishment Environmental Assessment Methodology
BROCS	Building Related Occupant Complaint Syndrome
CBI	Carlini Building Intelligence
CM	Construction Manager
DDC	Direct Digital Control
DEGW	The company of F.Duffy, P.Eley, L.Giffone and J.Worthington
DPEX	Digital Private Branch Exchange
DSU	Digital Service Units
ESCO	Energy Service Company
EIBG	Europe intelligent Building Group
EMS	Energy Management Systems
ERA	Electrical Research Association Technology
FM	Facilities Management
HVAC	Heating, Ventilation, Air-conditioning
IAQ	Indoor Air Quality
IAQ	Intelligent Amenities Quotient
IB	Intelligent Buildings
IBI	Intelligent Buildings Institute
IBMS	Intelligent Building Management Systems
IBS	Intelligent Building Services
IIS	Integrated Intelligent System
ISDN	Integrated Service Digital Network
IT	Information Technology
LAN	Local Area Network
MTDM	Multimedia Time Division Multiplexor
NTT	Nippon Telephone Telegraph

OAS	Office Automation System
ORBIT	Organizations, Buildings and Information Technology
PBX	Private Branch Exchange
PC	Personnel Computer
PDMX	Programmable Digital Multiplexor
POE	Post Occupancy Evaluation
PWC	Public Work Canada
REIT	Real Estate Investment Trusts
SIS	Strategic Information System
STS	Shared Tenants Services
TS	Telecommunications Systems
TTC	Telecommunication Technology Committee
UPS	Uninterrupted Power Supply

Chapter 1

INTRODUCTION

1.1. The aim of the study

Intelligent Buildings (IBs) are becoming daily encounters for everyday life throughout the world. Also, design of IBs constitutes a challenge for architects, engineers, owners and users for the last 25 years. Humanity has built shelters for serious purposes throughout the history. Concept of shelter concept has changed and developed during the centuries with the development of new construction systems. Moreover, technological developments almost in all fields of production resulted in new needs.

The concept of alteration has been in the life of human beings since the beginning of the humanity. Life is in such a movement that always renovates itself. As a result, earth with its unknown situation has always headed mankind towards new inventions. Consequently, alterations in the sense of changes have always been a continuous activity in the course of time. As a result, architectural works reflect the cultural, economical, sociological and technological structures of the society.

It is also important to take into consideration that all technological developments do not result in advantageous situation. It is even the case that many problems can easily be ascribed to technological developments. The best example of the above is the energy crisis, which definitely is the result of extreme advancements in the field of technology. In 1973-1974 and 1979 crisis periods, designing “energy conscious buildings” became an important aim for mankind. Throughout the following years the rapid improvements in technology especially on building structure have affected the architectural works and “high-tech buildings” have become a current issue. These buildings have complex organizational structures involving many technological possibilities to respond the growing capacities of buildings. In addition to that, as a result of economical and social conditions, users prefer the work-centered life to home-centered life. So that different user requirements that are provide to facilitate the user’s life, have started to appear in time.

It can be easily seen that the energy related problems, economical problems and user-based problems have been continuing. As a result of these situations, integration of "sustainable architecture", "high-tech architecture" and "user-friendly architecture" is becoming a sine-qua-non for buildings. The buildings, that are applied this approach called as "intelligent" in USA or as "smart" in England, have appeared in our lives.

Intelligence of buildings is the ability to keep up with even changing situations. From this point of view, IBs are the structure, which collects the comfort, energy protection, economy, technological infrastructure and flexibility properties in itself while considering the user expectations. With the flexibility of the building, it is aimed to respond the variation of population, function and users' comfort requirements by keeping step with the development of technology. These buildings are formed by many integrated architectural concepts and involve a lot of technical subsystems in their bodies. At this point, it is essential to constitute a trans-disciplinary approach in design period. While in conventional buildings design is the major responsibility of the architect, cooperation of architect, engineer, owner and user is a sine-qua-non for the design of an IB. Therefore, it can be clearly understood that the architect has an important role to come up with an IB. In the buildings in which the working of technical infrastructure is very important, architect is the person who determines the user requirements and main decisions of the created scenario related to these requirements and create the comfort and aesthetics in this space. Each person has different evaluations or concepts about intelligence in this trans-disciplinary approach. For instance; according to the owner, intelligence is directly proportional with "easy renting or selling" of the building.

IB concept has been discussed in Turkey since the beginning of 1990s. However, many buildings in Turkey take this name after the construction because of the worry of "easy marketing". A building, which has to have the abilities of "building automation system (BAS), office automation system (OAS), telecommunications system (TS) and responsiveness to change" in order to be called as an IB, can be presented as intelligent despite having only one of these properties. At this point, the concept of "measuring the intelligence" has become a current issue. Therefore many research studies on this subject are now being carried out.

There are two objectives of this study: The first one is to investigate the concept of IBs that is met by chapter 2 and chapter 3 and the second one is to evaluate their impacts on architecture in Turkey that is met by chapter 4. Within this perspective, design of IBs in Turkey is evaluated.

1.2. The domain of the study

Concept of IB is known since the beginning of 1980s. Numerous studies and research projects are being carried out in mainly USA, Canada, Japan and Europe. These studies are mostly about defining the IB systems, forming IB design criteria, measuring the intelligence of the buildings and evaluating the benefits and problems of IB to their users.

Due to the effects of information century, demands and requirements of mankind have started to increase and change. People have generally started to prefer new comfortable living places distant from the city centres in order to get rid of its chaos. However, the people who think the distance to the city as a problem prefer living in multi-storey residences, which can be called as small towns. The existence of Internet, cable-TV, home office in the building and creating a comfortable surrounding is not enough for the intelligence of the building. In addition, to equip the place with the machines such as; intelligent refrigerator, washing machine and oven; is not enough for providing the intelligence as well.

The design criteria of IB could be listed as follows:

- Real intelligence starts with designing the building intelligently. Making intelligent decisions from the orientation of the building to selecting materials of buildings. Thus, to benefit from the renewable energy sources and natural materials.
- Formation of the design group that includes an architect, an electrical engineer, a mechanical engineer, a civil engineer, an environmental engineer, the owner, the contractor and if possible the client to make the scenario of IB.
- Providing the flexible solutions to response the increasing population requirements of future while designing structural, technical and spatial installations.
- Designing the comfortable, of good quality, safe, economic, energy-conscious, flexible and easy-using buildings according to user requirements.

- Integrating the technical systems of buildings.

As a result, when noticed on this criterion it is obvious that, the “integration” is the main subject of IBs. This appears as the integration of different architectural approaches, the integration of different disciplines and the integration of different building systems. Nowadays, although IB concept has few of these properties, it is confused with “trend” anxiety. This approach that is started to be frequently seen in Turkey, has pointed the study’s context at the investigation of the correct usage of the “concept of intelligence” in Turkey.

1.3. The method of the study

In order to achieve above-mentioned objectives a thorough literature survey on IBs has been conducted. State-of-the-art technology and most current literature and research in IB area have been investigated.

Examples from Turkey are studied in order to understand the current situation in Turkey. In order to select examples of IBs in Turkey, a through literature review and a selective market search has been conducted. Then both residential and commercial IBs are selected on terms of accessibility of their architects and projects. For each selected case, its project is evaluated in terms of IBs’ concepts. Then their designers both architects and engineers are interviewed by using a structured questionnaire (Appendix B). Total of eight architects and two engineers are participated to the study. In these interviews, the following items are investigated:

- Criteria that defines “intelligence” in buildings
- The role of architect in IB design
- The differences between IB and conventional building design processes
- Intelligence measurement for buildings
- Current practise in Turkey

At the end of this study, conclusion are interpreted in the concept of this study, findings are presented. Finally, topics for further research are listed.

Chapter 2

DEFINITIONS OF THE INTELLIGENT BUILDING SYSTEMS

2.1. An Historical Overview and Evolution of the Intelligent Buildings

In this chapter, history of IBs is discussed in the light of their technological developments. In this concept, the effects of the second Industrial Revolution; which has started as a result of developments in Information Technology (IT), the effects of the IT on IBs have been discussed. Based on the above, the three major systems of IBs: "building automation, office automation and enhanced telecommunication" are interpreted. For a better understanding of the evolution of the IBs; the three distinct periods were explained by Harrison (1998); "Automated Buildings (1981 – 1985), Responsive Buildings (1986 – 1991), Effective Buildings (1992- >) ". Finally, the development of the concept of IBs in various countries and prospective aspects of the IBs are also discussed.

The 19th century was one of the technically inventive centuries so far as the industrial developments are concerned. The effects of the Industrial revolutions on building design & production can be summarized as: new production technologies, new building systems, new materials and new systems heating and air-conditioning so as to provide comfortable spaces (Utkutuğ, 2001). Scientific researches have changed habits, life styles and operational system (Davies, 1988). As all occupations; architecture effected these developments too. Than, a new architectural style was born called as" International style" at the end of this century. This style was not give any importance to climatic conditions and it was trying to provide comfort by using the mechanical and electrical systems. This approach caused a crisis in terms of energy consumption and undesirable effects on environment in seventies. Than, 1980 perceiving that reducing of fossil based energy resources and the scope of the environmental pollution accelerated the studies on energy-ecology in 1990s (Utkutuğ, 2001). In the middle of 20th century, a new architectural style was born too " High-tech architecture". This architectural style introduced at " High-Tech Building '87 Conference " in London. The main idea of high-tech buildings is to display and exalt the technology.

Although there are lots of advantages of technological studies; some disadvantages are also apparent especially on the consumption of the energy sources. In 1973-74 and 1979 the energy crisis started. “energy efficient design”, “intelligent buildings (IBs)” and “user-friendly buildings” concepts entered the architectural terminology.

IBs are one step ahead of high-tech buildings. According to Harrison, et al. (1998), the term IB was born in the early 1980s in United States and it has become a “buzzword” in this period. The aim of these buildings is to control the energy consumption, managing the systems and provide integration on technologies (Fisher, 1984). The definition of Intelligent Building Institution in Washington is as follows; “ an IB is the kind of buildings which integrates various systems in order to manage resources in a coordinated mode to maximize occupant performance, provide savings in investment and operating cost and also to achieve flexibility.

The first IB has been realized nearly 25 years ago. The first IB called “City Place” was built by Technologies Corporation in 1981-1983 in Connecticut Hartford, USA. After the first implementation in USA, the subject “IB” started to be known all over the world. Especially in England, a study called “The Electrical Research Association (ERA) Technology” - that compare the performance and user experiences of an American IB and the present and future user requirements of the England’s buildings – be interested by different kind of professions (Hawkins, 1987). The first intelligent house in the world was built in Germany by Florahoufu Institute of German. (www.ib-china.com)

Since IB was born; the differences and similarities between High-tech buildings. According to the “EOSYS” company’s engineer David Firnberg, while high-tech buildings design for responding the organization that includes the personnel who is work for complex research and production; IB design for to provide facility on building controls and user services.

The growth of information technology (IT) was developed the concept of the building intelligence in 1980s and definitions of this concept focused on major technological systems:

- Building automation systems (will be examined in section 2.3.1.)
- Office automation systems (will be examined in section 2.3.2.) and

- Enhanced telecommunications systems (will be examined in section 2.3.3.) (Harrison, 1998).

Harrison, et al. (1998) divide the history of the IBs into three distinct periods: " Automated Buildings (1981-1985), Responsive Buildings (1986-1991) and Effective Buildings (1992->) ". Kevin Foster in his "Total Integration" lecture (1991) explains the history of IB;

Up to the late 1970s

• Up until the late 1970s most buildings had minimal integration of electronic building systems. (Mostly analogue systems)

• Security systems stood alone.

• HVAC systems stood alone.

• Fire alarm systems stood alone.

• Lighting control systems stood alone.

• Lift control systems stood alone.

• Telephone systems stood alone. &

• Data communication systems stood alone.

Automated Buildings (1981 - 1985)

• Emphasis on shared tenant services.

• Many buildings have mainframe computers.

• Mini-computers offer many new capabilities in building control, monitoring, and alarm systems.

• Telecommunications infrastructure in buildings no longer monopolised by telecommunications carriers.

• In 1984 in the US, some facility managers negotiated large volume discounts on long-distance telephone carrier services, based on the traffic of all building tenants.

• It was hoped that these automated buildings would have a marketing edge over conventional buildings.

• Not very successful in USA due to concerns about the security and integrity of shared voice and data networks (Harrison, et al, 1998).

• Japan embraced the concept of an automated 'intelligent' building

• In the 1970s Japanese office buildings were not up to the standard of Western buildings.

• The Japanese Ministry of Construction offered substantial financial incentives to companies wanting to construct IBs.

• Toshiba's HQ was the first Japanese IB in 1984 and NTT's HQ was the next in 1986

Responsive Buildings - 2nd generation IB (1986-1991)

• Realisation that technology alone could not achieve the level of integration required to meet tenant requirements.

• Responsiveness to change was very important.

• Building life cycles were important, especially with respect to fit out and furnishing changes.

At this period, definitions of the purely technological building intelligence and its limitations began to become apparent. The architects of DEGW - the company of F.Duffy, P.Eley, L.Giffone and J.Worthington - began study about the interactions between organisations, buildings and information technology in the context of a rapidly changing work environment.

One of the key findings of this study which is called as Office Research into Buildings and Information Technology (ORBIT) research was that buildings are unable to cope with changes in the organisations that occupy them and, information technology usage would become prematurely obsolete and would either require substantial refurbishment or demolition (Andrew Harrison, et al, 1998). The first ORBIT study, completed in March 1983, explained the impact that new technology was having on design of offices in England, and indicated how this would increase over the next ten years (J.A. Bernaden, et al, 1988).

Atkin (1988) describes that, the ORBIT 1 study (1982-1983), established design criteria for offices in the era of information technology in the UK and ORBIT 2 study (1985) developed these criteria in the quite different context of the US into a technique for aiding building users and developers to assess how demand for office space, by different kinds of office organisations with different kinds of technology, was changing.

The ORBIT 2 technique also allows the same users and developers to measure supply in terms of the capacity to accommodate changing organisational and technological demands of any given building.

Harrison et al. (1998) state that, a new dimension is added to the definition of the IB "**responsiveness to change**" (will be examined in section 2.3.4.). An IB must respond to user requirements, relating to the life cycles of shell, services, scenery and settings. In the 1960s the design of office buildings was influenced primarily by organisational efficiency. In the 1970s a new factor emerged which overtook but did not displace operational efficiency in office design: the need engendered by the energy crisis to cope with "cost in use". Cost in use in their turn have been overtaken in the 1980s, but not supplanted by a new wave of concern for office quality (Duffy, 1988).

Effective Buildings - 3rd generation IB (1992-)

- The facility services must contribute to the businesses of tenants.
- Focus is on the needs of the occupants of the building.
- Integrated technologies are used as the means of achieving business objectives.
- Technology is not the goal.

Goals of a 3rd generation IB;

- Building management achieved with human facility management systems and building automation systems.
- Space management designed to management facility changes while minimising operating costs.
- Business management obtained via facilitating the processing, storage, presentation, and communication of information.

The concept of building intelligence in Europe was not developed as the United State and Japan. So in 1991 – 1992, DEGW and IT consultants Teknibank undertook a research project that called ' Intelligent Buildings in Europe (IBE)'. This project defined as an IB any building that "provides a responsive, effective and supportive intelligent environment within which the organisation can achieve its business objectives" (Harrison, et al, 1998).

The concept of the IB was developed in different periods and in different ways. For example, Japan and Britain adopted the concept of the IB in 1980s while China's IB industry started in the 1990s. In this period, Japan designed the buildings that are some of the world's most technologically advanced IBs. Such as Toshiba HQ (1984), Nippon Telephone Telegraph (NTT) Twins (1986) in Tokyo, etc. (Harrison, et al, 1998).

Gann (1990) states that, in Britain, the market growth in IBs was precipitated by the needs of financial services sector and the growth of the information economy in 1981. Britain was the leading country in Western Europe in the number of installed network terminating points. Deregulation of the telecommunications infrastructure in 1984, and the City "Big Bang" in 1987 added further stimulus to demand for building and office automation system. The concept of building intelligence in Europe was not developed as the United State and Japan.

The " French Revolution (1789)" and " Industrial Revolution (1776-1840)" were important by giving form to the next centuries. The development of science and technology are the major indications of the development of today's " four – Cs " technologies that describes "Computer-Control-Communication and CRT graphic display technologies" (www.ib-china.com). The entrance of computer to our lives and development on microelectronic and information technologies creates a new revolution that effective and strong than industrial revolution (Utkutuğ, 2001). As a result of this, 20^{th} century was the computers century and 21^{st} century will be Internet and Intranet century technology. In this section, the effects of the information technology (IT) on IBs and evaluation of IB are discussed. In the next section, the definitions of the IBs will be dealt with.

2.2. Definitions

In this part the meaning of intelligence that is searched from dictionaries and the meaning of IB will be discussed.

2.2.1.Definitions of the Intelligence

"Intelligence, like art, is in the eye of the beholder."

Although there have been several studies and different approaches to define exactly the meaning of intelligence, none is really universally acceptable definition for the IB. In Powel's words (1988), the word "intelligence" could provide an alternative view in relation to IBs. The term intelligence has been used since the 14^{th} century. Whenever scientists are asked to define intelligence in terms of what causes it or what it actually is, there are different definitions. For example, in 1921 an academic journal received 14 different definitions from 14 experts, many of them defined the intelligence "the ability to learn from experience and the ability to adapt to one's environment". Researchers repeated the experiment in 1986. In that way they asked 25 experts and they received many different definitions:

> "general adaptability to new problems in life; ability to engage in abstract thinking; adjustment to the environment; capacity for knowledge and knowledge possessed; general capacity for independence, originality, and productiveness in thinking; capacity to acquire capacity; apprehension of relevant relationships; ability to judge, to understand, and to reason; deduction of relationships; and innate, general cognitive ability" (http://encarta.msn.com/).

The synonyms' of intelligence are;

> "* brains, intellect, *sl.* loaf, mind, reason, understanding * acumen, acuteness, brightness, cleverness, common sense, insight, *colloq.*nous, perception, percipience, perspience, perspiacity, sharpness, shrewdness, smartness, wit" (Oxford Dictionary).

English language distinguishes between different levels of intellectual skill like bright and dull, smart and stupid, clever and slow (http://encarta.msn.com/). The Cambridge International Dictionary of English defines intelligence as **"**the ability to understand and learn and make judgments or have opinions that are based on reason ". Similarly this term defined as "(good) ability to learn, reason and understand " in dictionary of Longman, "quickness of understanding" in Oxford dictionary and "the ability to learn facts and skills and apply them, especially when this ability is highly developed" in Encarta World English Dictionary. Encarta Encyclopaedia maintains the description of intelligence as;

> "term usually referring to a general mental capability to reason, solve problems, think abstractly, learn and understand new material, and profit

from past experience. Intelligence draws on a variety of mental processes, including memory, learning, perception, decision-making, thinking, and reasoning".

Other descriptions for intelligence are "the ability to learn or understand or to deal with new or trying situations" and "the ability to apply knowledge to manipulate one's environment or to think abstractly as measured by objective criteria" (http://www.yourdictionary.com/).

There are some fundamental questions such as; is intelligence a general ability or several independent systems of abilities? Is intelligence a property of the brain, a characteristic of behaviour, or a set of knowledge and skills? The simplest definition proposed is as follows: intelligence is whatever intelligence tests measure (Encarta Encyclopaedia).

The intelligence defined as "a general term encompassing various mental abilities, including the ability to remember and use what one has learned, in order to solve problems, adapt to new situations, and understand and manipulate one's environment" in psychology and defines as "the ability of a device or system to process data, to solve problems more automatically or more skilfully than competitive systems" in computer technology and again defines as "data, information, or messages that represent some meaning to humans or machines" in telecommunication technology (http://www.harcourt.com/dictionary/).

Most of the definitions explained intelligence in terms of human intelligence. The buildings intelligence is not fundamentally different from human intelligence. There are new terms as "Artificial intelligence (AI), Distributed intelligence, user-based building intelligence, etc."

AI has been known since 1956, described as "the capability of a machine to imitate intelligent human behaviour" and "a branch of computer science dealing with the simulation of intelligent behaviour in computers" (http://www.yourdictionary.com/). Cambridge International Dictionary defines it as " the study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems and learn. While Eastwell (1988) states that, "the artificial intelligence means that the computer makes inference judgments"; the Longman Dictionary defines it as "a branch of computer science which aims to produce machines that can understand, make judgments, etc. in the way that humans do".

"Distributed intelligence" and "user-based building intelligence" defined by Powell (1988). Distributed intelligence is the directed information that is served by dedicated microcomputer outstations and supervised by a centralised electronic management "controller". The user-based building intelligence provides for users to have the facility to see, gather and choose information and environments appropriate to their own and their organisations' needs.

2.2.2. Definitions of the Intelligent Buildings

After defining the concept of intelligence we can explain the term intelligent and IB. The term intelligent has been known since 1509 (http://www.m-w.com/cgi-bin/dictionary). Powel (1988) states that its Latin roots give inter – meaning between – and legere – meaning to see, to gather and to choose. This term is the adjective of intelligence and the synonymous' of intelligent are;

> "able, astute, brainy, bright, brilliant, canny, clever, discerning, penetrating, perceptive, quick, sharp, shrewd, smart"(Oxford Dictionary).

The Longman Dictionary defines intelligent as "having or showing powers or learning, reasoning or understanding, especially to a high degree". Intelligent can also describes as "having a high degree of intelligence, showing sound judgment and rationality, appealing to the intellect and in computer science; having certain data storage and processing capabilities (Dictionary of the English Language).

In terms of computer science it also defines as "guided or controlled by a computer; especially using a built-in microprocessor for automatic operation, for processing of data, or for achieving greater versatility" (http://www.m-w.com/cgi-bin/dictionary**)** and "a system or device that operates with a high degree of sophistication and independence, in a manner regarded as comparable to human intelligence" (http://www.harcourt.com/dictionary).

"The Essex Intelligent Buildings Group points out that the difference between the term intelligent as meaning "automation of building management and control activities we usually associate with needing human thought" (Callaghan 99) and again the term intelligent in terms of the broader view of the general building industry to describe the way of design, construction and management of a building can ensure that the building is flexible and adaptable, and therefore profitable, over its full life-span".

The term IB has been in our lives just for twenty years. According to the general manager of Intelligent Building Services the most generally accepted definition of an IB is "one which totally controls its own environment" (Stubbings, 1986). In such a definition the emphasis is seen to be on the building, or rather its management computer system, taking control by technical means over: heating and air conditioning, lighting, security, fire protection, telecommunication and data services, lifts and other similar building operations (Powel, 1988). McClelland (1988) states that,

> "generally, IBs seem to be the name given to buildings which have been purposely designed to employ – and coordinate- process control and data communications technology to best advantage in order to make the most of resources and facilities available to run the services".

There are two different way of definition of IB between "Intelligent Building Institute (IBI)" and "European Intelligent Building Group (EIBG)". IBI defines it by technocentric approach; "an IB is one that provides a productive and cost-effective environment through optimisation of its four basic elements -structure, systems, services and management- and the interrelationships between them" (How Can., 1997). In another way, EIGB defines IB by econocentric approach; "an IB creates an environment that allows organisations to achieve their business objectives and maximises the effectiveness of its occupants while at the same time allowing efficient management of resources with minimum life-time costs" (Yılmaz, 1998).

In 1985, as a result of International Symposium on the IB in Toronto a new definition explained: "an IB combines innovations, technological or not, with skilful management, to maximise return on investment". In another approach, Kegel et al. (http://www.hb2000.org/workshop30.html) describes the IB that will provide for innovative and adaptable assemblies of technologies in appropriate physical, environmental and organisational settings, to enhance worker productivity, communication and overall satisfaction. The intelligent, smart, or Shared Tenant Services (STS) buildings can centrally monitored and controlled automatically by a main computer, specialised cabling, electronic sensors, and digital telecommunications equipment (Wieghorst, 1988).

According to Kell (1992), an IB utilises the best available concepts, materials and systems and integrates them according to users requirements. Similarly, Essex Intelligent Buildings Group defines the IB as being "one that utilises computer technology to autonomously govern the building environment so as to optimise user comfort, energy-consumption, safety and work efficiency" (Callaghan99).

Hawkins (1988) in his essay asks " Will the US experience be repeated in the UK? " and accepts that "an "intelligent" building may be defined as one that takes the three key elements of the electronic infrastructure of a building - the controls, the communications and the information processing – and brings them all to the most efficient level." M.Zaheer-uddin (1993) defined the three key element parallel to Hawkins in same manner, Kujuro (1988) states that, these three key elements together with the environmental planning and building engineering systems that support them, bring to reality optimal living and working environments**.** Dubin (1988) agrees with Hawkins and states that the IB is defined in terms of state-of-the-market building automation, information processing and telecommunications services**.**

Moreover, Wong and So (1997-1998) add another key to this three key elements in their approach; "Computer Aided Facility Management System (CAFMS)".

According to Zaheer-uddin (1993) there are two basic definition of IB; the first one is highly idealistic and futuristic: "people shall merely content themselves for the moment in saying that it implies a much higher degree of symbiosis between human and machine than that which is attainable today". The second one is more realistic, permitting many different implementations such as internal telecommunications systems, building subsystems, etc.

As a result of this definitions, the key words of IB are; controlling environment, optimisation of systems, minimum lifetime costs, energy saving and efficient management and ability and adaptability to its occupants (Yılmaz, 1998). Brown (1992) accepts that "the only characteristic that all IBs have in common is a structure designed to accommodate chance in a convenient, cost effective manner". In another view, Ivanovich and Gustavson (1999) list the characteristics of IBs as follows:

- Can automatically adjust to naturally varying light, temperature, and humidity changes.
- Occupants can customise themselves to individual preferences.

- Was designed and constructed with intelligence and talent--a building that's secure and safe.
- Operates efficiently and assists with its own maintenance--a building of distinction that reflects its owner's character.

In addition for this approach, in an IB should be the technical control of heating and air conditioning, lighting, security, fire protection, telecommunication and data services, lifts and other similar building operations that is important- a control typically given over to a management computer system and so that building totally controls its own environment (Powel, 1988)**.** And according to IBI, this environment maximises the efficiency of the occupants of the building while at the same time allowing effective management of resources with minimum lifetime costs (Ivanovich and Gustavson, 1999).

Duffy (1988) states that 'IBs mean different things to different people in different countries'. Similarly, Allen et al. (1988) describe the IB as "something different to the architect, engineer, owner/developer and tenant". While IB means to design flexible and comfortable spaces for changeable users and functions of the space for architects, it means to integrate intelligent systems and intelligent structures for engineers.

Owners/developers and tenants take up the concept of IB different from architects and engineers. There are some notions of owners/developers as "IBs are said to be more attractive and easier to lease" (How Can, 1997) and similarly "a building only becomes an IB when it is fully rented" (Powel, 1990). Tenants define buildings as intelligent especially according to benefits on economy (these approaches will be examined in section 3.3.). Although these different approaches the stakeholders of IB point toward similar conclusions: to design future of the building now.

2.3. Intelligent Building Systems

In this part, the systems of buildings that contribute the intelligence of buildings will be discussed.

2.3.1. Building Automation Systems

There have been considerable developments in building industry since the technology is in our lives. The capacity, shape and functions of buildings started to be more sophisticated than in the past. In the line with that, the user requirements are increased too. These are; heating, ventilating, and air conditioning (HVAC), lighting, horizontal and vertical circulation, watering, storing, refining, security systems. The control of these systems became difficult for advanced buildings especially for high-rise office buildings. The "Building Automation Systems (BAS)" was born by taking advantage of electromechanical developments to find a way for this problem.

The BAS is the most developed area of IB technology, which includes energy management, temperature, and humidity control, fire protection, lighting, maintenance management, security and access control. The aim of this system is to create a "wired" building in which a network links sensing, monitoring and control devices to a computerized management system (Gann, 1990). According to Kujuro and Yasura (1993), building intelligence starts with a monitoring and control information service called as BAS and growth of IB systems has been paralleled by an increase in the functional integration of BAS. He maintains the view that, The BAS can offer a comprehensive range of security functions such as fire, accident, and crime prevention, as well as surveillance of building facilities (Kujuro and Yasura, 1993). Kızılok (1998) states that, "certainly, monitoring the building services from computer is intelligently but we can talk about "intelligence" and "to be intelligent" when it connects with decision-making process and making modification on result of application". He maintains the view that, "The intelligence degree of Intelligent Control System which makes building intelligent determined by the appropriateness with communication protocols.

Neubaer (1988) states that, "most buildings today have the beginnings of a BAS in the form of thermostats, time clocks, smoke detectors, door alarms, and other devices. Implementation of a building automation system is an essential first step in the development of an IB". Today, most of the buildings are controlled by BAS which helps building owners and also managers to use electromechanical systems such as fire alarm, security, HVAC, lighting, load management, elevators and process control systems more efficient (Mete, 2000).

In Atkin (1988)'s words; the BAS; " enable the building to respond to external factors and conditions, simultaneous sensing, control and monitoring of the internal environment; and the storage of the data generated, as knowledge of the building's performance, in a central computer system". Similarly Özer (1996) states that, the systems of buildings such as heating cooling, air-conditioning, the process and distribution of using water systems, weak current systems and lifts manage from a computerized central station to provide management convenience, management reliability, management economy and this system called as "Building Automation Systems". In another approach, Mete (2000) define the BAS as an electronic system that result of high technology and this systems aim to create maximum comfort conditions, effective management and central control, security and energy efficiency of building economically with minimum personnel and by no any mistake.

The BAS originated about 30 year ago, growing as control needs became more critical and energy supplies became more expensive (Katzel, 1998). The concept of BAS was first revealed in 1950s.The first BAS was a system that all data and control points were connected to main control panel with cables. In this system the operator can interfere the system from main panel besides his own panel.

At the end of the 1960s and in the early 1970s the fast data transmitter systems and electronic devices were developed the BAS. In this system, a field data transmitter panel collect the data such as heating, pressure, and moisture and send them to central workstation. Central workstation comment on the data than send and command to field data transmitter panel what should be do. In the middle of 1970s, using the small computers in the central workstation enabled to supervise the system from different centres and to add new units to the system such as printer.

In the middle of 1980s As a result of the developments on computer technology, the field data transmitter panels started to analyse the data itself than it was sending the data only or observing from central workstation. In this way, there was a respectful decrease on cost of BAS (Avincan, 1999).

Avincan (1999) states that BAS use for to shape the surroundings conditions, as different from the controlling the devices and systems, which are, make production in a production process and effect the production directly. By depending on the annual programme, the BAS supervise the heating, cooling, energy consumption and electrical load of building by digital controllers. The main aim of BAS is, while providing the maximum output and quality with minimum personnel, energy and time; at the same time make the life easy for the users. BAS can easily accommodate the data that can be added or removed from the system later and can determine different control strategies according to function of the building.

According to Mete (2000) the main functions of BAS are;

- **Collecting Data:** The BAS collect and store the data need for effective building management. These are; heating, humidity, pressure, standing, tension, power, power factor, energy consumption, equipment status (on/off), etc.
- **Informing the Manager:** The BAS transfer the commented on data to manager by colourful monitor as a graphical image and by printer as a written document.
- **Arranging/Regulating:** The BAS provide the comfort conditions as to beforehand-determined regime, changeable system parameters as to requirements of users, optimum HVAC conditions for each part of the building and coordination of systems without caused extreme loads on energy usage.
- **Protecting:** The BAS inform the failure or alert conditions automatically even in some cases the system can make precautions as to before determined strategies.

In Sancar (2001) words, the BAS's functions are; to examine the indoor an outdoor conditions of buildings, to manage the system of buildings-such as HVAC, active/passive solar systems, building envelope, lighting, lift systems- from a central workstation by sensors and thermostats. In other words; BAS provide increasing the total performance of building by integrating all systems of building and also reducing energy consumption by central operating and maintaining.

An automation system that called NTT-BAS (Nippon Telegraph and Telephone Corporation) incorporates the latest NTT telecommunications technology. Kujuro (1988) states that, NTT-BAS has the following features:

- NTT-BAS integrates building control, energy saving and security systems.
- By means of a facility management computer with improved data processing capacity, the system provides the building owner or a manager with management data.

- Using a digital private branch exchange (D/PBX) interface and network interface, the system can offer a variety of building information and services to office workers, and can manage data from several remote buildings in a network.
- The system is configured for vertical and horizontal expansion, according to building scale and quality.
- The operating system and programming language are designed for smooth interconnection of information and telecommunications systems. New services can easily be added to the system" (Kujuro, 1988).

In automated buildings, all electromechanical systems and all comfort conditions can be control without need any personnel except the expert who monitors all the system from central office. Thus; the energy usage can be optimised and the number of manager and personnel is reduced. In addition to that, probable problems can be determined beforehand thus managers can take measures without caused most important problems (Mete, 2000)

Mete (2000) also lists the advantages of BAS as below;

- Provide the economy on human force
- Reduce the Maintenance Cost
- Provide the long-term life to equipments
- Warn the failures and emergencies
- Provide an effective manager thanks to central control.

According to Avincan (1999) thanks to BAS;

- Repeated operations can be automated
- Thanks to graphical diagrams and usage directions managerial personnel can use the electromechanical systems effectively.
- The comfort conditions can respond the changeable situations such as function or capacity of building.
- The failures can determine and the problem can solve easily
- Energy consumption can reduce
- System can manage effectively

- Flexibility on solutions can be provided
- Facilitating the building management can provide by monitoring fire alarm, security and communication system's integration.

The BAS's capital costs are significantly higher than for most recent building designs. In Atkins' (1988) words; "Cost/price databases will need to be expanded beyond merely recording the details of yesterday's designs, which may provide no really useful benchmark for predicting tomorrow's construction costs/prices".

The BAS's Components

BAS; has many control and observance terminals and supervisory control structure which is connected to a communication network and can be controlled and directed from a single point (Avincan, 1999). The components of BAS can be listed as below;

- **Field Equipment:** The devices that communicate with electromechanical systems directly.
- **Field Controllers:** These are the programmable and automatic devices that comment on data which received from field equipment and than, give instructions as to communication scenario to field equipment.
- **Graphic Central:** A high capacity personal computer, printer and communication interface provide the integration exactly. Thus provide to monitor and control all the building systems by a central point (Mete, 2000).

The field controllers use principle of "Direct Digital Control (DDC)" and their programmes load on themselves. Thus, if the central computer collapses they continue to serve their zone (Mete, 2000). In another approach BAS include:

- Central Work Station and Printer
- Supervisory System Software
- Portable Service Terminal
- Network Control Unit (NCU)

- Direct Digital Control (DDC) Equipment
- Independent Programmable Field Equipment (Özer, 1996).

The BAS should be modular. It should be possible that to expand the capacity and characteristics of system by additional field equipment, NCU and central computer (Özer, 1996). According to Avincan (1999) IB automation serve to subjects below:

- **HVAC System's Automation:** The components of this system;
    - Central cells
    - Fans, antigorites
    - Humidifiers
    - Filters
    - Mixture cells / dampers

  The features of HVAC Automation Software;
    - Conversion point,
    - Optimum working point
    - Set value point
    - Control transformation point
    - Time and holiday program point
    - Programmable point
- **Lighting System's Automation:** The lighting control strategies are;
    - Timing – anticipated timing
    - Local Control
    - Light-flux Control
    - Peak time limiting
    - Natural Lighting

  There are three lighting control methods:
    - Switching and darkening
    - Central and local control
    - Manual and automatic control
- Power system's automation
- Closed-open circuit camera system
- Communication control, access system

- Fire perceive and interference systems automation

The BAS programs can be examined in three groups;

- Central Command and Control Programmes
    - Start/Stop programmes that depends on the time
    - Event programmes
- Energy Management Programmes
    - Duty cycling programmes
    - Power demand programmes
    - Optimum start-stop programmes
    - Load-reset programmes
    - Chillier optimisation programmes
- Security Control Programmes
- Patrol Tour programmes
- Access control (Özer, 1996).

The Telecommunication Technology Committee (TTC) has been studying PBX computer (Private Branch Exchange) interface standards in Japan. In this study the air conditioning and lighting may automatically adjust according to the number of occupants in a room. This provided by the radio terminals that are sending personal identification codes, PBX management of the personnel location, and transmitting this information to the building automation system. In another example; when the building automation subsystem detects a fire, it rings an emergency alarm and transmits the alarm information to the PBX, then system calls predetermined telephone numbers automatically and control the air conditioning and lighting systems and broadcast announcements from extension telephones (Kashiwamura, 1991).

2.3.2. Office Automation Systems

The "Office Automation System (OAS)" is the second information service provided by IBs. Since the mid-1970s, the market for provision of electronic mail, word and data processing, management reporting, fax machines, and internal communications has grown rapidly particularly with more widespread use of desk-top micro-computers and the growth of the information economy (Gann, 1990). As a result of this growth, people need for the installation of network cabling especially in office buildings. The OASs have become important strategic items because of these are expanding from being merely effective tools supporting business information processing requirements to systems providing essential business service functions (Kujuro and Yasuda, 1993).

According to Atkin (1988) IBs contain OAS to provide management information and as decision support aids, with links to the central computer system. Lush (1988) explains the components of OAS as, telephones, telex, FAX, computers (mainframe with terminals and desk top machines), word processors / desk top publishing systems, audio-visual conference facilities, specialist requirements such as dealers' consoles. The OAS's "high-tech" office equipments, such as word processing, large volume printing, electronic filling, electronic diaries, credit-card access for timekeeping or for access to cafeteria and common office services, software support, and even 'War Rooms' where data is assembled and manipulated in electronic form, linked together using Local Area Networks (LAN) (Duffy, 1988). According to Atkin (1988) thanks to LAN distributed processing, file servers and printer spooling have rapidly become the norm and also it provides the central nervous system of an IB. Kujuro and Yasuda (1993) points out that IBs are essential for providing the technological environment for developing strategic information systems (SISs), that is high-level information processing systems based on computers and LAN's.

Fujie and Mikami (1991), points out that the highest priority is given to maintaining a high quality work environment for the employees. According to Neubaer (1988) the preferred office automation system integrates data and word processing operations, making it possible to achieve full data integration capabilities. In another approach the Nippon Telegraph and Telephone Company (NTT) states that a high level of OAS provided by the building owner for tenants or for the use of his/her own organisations (Duffy, 1988).

Rapid technological progress is being made in several fields such as "decision room". This is a kind of building office automation system and installed in special-purpose conference rooms within the building. This system consists of a number of desks in which are mounted large, heavy CRT display units (Kujuro and Yasuda, 1993). The PBX-computer interface standards that has been executing by Telecommunications

Technology Committee (TTC) keep track of personnel working hours by using ID cards and telephones with an ID card reader. PBXs can manage an employee's whereabouts using radio terminals that send ID codes or telephones with a card reader and it can also forward a call to the telephone nearest the employee's current location. An ISDN network can send a calling party's telephone number to a computer that may then display relevant customer information (Kashiwamura, 1991).

2.3.3. Telecommunications Systems

The "Telecommunications Systems (TS)" is the third strand of IBs. According to Ringkjob (1988) the future of IBs rest primarily on the strategic applications of today's telecommunications technology. IBs contain TS to enable rapid communication with the outside world, via the central computer system, using optical fibre installations, microwave and conventional satellite links (Atkin, 1988). Morgan (1988) points out that telecommunications is the latest newcomer on the scene and it must be a major consideration in the IBs. He also maintains the view that,

> "for the building's intelligence to be of much use, it must be distributed. This is done via telecommunication's two basic functions -- transmission and switching".

Technology and people are the main components of any communication infrastructure. In the line with this approach NTT defines advanced telecommunications as:

> "The potential offered to tenants or user organisations to have ready access to a far more up-to-date and wider range of telecommunication services than they would normally expect. This wider range is achieved through digital switching and fibre optic cabling and leads not only to considerable advantages in volume and cost, but also to particular services such as FAX, voice mail, computer graphics, as well as voice, video and computer conferencing" (Duffy, 1988).

Similarly Coggan explains that:

> " Intelligence with respect to telecommunications in an IB consists of the offering to tenants of many sophisticated telecom features at a

considerably reduced cost due to the fact that the equipment is shared by many users" (http://www.coggan.com).

In Lush's (1988) words;

> "All communication systems or infrastructures are people dependent and technology is one of the tools used to make it easier, or so we are led to believe". He maintains the view that "The success of high technology buildings is ultimately dependent on the people involved not the technology installed…and two points should be emphasised: the importance of people and *caveat emptor*".

Sancar (2001) states that TS enable the automation of viewed, voiced and written systems to provide communication between indoor and outdoor of the office. Similarly; Gann (1990) explains that TS need to develop better telecommunications infrastructures between the activities within a building and those outside thus the need to link LANs with wide area networks (WANs). Thanks to communications systems technology, multiple moving images from several different locations can be displayed simultaneously on the screen of a single personal computer, thereby allowing multiple locations to be connected simultaneously (Kujuro and Yasuda, 1993). Morgan (1988) states that the two growing area: telecommunications and computers are heavily merging due to their interdependence. Telecommunications is capable of producing income directly and also making money indirectly (Morgan, 1988). In his words,

> "Telecommunications is now seen as a true resource, rather than a 'necessary evil', which one must live with".

The communications system is represented by multifunction telephones and electronic or voice mail (Fujie and Mikami, 1991). An IB's facilities such as host computers touch screen terminals, and a DPBX provide information and communications services, which are necessary for tenants and manage building operations smoothly. The communications network operates around the clock, which means ensuring twenty-four hour building services and free and safe building access using an ID card, so that information can be transmitted around the world. In IBs, there is usually a company, which takes responsibility for carrying out and supporting building functions. It also provides inclusive information and communication services and also maintains building equipment (Fujie and Mikami, 1991).

In the construction industry there are professionals and technologists from project conception to practical completion. There are problems of communication, at whatever level of technology is used because of buyers and users do not always ask the questions most relevant to the needs of their system and suppliers are not always aware of, or forthcoming about, deficiencies in their own systems. (Lush, 1988). Otherwise, TS include complicated and multiple systems that occupants should understand and operate. These are;

- **“Analog PBX”** systems that are used for internal and external voice telecommunications and operated with modems to make possible data as well as voice telecommunications. In these days, “Digital PBX” systems are becoming increasingly available this systems make it possible to process voice and data telecommunications more efficiently (Neubaer, 1988).
- **“Integrated Systems Digital Networks (ISDNs)”** which are combine the features of telephone network services with the data transmission capabilities of digital networks. Kujuro and Yasuda (1993) will offer the potential for many novel applications, such as sophisticated voice and data switching systems (Gann, 1990). In Kujuro and Yasuda’s words, “ ISDN service can make use of its high-level services at low cost and therefore IBs should fall in line with the development of ISDN networks and promote their growth”.
- **“Programmable Digital Multiplexors (PDMXs)”** which distribute intelligence out from the switch and into the network, are superseding the traditional public exchange (Gann, 1990).
- **“Multimedia Time Division Multiplexers (MTDM’s)” and “Digital Service Units (DSUs)”** make it possible to carry out multiple access communications. They enable signals such as data, audio, facsimile and images to be multiplexed and sent in digital format (Kujuro and Yasuda, 1993).
- **“Digital Private Branch Exchange (DPEX)”** is the pivotal element of IB functions. It contains a substantial amount of software, which simplifies functional expansion and makes it easier to select machine types corresponding to the scale of the building and also possesses a function for selecting the optimum route through the external long-distance toll network (Kujuro and Yasuda, 1993).

Morgan (1988) lists the ways of managing telecommunications of IBs as below:

- Hand off the major effort to an established telecommunications organization.
- Work with an architect who has added a telecommunications group or will subcontract to a telecommunications consultant.
- Form a strong in-house telecommunications group.

Gann (1990) explains the a major projects to develop teleports which are, combine long-distance communications media, such as satellite, optical fibre and microwave radio systems into a single project to provide a long-distance communications network for local business centers, in Tokyo, Osaka and Yokohama facilitate extended communications highways to local offices. He maintains the view that, the development of teleports will mean the construction of IB complexes, and the refurbishment of existing buildings to accommodate the new IT.

2.3.4. Responsiveness to Change

While the aim was sheltering, protecting, and providing the privacy in old days, in parallel with development on technology, psychological and physical requirements of users developed and this naturally effect the spaces where people live. A building is a dynamic entity and changing is not a new concept for architecture. It is inevitable that architecture reflects the cultural, technological, and economical changes on our lives and on architectural products (Sancar, 2001).

"Flexibility" is the key word of design and according to Powel (1988) two questions need careful consideration before designing any such building: how flexible will the 'official' system be to autonomous local definitions of relevance to a user, and how flexible can it afford to be? Buildings should be able to cope with change and meet the increasing demands of an expanding and changing world. However, a new keyword emerges as "functionality" (Pengilly, 1988). In historical view, the design of office buildings was influenced primarily by organisational efficiency In the 1960s. There were some problems of inflexibility; particularly for operational changes and systems expansions in early automation systems the introduction of computers into these systems in the 1970s enormously improved their flexibility, accuracy, speed of response and intelligence (Işık, 1994). Also in this period, a new factor 'costs in use' which did not displace operational efficiency emerged in office design (Duffy, 1988). In these days almost every buildings design as they can accommodate higher levels of servicing than before to support communication, energy management, fire and security protection systems (Özer, 1996). Kujuro and Yasuda (1993) deal with the ability to keep up with changes in another view; responsiveness to change is also important for not to lose competitive edge.

According to Duffy (1988) the fourth dimension of intelligence is the capacity to respond to new kinds of demand. He also maintains the view that responsiveness to change is the ability of buildings to accommodate, overtime, changes in individual requirements and organisational demands. Responsiveness to change is more subtle, more qualitative, aspect of building intelligence. The area of IBs implies a level of complexity so IBs mean 'better' buildings. For a building to be fully "intelligent", it needs to be planned and equipped to accommodate the changed requirements as existing occupants and their technology place new demands on the facilities they occupy. Also potential occupants compare buildings to determine which will best accommodate their information technology and organizational change (Davis, 1988).

Clients vary in terms of how they define their requirements. Also, owner / occupier do not know who the occupant is or whether it is a single or multiple tenant situations. In multiple occupancy buildings, lack of common standards means that equipment installed by the landlord may be incompatible with that which the tenant wishes to install (Gann, 1990). Therefore, it can be difficult to clarify all the permutations for future use, changes in working practices, adoption of new technology and the flexibility to accommodate those (Lush, 1988).

Fujie and Mikami, (1991) states that IBs have been designed with structures and facilities that consider the future development of intelligence so that they are different from conventional buildings especially in terms of furnishing and interior view. IBs must maintain an effective working environment, run automatically and comprehensively and they must be able to adapt to the function required in the business future. They also flexible to adapt to future changes in work environment needs. In order to be responsive to changing environmental and occupancy conditions, buildings have to be conceived s totally dynamic systems (Mill and Dubin, 1988). Smith (1988) describes the three characteristics of IBs as below:

- When the basic system is in place, various types or groups of components can be added to it to increase its capabilities layer on layer
- Groups of components that are chosen are likely to have a number of different uses and applications
- The basic IB network will accommodate all kinds of appliances and components, it can support new and future technologies and it can be adapted to changing times, interests, needs, and tastes.

And Davis (1988) explains that to respond office facilities should be:

- more easily adapted and replanned for different occupants
- more easily subdivided and expanded
- better able to handle electronic systems
- better able to accommodate diverse hierarchical and social structures
- better equipped with meeting and social spaces
- supportive of unplanned, informal, face-to-face contacts and
- well equipped with technical support services.

Işık (1994) points out that the weather and outside environment are constantly changing, the occupation and functions within a building are constantly changing, management and operational policies are changing, safety and security measures are constantly changing. Also, electrical and heating loads in IBs are not only increasing; they are also moving because of organizational changes result in continual personnel relocations. In other words, as people move, their workstations and related loads go with them. Therefore IBs must design as accommodate these moving loads. Because of increasing load movements, there is a trend today toward use of the raised floor. The raised floor has been used for many years to carry cables and then to transport warm or cold air supply and return distribution (Dubin, 1988). Therefore a building has to provide and protect the internal environment and the whole range of support activities in a constantly changing scene. Meanwhile, a building not only responds to these changes but also can adjust the control parameters so that it can be optimised to meet other needs. It is now possible to provide advanced control systems with computer-based technology. This technology able to respond to changing needs, and it provide not only a dynamic control system but also all sources of information and data about all the functions and activities in a building

Most new information technology will be installed in existing buildings. This is often more difficult in recently built offices than in older buildings with robust structures and large floor-to-ceiling heights that can accommodate cables, air ducts and access floors (Davis, 1988). Distributed vertical communications ducts will reduce the horizontal cable runs required, facilitating the addition of new changes in the location of existing ones. Air conditioning plant must have adequate capacity for the possible future installation of extra suites, or, alternatively additional plant space must be allocated (Hawkins, 1988).

A research project, which carried out by DEGW, the Building Research Establishment and a number of sponsors to study inter-relationship between nature of the work, environmental systems and building forms, try to find an adaptable model which can cope with changes as they occur at social and architectural levels. The three groups – defining user needs, sustainability with respect to air quality and energy demand and buildings for change – were formed in workshop. Innovations can be accommodated so that technological change can be incorporated easily. IBs should provide a responsive, effective and supportive environment within which an organisation can meet its performance objectives (http://www.hb2000.org).

2.4. The Integration of the Intelligent Building Systems

Intelligence is now an indispensable factor in designing building and it needs to focus on user and organisational goals. According to Yılmaz (1998),

"Intelligence lies in the ability to integrate all automated systems".

Atkin (1988) states that the missing subject is the ability to bring technology together or in other word "integration". With the integration of all technologies and responding according to them is the main idea for being intelligent. Similarly Klein (1988) states that integration is the key point of an IB and also according to Mete (2000), integration and interoperability are must for an efficient building management.

ISDN (1990) deals with integration in another view. According to him an intelligent system uses an intelligent crust with a simple core. The crust would provide the flexibility to offer stable user interfaces and it also new non-standard services in fast response to new market needs. ISDN (1990) defines this approach as intelligent integration, which wants to create an intelligent network that provides a maximum of useful services and also it should offer basic capabilities to satisfy customer needs (ISDN, 1990).

In terms of integration, Walter (1988) looks like the IBs to the human body, with all parts working in harmony to make the whole. The integration of building subsystems - such as heating, cooling, air conditioning, lighting, transporting (lift, escalator, etc.), fire alert, security control - both each other and also environmental conditions are so important in terms of user comfort. (Mete, 2000). IBs utilise the best suitable concepts, materials and systems, and integrate them into the building to meet requirements of the building's stakeholders (Alan, 1992). Klein (1988) points out that the IB is not just a building with the latest BAS; it also integrates computers, communications, and OAS with BAS to organize a building's support functions into one package to reduce a building's operating costs for the owner and tenants.

Integrated technologies are used as the means of achieving business objectives in the period of Effective Buildings or in other words in 3rd generation of IBs (Foster, 1999). Various forms of integrated systems have been applied to commercial buildings and industria1 plants for more than 20 years (Occhionero, 2000). Neubaer (1988) explains that the idea integrating different technologies is initially focused on integrating BAs and TS or PBX systems. Integration of these two systems makes it possible to use either special-feature telephones or integrated voice/data terminals. Thus, integration enabled not only makes phone calls but also access a BAS.

The original integration of voice and data began in the 1960's (Morgan, 1988). Than, in the early 1970s, the concept of integrating Information Management and People Management Systems were introduced, when the BASs were quiet expensive. Nevertheless, integrating the fire alarm and supervisory system functions into other building control systems provide the enhance cost-efficiency of the BASs (Transue, 1988). In the early 1980s digitising of video and facsimile became practical. Also in this period the digital microprocessor boom produced word processors and personal computers (Morgan, 1988). Meanwhile, in the late 1980s, integration may well be the most overused, misused, and maligned buzzword in the BA marketplace.

In these days work is proceeding on the integration of BAS and TS with OAS via base band, broadband and fibre optics networks. Also, video communications and satellite systems will undergo integration in the future (Neubaer, 1988). Nevertheless, the latest studies on IBs are integrating four areas of IBs – BAS, OAS, TS and responsiveness to change – into one single computerized system. There is some standards that have been studying to develop communication of systems. One of them is ASHRAE's communication protocol standard: BACnet. This is designed to provide flexibility in system design and seamless integration or in other words it provides communication of systems by a common language (Mete, 2000).

Walter (1988) states, that interfacing building services to one another is not integration. For example, the fire controller may send a signal to shut down the ventilation system or be interfaced to the telephone system to signal an alarm to a remote manned central station. The individual systems are totally independent and usually only a very small number of dedicated hard-wired links are made between them. According to him by integration, it is implied that components in the system are shared, such that individual sub-systems may share a common database in order that the operating characteristics of one system are dependent upon the status of another. For instance, an intelligent fire detection system could be integrated with an energy management system so that signals being received from smoke detectors could be compared with signals being received from room temperature sensors. With appropriate software, this might help to confirm a genuine fire condition (Walter, 1988).

According to Neubaer (1988) the integration of functions is not a requirement for IB, but the capability to achieve total, functional integration of systems is an ongoing process. According to Clements-Croome (1997) the aim of IB is integrating different technologies and their business and space management to serve the overall effectiveness or organisational performance. An IB also aims to create a highly productive, efficient and comfortably working environment that can be shared by both building users and operators. In another approach Occhionero (2000) explains the aims of integrated systems as increasing energy efficiency and reducing operating costs. These systems also offer a distinct opportunity to conserve energy resources, improve indoor air quality, and reduce greenhouse gas emissions.

Kelly and Borthwick (1988) explain that three key features of Integrated Building Systems (IBS) as: ease of construction, ease of maintenance and ease of change. The basic elements of lBS are mechanically and electrically independent service modules. These are comprises,

- “a service bay which houses the air-handling, electrical and communication equipment for that module
- a functional zone where laboratory activities take place
- a service zone or interstitial space above the functional zone for carefully subzoned utility distribution” (Kelly and Borthwick, 1988).

Integration of the systems should be based logical approach. For example, it is, no more logical to integrate the telephone system with the energy management system because of both of them have different functions and the condition in one is not dependent upon the condition in the other. However, it is, logical to integrate fire, security and energy management systems. Because they can benefit by sharing a common database, share at least the same technology, if not the same components and also engineers from these three disciplines usually have a similar background (Walter, 1988).

The needs of each building are usually quite different. Therefore, there is considerable difficulty in getting one fully integrated system to handle all of the electronic building services. For example, in small buildings, multiple alarms are a very rare occurrence, but in larger buildings, as the number of input points to a system is greater, the probability of multiple alarms rises considerably especially in an emergency such as a fire (Walter, 1988). Also Neubaer (1988) points out that:

> “An owner-occupied building may provide greater integration of systems than a tenant-occupied building in which the owner/developer is offering Shared Tenant Services (STS)”.

He maintains the view that, if owner constructs an IB for the use of employees, he/she may be able to make a larger initial investment to achieve greater integration because of a longer timeframe in which to justify the investment. On the contrary, if owner/developer plans to lease IB space to tenants, he/she may not be able to justify as large an investment because of a shorter timeframe created by the need to conform to the current market for commercial office space. (Neubaer, 1988) If the integrated system was designed badly it cause disrupt the entire system although each system work properly (Walter, 1988). According to Klein (1988) “integration permits each tenant to have access to,

- the comfort, safety, and security provided by a BAS
- the services available with OAS
- the communication capability available with multi-dimensional TS that provides voice, data, teleconferencing, telex, and facsimile communications."

Thanks to integration subsystems, building's operating costs for the owner and tenants can be reduced and also building can be operated more effectively and efficiently. Walter (1988) explains the benefits of integrated systems as below:

- There is no necessity a highly skilled personnel who would be employed to monitor the building 24 hours a day.
- Integrated systems prioritise multiple alarms. The procedures to be taken in the event of alarms being raised should be planned before especially in complex buildings.
- By integrating fire, security and energy management systems, these complex procedures are stored in a central processor. So that simple instructions can be given to the operator and it is less likely to make a mistake in an emergency.
- Faster and more efficient maintenance provided by the ability of skilled operator or service engineer can monitor the entire system, diagnose incipient faults within the systems components and in some cases affect a temporary repair from the central station.
- In some cases integrated system can be interface to the telephone network via a modem. Thus, the supplier's service department can assess and control all parts of the system.
- Safeguards have to be incorporated in fire and security systems. Certain changes to the systems must be followed by a walk test to check the correct operation of the devices. Nevertheless, this is a great benefit to the user who can enjoy a much faster response.
- A further benefit of integrating fire, security and energy management systems is the obvious reduction in cabling by sharing the same data communication bus. The integrated system philosophy is usually coupled with distributed intelligence; the number of signals may often be reduced. In addition to this,

- thanks to using digital communication, the amount of information available to pinpoint the source of any problems accurately is greatly improved.
- Intelligent systems keep a record of all alarms, faults and action taken, together with the time and date. This is very useful in helping to determine trouble some areas quickly and with the minimum of nuisance.
- Integration increase functionality while reducing costs.

Walter (1988) divides electronic building systems into two groups: “foreground” and “background” operations.

- **Foreground Activities:** These activities include telephone, telex, FAX and computer data communication in other words this system includes voice and data communications facilities. The features of them are, operating at a constantly changing level of use and changing in capacity over time as users needs evolve. While these services are stretched to a maximum during busy periods, they may also be under-used during slack periods (Walter, 1988).

- **Background Activities:** By contrast the “background” services include facilities, which the occupant is perhaps normally unaware, such as fire and intruder detection, security and environmental control services. These services are capable of raising an immediate alarm that should alert the human occupants as rapidly as possible by easily read, common display way. When all equipments are work properly, these services work away quietly in the background, but when something goes wrong they must spring into action in an instance. No delays can be tolerated, particularly in a fire system In complicated situations, the integration of emergency services into one unit that advises human attendants in clear ways and step-by-step instructions has distinct advantages. The same ideas are not easily applied to foreground services however. Different occupants may have different requirements for these facilities, which may change in different ways over time. These background services need prompt response by a human and they need to be monitored by a human. It is logical; therefore, to consider the integration of these services at least at a level, which permits all alarm messages to be displayed on one device within the background services there may well be different emphases in the different facilities. For example, in a heating and ventilation control system, data traffic is likely to be relatively heavy as sensors for each area are scanned and information extracted. While data reliability and integrity is obviously important, on the other hand a malfunction in any loop is probably not a critical event. In the case of an intruder detection or security system, data traffic is still likely to be significant; a consideration is the integrity of both data and physical system (Walter, 1988).

There are also different systems that based on integration. Weaver (1988) defines a "Fully Integrated System", as it would include physical and functional access to building operations data from any system or subsystem within the building. The list of systems would include at a minimum the following (Weaver, 1988):

- Engine Generator or Standby Power Systems
- Uninterruptible Power Supply (UPS) Systems
- Emergency Lighting Systems
- Lighting Control Systems, either discrete or integrated into fixtures
- PBX or Telecommunications Systems
- Office Automation or Management Information Systems
- Control Systems on packaged equipment, including chillers, boilers, computer room HVAC, kitchen equipment, laboratory equipment, etc.
- Fire Management Systems, including detection and smoke control devices
- Security Management and/or Access Control Systems Time and Attendance Recording Systems
- Maintenance Management Systems
- Miscel1aneousBuilding Systems, including booster pumps, sump pumps, etc.
- Elevator Control Systems

In another approach Foster (1999) in his Facility Management lecture lists the typical technologies in a fully integrated IB as:

- Information Technology and Telecommunications
- Building control systems

- Mechanical services
- Electrical services
- Lighting systems
- Security systems
- Acoustics
- Fire Engineering
- Façade Engineering

In addition to this Rao (1992) defines an "Integrated Intelligent System (IIS) ", which is a large knowledge integration environment that consists of several symbolic reasoning systems and numerical computation packages. They implement real-time distributed intelligent control systems are controlled by a meta-system, which manages the selection, operation and communication of these programs. In summary, IIS as following:

- "Intelligent control is an interdisciplinary field, which extensively applies the knowledge of computer science and artificial intelligence as well as system engineering to industrial processes.
- The knowledge-based systems are the additional welcome to the existing knowledge. They can never be the replacement for today's science and technology in real time control.
- The IIS is an innovative intelligent environment that can help achieve knowledge integration and management and also a universal configuration that will lead a new era for Al applications to the real-world problems.
- New knowledge may be generated in the processes of developing knowledge-based systems, which may complement the knowledge of artificial intelligence techniques, control engineering, and related domains".

According to Rao (1992) integration architecture includes:

- integration of the knowledge of different disciplinary domains;
- integration of empirical expertise and analytical knowledge;

- integration of various different objectives, such as research and development, engineering design and implementation, process operation and control;
- integration of different expert systems;
- integration of different numerical packages;
- integration of symbolic processing systems and numerical computation packages;
- integration of different information, such as symbolic, numeric and graphic information".

There are some possible applications based on the integration of IB systems; such as:

- The light switch is close to the door; a time switch turns the heating on in the morning (Walter, 1988).
- Occupants are able to "call up" the BAS and enter commands to selectively turn HVAC equipment and lights on or off. Security personnel can call in checks while making rounds or alarms can be activated (Neubaer, 1988).

There may also be some false or unwanted alarms. For example; clogged grease filters over a kitchen range may result in cooking fumes leaving the kitchen and triggering unwanted alarm. These alarms time and location should exactly be determined to help to identify the real cause of the problem (Walter, 1988).

Transue (1988) states that developments on computer-based alarm systems, multiplexed wiring and digital communication have created an opportunity for interfacing or integrating a building's fire safety systems with other building control and communication systems. Therefore, designers of the IB would be wise to maintain dedicated fire safety systems, connecting them to other building control systems only to the extent required for fire protection purposes in harmony with the fire safety program. Fire Management functions provide that all building systems would allow many functions to take place from a fire fighter's control panel. And also fire fighters could readily issue override commands to smoke control systems, elevator systems, electrically auxiliary power and pumping systems by receiving alarm and event information from the full spectrum of building systems (Weaver, 1988). According to

Walter (1988) because of today's fast developing building standards, it is becoming important for designers to look for a single competent supplier for the fire security and energy management systems.

Jeanine (1998) points out that, in addition to traditional controls contractors, a new player has entered the field: "the system integrator". In the line with this approach Neubaer (1988) states that the role of owner/developers is so important as systems integrator:

- They specialize in selecting, interfacing and integrating IB systems.
- They make it possible to economically and efficiently use a multi-vendor approach in the development of a leading edge, state-of-the-art IB (Neubaer, 1988)
- They affiliated with one or more BAS suppliers,
- They take responsibility for the entire system, including the BAS and the functions it controls.
- They are able to create a fully interoperable system because of their networking knowledge (Jeanine, 1998).

In addition to that, a building with an integrated system has terminal equipment on each floor, which enables tenants to control the lighting and heating/air conditioning (Fujie and Mikami, 1991). The integrated system also provides one integrated display and control unit. Any number of display terminals can usually be added to the integrated system as appropriate. All alarm messages can be correctly prioritised under computer control. Buildings such as hospitals, universities, shopping malls, banks, leisure centres, retail headquarters, defence establishments and schools can also be networked to provide a central monitoring point at a remote location (Walter, 1988).

Chapter 3

THE DEVELOPMENT PROCESS OF AN INTELLIGENT BUILDING PROJECT

3.1. Process of the Intelligent Building Project

In this part, the process of IB project will be discussed.

3.1.1. Inception Phase

Feasibility studies, requirements definition, standards integration and development, and technology evaluation are only some of the topics within this stage (Flax, 1991). In other words, this phase aims to determine requirements of buildings' stakeholders, cost limits of the project and also most suitable decisions for project by coordinate and trans-discipline working. For designing a successful project enabling an effective coordination and communication is must. All communication systems depend on human activities. In addition to that, there are expert personnel in every stage of design and also the quality of personnel who will operate and maintaining the systems at the end of the design is also important to achieve a successful IB project.

There are need for greater energy efficiency, better control over the internal environment, and new ways of doing business using IT. The designers should define these requirements at an early stage (Habitat, 1990). Flax (1991) states that the correct business and consequent technology strategy should be defined and implemented in this stage. Policy formulation and dissemination together with technology strategy definition, both present and future, form the foundation stones on which an IBs must be built. Özer (1996) states that IBs are a complex structure in terms of both its different systems and also different requirements. So that design solutions are not standard they change project to project. There are a number of project procurement systems in use and essential differences between them. These differences are based on:

- The roles and relationships of the specialists used.
- The arrangements for determining the cost of the project and identifying the contractor to contribute to the design.

- The process structure adopted including such aspects the overlap of design and construction.
- Details including in the conditions of contract such as provisions.

The requirements of users or owners are so important to determine limits of design. While some owners have a detailed requirement list, some have a brief list that includes only necessary requirements. It is so difficult for owners/contractors to constitute a programme that adaptable for future usage alternatives and new technologies especially if owner does not the user of the building (Özer, 1996).

New organizational methods are becoming used in recent years to reduce both time and money and to provide high-quality structures. In different projects we accept different organization. It depends on characteristics of product qualification of contractors/sub-contractors and the other participants. There are three forms of basic organizational approaches: programmed, professional, problem solving organizations.

Each basic form has got its own sub-organizations. There are three approach: design+build, design+build+management or separate responsibility of each of these disciplines. In recent years the design +build proposal have become in common use. The objectives of maximizing the degree of technical factors and maximizing the cost are in conflict. There are mainly three approaches to undertake responsibilities (Özer, 1996):

- **Subcontractor Approach:** In this approach, there is a firm that design and manage the building. There is so different subsystem and also lots of agreements in IB, so that the supervision of construction team is so hard. However, this approaches requires completing design before agreement thus the project cannot flexible to changes. IB points out the accelerated process of design and construction. In this respect this approach is not suitable this kind of buildings.
- **General Contractor Approach:** In this approach, a firm undertakes all construction works. The designer gets out from construction team and this cause reducing the quality of works. Some firms achieve to add design process to undertaken responsibilities. This approach is suitable for IBs that give importance the quality, performance and also time management of work.

- **Construction Management Approach:** In this approach, the subcontractors give design directions from design firm and management directions from management firm. This two firm makes the design than they coordinate the construction team. This approach balance the design and management goals and combine the other two approach's advantages. However, in complex projects such as IBs the coordination between these two firms is so important.

Because of technological developments the control of different activities became difficult. Instead of central work, designers started to work autonomously. In high technology buildings, the operating process and communication between design team and owner is so important (Özer, 1996).

As a result of these situations, a new approach called "Total Involvement Engineering (TIE)" points out the team concept during the constructions process instead of hierarchical organisation. In this approach, the flexibility and communication are provided in design process and the changes on adjudication process enable competition to ensure technological systems. Designers are responsible for starting and running the process. Also this approach usually adapts the changes on appropriations in design, construction and commissioning phases (Özer, 1996).

3.1.2. Design Phase

The design criteria have been changed since IBs in our lives. The general aims of conventional building design process are; to design a building in a short time, in an optimum cost and at maximum quality. However, there have been new aims in IB design process such as providing the communication of building with its user and services. This requires the location of electrical and mechanical systems that are integrated and managed by a central computer system. In addition to that, an IB provides energy saving in the way of downloading the energy conscious systems. There is also one more aim that lot of important for intelligence of building.

An IB should consider the future requirements so that it should be designed as possible as flexible. Flexibility of space, in other words knowing how systems can be enlarged in the future is also an important input of intelligent design process. In design phase, the design team that comprises architect, electrical engineer, mechanical engineer, owner, tenant, takes some decisions to enable flexibility. Such as the space organizations and cabling system of building should be design depends on the evolution of communication technology. The cabling system can have an additional capacity and also the equipments of computer technology can be located in building easily. The building services should response the users future requirements such as electrical power, communication, information technology and environmental control systems. This approach also provides financial benefits (Özer, 1996). Özer (1996) explains this approach as:

> "an IB should enable the flexible usage possibilities and comprise much of advanced systems:
>
> - to increase environmental performance
> - to provide comfort and security of users
> - to minimise the energy consumption and cost expenses
> - to response the unknown future requirements of users".

In addition to that, Croome (1997) states that integrated systems approach is fundamental and control strategies are a key feature within IB design process. The difficulties on integration of systems affect both project and also the organizational structure. This makes each IB project a special product. In other words, an IB has a complex, non-repeated and dynamic character. So that IB process cannot keep up with the traditional approach that point out stable and non-participation process (Özer, 1996). In another view, Mawson (1994) lists the responsibilities of buildings as listed below:

- must be designed with real recognition of the types of business activities and functions, which may be conducted through their life, recognizing that they will probably have a longer life than most of the organizations, which will occupy them.
- must sustain healthy effective life for the people working in them.
- must be environmentally friendly in all aspects, with minimum emissions and energy usage throughout their lives.
- must be capable of coping with change on a number of fronts such as organization change, user change, functional change, technology change, economic change and regulatory change.

- must have IT-based management systems which enable them to be managed effectively, providing high levels of service and control quickly and economically. There must be a hybrid approach to the management of buildings, systems, facilities and structures.
- must not only be able to withstand developments in technology, but must be capable of taking advantage of them as they become economically viable, bringing their benefits to investors, users and managers.

The steps of IB design can be listed as below:

- The total system design that will simplify the installation and administration of each subsystem should begin after the detailed analysis of user requirements has been completed (Flax, 1991).
- Clients must be as quick as possible to choose the technical equipments to accelerate the process. (Özer, 1996).
- Decisions and precautions that make building intelligent should be determined by a trans-disciplinary approach.
- The design must cover all aspects of cabling, security, documentation, furniture layouts, and voice and data communications and also all aspects of strategy and analysis (Flax, 1991).
- The cabling system should design according to electronic devices location. They should also be controlled by management system. Otherwise the manager obliged to use most expensive solutions to prevent the reducing effectiveness of building (Okutan, 2001).
- Designers try to translate design into mechanical or electrical system.
- An IB should enable flexible usage possibilities.

As an example of user-intelligent approach, Mill (1987) developed and tested a study in the Canadian and Scottish contexts. In that approach, the potential users take part at the preliminary design stage, during its detailed design, construction and in setting up the eventual facilities management. According to him the key steps of work for successful user-IB design as follows (Powel, 1990):

- "During the early stages of the design, users are allowed to explore alternatives fully, through full-scale mock-ups, and to take part in the design process, using specially developed techniques.
- Users continue to have a decision-making involvement throughout the design process, its construction and in its commissioning. They attend building 'walk-through' surveys and are adequately briefed with documents in a language appropriate to their understanding.
- All user-intelligent environmental designs provide users with as much autonomy and flexibility as possible, through the development of localised user-controlled task and living environments. A new unit called "FUNctional DIagnostic (FUNDI)" use to provide it. This unit also:
    - enable individual control of ambient and task lighting and heating, cooling, fresh air, ambient and task sound masking, even ambient and task special definition.
    - permits users to optimise each aspect of their own environments through separate controls.
    - allows for sensory environmental inputs concerned with welfare, satisfaction and productivity to be passed on to the central server.
- During both commissioning and routine maintenance, a series of building diagnostic techniques are employed to assess parsimoniously whether a building conforms to its performance specification.
- The final refinement of user-controlled building intelligence takes place during and after the commissioning process. Each user's environmental control system is fully integrated into the local use patterns and needs. This requires the design team not only to produce user-sensitive designs, but also to 'stage-manage' those designs into the real world — adapting, extending and focusing them where necessary in response to users' demands".

According to Kutlu (1999), the primary design parameters, which are related to built environment and affective on energy conservation, can be listed as follows:

- The selection of area
- Distance between building

- Orientation of building
- Building forms
- Solar radiation and thermo physical properties of the building envelope.

Orientation of building is one of the most important factors effecting indoor climate. In addition to that the building form and external walls are one of the most important components with respect to total heat loss of whole building and different building forms will have different heat loss, so that it should be taken into consideration in detail in design phase.

In addition to that, orientation of the building to the sun is the most important constraint in the passive use of solar energy for building heating. The main design idea of this passive solar heating technique is to cover the building with a transparent shell in the southern and northern sides, and by making use of the solar energy gain, to increase the temperature of the spaces between the building and the transparent shell (Tan, 1993).

Levin and Boerstra (2001) states that the measurement and verification of the ability of the building performance can be enabled against targets or design criterions, which are specified by design team for various indoor environmental parameters such as temperature and humidity, moisture, air quality indicators, acoustic quality indicators, mechanical energy limits, light quality, electromagnetic fields and non-ionising radiation.

As mentioned before, the ecological design is one of the subtitles of IBs. This enabled with intelligent design and intelligent applications. According to Utkutuğ (2001), in the next century the prior aim in building solutions should be "to minimize the impacts of buildings on ecological environment". According to this aim;

- "Ecological (green) approaches", which include the integration of a building's all the inputs and outputs coming from its birth to its death with the biosphere system, recycling of these inputs and outputs for re-use and paying attention not to produce harmful waste, are appropriated.
- The idea of using the technology as a tool of ruling environment and emphasizing the power and wealth should replace with the idea of

"ecological ethics intelligence" which thinks the technology as a tool of making the relation between humanity and nature harmonious.

- With the ecologic perspective vision, "efficient energy design approaches", which aim to increase efficiency of energy in design / construction / operation / maintenance periods and to minimize the amount and cost of energy inputs on the behalf of individual social benefits, has become important. The approaches having great potential in this situation;
  - "Bioclimatic design", which aims to decrease the active lighting and air conditioning requirements by evaluating the climate data, and heat resource and absorbents in natural surroundings effectively.
  - By benefiting from IB properties, to inspect the building systems and to increase the building performance and energy efficiency.

Utkutuğ (2001) also states that efficient energy approach that based on ecological perspective aims to minimize the cost and amount of energy inputs on the behalf of individual and social benefit

- in the production of all the materials, components and systems constituting the building.
- in the design, production, usage, operation, and maintenance of the building.
- in the design and the operation of all the electro mechanic systems beside all the building systems
- in the re-use of the building inputs after recycling.

In addition to that, Meier (2000) explains the principal measures for reducing energy consumption in ventilation and air conditioning systems are following:

- The operating and organizational conditions, which will facilitate low energy consumption in the system, should be established.
- The need for the proposed application should be carefully investigated.
-

- While the sizing criteria in accordance with actual demand should be determined, the unnecessary functions, and oversized systems and components should be located in system.
- The components should be used with high efficiency levels across the whole operating range
- The systems should be designed for demand-controlled operation, which reduce costs even more substantially without reducing the required degree of comfort.

In the light of all these explanations; we can summarize the design concept of IBs as follow: There are integration of different approaches such as; ecological design, energy conscious design, flexible design, user-friendly design, high-tech design and IT-based design. This situation requires a trans-disciplinary approach in this phase. So that, the experts of each discipline should be informed about the others profession. The architect enable the organisation of these stakeholders who are generally consist of electrical engineer, mechanical engineer, civil engineer and contactor.

However the user of building is the most important stakeholder who formed the design. The location of building is also important in terms of using natural energy sources to provide energy saving and economy on operation of building. In addition to that, design should be provide flexible usage of space for responding changeable requirements of users or owner. The integration between IT and building design is another subject that differ IBs from conventional ones.

In addition to them, as experts said, there is not a formal specification or building standard in the field of IBs. On other side, it is obvious that it is impossible to talk about these standards when there is not a certain definition of this concept. However, as Emre Özmen said there will be these standards in short period. Because the significant developments that on this concept are spreading quickly all over the world.

As a result, the important points of IB design process are:

- Providing the interdisciplinary approach
- Additions on space list, such as one or more computer command centers.
- Changes on section of buildings such as raised floors and suspended ceiling.

- Considering the selection of materials.
- Providing flexible space organizations.
- With intelligent designs, providing the use of intelligent electronic devices.

3.1.2.1. The Stakeholders of Intelligent Buildings

All communication systems or infrastructures are people dependent and technology is one of the tools used to make it easier. The starting point for establishing a model of an IB is people, who are not passive recipients of their environment but can adapt physiologically and behaviourally. They also determine the mind force of the building against which machines have to act (Croome, 1997).

Instead of these professionals and technologists are involved and there are still problems of communication, at whatever level of technology is used (Özer, 1996). Similarly, according to Ivanovich (1999), IB technologies are not being used enough in new construction to achieve maximum building performance. Many reasons of poor communication are usually based on the stakeholders of IBs mistakes. Such as in his words:

- "Many manufacturers, engineers, contractors, and energy service companies (ESCOs) are unable to quantify and qualify the benefits of lB technologies to owners, so owners are unwilling to support them.
- Outside of niche applications, engineers do not generally know how to work higher-end, software-driven lB technologies into their designs and other construction documents, and manufacturers do not understand how to develop products more amenable to lB approaches.
- Many contractors don't know how to install or integrate lB technology, so systems function poorly or start-up operations and occupancy are delayed.
- Coordination of roles and responsibilities is difficult because lB hardware and software cuts across so many building components. Moreover, documentation needs are extensive, and the resulting manuals and databases are difficult to maintain.

- Building owners don't understand the value lB technologies can add to their property, so they do not seek out the higher levels of performance such technologies afford.
- Many building operators who "dumb-down" or turn off lB systems because they don't understand them cannot adequately support them or do not believe they are necessary. Clearly, lB challenges and opportunities abound for everyone.

He maintains the view that the rapid pace of technological innovation has overrun the capability of utilizing present day technologies effectively and efficiently. So that, improving practices rather than important from improving technologies. IB demands intelligence applied at the concept, construction and operation stages of a project by clients, designers, contractors, manufacturers and facilities managers.

Clients: According to Tetlow (1996) clients are turning increasingly to designers to create a framework in which they can succeed in today's business world. Similarly Powel (1990) states that the most vital role the client has is the choice of designer. The prime objective of clients should be to secure designers who will be in accord with their view of the world. Otherwise a client's deepest-held beliefs are in danger of being swept away by the designer's own enthusiasm.

Client / user is the most important input to provide intelligence so that he/she has to be a member of the design team from concept to application processes. In addition to that they must also educated on the benefits of good office design and planning in order to help them see that just cutting costs will not make companies more competitive (Harbour,). However enabling the inherent flexibility to allow for changing staff, size, projects, and cultures, all of which are greatly enhanced and facilitated by the use of new technology is one of the most important criterions for clients. Gray summarize the roles of clients as following (www.rgg.ac.uk):

- Know about the design
- Demand value
- Manage the decision making
- Align the business to the project.

The computer based new life style and enhanced technology change demands of occupants and there are also some advantages as following (Ivanovich, 1999):

- They become well informed and begin to articulate precise needs and requirements.
- They begin to shop and pay more for them.
- They begin to demand proof of individual control capability and building performance that depends heavily on BASs to monitor, store, and report the building-generated data and subsidiary computer software to process the data into summary reports.

After practical completion, building users are expected to understand and operate the multiple systems designed into the building. They also need to be aware of how their buildings function and the facilities that is available. Otherwise users turn off the systems and revert it to manual operation (Habitat, 1990).

Designers: Tetlow (1996) states that designers should focus on finding out what clients need and then on developing the strategies to deliver the services, which meet those needs. In her words:

> "Technology is important, design and production are critical, but understanding the client's business is essential ".

They also use all their subtle and subversive skills to move the client slowly but surely towards an overall solution consistent with their own attitudes and ways of thinking (Powel, 1990). Designers also having to re-think how the workplace is designed and how to integrate design, technology, data and service to create a business insight. This is especially true as companies continue to look for ways not only to downsize and consolidate operations, but also to take advantage of new technologies and make employees more productive (Tetlow, 1996). In other words Harbour (1996) explains that a designer's work must exemplify one reality; good design can have a direct impact on a company by increasing productivity, adding value to the organization, and enhancing the environment and personal well being of employees.

There are four 'strategy sets' that allow both consistency in design and viability in general. The particular 'strategy set' was found to be closely related to the way designers approached learning. Kolb has been investigated the field of learning and summarised the various approaches open to an individual by a learning cycle. In Powel's (1990) words,

> "Kolb's model portrays an ideal situation where the learner has immediate experience of the world, steps back to reflect on this feeling in context and thinks up an abstract model to explain the phenomenon, which is tested by further active exploration. These 'doing' actions cause the learner to 'resense' the world and so begin a learning cycle".

However, architectural design places severe constraints on this ideal cycle. The necessity to make fast decisions causes designers to align themselves with a particular 'strategy set'. These 'strategy sets' short-circuit active learning to an arc or quadrant of the circle. Some operate mainly within one arc or quadrant of the circle: for instance, entrepreneurial types move on an arc between sensing and doing; whereas design engineers and technologists, such as lighting experts and acousticians, tend to watch the world and then think about it. 'Watching' here implies systematic observation. 'Sensing' is more intuitive and feeling-based. It is important to stress that these observations are of architectural designers' preferred action styles. Nevertheless, in order to cope with pressures of time and money, practising architects will 'stick' to their preferred learning approach and corresponding design style. This gives designers a secure basis from which to design, and they rarely change their approach to learning new ideas — it is not only too much effort it also drains their confidence. As a result, architectural designers tend to think and design using one of four 'strategy sets'; each is different, independent and recognisable. Powell (1990) has identified these designers as "Dynamics, Focused, Rigorous and Contemplatives" (Powel, 1990):

- **Dynamic architects:** These architects have an approach to learning, which is centred, on 'doing and sensing'. They are entrepreneurial and innovative, acting for the moment, sensing its potential and doing something about it immediately. It is the dramatic, active events in the world, which give them motivation and allow them to register understanding. To learn, they must be personally involved, and if this necessity is satisfied, then they are eager for challenges and novelty. By being assertive and individual in their actions they can swiftly switch tack, being entrepreneurial and initiating centres of profit at one moment and, at the next, rapidly creating innovative designs. These designers seek acclaim and their risk-taking attitude makes them 'good copy' for architectural 'glossies' and the professional financial and management pages of national newspapers.

Dynamic architects have and want attention, and active manipulation of their surroundings is the quickest way to satisfy this desire. To this end their designs will he unusual and will certainly have novelty value, hut they may all too quickly dismiss considerations a client sees as necessary to the success of the design. These designers are the most aggressive ill making any brief fit their present ideas, and the clients can easily fall victim to the 'flavour-of-the-month' (Powel, 1990).

Focused architects: These architects concentrate their attention on decisive action. They operate in the world with a down-to-earth approach, which is above all practical. Their need to do can often lead them into being campaigners and expounders of alternative technologies and conservation policies. This 'small is beautiful' philosophy may make them reticent to try untested approaches to design. Instead, these architects stay with the 'safe', known approach. If one requires something that is tried and tested, and a building that will actually work, then these architects are appropriate. The concern of focused architects is to ensure designers are useful, and if the needs of people are not in conflict with those of nature, then the former will be taken into account. Caring for nature's interests in general, these architects look for the solution that fits the environment — the one that gives least distress to nature. For this reason, focused architects need the values of the client to be in agreement with their own. Protecting the rights of man and nature and honing practical solutions are the aims of the focused architect (Powel, 1990).

Rigorous architects: These architects understand the world by creating abstract models. These models give the architects predictive power over the environment. Through assumed knowledge of the underlying patterns in nature, these architects have secured rules that guide them in their designing. They stand as the guardians of professional standards, and aim to prod rice competent solutions. However, there is a tendency amongst them to provide very rigid solutions, and this can lead to designs that are restrictive of human behaviour, placing too much emphasis on unseen control. They will certainly not let a client down, for there is always some kind of technical 'fix' at hand, but it may not always be appropriate. Furthermore, their designs may be fairly standard, lacking any innovative flair. These designers are the self-disciplined managers of any task they are presented with — each is given due attention, resulting in an efficient and effective solution. Complex buildings like hospitals require the abstract modelling skills of these designers, and any client with this type of brief would be wise to have access to this analytical resource (Powel, 1990).

Contemplative architects: These architects with their emphasis on reflection may feel no great urgency in getting designs into the real world. Their reluctance emanates from a desire to create the all-encompassing solution. To this end they will thoroughly analyse all the data, which are at hand, and then try to retrieve more in an effort to ensure every angle has been covered. Contemplative architects find it very difficult to reach decisions — the holistic insight they so often seek nearly always eludes them. If someone else makes decisions, they can become effective job architects; otherwise small commissions with a large time-scale are the most they can handle. For the client with strong ideas and a thorough brief, these architects will be a considerable gain, modifying their own ideas to fit the will of the client. There are some designers who try to take the contemplative theme to an extreme, and use all the strategies identified above. However, Powell and his colleagues have shown that such a multi-perspective strategy makes decision making almost impossible in any one individual; so these architects become ineffectual. However, to achieve an effective 'well rounded' design solution, all strategies should he utilised. To successfully 'stage-manage a fully integrated building into the real world, many skills are required. The ideal would be a sure fast-acting decision maker who can listen, innovate, evaluate and organise; produce a coherent whole that is unique and humanly responsive, and work selflessly in the optimisation of resources and time. The afore-mentioned studies by Thompson, and Newland and his colleagues, clearly indicate that such abilities, skills and understanding cannot reside, with any quality, in the mind of one design individual (Powel, 1990).

Building Owners: Building developers and owners understandably confused about all the technical options. However they still incorporate the latest technologies to make their buildings intelligent because of the fear that not doing so will result in an ordinary building that is harder to lease than its more intelligent competitor (www.coggan.com).

There are some basic issues that owners must explain. One of them is the dilemma between first-cost investment strategies versus life cycle costing that viewed primarily as a marketing issue. Owners have to sell this issue on the value of alternatives that may have a higher first cost or require improved support. In addition to that another owner trend was the growing population of real estate investment trusts (REITs) and other financial institutions. While some participants thought that such ownership would mean more short-term thinking with an eye on quick profit, others thought that such owners might represent a paradigm-change opportunity because they're investment-savvy and are more likely to consider more complicated financial strategies. In some cases such as tenants are not willing to pay more for a more productive work environment, owners will continue to see technology as optional additional costs rather than profit-making investments (Ivanovich, 1999).

Building Operators: Özer (1996) states that in these days' operators pressured to increase profitability or reduce costs by owners while providing the user performance by using their experiences.

While owners are implicitly or explicitly moving toward outsourcing the O&M of their buildings, many operators are unable to keep up with the fast-paced technology revolution. Outsource firms'; such as ESCOs, core competencies lie within providing "Indoor Air Quality (IAQ)", comfort, extended equipment life, and energy efficiency. These firms should also be investing more in continuing education, new equipment, and R&D (Ivanovich, 1999). In other words, firms will have to undertake customer training (Habitat, 1990).

According to this approach, chief facilities supervisors and staff engineers may evolve from crew leaders into contract managers and many facility managers and staff engineers will be empowered by modern technologies. In other words it is not a dismal warning for job loss in this industry. Utility rate negotiations, pollution prevention, occupancy churn control, and litigation avoidance/response will have become translatable into costs and returns on investment. Operators and staff engineers will need to coordinate more often with IT departments or their contractors. Patching into Internet and intranet systems for getting BAS information from one place to another requires shared responsibilities. This approach needs to be condensed and displayed in user-friendly, quickly digestible formats, such as visual images and also databases, networks, user-interfaces, and varieties of mass storage technologies will all become part of the operator arsenal for management of HVAC/R systems and staff (Ivanovich, 1999).

In addition to them there are some expectations such as, equipment vendors hope to sell PBXs, computers, sensors, and service providers hope to make a living by managing the smart devices (Froehlich, 1985). As a result, despite all of these pressures, change for the better will come.

3.1.2.2. The Design Team Approach of Intelligent Building

Özer (1996) points out that in contrast with the traditional approach, the choice of building systems should be based on trans-disciplinary approach that integrate effective design, engineering service, operating and management of building with an effective communication system or infrastructure. This approach enable easy deign, improved comfort conditions and increased life cost of the building.

When undertaking the construction of a building, owners, developers, project managers, architects, engineers and cost managers all aim to control the project scope, cost, time and quality. So that there should be effective communications among all project participants. Thus the problems can be identified at early stage and also design and construction delays, cost overruns and claims can be reduced (www.uniformat.com). Similarly according to Croome (1997), it is essential for architects, engineers and clients to work closely together throughout the design, construction and operational stages of the conception, birth and life of the building.

In a traditional building design the design and construction processes are accomplished almost completely independently from one another. In contrast with that in an IB designers and contractors should together understand that how the components of a building operate and they should show how they have done similar projects earlier. All participants need to listen to each other and to learn from each other what they know about these buildings.

In another view Levin and Boerstra (2001) in their workshop that called " Quality Control for Healthy Buildings in Construction Process" explain that the design team must also specify the criteria for material performance and requirements for acceptance of their use in the project. The plans and construction specifications can include:

- requirements for submittal of material or product chemical content
- chemical emissions measured in standardized environmental chamber testing
- labelling or classification where applicable
- sensibility to moisture, alkalinity and temperature of products depending on material itself and on the location in the building
- details for packaging, shipping, storage, handling, and installation (www.hb2000.org).

There is also an interaction between local authorities, legal procedures and approved standards in addition to different organizations experts in design stage of the building (Özer, 1996).

Powel (1990) states that before approximately 20 years ago there was a substantial insight into a means of creating the forum for such a team. According to this approach, the individuals - who would first and foremost recognise the enhanced potential gained through complementing their skills with those of other team members who would bring their particular skills together into a 'melting-pot' of creative fusion.

- **Functional roles:** The notion of 'team' presents the opportunity to expand the number of jobs usually associated with architectural design and provides a range of functional roles that are eminently flexible. While designing an user-IB there must be substantial expertise and experience at hand. . The roles of architect, quantity surveyor and both structural and service engineers must be taken up by competent individuals who can be separated into two group according to their roles: some have a background in social science skills to elicit user needs effectively, and others whose ability in building diagnostic skills ensures the effectiveness of a building's physical and control characteristics. Having the right combination of functional skills does not ensure that the individuals making up the team can play the roles necessary to form a viable working unit — the factor of team roles is of equal importance in acquiring a true trans-disciplinary design team.

- **Team roles:** A team is an entity that can be more than the sum of its parts. The different parts of its 'personality' can reside in different individuals and each can be called upon at the appropriate juncture. The qualities of drive, prudence, enthusiasm, understanding, opportunism, reliability, all have their parts to play. A team that is going to operate with viability needs a balanced mix of personalities and it has the opportunity to emphasise the strengths of each individual and eliminate the weaknesses. According to Belbin a successful group should contain the appropriate mix of following eight roles are open to them (Powel, 1990):

    - "**Chairman** ensures that the best use is made of each member's potential. The chairman should be self-disciplined, dominant but not domineering.
    - **Shapers** look for patterns and try to shape the team's efforts in this direction. They are out-going, impulsive and impatient. They make the team feel uncomfortable but they make things happen.
    - **Innovators** are the source of original ideas. They are imaginative and uninhibited. They are bad at accepting criticism and may need careful handling to provide that vital 'spark'.
    - **Evaluators** are more measured and dispassionate. They like time to analyse and mull things over.
    - **Organisers** turn strategies into manageable tasks, which people can get on with. They are disciplined, methodical and sometimes inflexible.
    - **Entrepreneurs** go outside the group and bring back information and ideas. They make friends easily and have a mass of contacts. They prevent the team from stagnating.

- **Team workers** promote unity and harmony within a group. They are more aware of people's needs than other members. They are the most active internal communicators and the cement of the team.
- **Finishers** are compulsive 'meters of deadlines'. They worry about what can go wrong and maintain a permanent sense of urgency, which they communicate to others".

According to Powel (1990) organisations can identify these eight characteristics and how they mutually react in a team context through the use of management game techniques. An example of game called as "Teams" was developed by the HART group and this provide a forum in which member responses, attitudes and ideas can be discovered but not in a way where people feel threatened. Powel (1990) also states that when the equal balance of both functional and team roles is respected the effectiveness of a team far out -performs the potential of any individual. It can only be reiterated that the prime objectives of clients should be to seek an intelligent team if they require IBs, which need to be more than the sum of their parts. Such buildings will lead occupants to generate their own comfort without caused extremely resource wastage and also lead to increased productivity as users feel themselves to be a greater part of the team.

The IB, which enables good user control and encourages positive feedback, stands as a metaphor for the pluralistic negotiation that is forged through teamwork. Only design teams with the right balance of those strategies described can create user-IBs and 'stage-manage' them from conception into a fully integrated building that stands as a testimony to their efforts in the real world. It is in the choices made by clients that the vital balance lie.

It is imperative that the Construction Manager (CM) builds a good team with the client, designers and the specialist trade contractors and aims for totally satisfying the client, drives to increase performance, communicates well, treats people well and has no hidden cost agendas**.** Picking the right people at early stage helps bring risks out into the open, removing communication barriers and encouraging conceptual thinking but this can take a long time (www.rdg.ac.uk).

3.1.3. Construction Phase

According to Özer (1996) this phase includes:

- the application of field works,
- setting and testing the systems
- commissioning the systems
- practical completion of the systems

Construction projects are intricate and time-consuming undertakings. The total development of a project normally consists of several phases requiring a diverse range of specialized services. In progressing from initial planning to project completion, the typical job passes through successive and distinct stages that demand inputs from such disparate directions as financial organizations, governmental agencies, engineers, architects, lawyers, insurance and surety companies, contractors and building tradesmen. During the construction process itself, even a structure of modest proportions involves many skills, materials and literally hundreds of different operations (Özer, 1996).

IBs are usually high-rise and big buildings. Therefore the structural design as important as space design. This enables by two ways: the first one is to enlarge the size of structural elements and the second way is to change the shape of this elements. The second one is more practical and economic than other one. Some design principles of IBs are listed below (Özer, 1996):

- The IB should have suitable structure that does not cause hard situation
- The floor system should easily adapt the changes on mechanical, electrical and hydraulic services.
- Floor loads should be calculated according to unpredictable factors such as different user requirements.
- Transverse loads, such as wind load should be in limit, provide comfort and also do not cause additional wind load.
- The storey height should appropriate to set the system.

Construction work is accomplished by contractors. Levin and Boerstra (2001) states that contractors who are unfamiliar with a product, material, or construction procedure may estimate the cost of construction inappropriately high simply due to their lack of familiarity. This is a common occurrence in the construction industry. Therefore, it is important to ensure that potential bidders on construction contracts are sufficiently familiar with the nature of the products and processes required that the contractors do not raise their prices above the actual cost necessary to properly complete the project.

The contractor also protects materials from rain or snow, construction or site dust, and accidental contact with workers, equipment and vehicles. Gases and particles from the outdoors can contaminate or damage materials during construction. Construction filters will protect materials against contaminants from the outdoors. Dust in the air during painting or application of lacquers or sealants can be trapped in the wet finishes and detract from the appearance of the finish. Contaminants can also affect the curing process and result in inadequately cured materials. Temporary filters and physical barriers should be used also for protection of remaining occupants during partial reparation.

The needed time of construction function in an IB is much more than traditional ones. In construction phase the sequence of installations must be planned. Such as, the automation systems cannot commission before cabling finished. Otherwise there will be lateness at the end of the work (Özer, 1996) and textiles should not be installed before wet processes are finished and the start of the main ventilation system should be specified (Levin and Boerstra, 2001).

Levin and Boerstra (2001) states that some building products and materials require certain environmental conditions, which could include air temperature, humidity, and chemical levels. Certain products require good ventilation during their installation to avoid exposure of installers to harmful chemicals or particles and to ensure proper curing or drying of the product. In some cases, ventilation during construction is important to prevent volatile organic chemical adsorption on surfaces (sink effect) leading to re-emissions during occupancy of the completed building.

New specialist high-technology firms are competing for the installation of equipment into buildings and play bigger role in the design and construction management processes. This new competition is causing industrial restructuring with a shift in power away from traditional construction firms. The trend is represented by the shift from craft-based construction activities to engineering and assembly work, with a much higher proportion of the value of new buildings in mechanical and electrical systems (Habitat, 1990).

3.1.4. Operation and Maintenance Phase

In this phase the personnel's responsibilities starts such as run, repair and maintain the system. It is clear that who are the building administrator and management personnel in first stage of the building design. The building manager enables the users security and comfort by central management. He/she monitor and control the activities in effective cost (Özer, 1996).

Throughout its lifetime, an IB system is required to maintain an optimal environment while supporting OASs, TSs and BASs. This creates the need for "Facilities Management (FM)", a comprehensive procedure for managing building facilities (Kujuro and Yasuda, 1993). The term FM was coined to identify managers of change, and is concerned with preventing building obsolescence brought about by functional or technological obsolescence. Kell (1996) states that IBs need FM to define requirements, justify investment, and deliver benefits. At the same time, facilities managers need IB to control building performance, manage distributed services, adapt rapidly to changing requirements, and provide crucial management information. This role contrasts directly with the role of the maintenance manager, who combats the effect of physical deterioration in an attempt to maintain the status quo of the building. Periodic maintenance allows the building capability to be recovered to a level comparable with the building's initial condition. However, a gap continues to emerge throughout the building's life because user expectation increase and organisations change. This may result from innovations in IT imposing greater demands on the building or organisation and thus requiring a read justment of functional capability. The maintenance gap only arises once the building is initially commissioned, whereas the technological and functional gaps can arise from the point of design inception partly owing to the time lag following inception, during which time, changes may arise. The facilities manager does, however, have a key contribution to make at the inception stage ensuring that knowledge relating to changes of previous buildings are considered in the new building. The facilities manager is emerging as a key role in ensuring that the building, the systems and the people work and interact effectively (Croome, 1997).

Croome (1997) points out that FM comprises numerous integral measures that are necessary to ensure effective use of property for owners and tenants. The qualitative and quantitative individual goals of the clients are considered throughout the complete life cycle of the building. This means that the economic execution of the organisational, financial and operational processes as well as the continuous fulfilment of the quality, security and environmental requirements, constitute the principal elements of FM. The improvements after the introduction of "computer aided facility management (CAFM)" are highly significant throughout the design, production and operation processes (Bochsler, 1994).

There is some basic differences between traditional and IBs (Özer, 1996):

- In traditional approach the first investment of building is minimum by using only most necessary services. Owners should determine some basic proposals in first phase of the project to stop the tenants to leave their homes.
- Such complex and large buildings from conception to operation stage require a greater engineering and architectural effort than traditional ones. This kind of effort point out the progressive management and organizational methods.
- An IB increases the image and request of building. So that it is easy to rent an IB than traditional buildings. Because of the reasons that make building intelligent such as different subsystems and their relationships the process of this buildings is different from traditional ones.
- In traditional approach, field construction has not been started until the design team has completed and finalized the design. In an IB process it is possible to reduce the total design-construction time required by thinking design and site activities in parallel. This accelerated process saves many of time.

The IBs consist of special items that have unpredictable quantity and price. It is also so difficult to predict the advanced technology systems' facility and costs in production of the building. Therefore the design team orients to use more changeable procurement methods. Economy is one of the most important factors to choose the right system. Determining the cost is based on contractual arrangements. There are a number of arrangements but only a few methods are in common use. These are (Özer, 1996):

- **Lump sum arrangement:** all design works (final working drawings, specifications and documents) are prepared by the design tam for the future building. A contractor is then chosen and a price determined, either by competitive tendering or by negotiation and a contract signed. The building is then constructed.
- **Cost plus arrangement:** the contractor or contractors are paid the cost of the work-completed plus- a fee. It is now mainly used when construction must be carried out so quickly that design cannot be completed for the whole project before work commences.
- **Unit price approach:** certain prices are used for each item of the project. But the unpredictable character of advanced technologies may eliminate this approach. To define a certain price is difficult for IBs' systems.

Kujuro and Yasuda (1993) states that the office environment is evaluated and managed by carrying out prompt space planning and making full use of appropriate technologies. Depending on circumstances, this may involve restructuring the environment to account for the way in which the office is used. Management of the information system's equipment and wiring system is also indispensable. The performance of building is measured by the end-user of the building. There are also another group who measure the success of the building according to benefits that enabled during a year and the ability of responsiveness to change ability (Özer, 1996).

Özer (1996) points out that the testing and commissioning process of time differ from project to project. Such as, the testing process should be starting three month before building started to use. Generally, in IBs firstly the heating system starts to work to dehumidify the building. After this the air conditioning system works and other systems orderly starts to work. There are a building manager and different departments such as:

- Security department
- Engineering department

- Purchase and Cleanness department
- Customer department

She also maintains the view that the acceptable limits of imperfection of contractor firm should be maximum 5%. The contractor firm gives 6 month for management guaranty and 1year for building materials guaranty. This period called as “defects liability period” and the certain assent is made at the end of this period. After the systems start to work, during the first 6-month the contractor should inform personnel about how they should use the systems of the building. Levin and Boerstra (2001) explains that, often training required in the contract documents does not occur because the building systems are not yet working properly at the time the training is scheduled to occur. The contractor’s personnel are on-site for training, but instead they help solve problems and assist in getting the building to operate properly. The actual training and motivating must occur after the adjustments are made so that the full time planned for training actual occurs.

Flax (1991) states that management record keeping tools will make it very easy to keep all subsystems up to date, facilitating doing business with the building’s administrators. In the line with this approach, Levin and Boerstra (2001) explain that documentation includes preparation and handover of building manuals that describe fully and accurately the design intent; the actual equipment installed; records of the start-up, testing, adjusting, and balancing; and the verification measurement results. The documentation should include a narrative of the building operation sequences and the control mechanisms for changing operation mode. It should also include full description of the design assumptions in terms of occupant density, activities, loads etc. on which the design was based. This will allow future operators to assess the adequacy of the building systems in the event changes in the use occur or are considered.

3.2. The Basic User Demands and Requirements

The human needs are the basic factors that effect the design phase of building. The satisfaction of user and create a comfortable and user-friendly spaces are the main aims of design. The basic user requirements are physiological needs such as heating, air conditioning, ventilation, light and water.

In the late 1960's Abraham Maslow developed an interesting and useable framework that helps explain the strength of certain needs. He was a humanistic psychologist who believed that people are not controlled by mechanical forces or unconscious instinctual impulses of psychoanalysis alone. According to him humans strive to reach the highest levels of their capabilities and he set up a hierarchical theory of needs that represented as a pyramid. There were the basic needs at the bottom and the needs concerned with man's highest potential at the top. The each level of the pyramid is dependent on the previous level or in other words, a person does not feel the second need until the demands of the first have been satisfied. These needs can be explain as below:

- **Biological / Physiological Needs:** This needs are consist of the needs for oxygen, food, water, and a relatively constant body temperature or in other words, anything the physical organism needs to survive.
- **Security / Safety Needs:** This needs means protection from physical and emotional harm, dependency, security, stability, reliance on orderiness, freedom from fear and anxiety, need for certainty, structure, order, law and predictability and so on.
- **Social (Love, Affection and Belongingness) Needs:** This needs involves love, affection, belongingness, acceptance and friendship.
- **Ego / Esteem Needs:** People need a stable, firmly based, high level of self-respect, and respect from others in order to feel satisfied, self confident and valuable. Therefore these needs may classify into two subsidiary sets:
  - Recognition by self and others of strengths, competencies, achievements, personal adequacy, mastery. These enable confidence within the domain of action that involves others.
  - Reputation or prestige (respect or esteem from others). This need is met by being valued by others who give attention, attribute status, offer recognition and appreciation.

In other words, the internal ones are self-respect, autonomy, achievement and the external ones are status, recognition, and attention.

- **Self-actualisation Fulfilment:** Maslow describes self-actualisation as an ongoing process. In briefly this term means doing things. In his words;

> “musicians must make music, artists must paint, poets must write if they are to be ultimately at peace with themselves. What humans *can* be, they *must* be. They must be true to their own nature. This need we may call self-actualisation."

In addition to them, the technological developments created a new life style and new requirements are added our lives such as safety needs, communication needs and flexibility needs. The IBs aim to meet all of these needs. In other words, Bernaden and Neubaer (1988) define IBS as:

> “a dynamic tool, which can be used to create the personal, environmental and technological conditions necessary for building occupants to maximize their individual capabilities, productivity and satisfaction”.

Similarly, Bernaden and Neubaer (1988) explain the systems that IBs based in terms of user requirements as below:

- Information systems: that designed to better meet physiological and safety needs by automatically monitoring and managing energy consumption and security and fire protection.
- Telecommunications systems: that implemented to meet needs for social or verbal communications.
- Office automation systems: that are developed to satisfy data and word processing needs and also
- Other systems: such as videoconferencing and satellite communications may also be added to further respond to the ever-rising needs of building occupants.

In addition to that the businesses also have some requirements and Harrison et al. (1998) explain them as listed below:

- new business applications
- graphics interfaces
- fast straightforward facilities — storage and access

- simple procedures for global communications
- geographical/special flexibility
- control of local environment
- adaptable working space

In addition to that, IT developers have been studying to respond these requirements and they found new techniques and systems as listed below (Harrison et al., 1998):

- new environments and applications: Windows, graphics packages, e-mail, fax gateway
- integration of communications networks: data, voice and image (multimedia), local and global
- access to international networks such as Internet
- wireless systems such as telephony, paging, data networks
- facilities management packages
- integration of building control and management

Especially office workers demand comfortable working spaces. The flexible space design, flexible environment settings and enhanced control systems are the most important user requirements. The office environment settings could vary with seasons or in other words they could design to create healthy environment. For example having a fixed temperature to 24 ± C is may not suitable for all users. In addition to this, office workers need the automated control systems such as light switches and temperature thermostats.

According to Harrison et al. (1998) as the level of electronic control in the building increased, the level of local control has reduced. As a result oh-f this user access to light switches or temperature thermostats became very limited and recent regulations now enforce the need for providing the user with easy access to light switches.

As a result, the designing an IB is not extremely different from conventional buildings. The main aim is satisfying the user so that the first step of design is always determining the needs correctly. These can be different person to person or with changeable conditions such as function, climate but the general aim is designing comfortable and healthy spaces.

3.3. Benefits and Problems of the Intelligent Buildings

There are some benefits and problems of IBs. In this chapter, different kinds of benefits will be explained.

3.3.1. Benefits of Intelligent Buildings

Generally, the IBs provide some benefits by using advanced information systems for "consumers, service providers, manufacturers, and developers". The.com Home lists these benefits as listed below;

Consumers

- Integrated phone, TV, and security systems in the home
- Remote monitoring of home care and activities
- Kitchen and other appliances manageable away from home
- Electronic message boards shared between family, office, and school.

Service Providers

- Value-added services delivered directly to the home
- Standard protocols to allow consumers to simply connect
- Common services that can be shared across home devices

Manufacturers

- Next-generation technologies empowering everyday appliances
- Remote monitoring and repairing of networked devices
- Improved relations with service providers and consumers

Developers

- Familiar, open interfaces in the Java programming language
- Technologies based on industry standards

- Java platform’s “ Write Once, Run Anywhere” value proposition (www.)

On the other hand, Bernaden, and Neubaer (1988)’s approach of the economic and functional benefits of the IB is different from the The.com Home. These are;

- Longer building life
- Lower installation and life cycle costs
- Reduced energy consumption
- Higher space efficiency and
- Greater worker productivity

Similarly Flax (1991), explains the areas of maximum benefits as follows;

- IBs integrate all kinds of building systems thus protect the investment made in the building both now and far into the future.
- An IB network gives a building a marketing advantage thus the building’s resale value or the leasing image increases.
- IBs also provide staff efficiency and response customer needs at the lowest possible cost.

Okutan, (2001) explains the benefits of an IB as listed below:

- Efficient use of energy, reducing energy cost
- Reduced churn: cycle in the system
- Harmless to the environment
- Optimising the operational costs; continuous production
- Lower installation costs: intelligent investment
- Easiness in medical watch for the handicapped people and for whom needs special care
- Forming conscious investor and user in sector
- Gathering useful information for the army forces among IBs those are integrated.

Besides expectation of protection for the outside conditions, an IB has to obtain inside air quality and thermal, acoustic, visual comfort for the users. He states that in a modern building just by turning off the lighting and the heating in the rooms that no one uses, there could be %20 or %30 reducement in energy consumption (Okutan, 2001).

In the same way Utkutuğ, (2001) emphasizes that the internal comfort has to be altered according to the users quality and quantity. Due to increase in user comfort and security, the increase in life standard could be seen. By the help of building automation systems which is a qualification of IBs, energy saving could easily be obtained.

Flax (1991) also states the cost effective manner of the benefits. In his words, notable and major advantage of the IB is being done with one cable network for all systems. Thus there is a substantial reduction of the order of 15-20 % in the cost of initial installation. He points out that, all ongoing expenses (power, air conditioning, environmental controls, technology, costs, etc.); relocations costs (adds, moves, and changes) of individuals and services, or large group revisions; integration problems and their associated cost should be kept as low as possible.

As a result, in the line with these ideas, the benefits of an intelligent network system are:

- Lower installation cost of the building control subsystems
- Reduced churn operational costs
- Investment protection of interfacing future devices and
- Reduction of energy costs to operate the building. In today’s environment of reducing costs, one cabling system is the answer for the building network. (Flax, 1991)

In other approach; the IBs called as “learning buildings” and their key features can be listed as above;

Adaptability: ensuring the environment, both internal and external, can be configured and reconfigured to suit different building users, their changing needs, work processes and layouts.

Capability: providing the potential to introduce, replace and change building elements, services and systems throughout the user's occupancy of the building and the building's life.

Compatibility: ensuring that all aspects of the building are wholly coordinated and integrated, and none selected or installed without its influence upon, and influences from, all other elements being considered.

Controllability: providing users with the means to maximize their use and operation of the building, its services and facilities, while minimizing the conflicts between corporate values and individual values

Sustainability: to ensure that the building and its facilities as "assets" are operated and maintained to enhance individual and corporate productivity, health and well-being at all times throughout the entire life of the learning building (McGregor, 1994).

In Flax (1991)'s opinion, technology options and user requirements change continuously. So an IB network should bring flexibility and versatility to the project. The re-programmable and functionally distributed systems of IBs can be upgraded to meet changing requirements and minimise the need for costly structural modifications (Bernaden, and Neubaer, 1988).

Mill et al. (1988), suggest that, the healthy and acceptable limits of air quality, thermal quality, acoustic quality, or visual quality should be set for the central management and control system. However, there are no 'typical' users, activities, or exterior environments so code limits are not enough for all users. Nevertheless the typical user or typical activity should be defined as connected with the present codes and standards for approximately 80% of the occupancy. In fact, the building occupants can independently respond their thermal, air quality, acoustic, visual and special environments and can allow changes in an integrated fashion.

As Wyon (1987) mentioned, in ventilated computer floor systems, it's recommended to use auxiliary fans that will allow to alter the effective temperature of the micro-climate by ± 4°C without effecting the others in the room. In Mill, et al., (1988)'s words, occupants are complex sensors of environmental conditions, often severely affected by combined stressors - the 'sick building syndrome - which independently do not exceed acceptable limits. In addition to this, IBs can integrate different systems to each other, locate workstations practically anywhere, and can be flexibly accommodate technological developments of the building systems.

Bernaden and Neubaer (1988), presents the three benefits of Dynamic Control that depends on the building envelope, HVAC system characteristics and building location;

- Improved Energy Performance
- Improved Comfort Conditions
- Reduced Maintenance costs

IBs also increase worker productivity and on the contrary hold down the personnel costs. At the same time, while providing adequate comfort levels in buildings less energy is used, therefore more efficient building operations are achieved at less cost.

According to Duffy (1988), there are two important benefits for architects and clients. Firstly, they learned offices, which are built in different countries and they can compare them in terms of values held by the individuals and social structures. Secondly, architects and clients are understood the advantages of office buildings and how they are built, managed and serviced. Owner/developers obtain maximum benefits from IBs. The advanced information systems capabilities make it easier to lease IB space. Summing up, the IBs provide better conditions than the conventional buildings for consumers, service providers, manufacturers, and developers.

3.3.2 Problems of Intelligent Buildings

There are also some disadvantages of IBs. In contrast with the human centered idea, new building approach represents a technological base. The interdependence of building, information and communication systems cause some problems so some systems should take part in IBs. The automated systems, which are one of these systems, must facilitate the location and diagnosis of problems. Although this systems use for monitoring the work performance; they have some detrimental effect on the perceived quality of working life (QWL). However, in a situation such as these automated systems are not available or are not yet costs effective; manual systems should be preferred. The office systems as word processing, information management or communication; use for improving the productivity. While the computer programmers are the most important people to explain the new technology; end-users rarely part of the process used to select systems and they try to learn new systems, languages and technology (Atkin, 1988).

In IBs security systems, electronic tools, air-conditioning and cooling systems, audio-video systems are automated by software. Although computers bring a lot of innovations in our lives they may also cause to uncomfortable spaces. Lapsing software or virus problems may cause some dangerous problems such as; the heating system of your intelligent home may start in summer or you cannot go in your home because of a problem in security system. These potential drawbacks of IBs are thought provoking but the evolution of technological developments will solve these problems quickly (Netlife, 1995).

Okutan (2001) points out that especially in office buildings due to computer systems and communication systems needed, high amount of cabling installed, which make inconvenience. Thus extra payment has to be done for the raised floors as initial investment. He also emphasizes the social aspect of the IBs. In his words, because of the qualifications that make life easier, IB users don't need to be social in consideration with the rest of the people.

In Public Works Canada (PWC), the following problems have been found repeatedly in occupied buildings:

- Sensors not calibrated
- Line connections between sensors and central management not functioning.
- Central computer systems not installed or not operated as intended (lack of training).
- Local controls (for example, VAV dampers) not adjusted for the occupancy.
- Local sensors not corresponding with local controls due to frequent spatial /layout changes (Atkin, 1988).

Current centrally managed environmental control systems can't cope with the changeable building functions, activities and exterior environmental conditions. In PWC's opinion, the results of the long-term integrity of buildings are:

- moisture migration into the structure
- excessive energy consumption
- poor visual environment
- poor air quality and
- inadequate maintenance procedures and practices (Public Works Canada, 1981).

PWC maintains the view that one should acknowledge that;

- Buildings are not designed to adapt to human needs.
- People axe not adequately protected from visual discomfort, noise or from interior air pollution and electro-magnetic radiation.
- Human needs for privacy, variety, interaction and identity are not met.
- Buildings do not always contribute appropriately to the fabric of the surrounding community (Atkin, 1988).

An IB should provide flexibility and mobility to accommodate future change. While designing an IB, designers can encounter with the major technical problems but these should solved in terms of maintain the integrity of the project. These problems in project phasing are:

- Vertical distribution (risers).
    - Cooling
    - Heat
    - Plumbing.
    - Electrical.
    - Telecommunication.
    - Data network
    - Communications
- Horizontal distribution.
- Ceiling selection and design (McClelland, 1988).

Sick Building Illness: The IBs with intelligent environments are one of the results of the technological developments. Although people are becoming used to enjoying the heights of technological advance, there are some problems occurred, called as ‘sick’ building syndrome. In Powel’s (1990) opinion, especially in office buildings, people cannot put up with poor working situations. They want to control their lives, their environments and their futures. Actually, it is possible to design a building that can cope with the most commonly occurring situations, and that have the flexibility to respond to human needs by providing necessary controls during the inception of a building’s design. The health conditions of IBs divide into three part:

- building related illnesses,
- sick buildings syndrome and
- symptoms that related with them.

In these days a new definition “Building Related Occupant Complaint Syndrome (BROCS) can be used instead of these three subject (Öğütveren, 2000).

Razgat (1997) calls this syndrome “building illness syndrome” or “tight building syndrome” .In his opinion the complaints reduce while the workers statute increase and the workers that works with computer complains more than others. Monitors usually put on windows this situation causes brainfag because of reflection. The general sick building illnesses are; having headache, having concentration problems, to have difficulty in taking breathes, having the snuffles, etc. The studies on “sick building syndrome” cannot explain what the reason of this syndrome is; the physiological factors or other sicknesses results. The experts of occupation sicknesses states that the organisms, which live in heating and air conditioning systems, may cause big problems. IBs defined as the buildings that include carcinogenic components. In another approach, psychologists’ state that the workers complaints are not because of claustrophobiatic problems; these are only because of dissatisfaction on occupation.

- Social problems
- The protection, closeness apprehension and acrophobia problems in high raise buildings
- Psychological problems such as aggressive behaviours because of confined spaces

In Taner Öz's - who is the project manager of Nural Plaza - words, the role of architect while designing IB is to notice the density of people in spaces. In other words the architect shouldn't design crowded and obscure spaces and also take precautions for aggressive and harmful attitudes in details during the design stage. Except them there should be some technical precautions as listed below:

- Walls and indoor air should cleaned at least annually
- The ventilation system should provide the circulation of fresh air in building. Increasing this systems performance it should be cleaned and renovated.
- The rate of damp shouldn't more than 60%
- A dry and clean air filter should be used in ventilation system and it should frequently renewed
- The zone that taking from fresh air to inner space shouldn't be parking or loading area.
- The hardware should be placed in well ventilated spaces and users should obey producers directions
- Computers should cleaned semi-annually by hygienic computer and electronic cleaners (Öğütveren, 2000)

Razgat, (1997) adds to these precautions that;

- Illumination power of office buildings should be 500 luxuries.
- In air-conditioning buildings the boundary of air speed and the turbulence force of air are should be approximately 0.2 m/s. Otherwise there are some problems because of thermal ease such as rheumatism problems.

3.4. Measuring the Buildings Intelligence

In this chapter, the methodologies to measuring the level of intelligence will be examine. People have been trying to develop techniques for measuring the level of intelligence since the subject of IB is in our lives. The aim is that comparing buildings anywhere and determining which was the most IB. The "most" IB may be also "most" complex. Therefore, the maximum possible 'lQ' should be set at 200 to provide a readily understood measure. Harrison (1998) et al. states that the building IQ is an unfortunate borrowing from psychology because it brings with it assumptions about the fixed nature of intelligence. This intelligence would be distributed normally throughout the 'population' of buildings. How intelligence is measured is clearly dependent on how building intelligence is defined. He maintains the view that, while the early definitions of building intelligence were very technocentric; in other words a building with wide range of computer systems covering building automation, office automation and telecommunications; a rating method uses this definition would essentially consist of counting the computer systems.

IBs have demonstrated varying degrees of intelligence as well as success nevertheless there are no recipes for success. Intelligence of building depends on combining communication services, word processing centers, and other information technologies, which are in their early development, into package. Similarly many "shared tenant service (STS)" providers are still in an experimental stage of offering a mix of services without fully understanding the unique needs of each building. The existing projects can also upgraded by rewiring it and installing the communication systems and information technologies for shared use by the tenants. This type of project is called a retrofit and is considered to be more difficult to implement than new construction (Carlini, 1988).

Harrison, (1998) et. al. explains that the "building rating methodology" developed in Europe and it proposes a new rating approach to measuring building intelligence that has developed out of the IB Asia research and case studies. The rating process can form the basis of a computerized rating system, perhaps utilizing artificial intelligence. This would overcome many of the problems associated with a paper-based rating approach, which is only able to consider one variable at a time.

There have been most of rating methodologies such as (Harrison, et al, 1998):

- Orbit 2.1
- Building-in-use assessment
- ABSIC's total building performance evaluation tool and

- Building Research Establishment's environmental assessment method (BREEAM)

There are also new studies on rating methodology. One of them is the Carlini Building Intelligence Test that is created by James Carlini. This is one of the good examples of this approach that studied in 1985. This test focuses on measuring a building's IAQ (Intelligent Amenities Quotient) and rates the IBs from one to four. While Level 1 include energy management, HVAC elevators, life safety and security systems; in Level IV shared tenant services office automation, sophisticated voice and data communications added to Level 1. He designed the ITs portion of the test and J.M. "Jack" Fischer, Manager of Automated Systems for Urban Engineering developed the Mechanical, Electrical, & Automated systems portion. Together, they designed the test to consider all critical operations in an IB (Carlini, 1988).

The CBI test is divided into three parts: communication, information technologies, and building automation technologies. The intention of the test is to bring a more informed audience to the negotiations table than what has been the case in the past. It enhances the tenants' information base and provides a yardstick to measure areas that have been previously vague or non-existent. The test can also be viewed as a tool to the appraiser that is trying to evaluate a building and take into consideration these new intelligent amenities during the evaluation process. To the developer, the test provides a means of measuring the market to determine what services and amenities should be established to remain competitive with the surrounding developments (Carlini, 1988).

According to Carlini (1988) office building intelligence can be divided into one of five categories depending on the level of intelligent amenities present in a building. While individuals view the Level 1 capability as a basic requirement, the higher levels are not currently understood and appreciated by them. In other words, as the level of building intelligence increases, the awareness and acceptance decreases from all of their perspectives. While the buildings that at Level 1 called as "Frankenstein", at Level 4 they called as "Einstein". The "Einsteins" separated from "Frankensteins" by giving a numerical score for each building so that there is an objective way to differentiate buildings. The use of those scores can help everyone understand the market, the pricing of leases, and the differences between intelligent and not-so-IBs without having to be an engineer or a computer scientist.

In addition to that David Boyd and Ljubomir Jankovic attempted to produce an lQ rating system evaluating a combination of individual user needs, organization/owner needs and local and global environmental needs at the Intelligent Building Research Group, Birmingham Polytechnic in 1992 (Harrison, et al, 1998).

In Harrison et al. (1998)'s opinion there are advantages and disadvantages of the rating methodology. These advantages are;

- The rating process helps building users to ask sensible questions about their buildings and information technology and assess their building stock by determining which buildings best suit their needs, which may be refurbished to bring them up to a suitable level and which should be disposed of at the earliest opportunity
- It can identify the organizational requirements that will have an impact on the provision of an IB.
- It can be used to produce a database of building shells, which will help in the comparison of buildings on a regional, national, or international level.
- The values and weighting systems which are part of the rating system can be varied through continuing experience and in the light of additional research data, to reflect changing expectations and requirements.

In contrast with them the development of any rating methodology is fraught with problems and this brings mind some questions such as (Harrison, et al, 1998):

- How valid is the methodology?
- Does it measure what it is supposed to measure?
- Will the same building evaluated by two different people receive the same rating?
- What is considered good practice may also change over time and rating values must be updated periodically to take account of this.

An IB offers following individuals more than a conventional building (Carlini, 1988):

- Developer /Owner

- Financier/Appraiser
- Leasing Agent
- Facilities Manager
- Tenant

These individuals must have a good understanding of IBs in order to evaluate the "shared tenant services (STS)" offered in various buildings. Each individual's perspective can be analysed as:

- **Developers/owner's perspective:** Developers/owners, should be able to measure the surrounding competitive buildings to determine what services should be provided in the building to attract and maintain tenants. In some cases, developers have implemented too many services or the wrong mix of services and have not generated the anticipated revenues that were initially expected. (Carlini, 1988)
- **Financier's/Appraisers perspective:** The financial organizations have the greatest amount invested in the actual building so that the financier's perspective is critical. These organisations are not focusing on the critical issues of applying communication and ITs that affect value in newly constructed and retrofitted IBs. If appraisers use the standard income approach in establishing value in a property appraisal, they should include the revenues generated by the IB services and any rooftop communications revenues that the property generates. By including this income stream in the appraisal, the intelligent amenities along with the rooftop revenues will change the whole evaluation of a property. As more and more financial institutions become comfortable with this expanded approach, the developer that is shopping for capital will have to compete with those developers that include these new revenue streams on development projects that potentially reduce the risk of the lender and creates a "safer" project to invest in (Carlini, 1988).
- **Leasing agent's perspective:** The leasing agent's perspectives on measuring IBs are ones that have to expand their understanding of the terminology as well as the comparison of different IBs for prospective tenants. If leasing agents do not understand the additional benefits afforded to a tenant in an IB, they will not

be able to provide good service in helping the tenant select the best office space suited for the tenant's individualized needs. The leasing agent must become comfortable in analysing a whole new set of amenities as well as being able to differentiate the services provided by one IB from another. In today's market, the leasing agent is not exploring the advantages and selling points of intelligent amenities to their fullest extent (Carlini, 1988).

- **Tenants' perspective:** In any office building market, the tenants' perspectives focus on critical elements that attract them to certain buildings. All tenants looking for space focus on certain minimal amenities including (Carlini, 1988):

    - Location
    - Heating, Ventilation and Air Conditioning (HVAC)
    - Security
    - Parking
    - Building Maintenance (Janitorial) Services
    - Elevator Service (in major office buildings)

Tenants need high level of service as well as the high level of comfort in an office setting. They also need support in putting together the right mix of communications and ITs to allow their businesses to maintain a competitive edge. In the line with that the overall quality of a building and its property must be evaluated with an analysis that includes these new systems and technologies. There are other factors that are considered in the decision-making process that already have a high-level of awareness including location, comfort, and others that vary greatly with the organization and its individual preference. The ability to objectively compare buildings and their intelligent amenities through a comprehensive test that measures the amount of services and systems present in a building has become significant in this decision-making process (Carlini, 1988).

According to Carlini (1988) the tenant, as well as the appraiser, must also consider factors that include energy costs per square foot per year, service costs for long distance calls per minute and other service costs for comparisons of different building as well as outside versus in-house services. As the test results would support, label of "IB" does not mean the least expensive or the most expensive building to operate. It designates that certain services and technologies are available for the tenant. The tenants must decide whether or not those services fit the needs of their businesses. The mere fact of having these intelligent amenities in a building does not discount the importance of the tenant understanding and taking into account the price performance of services in a smart building. The needs of office building tenants, who are really providers of products and services themselves, are being shaped by domestic and as well as international pressures to be more competitive and to maintain high quality standards. The shift in needs has created a new dimension in applying communication and ITs at a building level rather than an individual tenant level to realize the economies of scale (Carlini, 1988).

Carlini (1988) also points out that, state-of-the-art tenant needs will not be satisfied by turn-of-the-century building amenities. Comparing the new and existing buildings and their amenities in both stable and overbuilt markets will become critical to owner, leasing agent and tenant as well as to the financial institutions that have major interests in these development projects. Being able to measure building IQ in order ask and answer the question “How smart a building do you have?” is as easy as “How much space to you want to lease? will give everyone working with real estate a much higher comfort level in both selling and leasing high tech office space.

Chapter 4

CASE STUDIES

In order to reach the objectives of this thesis, some cases are selected to investigate. Investigation of examples is carries out in two parts. In the first part, the selected IBs are analysed in terms of their architectural and systemic properties. On site visits, interviews and literature surveys are used for this purpose. In the second part, semi-structured face-to-face interviews with designers were conducted about their experiences and concepts of IBs. Interviews are done by a questionnaire, and recorded by a tape. In order to select examples of IBs in Turkey, a through literature review and a selective market search has been conducted. Then both residential and commercial IBs are selected on terms of accessibility of their architects and projects. Total of eight architects and two engineers are participated to the study. The selected buildings and people who is interviewed are as listed below.

- **Metrocity Millenium Towers** Doğan Tekeli, Architect
- **Polat Tower Residence** Cüneyt Çömez, Electronical Engineer
- **Sabancı Towers** Haluk Tümay, Architect
- **Sabah Foundations** Mehmet Konuralp, Architect
- **Arkas Office Building** Ahmet Yağcıoğlu, Architect
- **Aqua Manors Housing** Tolga Bıyıklıoğlu, Architect
- **Flora Digital Houses** Bülent Onur, Architect
- **Hotel Aktif** Ertan Anıl, Architect
- **Polat Residence** Halit Yüce, Architect

Furthermore, the seminar, whose topic was " Software, Hardware (Equipment) and Digital Life", was carried out with the participation of Microsoft, Arçelik, Compaq, Vestel, Sentim and Teba companies. Information about the benefits and problems brought into our lives by intelligent equipments such as intelligent oven and laptop and the role of architect in making a building intelligent, was taken from this seminar.

4.1. The Intelligent Building Examples from Turkey

In this part of the chapter 4, the selected IB examples will be analysed in terms of their architectural and technical properties by the way of site visits, interviews and literature surveys.

4.1.1. METROCITY MILLENIUM TOWERS – DOĞAN TEKELİ

Architectural Project	Doğan Tekeli
Decoration	Antony Belluschi Architects LTD
Contractor	Gümüşsuyu-Bisaş Partnership & Yüksel Construction Investment
Contractor Firm	Metrosite Construction Consultant Service Company
Statics	Balkar Engineering

Fast changing life conditions bring up the new life styles and change priorities. The priority given to business life cannot be abandoned, so the connection problems of new business settlings out of the city zone with the city bring up new solutions to be searched. Here the "Metrocity Residence and Business Center Project" has an atmosphere like a self-city. This project is designed to prove that maximum comfort and liveable environments could be obtained in the city center, so the city can gain a different life style.

At the end of 1997 the building foundations have been erected and at the end of 1999 structure of the building has been completed. This building stands the on the junction of Zincirlikuyu and Levent on Büyükdere Main Road. Metrocity consists of two towers named as Star Towers and Moon Towers, both has 27 storeys of residence functions and a tower of 24-storey office function. In towers there are 189 flats, which have the sightseeing of İstanbul and Bosphorus. The flats are designed between 121 and 372 m^2 and there are six alternatives between studio and double flats. The building has the dispersion of m^2 below:

- Office Area: 16.500 m^2
- Residence Area: 46.500 m^2

- Shopping Center Area: 52.000 m^2
- Car Park Area: 85.000 m^2
- Social Foundation and Sport Areas: 10.000 m^2

DESIGN: Metrocity Residence is a product of a great engineering work besides architecture and at the first sight the project attracts attention with the used materials' quality, then with importance the sensor systems, security cameras, alarm systems, ventilation systems offer a different space quality. Comfort became to be the first input in design of these kinds of buildings and according to the user demands flexible solutions are searched for spaces that would be created inside and outside the residences.

STATIC: Metrocity Residence and Business Center Project, with all its special characteristics shows a serious example of engineering work. The construction has been made on a rock formation ground, by means of 1st degree seismic zone calculations and the static construction project is designed to be bearing a 9-intensity earthquake by Balkar Engineering. About seismic subjects, all instructions including the ones in USA have been examined and in these buildings the structural system solutions have been anticipated according to the ANSI, ACI 318 and UBC seismic standards. In this project for construction period and the materials that would be used, an effective supervision system has been carried out, ready-made concrete with BS 35 resistance class has been used and in production concrete has been controlled with samples and tested for endurance from the start out of the concrete central until it is moulded. These tests have been made under supervision of the project representatives in the ready-made concrete establishment's laboratory.

INFRASTRUCTURE AND SYSTEMS: Metrocity project has many technological infrastructures and new technology products in its constitution. Although most used systems which are new for our country could face up adaptation problems, for all products a usage guide with 300 pages, which tells how to use, is planned to be given to the residence owners.

Inside residences, by applying Internet and computer technologies' help, home theatre infrastructure, digital television connection, Internet and data line connections are supplied and all communications with the outer world have been prepared. Besides a carbon-pollen filtered central ventilation system which filters the dirty air twice and then takes in is used and VRV system which can any spaces in difference cools or warms and offers energy economy is installed. In company with these, like electric interruptions, cooling, problems have been overtaken by generators which could afford all electricity need. In addition by means of UV filtered windows, which can be, opened the syndromes - fear of being airless, headache, adaptation problems etc.- that can be faced in many-storey buildings have been also overtaken.

In the project one of the most important cases is security. In Metrocity, which is equipped with the latest technology of security systems, to get from car parks to the flats, in the entrance lobby there is an obligatory elevator exchange and a special security cart system application is proposed. Near the entrance doors of the flats there are visual phones and controlled security alarms. In addition, with the security cams in the entrance lobbies, floor halls and elevators visual connections can be established between security department and reception. Besides as an elevator system, which the elevators can go to the nearest floor and open doors in a probable earthquake, was chosen.

With importance, against the danger of fire in many-storey buildings intelligent precautions were considered and materials with higher fire resistance were used. In all flats, floor halls, elevator cabins there are fire detectors. In a fire case automatic extinguish systems come up in turn and people can take out by the help of guides. In these kinds of buildings, which have a large number of user capacities, for the inhabitants there is a 24 hours service of doctor and ambulance, and a first aid service and an elevator for stretcher transport is ready for emergency conditions.

SOCIAL LIFE: As an addition, Metrocity Millennium Residences can offer the inhabitants an environment which they can spend time with pleasure outside their homes. The inhabitants who feel suffocated because of all day's hard working rush and traffic can relax in the swimming pool which is in summer open and in winter closed and heated and other facilities like sauna, solarium, squash, fitness center and massage saloons, also people can make sports in the basketball field, open and closed tennis courts and skate area. Besides there exists a 6000 square meter green area with tracks for resting, strolling and jogging, and the area is designed to offer a feeling of living away from the city center.

In Metrocity Shopping Center there are 250 shops, 5 cinemas with DTS Surround System, a concert and conference hall for 150 people, in the center a space for fast food and from dry-cleaning services to the post office any facilities that can be needed exist. Besides Metrocity Millennium has a car park with 5 storeys and 2360 vehicle capacity.

COST: The building, which is formed with a cost of 180 million dollars by Yüksel Construction Investment, has the gross sale price for a square meter between 2 thousand 3 thousand dollars. Flat prices change between 290 thousand and 1 million 75 thousand dollars according to the position of the flat, sightseeing and height. The shopping center building has a total price as 40 million dollars. For Turkey purchase and investment values are very high and for these buildings to be accepted the invested values must pay off themselves in time and the process must be evaluated well.

ADDITIONAL SYSTEMS AND SERVICES: To summarize, we can put down the innovations and advantages that Metrocity has brought up in our lives in line:

- Instant access to all meteorological information.
- Sound or visual connection with security and reception.
- In need sound connection with doctors and nurses.
- Infrastructure of home theatre.
- Connections of digital televisions.
- Internet and data lines.
- Generator system in need of electric interruptions.
- With VRV system distinct cooling or warming for spaces.
- Central Ventilation with Carbon-pollen filter.
- Openable UV filtered windows.
- In summer open, in winter closed and heated swimming pool. From the flats direct access to the pool.
- Open and closed tennis courts.

- Sport facilities consisting of fitness saloon, solarium, sauna and steam rooms.
- Concert and conference hall for 150 people.
- Five cinemas with DTS Surround System.
- Shopping center, from post office to dry-cleaning any facilities that can be needed.
- 6000 square meters green area with tracks for resting, strolling and jogging.
- Car park with 2300 vehicle capacity.
- Controlled security alarm at the flat door.
- 24 hours security and reception service.
- 24 hours doctor and ambulance service.
- In all floors and elevator cabins security cameras.
- In all flats, floor halls and elevator cabins fire alarm detectors and automatic extinguish systems.
- Structural system solutions according to ANSI, ACI318 and UBC seismic standards.
- Seismic sensitive elevator system.
- In all flats direct elevator connected, ventilated, having special security system warehouse rooms.

Metrocity Residence and Business Center Project with the integration of automation systems, high quality material use and intelligent house objects created "user friend" or "equipped/qualified" spaces and didn't avoid from any cost to reveal this. With these, Metrocity especially became to be a building, which is made intelligent by engineers with a "trend" worry. Although existence of architect is reflected to the project by the well-proposed requirements programme, qualified space design, the chosen materials and the technical details, which are solved according to the aesthetic needs. By this meaning Metrocity Millennium Towers is a work, which needs appreciation about the courage of taking a step into the innovative concepts in Turkey.

4.1.2. POLAT TOWER RESIDENCE

Architectural project	Polat Construction
Static	ERALKO
Automation Systems	Honeywell
Electrical Project	Ünlü Engineering
HVAC System	Rentaş

Considered as the most smart complex of the world, Polat Tower Residence is the tallest building in Europe as a residence and as a construction second tallest building of Turkey following İş Bankası Towers with its 152,10 m height. 42 storeys Polat Tower residence, which was constructed as a smart building by an expense of 4 million dollar, foundations were laid 2 years and 9 months ago. The building, which totally has 400 flats include 396 studio flats and a helicopter deck in its 33 stories above ground.

STATIC: Polat Tower has 4-meter thick foundation raft on the steadiest rock locating between Mecidiyeköy and Beşiktaş. It is a 15.000 ton huge mass consisted of 800 full mixer load of concrete and approximately 800 tons of iron.

INFRASTRUCTURE AND SYSTEMS: 31500 points of Polat Residence is controlled by automation systems. In the point of view of Namık Ünlü, author of the project the number of those points indicates the level of the smartness of the building. For instance, owing to this system, any breakdown in the plumbing system, which might be occurring in a flat would be noticed by the main computer via smart chips. The technical team without any request from the householder could solve the problem.

For the transmission of high voltage, the Busbar system, which is consisting of small modules joining each other, was used. Owing to this system, in every case of problem, for example in a state of a probable earthquake the module would break off and the electricity would cut off.

The building has two transformers, which is 1600 KWA. Besides, Polat Residence has three generators, one for stores (1600 KWA), two for flats (2 * 2200 KWA) in order to maintain electricity in the case of a probable shortage. Furthermore, the building is supported by a 150 KWA ups system to prevent loss of data in computers during possible short shortages. In addition, there are some smart counters working integrally with the electronic system of the building, which control the electricity consumption of each flat. No one may come across to payment caused by the consumption of generator's electricity when they are not at home, because these counters are able to distinguish the utilization of local electricity and generator.

CLIMATIZATION: The building is rigged with a heat-pumped, water circulated, fan-coil ending and thermostat controlled cooling system and central heating installation with thermostatic valve system, in addition there exist a ventilation system specifically in each flat.

Furthermore, the fresh air and exhaust system was installed to recycle heat. The working principle of this system is transporting fresh air inwards, from inside the filthy air being ejected like capillary vessels in order to gain heat saving during the process of putting out the filthy air and taking in fresh air. By this system, for example during cold seasons, cold air encounter with warm air being put out and then cold air get in warmer. This system may be considered vice versa during hot seasons. That's how it provides high rate heat gain.

The climatization system may be programmed however required. As well as a certain degree of heat could be maintained it may be programmed to diverse degrees during the day. There are three different climatization programmes for flats.

- Economical mode: This mode controls the determined heat at +2 degree level.
- Stand-by mode: This mode works close to economical mode and controls at +6 degree level. This system, usually used when leaving house in short terms cut off water and electricity except for the equipments which should be keep on working like fridge and aquarium.
- Off mode: This mode cut off all electrical, heat and water systems. Thus householders pay nothing when they are out. However in order not to freeze building systems during very cold weather, this security system warm up the flats with very little values.

Householders may also prepare their own programmes. Besides, as well as the general climatization system, they may use the chiller climatization system designed specifically for each flat.

There are four, 1.100.000 kcal. smart boilers are working synchronous in Polat Residence. They determine their working level automatically as to the need of usage thus they provide energy saving.

SECURITY: Polat Tower is rigged with strict security precautions. The building is installed with alarm systems providing external door security in all flats and some cameras for strategic points of the Tower. Furthermore the car park entrance cards are put not on the front glass of the car but below the car in order to hide the addresses.

ELEVATORS: There are seven UPS supported elevators whose speed are 2,5 m/s. They work as to the usage manner due to the installed automation system. For example, the elevator system would notice automatically a householder who waits on 20^{th} floor for an elevator every morning at 07:00 am then would be ready for that person following mornings. Due to this statistics stored in data bank, elevators would be guided to the most visited floors in a case of emergency to accelerate the emptying process of the building. Owing to the weight-controlled system the elevators would reach first station without stopping on other floors unless they are empty in order to save time. In the case of pressing wrong button it would be possible to cancel it that is also an important feature for time saving. While six of the elevators are using by householders, one is using for emergency.

FIRE: Polat Tower Residence has an analogue fire alarm system related with the building automation system. There are fire sensor and automatic fire extinguisher in each flat. In the moment that a warning is noticed, automation system runs miscellaneous scenarios. Firstly the flat would inform by speakers. Secondly the most suitable plan in that situation would be chosen automatically and would be run by the automation system and security would be obtained. Besides, for car park areas, for corridors and in kitchens sprinkler are installed. There are also one elevator including a separation with positive pressure against haze, two fire exit stairs and 2000ton water depot.

EARTHQUAKE: Polat Tower was designed in order to resist even to severe earthquakes respect to its location and architectural construction. Earthquakes would be perceived before it occurs due to the receptors locating in the foundation and inside of the building. In that moment the automation system would set the electricity, gas and water systems to a safe level and warn people in order to keep them awake during earthquake by speakers in flats. Furthermore it measures small earthquakes that could not be noticed by people and reactions of the building against such earthquakes in order to make possible to evaluate or foresee building's reactions against bigger ones.

WATER: Polat Tower has 2500 m3 water tank which would be sufficient for about 1,5 month. Water level is observed by electronic system. The computers arrange all controls and fillings without any interference. Water cycling in the building is also observed electronically and in the case of a problem in cycling computer system would inform technical service automatically. Water in the building is well purified cleaned from chlorine and microorganisms.

In addition, there is exchanger system that provides hot water specifically for each flat supported by boiler system. Hot water get in the flat when the flat is used or when it is programmed to keep warm otherwise it would be directly guided to the flat where it is needed. Hot water warms the water inside while cycling in the house. Thus even it leaves, the house keep heat like a thermos. There are also calorimeter in the entrance of the flats that makes possible to calculate the temperature difference between the entrance and the sortie of the water and it is paid just as much as it warmed up.

COMMUNITY CENTER: Polat Tower Residence has a shopping center in order to provide fast service to the householders' needs. There are 34 shops and 3 cinemas with capacities of 125, 115, and 27 people each.

CAR PARK: The capacity of Polat Tower's car park is 650 cars. Every householders have a special card which provides time saving because it prevents waiting in the entrances of car parks. This system is also known as automatic passing* system. In addition to this, necessary payments are made automatically.

Technical features of the studio flats may be enumerated like the list below:

- The flats may be managed according to several programs by excel 150.
- All the equipments in the flat are remote controlled.
- Doors are open with access card.
- While entering to the flat with access card electricity, water, gas, and heating systems are run automatically to set required level.
- In the case of a breakdown, fixing can be made outside of the flat without getting inside.
- All systems in the building inform electronically central system about their working conditions. Thus system guides automatically technical service in the case of failure to the problem area.
- Besides electronic controls, these systems are supported with mechanical controls in order to reach maximum level in security and working performance.
- The probable risk, which may be originated from a failure in electronic system, would be prevented via mechanical and analogues controls and required security level would be obtained.
- Corridor's lamps work related to access cards and elevators. While entering to the flats or going out they would be on for a while. Thus shared consumption costs would be minimum.
- Garbage is stored in deep freeze depot in order to obtain hygiene afterwards they are discharged.
- All flats have sound isolation.

As a conclusion, Polat Tower Residence is the newest smart building of Turkey with its technological infrastructure and other features mentioned above. These apartments, addressing likely people with high income, will serve more than user expectations with their design and comfort.

4.1.3. SABANCI CENTER – KORAY CONSTRUCTION CO.

Architectural project	Haluk Tümay & Ayhan Böke
Main contractor	Koray Construction
Interior space design	Swanke Hayden Connell Architects N.Y.

Sabancı Center is a giant office complex, which is located at the junction point of Büyükdere Avenue and Fatih Sultan Mehmet Bridge highways. Center itself, on 20.475 m^2 it occupies 107.000 m^2 construction space. It has two towers in which Akbank and Sabancı Holding reside. Tower is 157.32 m high which is the first tall building and the most IB when its finished in its region. Besides towers, the center has two separate blocks, which occupies the department store and lecture rooms. It also has 5-floor basement, which includes car park for 600 cars, installation and HVAC spaces, a cafeteria and computer center. The center finished in 1993 with so many changes during construction process. Those unexpected expenditures initial investment cost by 38.000.000 $.

DESIGN: Koray Construction project manager Haluk Tümay points out that they cooperate with the people who are specialists in their areas. Tümay explains that the proposals with the capacity and management costs and initial installation costs for the preliminary design are taken and compared from different firms. Due to program needs the firm with the best proposal is been approved. Such as curtain wall system is selected like this and semi panel system put into practise that is very first seen in Turkey. The systems that will put into the project, are chosen according to statistical and environmental condition, user needs and building function. By this way the cost increase is obstructed.

STRUCTURAL DESIGN: As building construction system; according to the high cost of the steel construction that is exported, reinforced concrete skeleton system is preferred. In foundation system raft foundation is used. The statistical measurements are done for the earthquake and they are controlled to a German firm in Frankfurt, which makes the structural designs of the high-rise buildings.

ELEVATOR SYSTEM: High technology elevator system put into building, which is programmed according to the rush hours and daily user movements. Results of the measurements show that the rush hour is not the morning as everyone guessed, on the contrary it is the afternoon that everyone goes out to have lunch. The capacity and the speed of the elevator is determined by this way.

INFRASTRUCTURE: Sabancı Center is adaptable with the developing technology that makes the building flexible. All the sections in the building are managed by one center dominated with computer systems. Building uses the last technology building automation system in the period that it was constructed. This system is conceived to bring together all the other complicated systems to work separately and also to work as one system when needed. This cooperation among systems makes the building more effective. The technical features of project can be listed as below (İş-Alışveriş Merkezleri, 1994):

- A total of 24 elevators in the towers, including two fire and eight express elevators
- A fire warning, prevention, and intervention system that is compliance with international standards
- An energy distribution system which permits flexible office set - up and design
- Electrically commanded and controlled air-conditioning, and elevators
- Electronic security and prevention systems that meet international standards
- Modern, computer-aided building management
- Centralized clock system
- Card-controlled entrance and exit system
- Sound, music, and individual location public address system
- Inter floor document delivery via pneumatic tubes
- Satellite and radio broadcasting

- Computer-controlled maintenance and repair
- Economic energy use

In conclusion, Sabancı Center is a building that uses the new technologies. Although the building has a serious security system, assassination happened in the building had negatively effected the reliance on these kinds of systems. Automation systems firm specialists explain that the system at least has to obstruct suspicious people before they went out. Project manager Haluk Tümay points out that the system is capable to determine those people in order to catch them soon. This center is a distinct example of the human made automation systems can be defeated by human intelligence. Nevertheless Sabancı Center is one of the forthcoming buildings of Turkey with the technical systems it includes and the comfort and easiness it obtains.

4.1.4. SABAH FOUNDATIONS- MEHMET KONURALP

Architectural Project	Mehmet Konuralp
Static Project	Hasan Karataş
Installation & Ventilation Project	Zeki Aksu, Elmak A.Ş.
Electricity Project	İnterim A.Ş.
Infrastructure Project	Ahmet Alphan

In the last few years the developments in the newspaper companies are happening in a parallel aspect with the developments in the communication technologies like computer use or satellite systems. Today in many subjects, organizations are made for the needs of technology instead of the needs of people, because of this new approach new organizational and spatial criteria are needed .Yet when we think about the press functions, people (the journalists) are very important to collect the news and interpret them as well. At this point, for the success of the product, the coordination between men and technology has an important role. The architects of today are trying to learn and apply all these technological developments to their designs while searching for the best spatial quality (Konuralp, 1992).

Sabah Company had been a small company, which had a circulation of 100.000 newspapers when the foundation was in Mecidiyeköy. After the increase in the circulation of the paper, the company members decided to enlarge the facilities, so they made the decision of the construction of the new SABAH building in February 1987.

ARCHITECTURAL DESIGN: The building programmed as a four-storey building with a base of 27x108 m. The main concept of the design had been to integrate the main function in the building, which was to produce the newspaper. The main criteria of this design can be given as below (Konuralp, 1994):

- To optimise the needs in the design; the circulations of the material income-production- newspaper distribution & the circulation of all the employees in the building (hierarchically) and their social and psychological needs.
- To solve the traffic problem caused by the distribution of papers, storage of paper and the transportation of the personnel.

- To avoid the noise caused by the press machines by insulation within the small building area.
- To obtain temporary/permanent building technology in the press hall (aisle) for not to break the continuity of the press function while construction.
- To unite the contemporary working atmosphere with the new opportunities in communication facilities. Also to harmonize the traditional habits of press ethic with the modern space understanding.
- To show the press function to people rather then the company staff, so the press function becomes a visual show equipment by the designer.

PLAN-SECTION ANALYSES: Flexibility had been the most important criteria at the design of the working spaces. Working units has the chance of enlarging with the modular furniture units. Because of its function, this building had to be designed as a dynamic and changeable one, so the modulation of the infrastructure and working stations became a necessity. 60x60 cm grounding panels are modular and each one reaches the infrastructure system. Grounding panel holders are placed over the main structure system, so ground and ceiling becomes total. The ceiling is also made of 40x40cm modular system elements, which covers up the fire detectors and the lighting system, so another suspended ceiling wasn't needed. According to this modular system the structural coffered slab panels are made in 9m axes. Also in west and east side axes there are three technical shafts (9x9m axis) and all the technical functions and vertical circulation in the building are solved in these shafts. All shafts reach the ground level to solve the personnel circulation and also the fire exits (Konuralp, 1994).

STRUCTURAL SYSTEM: Konuralp (1992) summarizes the facts, which forms the structural system as below:

- Machinery gap to determine the kind of the space frame is 18m.
- Modular optimisation of the open office spaces, determination of the division factors- column axes.
- Modular optimisation of the covering, façade, material measures, determination of the measures of the coffered slabs panels.

9x9m grid system, 60x60 cm coffered slab flooring system creates the main structure of the building. Modular system causes economic construction and fast production because of the block uses. So even in finishing works, material standardization can be done. Structural element measures are determined by the same standardization principal rather than deciding the economic section. The column sizes are determined to be 90x90 cm. The north and south façades are covered with large glass panels and the panels are carried by 4x1.8m sized space frame system, which was measured by the optimisation of the wind effects (Konuralp, 1992). 1600m^2 net open space is covered by 18m sized, 150x150 cm modular space frame in this construction (Konuralp, 1994).

MECHANICAL INSTALLATION AND HVAC SYSTEM: Konuralp (1992) solved the HVAC systems as two separate systems:

1. In the basement the raised floor systems aren't used, so classical climatization center is used.
2. In ground and other floors HVAC systems are mostly placed in the shafts and also in the Hiross type HVAC centers which are placed in between 8th and 12th axes. The exhaust channels are placed in the raised floor and they reach the roof exhaust systems to clean the air in the building. The climatization system in the press hall is different than the rest parts. In the press hall the dust of paper and the vapour of ink should be removed from the place while preventing the air circulation between the press hall and the other units. Therefore, many climatization systems had to be used in the same building. Konuralp (1992), tells the advantages of this multi-use as:
   - Each center serves according to the needs of its part.
   - In a situation of a breakdown, the problem wouldn't affect the whole building.
   - According to central system, this system can be solved with smaller air channel sections.
   - By using shorter channels, ventilation flaps and thermostats can be controlled easily.

FIRE PRECAUTIONARIES: Fire precautionary of this building can be categorized as three main precautions (Konuralp, 1992):

1. Fire realizations and put out: Fire realization and fire detectors do reaction.

- The addressed detectors, which are placed in between the flooring system (in plenum), alarm the fire.
- In open spaces, there is heat and smoke detectors that hang down in coffered slab flooring. These also placed to alarm the fire in the open offices.
- There are also stored fires equipments in the shafts like hose cupboards helon tubes and pressured water systems.

2. Smoke evacuation: The atriums in the building allow the smoke coming from the levels to reach the roof like chimney. By this way the smoke reaching the roof spreads through the 150cm space frame beam and this section becomes a smoke reservoir, and smoke will be throw out by exhaust ventilation flaps located in the space frames.

3. Fire exits: There are fire exit stairs in the 6 different shafts of the building that gives you the chance of running away in any direction. All fire exits are opened directly to outer spaces by automatic system doors in the ground level.

LIGHTING: In this project, after the feasibility of daylight and artificial lighting systems are made, Glaverber, Belgium product 6/12/6 double-glazing is used. Konuralp (1994) designed open plan organizations in his project and to avoid the dark and small spaces, he designed the spaces in between the shafts as atriums (open spaces). There are 9x18m and 6x6 m sized roof openings over the middle atrium and office units at the top levels. By this solution, the negative effects over the employees are tried to be removed. Also, the transparent covering of the south façade takes the daylight inside the building through the hallway. The artificial lighting of this project can be examined in three parts (Konuralp, 1992):

- In the lighting of the working areas, the reflectors that are designed by ERCO Company with a cutting angle of 40 degrees are placed in the 60x60-coffered slab; so maximum visual comfort was obtained and the brightness of the computer screens was minimized. 25 armatures are placed in each 9x9 m axes and 350-lux lighting surface is obtained. The adjustment of lighting inside the building is done by the help of the addressed dimmer switchboards, which are placed in the shafts, according to the changing daylight during the day.

- For the lighting of the machinery hall (18x36m sized 16m high), 36 daylight colour, 70W ultra violet filtered hanging armatures are used.
- For the lighting of the Atrium and galleries (9x18 m sized), three phased rail systems are used which were placed over the space frame system.

NOISE CONTROL: One of the basic criteria of this design; "to show the original work in the machinery halls" caused some problems. The transparent wall that would also give the visual effect should avoid the noise of 120 db. at least (Konuralp, 1994).

FAÇADE CARVING SYSTEMS: Entire façade facing elements are covered with silicone filters, so the permeability of heat, water and voice is minimized too. The material used for the façade covering is ASTRAWALL 50 mm. (Konuralp, 1992).

SOCIAL ACTIVITY CENTERS: Sabah Foundations are located far from the center of the city, so the foundations are designed in order to serve all the employees in every respect. There are two dining saloons, a cafeteria and a bakery. Also a swimming pool, cinema saloon, a coiffeur, a health unit and many WC-bath-locker units are designed for this project (Konuralp, 1994).

Finally, we can say that this building was a contemporary example in the construction sector of Turkey, considering its construction system and program at the time it was built. Doğan Kuban says, "There is a logical function scheme in this building. And among the office buildings built in the last few years, Sabah Plaza gives its brief message without any difficulties." He also said that the building both pleases the ones inside (employees) and outside (the visitors) of it. He tells his ideas about the designer of the building, Konuralp as "He tries more than searching for the new and tries to give a new message in his each design. Which is a contemporary trend in modernist tradition of the architectural idea."

Yet, Engin Yenal thinks that the similar point in the projects of Konuralp is as; (Arredamento/11-'91)

> Functional organizations work well in the designs of Konuralp and contemporary technology and aesthetics are used logically and interpreted well before showing as a product."

This building is more intelligent than many of the buildings called as "intelligent" buildings in the last two years, with its new technology use, trendy materials and flexible details (that gives the chance of being comfortable in the building for the employees) (Arredamento/11-'91).

4.1.5. ARKAS OFFICE BUILDING - AHMET YAĞCIOĞLU

Project	Ahmet Yağcıoğlu & Partner **Electricity**
Installation Project	Namık Onmuş / Onmuş Energy
Installation	Genta
Elevators	Kone
Curtain Wall	Metal Construction

One of the examples of the IBs that we particularly see in İstanbul is being constructed also in İzmir. Although the architectural designer of the project, Ahmet Yağcıoğlu speaks that his building is not intelligent, the building owns the special features that the buildings in our country named as "intelligent" own.

DESIGN: İzmir Alsancak Harbour District, the building's foundations which is located parallel to the viaducts has been erected under another project's range, and this circumstance offers an approach of study about "making an existing building intelligent". In the design of buildings existed some forcing factors. These are:

- properties that the site has (loud noise because of viaducts)
- the restrictions brought up by the public improvement rules (template)
- the restrictions that come into existence by the obligation of assembling accommodation with the existing structural system (column axis)
- the restrictions come up with the requests of the property owner (not to compensate about storey number)

PLAN-SECTION ANALYSIS: Because of the restrictions that the Public Improvements Instructions bring up and the non-compensation of the property owner about storey numbers, under beams 245cm, from floor to floor 295cm remaining floor height led the design to have a raised floor application. The floor height, 9cm by floor applications and 4cm by suspended ceiling applications, is reduced to 232cm and the space which is proposed to be designed as open offices become darker and lower. At this point, some researches have been made and instead of raised floor canal system is applied. Canals are placed according to the modulated settling plan. The cables for the communication and computer systems, which are necessary for offices pass through these canals and in certain points they lead out and these cables are gathered in a certain switchboard. The electricity, fax or computer cables can be transported to a required point by the switchboard.

FLEXIBILITY: Ahmet Yağcıoğlu, architect, stated that making changes in buildings in respect of the functions or needs is not simple and he faced these kinds of problems in his buildings. The cable systems and ventilating systems which have been designed according to the open office systems, needed to be organized again because of the demand of interval partitions requested by property owner. The disharmony of the partition components an suspended ceiling grids and the difference between necessary light, ventilation levels of partitions and open spaces brought up new arrangements. For example outlets of applied ventilation / climatization system VRH/HRV has been arranged again.

MECHANICAL INSTALLATION-VENTILATION: When in this 30.80m height limited building climatization is required to be made, it has been clear that the Chiller System couldn't be applied because of the insufficient floor height. At this point solutions proposals have been decided and an agreement with the firm Genta as consultant has been made. Genta recommended a system, which collects on the roof on a place and which makes distribution with 15 cm copper tubes. Named as VRV/HRV, the system has a characteristic of taking out the dirty air and taking the fresh air in. After the system has been determined, as a result of the negotiations with civil engineer it has been clear that the copper tubes could be passed through the beams. By this decision the floor height that is already insufficient, as 245 cm wouldn't be invaded. Although the first investment cost has been high by means of the usage possibilities and energy conservation, in time the system would bring quite a cheaper cost than Chiller System, so the property owner has been convinced VRV/HRV system has been firstly installed in İzmir.

FIRE AND ELEVATOR SYSTEMS: In addition, in system exists an important computer net, an important UPS support and at the same time a generator system. In this building which has a central security system has been installed, a system has been formed which in case of fire smoke stimulants which are on car park floors and normal floors informs the center automatically. In the building the elevator systems has been applied by Kone. In this system the elevator doesn’t have a mechanical room, instead the elevator system controls are installed near the cabins. By this way, when the elevators breakdown or the electricity is off the elevators don’t stop between stories, they move to the very near floor and open their doors.

As a result, this building has the courage of many new systems’ applications for İzmir and despite existing conditions, solutions has been searched in technology about technical problems, so the building becomes an example project.

4.1.6. AQUA MANORS - SİNPAŞ

Architectural design Sinpaş
System design IBM Türk

IBM Smart home technology is used in Flora Digital Housing, which is designed by Sinpaş. Although they are not yet finished, housing aims to take people out from the chaos of the city. Instead it also aims to connect users with nature. Its main approach is to use technology quite much to obtain the life comfort.

Sinpaş Aqua Manors is situated in Çekmeköy, Istanbul, located 11 km far from Altunizade, and built on 172.000 m2. Design includes 134 villas and 192 residences, which have costs between 134 - 340 billion TL. All the villas in the project have 358m^2 and everyone has its own private garden, open-closed swimming pool, sauna and car park. Blocks called 'residences' are 145m2. These blocks have various services such as baby and house care, pharmacy, dry cleaning, post office and reception.

DESIGN: Aqua Manors Housing is beyond the ordinary that has a distinctive design approach. Sinpaş manager Seba Gacemer, points out that the starting point of the Aqua Manors is to try the newest and to give them to the human usage. In design process, user needs taken into consideration and various alternatives are tried to find the best cabling system, which creates the most flexible solution. As a result of IBM's lecture series, architects have chances to find aesthetical solutions to the technical details, which they are not familiar with.

Housing is conceived to obtain high quality life standards to the users such as: communication, mobility, comfort, security, and economy. In other words, Sinpaş aimed to have a new kind of life style in cooperation with IBM. From the beginning until the end, special designs with wide scopes are developed for every space in the project due to the needs. Nevertheless intelligence of the houses depends on their users dreams and expectations. Users are able to program the system with their own needs, which makes the system flexible. Briefly Aqua Manors intelligent housing could able to think as dreamed, and save time of users. The housing project is conceived in respect with the physical conditions of the environment and sociological infrastructure of the users. The approach is to bring nature and users together. Winter gardens and wide glass facades obtained the sunlight in to the depths of the vast volumes and closed indoor pools.

INFRASTRUCTURE: Equipped with the new generation programs and communication infrastructure of information technologies, Aqua Manors Housing is adaptable to the new systems of tomorrow. Thus new products in the market could be easily integrated to the system. Basically system includes a computer center and specially developed software with an easily used interface. In this respect, a user can manage the intelligent hardware by the help of interface can be reached from the Internet. In addition to this; only one net infrastructure obtained by IBM, without any need to other sub-systems such as security, computer, hardware control systems, can serve and transfer all the data, sound and image just with a cable. The distinctive advantage of the system is to control other unintelligent equipments even just to turning on and off. The network in the house is conceived to obtain both cable and wireless systems. It is possible to use various communication types with an IP based solutions which depends on Internet technology.

SECURITY: Control is made with indoor and outdoor cameras and sensors. In case of emergency system alerts and send warning to the users cellular phone.

EARTHQUAKE: Project puts forward high-level earthquake protection. Raft foundation and high standard structure technology are used. (France / Outinord Tunnel Form Work). Furthermore earthquake sensors located in the houses works in pair with the system. In case of any movement, electric and gas suppliers are shot off and a gloomy light is turned on by the system.

SOCIAL LIFE: Housing includes ponds, wide green areas, sports and entertainment centers, shopping centers. Aqua manors also have indoor pool, sauna, and private indoor gardens. Thus users rest and get rid of daily stress among the nature and water.

ADVANTAGES: It is possible to sum up the advantages of the technology used in Aqua Manor Housing complex as mentioned below:

Managing the time regulators, which save energy: Ordering HVAC system in order to keep comfort and to operate on time to decrease consumption. Information shared between lightening, HVAC and security systems to get effective house managing.

- Managing the electrical and electronic house devices: All devices can be controlled by control panel or can be reached by cellular phone outside home. In case of failure, problem could be solved by the system on-line.
- Image transfer inside and outside home: Visual data could be transferred simultaneously for the user, which is useful for the family members to obtain security and communication.
- The automation systems and sensors regulate the ordinary works, such as garden care, pool control systems and environmental lighting.
- Integrated security systems: Necessary controls are done 24 hour by movement detectors, thief alerts, besides the intercom system and visual phone.
- Efficient communication and networking, digital satellite TV, radio links are established by wide range band.
- Flexible network infrastructure obtains the user comfort, security, and spare time needs for now and tomorrow.
- HVAC systems: house temperature can be kept constant due to user demand, and can be programmed due to seasonal changes.

COMPEX - Smart Home Model

Building Sponsor	Sinpaş
Infrastructure	IBM Global Services
Intelligent Building Technologies	Arçelik
Sound/vision Home Technologies	Beko
Security System	PRONET
HVAC System	LG-BEKO

Compex Digital 7th Home and Office Technology Fair was arranged in Harbiye Lütfi Kırdar Rumeli Fair Center between 7-10 February 2002 in which Sinpaş has constructed an intelligent house model. The sponsor firms are mentioned above. Besides the systems of that firms represented, other additional technologies and new life-style represented that intelligent houses promise for the future, such as blue tooth intelligent kitchen wares (intelligent refrigerators, dishwashers, and ovens etc.), intelligent televisions. This model house is prepared to inform the concept of intelligent house to the potential users of the future. The price of the intelligent house, which is 145m2, is stated as 119 billion TL. The most important qualifications of the intelligent house is as explained below:

- The system could be reached kilometres away from the house, 24 hour 7 day with a network connection.
- House temperature could be regulated and security and thief alerts could be operated with a cellular phone or with a similar Internet system. In case of a penetration into the house without permission
- System sends message to the house owner and to the security personnel. Besides that system can take photographs of the burglar, which could be useful for police investigation.
- The needs such as fire protection and security against burglary could be controlled remotely.
- New intelligent products could be integrated to the system by the help of the intelligent sockets, which have phone, fax, digital broadcasting and network connection qualifications.
- The system could support more than one phone line, fax, computer network, video, indoors cameras, cable and satellite TV. Besides that system supports file and printer sharing while obtains net connections of the personal computers.
- Outdoor camera could transmit the image of the visitor to the TV monitor.
- Rain sensors could operate the shutters when it rains
- For potential fire and earthquake situations, system shuts off the gas and electricity.
- Home office, with developed e- mail, data and fax management gives opportunity to contribute to lectures from home.

Briefly as mentioned above with those entire complex infrastructure, the model explained hasn't got an architectural intelligence. Neither in details, nor in materials there is no sign of intelligence but decorated with the intelligent equipments and kitchenwares. Actually the model shown, which was a summary of similar IB applications in Turkey is a good explanation of how wrong the word 'intelligence' is used.

4.1.7. FLORA DIGITAL PROJECT – AKROS ARCHITECTURE

Architectural Project	AKROS Architecture
Structural Project	ABKA Construction Co.
Automation System	IBM

Flora Digital Project, in collaboration of IBM Turk, ABKA Cons. Co. And Akros Architecture is composed of 80 villas in Çekmeköy nearby Şile and designed for supplying the needs of future's living habitat being home-offices. The settlement, which composed of 240-600m² houses is placed over 53 thousand meter squares and grouped in three quarters due to the meter squares of the houses.

DESIGN: The owner of the Akros Architecture which also designed the architectural project of the settlement, Bülent Onur, claims that the project should not be evaluated only as an architectural project but it deals with every single unit in the settlement and facilitates scenarios which will provide the dreams of the inhabitants sufficiently. In other words, the basic parameter during the design process becomes certainly the inhabitant. The most important, indeed, is the prediction of the things that the inhabitants dreamed on and is expected to dream on and while fulfilling their practices, maximum gain utilizing the technology and optimum collaborations. He attracted the attentions to importance of the collaborations with leading companies such as IBM and ABKA Cons. Co. According to the IBM Turk Integrated Technologies Service Department Chairman Mustafa Gülenç, the 'hi-tech society' that is constituted by these collaborations is subjected to rescue the individuals from the physical boundaries of the working zone and 'home-office' concept is introduced to our life with its differentiated dimensions for comfort other than the traditional comfort principles (http://www telepati.com.tr/mart01/konu16.htm).

The desire for the houses is to supply the necessary infrastructure for previously being used technologies and the coming hi-technologies and by the way, constituting hi-tech societies (http://www.eWEEK Web.htm). Moreover, the equipments and systems that are to be added to the main infrastructure will be mostly fitted and adopted to the previously communicating systems.

Onur clarifies the aim of the project to fulfil a new habitat form other than the physical quantities and qualities of the project. In other words, constituting a living space for the societies that are using hi-technology is highly regarded as the most indispensable. Also, he adds that project envisions the living habits of tomorrow and future and acts as a concept that collaborates the highly accurate technological innovations with the housing sector. However, ABKA Cons. Co. Chairman Halil Kaplan describes the main theme as the collaboration of the clever buildings with 'clever men'. (Financial Forum-31 January 2001). IBM Turk Communication Service specialist Mehmet Erbil suggests that the project is not only an infrastructure but also it brings many opportunities for electronic shopping, health, education and social services and occupies a system that does not necessitate a deep knowledge and proficiency so as to supervise and will be handled from a single control unit.

This project also gathers the necessities of the modern life utilizing the hi-technology under its territory. However, it stands as a touchstone identifying the utilization of technology in construction in Turkey. Consequently, after an investigation in Europe hold by IBM Company, it shows that Turkey may be a beneficial market and there exists a need for such houses and technology in Turkey (http://212.154.21.40/2001/02/03/bilisim/bilisimdevam.htm).

INFRASTRUCTURE: Being the first in Turkey, the system rests mainly on a digital spine. According to Bülent Onur, technology, for the first time recognizes the construction and facilitates all its opportunities to full extent. The users won't necessitate going physically exterior to fulfil their professional, social and cultural activities and will be able to control all the system inside the house while being physically exterior. Houses, obtaining IBM 12 GHz "Smart Home" remedy package will be able to utilize necessary or multi technology by only one main cable via the infrastructure that will be established inside the house. IBM Turk Communication Service specialist Mehmet Erbil claims that, not only IBM Smart Home is infrastructure, Internet connection or house automations, but also it is a modular infrastructure, which collaborates all services and applications in an integrated system layout (http://www.eWEEK Web.htm). Erbil clarifies that, the main difference of that remedy lays behind the integration of multi intelligence concepts in a single structure and rather than the remedy woks with PC's as in North America, the remedy for Flora

Digital is not directed to a PC only but it works with any telephone, web, TV or any other equipment that may well be contacted with Internet. (Financial Forum -31 January 2001).

COST: Although the technology that Flora Digital carries is highly developed, the cost is not that much high. However, another mortgage system will be used for the marketing of the houses. The project, which has a budget of 36 million $, will be decided to be marketed with a payment procedure having 10 years expiration time without having any banking mediation by ABKA Cons. Co. (Financial Forum -31 January 2001). Nevertheless, the project was temporarily halted because of the lack of demand due to the economic crisis occurred in Turkey during that period.

BENEFITS: Bülent Onur, proud to have adopted the new concepts which, are being used by electronic based technologies in construction sector and to have caught the accuracy of age of information, indicates the opportunities of hi-tech houses/hi-tech societies such as:

- Plug & Play
- Customize
- Mobilize
- Internet
- Interactive
- Online
- Convenience Between Protocols
- E-Business
- E-Place (Digital Infrastructure)
- Ethernet; Intranet; LAN; WAN

Fig. 4.1. Metrocity Millennium Towers Construction Phase
(Source: http:/www.hürriyetim.com)

Fig. 4.2. Metrocity Millennium Towers
(Source: http:/www.hürriyetim.com)

Fig. 4.3. Visual Door Phone and Electronic Thermostats, Sensors

Fig. 4.4. Installations under Floor

Fig. 4.5. HVAC Installations, Pipes and Connections to the Electronic Devices Hidden in Wall and Suspended Ceiling.

Fig. 4.6. Installations, Pipes and Lighting Channels Hidden in the Suspended Ceiling

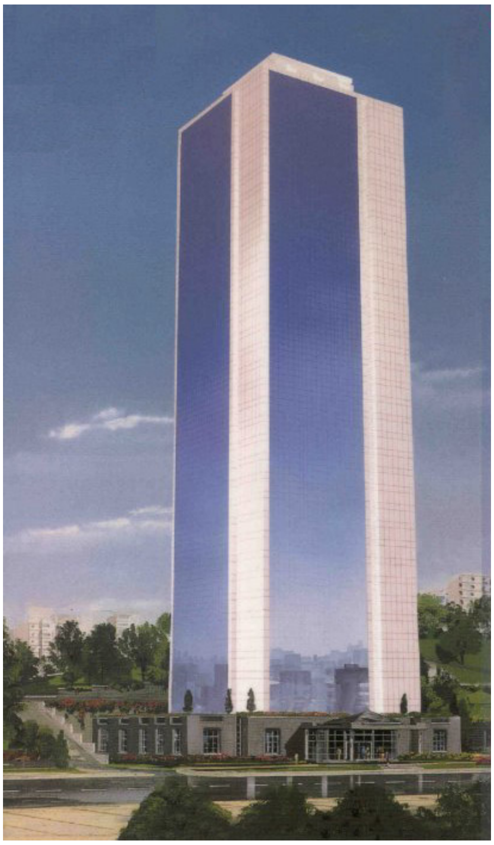

Fig. 4.7. The Polat Tower Residence
(Source: http://www.polatinsaat.com)

Fig. 4.8. Entrance and the Canopy of the Polat Tower Residence
(Source: http://www.polatinsaat.com)

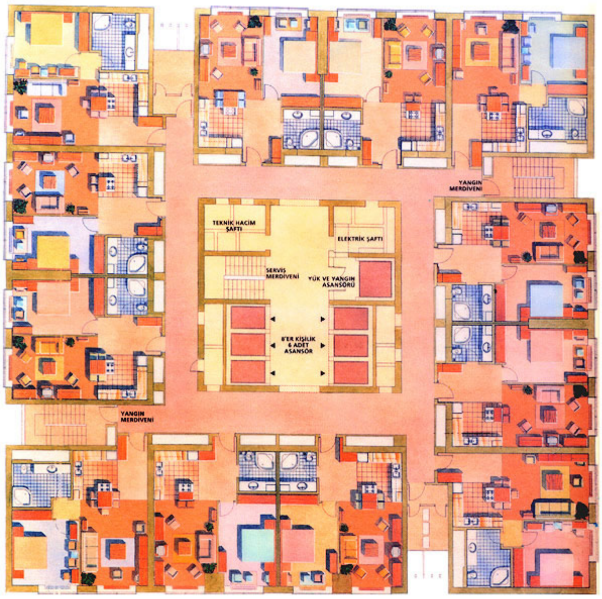

Fig. 4.9. Typical Floor Plan (Source: http://www.polatinsaat.com)

Fig. 4.10. The Indoor and Outdoor Panels, Chiller, Water, Heating and Fire Systems of Polat Tower
(Source: http://www.polatinsaat.com)

Fig. 4.11. Arial View of the Sabancı Center (Yapı, 151)

Fig. 4.12. Distant view of the Sabancı Center

Fig. 4.13. Equipments that are used in the Building

Fig. 4.14. The Conference Hall of Sabancı Center

Fig. 4.15. The Entrance Hall of Sabancı Center

Fig. 4.16. Entrance of the Sabah Media Center (Source: Yapı, 151)

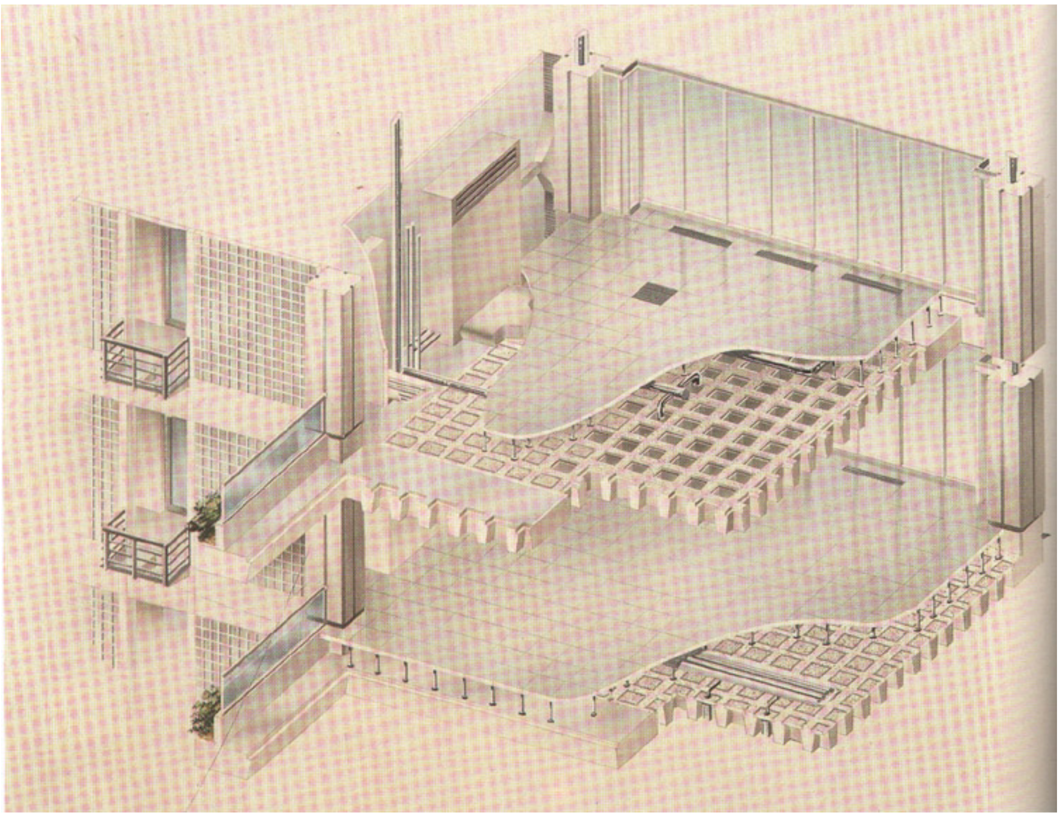

Fig. 4.17. Axonometric section view shows the system
(Source: Tasarım, November 1992)

Fig. 4.18. Interior view of Sabah Media Center showing publishing space
(Source: Tasarım, November 1992)

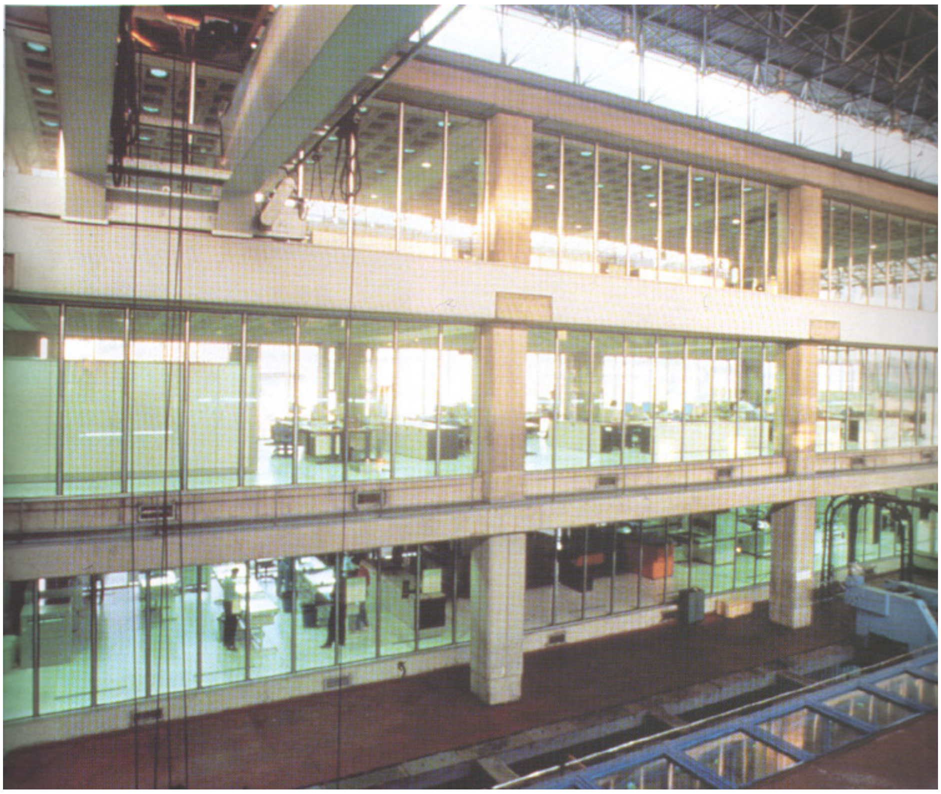

Fig. 4.19. Interior view of Sabah Media Center showing office spaces
(Source: Tasarım, November 1992)

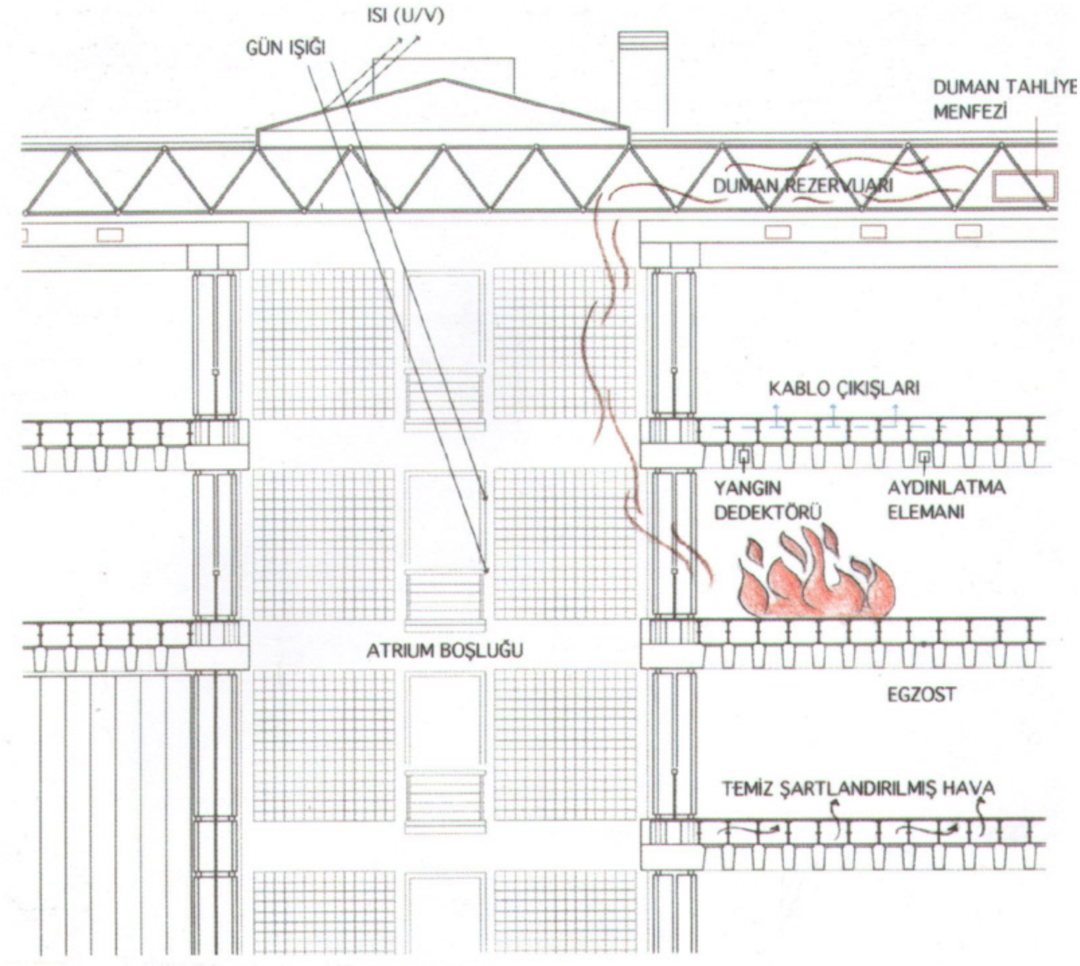

Fig. 4.20. Section of Sabah Media Center
(Source: Tasarım, November 1992)

Fig. 4.21. Arkas Holding Construction Phase

Fig. 4.22. VRV/HRV System Channels Cut Through the Beams

Fig. 4.23. Curtain Wall System of the Building

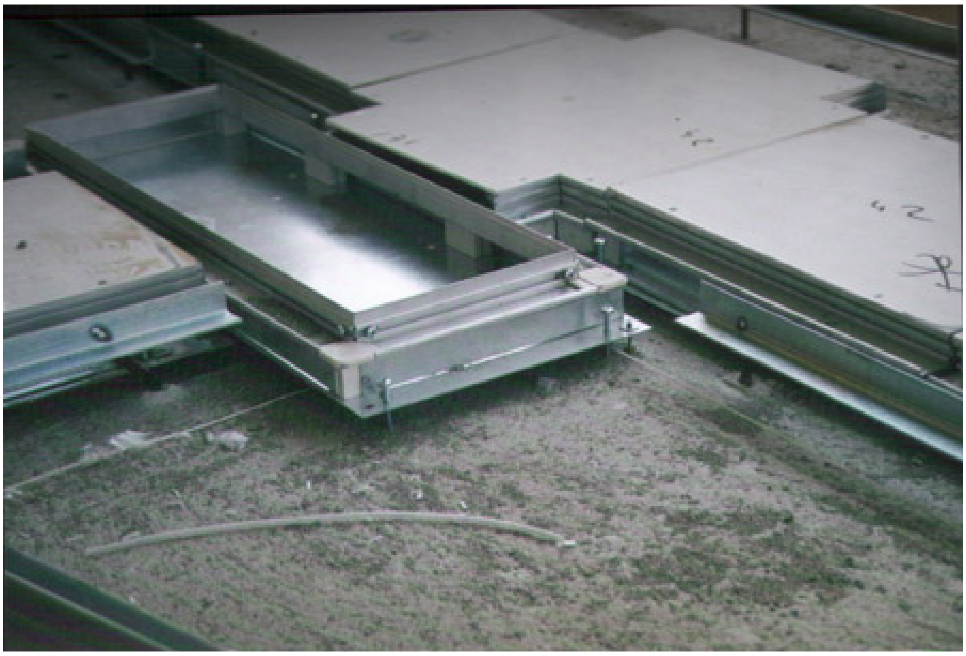

Fig. 4.24. The Detail of the Channel System for Cabling

Fig. 4.25. Channel System Grid for Cabling

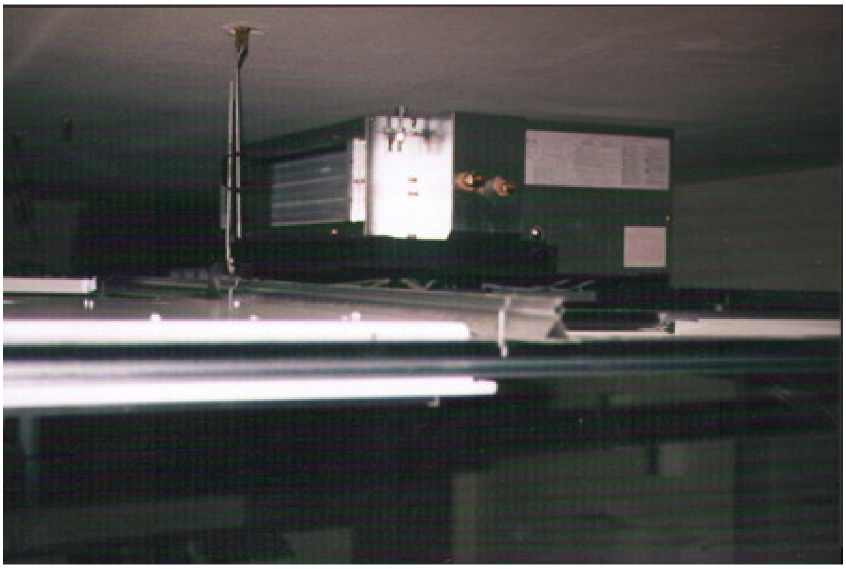

Fig. 4.26. The Ventilation Unit above Suspended Ceiling

Fig. 4.27. Channel System Grid and HVAC System Construction

Fig. 4.28. Channel Equipments for Electrical Installation
and Suspended Ceiling Detail

Fig. 4.29. Aqua Manor Site Plan

(Source: http:/www.sinpas.com.tr)

Fig. 4.30. Aqua Manor Photo-Realistic Picture

(Source: http:/www.sinpas.com.tr)

Fig. 4.31. Aqua Manor Illustration

(Source: http:/www.sinpas.com.tr)

Fig. 4.32. Aqua Manor Ground Floor Plan

(Source: http:/www.sinpas.com.tr)

Fig. 4.33. Intelligent House Model in Compex 2002 Fair in Istanbul

Fig. 4.34. House Decorated with Intelligent Devices by Sinpaş

Fig. 4.35. Inside of the Intelligent House

Fig. 4.36. Fingerprint Scanner

4.1.2. The Interpretation of Intelligence and Turkish Architecture

In this part of Chapter 4, the interpretations of interviews with designers of IBs will be presented. The questions and the interpretations of answers are as below:

Question 1: *What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?*

The marvellous structure of human brain inspired many innovations in artificial intelligence area. Therefore concepts like intelligence related to human being are started to be argued. The concept of intelligence is perceived as above a precise level or can be adaptable to the changing environments, started to be seen in living spaces as technology develops.

Interviews, which are made with the architects and engineers of the recent applications of the IBs in Turkey, put forward that there are several definitions of intelligence. One of the latest applications, Metrocity Millennium Tower's architect Doğan Tekeli explains the concept as; "Intelligence is the quality of the brain, and to be able to take decisions and to be adaptable to the situation."

Mehmet Konuralp who is the architect of the Sabah Media Center determines the intelligence as: to perform the program that downloaded the system before automatically. Similarly Ertan Anıl, who is the architect of the construction of Aktif Hotel in Ankara, describes intelligence as qualification to maintain ordinary workflow without any hesitation.

Different professions explain the concept of intelligence in different aspects. It's comprehensively argued in the seminar whose subject was Digital Life in Compex Computer Fair. Murat Şahin, is the Distribution Department Manager of Arçelik, defines the intelligence in terms of their products as "We are talking about devices which recognize its user, be aware of the life habits and consumptions and soft wares that works in pairs." Şahin goes on describing IBs as user based buildings which could communicate in order to serve the essential needs.

Mechanical engineer Emre Özmen, who has been working in big projects such as; Sabancı Center, İşbank Towers, Karum Shopping Center in EMO Automation

Company, explains that the concept of IB has more than operating the building from a center. According to Özmen, from now on IBs are those that are being operated by different BAS and also whose systems could communicate to others at the centre. This is the real intelligence and IBs in Turkey are not yet a part of that system. Doğan Tekeli agrees with Mr. Özmen and claims that there is a confusion and conflict about the concept.

According to Haluk Tümay, project manager of Koray Construction Company, buildings cannot be considered as intelligent; only the mankind can be defined by the term intelligent. In the same way Konuralp submits that intelligence is a result of human development process. Ahmet Yağcıoğlu, who is the architect of Arkas Holding Office Building constructed in İzmir explains that the concept of "intelligence" is a quite pretentious to use in buildings. A building could operate just as it is programmed. Not more or less could happen or expected. However, human keep the situations in the memory and act in order to them, but even in case of unexpected situations people can act flexible.

In this point criteria that make buildings intelligent, have to be examined. Even though there are not any precise standards in this subject; an IB has to be economic, energy conscious, easy to use and has to offer flexible spatial organizations. According to Tekeli, energy conscious design is not enough to be intelligent; it just makes the design more economic. He determines that the ordinary works are automatically done via electronic systems. Thus intelligence started to be questioned as if it is a result of technological development or not. IB applications, which have to be obtained by integrating architectural design and infrastructure systems, are quite technological. According to Anıl, intelligence in buildings is a product of computer and mechanical systems. Indeed computer system and building automation software is the operator and the manager of the system. Tümay describes the criteria for an IB in various ways:

- Easement in use and operate
- Modest in design
- Should not express its technology

Tümay also submits that intelligence of the building could be adequate if the building system could control the building without any intervention, if it could warn in case of any failure, if it could decrease the operation costs, and if it could offer alternatives. In addition to these, intelligence does not mean electronic systems. Building could not be defined as intelligent if materials are not chosen intelligently. Nevertheless, Tansu Yeğen, who is manager of the Department of Marketing in Microsoft, summarizes the intelligence criteria in three main parts:

- All electronic devices should be very intelligent.
- All equipments should be wireless connected to a network.
- There has to be a high-speed network and all devices could be connected via socket or wireless.

According to Şahin, in order to talk about a complete intelligence, all equipment should be intelligent itself, should communicate with other products, and should create a value with these qualifications.

In conclusion main criteria to define a building as intelligent are designing with a trans-discipliner approach and designing for user needs and demands. In other words, buildings with security systems or decorated with intelligent products are not defined as intelligent. Besides these buildings, which does not obtain user comfort and does not offer flexible details and programs, could not be involved in this class.

Question 2: *In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?*

Intelligence of the buildings, indeed, is nothing but the realization of the scenarios, which are set based upon demands and needs of residents, with the help of technology. The underlying point at this stage is determination of scenarios reasonably, which extends importance of trans-disciplinary approach. Fundamental issue in architectural design is fulfilment of user satisfaction. Therefore, main responsibility of an architect is to understand, define needs and, as a result offer comfortable and of good quality buildings to the user through a strong dialog. Ahmet Yağcıoğlu expresses role of an architect on the issue as: "more than the IB term, owner's point of view to the building, and architectural possibilities bring about the constraints and opportunities.

Exploring a solution in between those aforementioned and owners tolerance is now that the architects responsibility.” Engineers, on the other hand, within possibilities inform architect on the feasibility of scenarios, ensures development of decisions made as well. Haluk Tümay, states the role of an architect on design as: “knowledge is similar to a book on a bookshelf to an engineer, architect is the one who takes and utilizes them.” Ertan Anıl, summarizes tasks of an architect during design process as:

- satisfying sufficient coordination between disciplines
- placement and shaping of IB control centers, which might be of several in number for multi-storey buildings.
- resolving details to hide equipments of an IB in the design stage
- modification of spaces to fit human needs.

According to Ahmet Yağcıoğlu, “architecture itself is not pure art as in other arts, rather it is a profession that offers entire opportunities of the technology to human-beings in accordance with human-beings' needs. Economy, technology, sociology and even psychology are important aspects to an architect, and an architect deploys these to meet human needs. An architect is an organizer at the heart of all these. That is why, instead of “role of an architect” term, “how successfully has an architect utilized these or have them utilized” question is more important. Thus, complete list of systems applied to buildings must co-ordinately be integrated under the architectural project discipline”.

Along with development of technology, numerous minor disciplines have emerged and it became unmanageable for an architect to cover all building construction process alone. Architect at this point, must work closely with experts called as “consultant manager.” For instance, curtain wall or HVAC system is each now an expertise field. According to Tümay, designing projects is not an architect's single duty; he also must be knowledgeable on static, mechanic and electronic at least as he is on design. In other words, he should have the ability to add aesthetic values to alternatives that functionally recommended by engineers. Similarly, according to Konuralp; “an architect should have the knowledge both to organize all space features and to get into dialog with all technical disciplines.” Tümay explains the topic as: “consultant manager presents you an offer package, however, does not state how to deploy it. Architect plays the role at that point. If both the scenarios are well prepared and the people who work together are selected fastidiously, then results will be satisfactory. Otherwise, building itself becomes the design of the person studied the building on static, mechanics or electronics aspect." Tümay carries on as: "human has a single mind, if an idea cannot come to true even smartest people can not do it. However if it can, an architect should figure out the one already possible. Some of Turkish architects, unfortunately, are easy-going on this issue".

In addition, ensuring intelligence on architectural aspect is quite important. First of all architect needs to know how to take advantage of available sources to empower the building. Architect must ensure maximum utilization of wind and solar energy; for instance, via proper selection of structure shell form to materials so that a consequential decrease in energy consumption through airflow and heat gain can be obtained.

Nevertheless, as Doğan Tekeli states, due to intensive technical knowledge, architect's responsibility turns out to be space arrangement for hiding cables and canals aesthetically. Osman Çalışkan, Assistant General Manager of Teba Corp., as a mechanical engineer, simplifies the task of an architect as: "an architect's responsibility is to design spaces to comfort consumers and again, is to place tools desired by consumer into that space." By such means on examples in Turkey, architect does not play a key role in adapting intelligence to buildings. Apart from some particular cases, projects are being developed as they are in conventional instances and then transferred to engineers in order to integrate intelligence. This approach results in numerous space problems and system conflicts during implementation stage.

Question 3: *What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?*

Because of today's life conditions, people who spend most part of their times in buildings, expect to have the access to any service they demand easily. In IBs the features and so the applications of solutions have differences according to the function of the building and users. For example, in a hospital building the most important criteria is to provide hygiene, in bank buildings the security system takes precedence. Things that are mentioned up to now are not different than the design criteria of conventional buildings. But the new elements, which are included into the system to create the building's intelligence, play roles in shaping up the design process. According to Ertan Anıl, the most important difference between the design process of conventional and IBs is to determine the principles of automation system in design phase, so the design work is made appropriately. Similarly, according to Haluk Tümay, all systems applied to the building, must be shaped as the building is designed. Systems that are foreseen at the beginning, work in the same productivity until if work is done right. Here architects are charged with important duties. An architect must think about everything, including operation and maintenance of building that he designed, in design process.

IB, in design process, requires more trans-disciplinary work than conventional approach. At the same time this approach leads any professional group's members to have information about the other professions. It is not possible that the spaces we live will not be influenced from the information technologies that entered our lives. Technology has a base, which always develops and moves forward and parallel to this the designs of the spaces must have the same flexibility. For instance, in Konuralp's Sabah Foundation Buildings, in a modulated based approach, the suitability of building for the probable enlargements or partitioning is provided. As a support to this approach, the same flexible solution searches in electronics go on. By the power line technology determined by Osman Çalışkan from Teba, we may obtain information from the cables that we obtain electricity and step forward applications without cable systems are participating in our lives.

As a summary, we may list the particular points for the design process of IBs that are generally observed collectively:

- With trans-disciplinary approach, architects, engineers, property owners and users join and form the design together instead of conventional sequential way of design. Concurrent design process is utilized.
- In spaces' list, related to the size and the capacity of the building, designing spaces with the additional one or more computer command centers and the infrastructure and square meters that this application requires.
- In the building sections, searching the solutions for raised floors for cable channels and solutions for suspended ceiling for HVAC channels.
- In material selections, taking the sustainable properties in to consideration.

- According to the changing functions or users and developing technologies, providing flexible space organizations.
- With intelligent designs, uses of intelligent electronic devices are utilized.

Question 4: *Is it possible to make intelligent an existing building?*

With the spreading of intelligence concept, users began to endeavour to include this new style in their lives. This lunge sometimes made with conscious and sometimes made unconsciously with the effort of running after the new is sensed mostly in residences. Users, who don't have economic power to build a new intelligent house, get into the way of searching the methods to make their existing buildings intelligent. But this process, as Ertan Anıl has stated, is more complicated, and expensive than designing and constructing a new IB. While locating the channel systems for cable and HVAC systems that are needed to be placed in the house, in spaces, which have no raised floor or suspended ceiling applications, important problems are faced. As a result, the exposed cables and channels damage spatial comfort and quality. Also the required special spaces for these systems are not possessed, the performances of the systems decreases. For instance, Istanbul Profilo Shopping Center, which has an automation system designed bye EMO, is in fact designed as a factory building. Because of the limited spaces, computer command center accepted as the heart of the building is placed in the basement where also car park exists and so the access to this center is quite difficult, the place has no spatial quality. In the same way, the boiler group, which are supposed to be placed in the building, are parted into two because of limited space problem and the connection between the parts are tried to be provided with giant tubes. And this effect the system's output in a negative way.

In ARKAS Holding Company Building there is also a similar case. Buying a semi-completed building and converting it into an IB, brought up serious problems such as pre-defined floor heights are not appropriate for cable and HVAC channels. Because of these problems, a way for search of new systems is determined and for cables channel system application is chosen. But for the HVAC system–though by consulting the static engineers- a solution of piercing the beams has been an obligatory way.

So we can claim that, the infrastructure systems must be well considered with attention to tomorrow's expectations. For instance, the reason for Turkcell/Digiturk to rent the building built in Yıldız by Kemal Celal Polat Construction is because of a well-defined and constructed infrastructure system. Because of its function, this enterprise, which has many automatic control systems, has chosen this building by taking into consideration, the existing infrastructure in the building and location criteria.

Question 5: *What is the difference between an IB and conventional building in terms of cost issues?*

A lot more sources are is needed for the IBs then the conventional buildings at the initial investment stage. This, unfortunately, is a dissuasive factor for most of the users and property owners. According to Haluk Tümay, reflection of the investment to the architectural project is calculated as follows: What kind of savings do we have when using this technology? What is gained and what is lost? Ertan Anıl points out that IBs cost from %1 to %10 more than conventional buildings. This amount changes according to the level of the intelligence. Although this amount looks like a serious amount of cost, when the energy savings that are gained by this technology and additional costs that are gained by well management considered, it is understood that this numbers aren't so frightening. In other words, life cycle costing in the long run will be lower for IBs. With the expression of Mehmet Konuralp; IBs bring high amount of cost at initial investment, but brings low life cycle costs.

Emre Özmen says, it is not possible to figure out how long it takes for an IB to pay back the cost of the initial investment, because it varies from building to building. According to Özmen, even if we built two buildings, which are the same, but only if one of them has different thermal insulation, the amount would change. For this it is necessary to make very serious simulations. Additionally, investment made for building management systems saves from %30 to %40 and even up to %50 when the building is in operation.

According to Tümay, issues about cost are very important and everything has a cost. More importantly, designers must be thrifty when spending client's money. In this sense, task of the architect must be to find out the needs and the demands in a sound way and implementing the systems needed to the building according to these demands. It is not more than to make investment unconsciously because of the ability of consumption. Property owners try to decrease the building costs usually if they are going to sell the building, and they pay more attention if they are going to use it personally. In this point of view it is necessary to inform both the designers and the property owners in this issues.

As a result, it is obvious that the initial investment of IBs is more that conventional ones. However; the owner and users should be informed about that this big amount of investment would be paid back to them during the life cycle process of building.

Question 6: *How do you elaborate on trans-disciplinary process?*

Trans-disciplinary process is one of the most important aspects of the design of the IBs. While architectural project is being designed of, appropriate firms for service, reference and finance are determined. Architect as an organizer, with the expression of Konuralp, invites all the other disciplines that affect space to the design process. In addition to this, inviting the property owner or the user to this group would obtain taking more healthy decisions. With this approach, individuals would have an opportunity to improve themselves in other issues.

In the process of IB design, usually, some difficulties occur between the architect and civil engineers on flexible space solutions and between the electronic, mechanical engineers on the designing of the aesthetic design solutions. Time, strong construction and communication are required for providing the floor area needed and infrastructure demanded by the engineers for the building management centers and locating the electronic equipment in the building. Emre Özmen who is a mechanical engineer determines the main problem as follows; “For instance, when 10 m^2 area needed for an air conditioning terminal which mechanical engineer designed, and when the architect reserved only $5m^2$ for this system then the mechanical engineer has to divide the whole system into parts and this results in unproductive operation of the system.

In addition to this, there are important criteria for determining the location of electronic equipments like sensors. For example, heat sensor should not be located in the door entrance because there it would be affected from the airflow. In the same manner, it would cause unhealthy results locating it to a place where it would directly affected by the sunlight. Equipments in the living areas are assembled by the demand of the architect to the unseen technical areas like the spaces above the suspended ceiling. Yet, the design of air quality sensor, fan coil sensor and humidity sensor should be aesthetic and between the alternatives the aesthetical option, which is more likely for the architect's aesthetic demands, should be preferred.

Question 7: *Is it possible to classify the intelligence level for buildings or is it logical?*

Since the concept of IB is around, the development of technology has not slowed down; new systems are developed addition to the ones, which existed for the buildings. At this point, gradually increasing of the intelligence mentioned and measuring the intelligence has started to be considered. Some studies, such as Orbit and Carlini Building Intelligence Test, are carried out abroad about this subject. According to these studies and as Mehmet Konuralp said, level of intelligence is proportional with the services provided by the building and a classification is made on a scale of one to five. And according to Emre Özmen, a building is intelligent as the building has as much as possible points, which can be controlled. One disadvantage of this is the management becomes much harder as a building becomes much complex.

In the past, a building, which only had photocell tab or photocell door, was considered as an IB, at the moment called 3rd generation buildings have systems that can give commands one after the other- like sharing the vision- are considered as IBs. Like this, the development of intelligent home products is unceasingly continuing. As an example; an intelligent refrigerator, has an ability to order a box of milk to the market when recognizing that the milk has finished.

However, most of the architects who are interviewed share similar opinions on the issue of the classification of the IBs. Bülent Onur said intelligence is a concept, which is very relative, which its limits cannot be defined and pointed out that there is no parameter to define that concept. In addition to this, according to Haluk Tümay, the intelligence which is mentioned is proportional to whether the systems that are loaded to the building are determined according to the needs or not. Where Doğan Tekeli followed up with interest that this issue is a matter of equipment and intelligence is directly proportional with the money that can be spend. Increasing the cost for making the building more intelligent is a problem for having the desired level of quality for the building. At this point, the easy implementation of the equipments to the system, which can be added in time, should be the most important criteria.

Question 8: *What are the benefits and problems related to IBs? How does IBs effect on spatial quality?*

Although IBs have drawn attention with the innovations they have brought upon us, they have started to cause some problems. Haluk Tumay explains the benefits of the new age machines that have come into our lives; "man can not think as comprehensive as machines. Machines think and produce various scenarios, bring practical controls to life and find the most optimal solutions that man cant think."

According to Ertan Anıl by means of intelligence of buildings, the problems that can occur during operation are minimized, life quality is increased and energy is saved. In addition to that, Halit Yuce says that with a monitor user can see where the damage is. Thus, IBs are advantageous in terms of interrupting the system immediately and providing safety, saving money and also saving time. For instance, in case of a ventilation system trouble at indoor car park, people can be poisoned by carbon monoxide. The importance of urgent self-response and early warning systems are seen in such situations. Emre Özmen determines the benefits of IBs as the comfort and economy provided by HVAC systems. He maintains the view that the first reason to produce these kinds of systems is economy and secondly taking control without human interruption. According to daily mental manner, human could do mistakes easily, besides that machine operates your command without compensation. Above all this it has reduced personnel need. Bulent Onur adds on these advantages flexibility of space.

On the other hand the disadvantages of the IBs are seen recently. Haluk Tumay determines that for a healthy life people need comfort and HVAC systems is a part of that comfort. On the contrary HVAC systems needs periodical maintenance in order to get rid of sick building syndrome. According to Emre Özmen sickness is fault of neither building designers nor the automation system, this is entirely related to the cleanness and economy in design. Although the system warns for the fresh air, ventilation flaps, which are inadequate in number, could not provide more fresh air. Thus causes headaches nausea, and adaptation disorders for users.

In addition to all these, computer based structure, which can be accessed, is considered as a serious danger for privacy of families and security. Emre Özmen describes that a stranger cannot enter the system that easy and explains this situation as; "There are 4 levels of entry to the system. Alternative strategies can be applied if plan ‘A’ doesn’t work you can use plan ‘B’." And even if the computer shuts down the system runs. System runs in three levels; "data collection, process operation and communication”. Even if the 3rd level shuts down the first and second runs. Only visual connection can be lost. In this situation user may operate small hand panel sand second level bulletin board switch the help of the jacks, user can plug in to the system and make connection. Furthermore in case of earthquake when the first and second levels shut down there is a bypass system that controls the system manually.

Murat Sahin explains three combinations of the IBs "rigging, service, content". If they have enough comfort and quality they add very important intelligence to the building. You must think these very carefully: inside organization, the rigging elements, the materials that are using in the building and the life you are thinking of. Ertan Anil determines that comfort conditions of IBs are higher than the conventional buildings. And also IBs are more useful and safer than conventional buildings. For instance; Elevators are programmed to work due to rush hour passenger flow graphics. Cabins commute to floors where required automatically. In case of an emergency like electric cut, fire or earthquake the elevators move to the nearest floor and open their doors.

Nevertheless Dogan Tekeli says that the human always demand more comfort and different criteria. But both of the efforts are just extra expenses, leaving the nature, imitation and bring a point that can be passed. For Tekeli, the imitation materials-shell constructions, sandwich panels that are used in intelligence buildings cannot give the comfort of the natural materials. For instance; as a result of searching for a new things in engineering sector, in 1950’s bare concrete was used, but when buildings started to have corrosion in the beginning of the 1980's they have stopped using bare concrete. Same as this, when first started to use the BTM facing material it really attracts people but when time goes on it shows that it can be affected by the outer factors. You can not see these results without any try. It is really natural to see the disadvantages of the IBs by time.

Konuralp says that these kinds of buildings have the capability to respond user comfort, besides the need for flexible life and study places. Haluk Tumay determines that if mechanical systems and aesthetics join together that must be done in a really good sense. For instance; a lighting system, which could manage the indoor light level due to outdoor light level, adds the building more aesthetic. At this point the intelligence of the architect becomes really important. Architects are responsible from location of the building, formation of the designer group, and to the selection of systems and materials. In this way every step headed for the best design will reduce the problems that are explained and the spatial comfort will be at maximum.

Question 9: *How do you evaluate spreading of IBs in Turkey?*

Besides consumption has been gaining so much importance, especially in third world countries differentiation among humankind, in other words demand of being different than the others shows a great growing. Thus unconsciously fake and unsuccessful examples are done to catch up the ‘new’ what is in the market. According to Fikret Ergüder, Compaq Marketing Group Director, intelligence is not appropriate for Turkey if it will be seen as a brand. Nevertheless it could be appropriate if we will include it as a value and adapt it to our life.

IB applications in Turkey started in the beginning of 1990’s. Ertan Anıl summarizes this period as: “Growing demand on a high standard living, growing need for multi-storey housing because of high lot prices, demand for economy make IBs obligatory.” Murat Şahin determined the approach for new innovations as; “In Turkey transition to the colour TV has been finished 10 year before the estimated time, and also transition to the cellular phone has been done 6-7 year before the estimated time. That’s why transition to this platform is related to purchase speed and power. In this point of view, IB concept will not take too long to establish and to become widespread.” Konuralp explains that intelligence is in an early period in Turkey; firstly technological information has to be reached to the industry.

Question10: *If you think of the applications in Turkey, how suitable is the word "intelligence"?*

The IBs examples of Turkey, mostly includes just the BASs. Although these buildings are one step forward to conventional ones, it is not absolutely true that describe them as “intelligent”. Unfortunately, as a result of investigation of IBs in Turkey, it is clear that these buildings called as IBs after the construction finished. Doğan Tekeli explains that this approach is a result of marketing and propaganda of contractors and salesman who sell the electromechanical devices. The intelligence of building have been started widespread and become fashion in the last years, thus concept intruded in the every part of our life. Although this manner provides easement in marketing (easy sell, easy rent) it’s not appropriate in terms of ethical meaning.

In this point, another argument could be done about how these buildings can be called if they are not intelligent. According to Haluk Tumay, it is more realistic and will be better to call them as “usage of right system at the right place”. While Bülent Onur calls IBs as "e-place", Mehmet Konuralp calls them more realistic "contemporary buildings". Ahmet Yagcioglu determines that it is quite exaggeration to call them intelligent, according to him buildings that is managed with the given data must be called "robot buildings".

As a result, it is obvious that it is too early to call buildings as intelligent in Turkey. So that, sub-contractors and consumers have to be conscious and they should be informed deeply about the subject. This constitutes an important criterion for providing the evaluation of IBs, which is a new and trendy concept recently in Turkey.

Fig. 4.37. Akros Floradigital House Picture, Type A
(Source: B. Onur's archives)

Fig. 4.38. Akros Floradigital House Picture, Type B
(Source: B. Onur's archives)

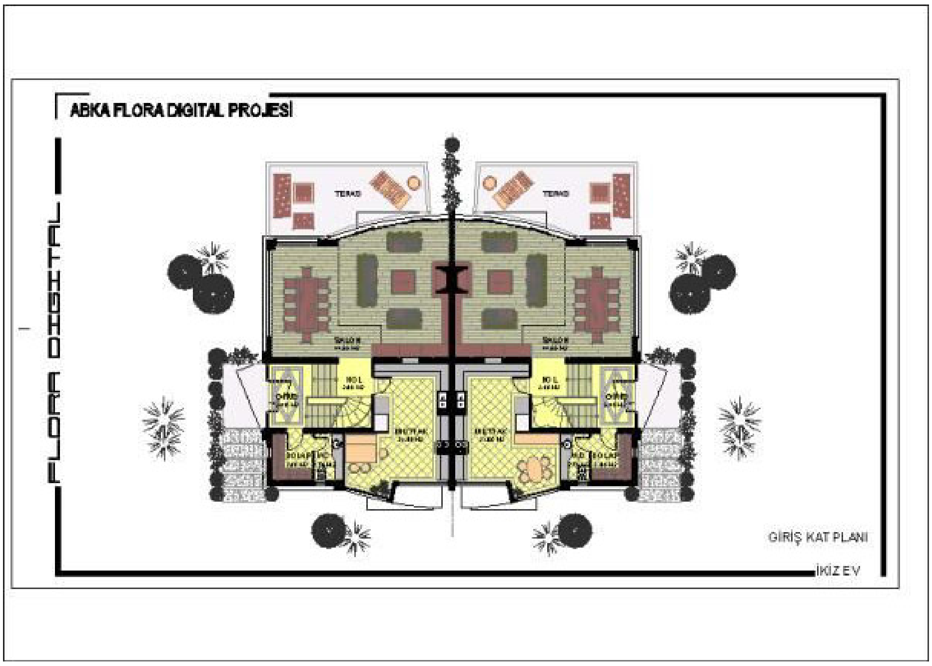

Fig. 4.39. Akros Floradigital House, sample house plan
(Source: B. Onur's archives)

Fig. 4.40. Akros Floradigital Houses, Site Plan
(Source: B. Onur's archives)

CONCLUSION

This research provides contributions in several areas. The following paragraphs itemize conclusions and major identifiable tasks that have been accomplished. At a global level, this thesis developed a general framework to understand IBs. Case studies and interviews have been used in order to interpret current situation in Turkey.

The word 'intelligence', which is defined as to be above a level or to be adaptable for changing environments, has a common usage for the spaces and the electronic equipments related with the technologic innovations. IBs are in literature since the beginning of 1980s. IBs are started to form examples firstly in İstanbul since 1990s in Turkey. Nevertheless because of the high investment costs they are generally used for office and banking buildings, company and broadcasting headquarters, and also for shopping centers.

In addition, due to economic problems, all the systems that add intelligence to buildings are not fully implicated. There has been a debate between contractors and designers on this subject. Majority of designers believe that intelligence, which is a human related concept, could not be used for buildings and therefore measurement of so-called intelligence of buildings is impossible. On the contrary contractors or owners define buildings, which have just BAS as intelligent in order to rent or sell them with higher prizes.

Investigation results about IBs and applications in Turkey are listed below:

1. Intelligence in terms of buildings which is determined due to previously stated needs, is described as; automatically managing ordinary works, in case of unexpected situations operating security system, able to establish communication between outside and inside users and electronic equipments with the help of software and automation systems.

2. Although there are not precise standards, the criteria are determined due to general opinions of the specialists. According to specialists criteria are economy, energy saving, easement of use, and flexible space organizations.

3. High-level intelligence in buildings could be provided by cooperation of intelligent design, intelligent designer and intelligent user. In other words IB design consists of sustainable architecture, high-tech architecture and user-friendly architecture.

4. Because of technical importance of the IB design process, the duty of architects is generally seem as to hide the cables and tubes that engineers necessitate by designing aesthetical details and making spatial organizations related with them. On the other hand, proper duty of architects is listed below:

   - Comprehending users by communicating with them, determining their needs and offering them alternative comfortable and high quality spaces.
   - Forming desired spaces and details in cooperation with engineers in the design team.
   - Being as a coordinator in the design team. Thus architect could obtain communication between various professions and users in design and management process.
   - Constituting coordinated work with the specialists of other branches developed with technologic innovations like curtain wall systems, automation systems.
   - Being aware of statical, mechanical and electronical knowledge besides design background.
   - Investigating renewable resources in order to use in building design.

5. IB design process is more complex than conventional design process. Intensive interdisciplinary work, comprehensive technical drawings and adaptable design process are seen in entire design process. In addition to that, IBs require more initial investment, approximately %10 more than conventional ones. This percentage changes according to measurement of building intelligence. Thus, IBs provide nearly %50 cost conservation in terms of life cycle costing. The cost of an IB

increases with the addition of new systems to the building. So that, the user needs should be well determined and unnecessary expenses should be avoided. The owners and the designers should be conscious on this subject.

6. Generally, intelligence level of the building is related with the investment, user needs and number of controllable points. In contrast with this point of view, architects whom interviewed with, declares that it is impossible to make measurement of intelligence among them. In addition, the limits of intelligence are could not be defined precisely.

7. Existing buildings could be possibly made intelligent. However inadequate infrastructure for the new system forms important problems while implicating and management and also necessitates grand investments for the solution.

8. The IBs enable to users and managers easement in use, comfort, flexibility, economy, energy conscious, security, easy management. The provided maximum comfort, quality and subsystems also increase the spatial quality of building.

   Although there are a lot of benefits, there are also problems that the IBs cause. These can be listed as below:

- The problems that appeared because of the lack of rapid maintenance of systems on time and the design of the system without hygienic and economical conditions. For instance, sick building syndrome
- The problems that appeared because of the computer-based systems of buildings.
- The problems that appeared because of the additional comforts that people looking for continuously and differentiation efforts. For instance, additional costs, artificiality.

In addition to that, if an IB is well designed, the possibility of appearing these problems is diminished.

9. The IB projects are spreading rapidly in Turkey. However this concept is not comprehended truly. So there are unconscious applications. Because of IBs are new and fashion, they attract attention. Except some examples, first architectural design is done and then other systems are integrated to design in order to complete on IB project in Turkey. So that, while the IBs should be the result of the integration of architectural design and subsystems, in Turkey, the applications are generally integration of computer technology to the conventionally designed buildings. It is necessary to inform the contractor and users to enable the development of this concept in an efficient and effective way.

10. The human mind also uses the emotional intelligence. However the buildings that are called as "intelligent" can only make combinations on the limit of data that are loaded to the central computer. Especially according to interviewed architects, the intelligence is an exaggerated and assertive term that is used by the contractors and the sellers of automatic devices. So that, designers started to investigate the new name alternatives such as "e-place" and "robot buildings".

As a result, building technology is developing day-to-day and becoming intelligent. So that, the technology also brings innovations to life and users want to see them in places where they live or work. So that it is inevitable that designers should follow the developments in building industry and apply them to their designs. Integration of the concepts of "sustainable architecture", "high-tech architecture", and "user-friendly architecture" is playing a vital role for the healthy development of IBs. Here integration at three levels plays an important role: integration of different professions; integration of different design approaches and integration of building systems. In Turkey, these integrations cannot be observed in the examples. However, building industry is adapting itself to the new requirements of IBs.

CONCLUDING REMARKS

Imperfections of the study:

The concept of IB is new and there is not a clear definition of an IB. So a definition of IBs was determined by the way of integration of different ideas on this subject. Therefore it couldn't be possible to make a clear definition and to determine the design criteria of IBs. Because of the nature of the subject, it was necessitated to focus on some specialized subjects such as building systems and their effects on architectural design. The technical face of subject is limited according to architectural importance and these issues were not investigated in detail.

Recommendations for further study:

As mentioned above, the intelligence of building is a new concept and there are a lot of unknown issues that can be studied. Some of these issues can be listed as below:

- Determining the design criteria of IBs in terms of trio of high-tech architecture, sustainable architecture and user-friendly architecture.
- Examining the similarities and differences between IBs and conventional buildings.
- Determining the benefits and problems of IBs.
- Measuring the buildings IQ
- Investigation of the effects of IB on spatial quality.

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APPENDIX A

Intelligent Building Design Concept

If we take a look at the concepts that have to be taken in to consideration, we can see that an IB concept and expert systems in this area are going together (Işık, 1994).

- On-line administration and financing
- Computer-aided design for space management
- On-line facilities management and planning
- Intelligent Command and Control
- Life support and comfort-personal comfort environments
- Wire management building and local area networks
- Computer
- Telephone
- Maintenance
- Repair and diagnostics
- Security
- Access and reporting
- Protection
- Information Techniques
- Video teleconferencing
- Audio bridging services
- Audio-graphic presentation equipment
- Computer-generated slides
- Sale, rent, lease of computer of office systems
- Intercom-only calling service
- Authorization of systems
- Maintenance of systems
- Messaging

- Electronic text messaging and network interface
- Paging
- Speaker
- Pocket pager
- Tenant/Test-building directory and information systems
- Archival Storage
- Vault storage and document shredding
- Intelligent/movable/programmable office environments
- On-line word/data/info processing
- OCR/facsimile/telex
- Tenant support and training
- Computer-aided instruction
- Encryption
- Systems security
- Intelligent Resources
- Conference and war rooms
- On-line room scheduling
- Temporary services
- Leased staff
- Package, mail-room, copier and delivery services
- Travel, conference and meeting planning services
- Day-care and health recreational gyms
- Print/copier/office supplies/services
- Interior design services
- Computer-aided design
- Educational/training services

APPENDIX B

QUESTIONS OF INQUIRY

SORULAR

Bu sorular Türkiye'deki akıllı bina uygulamalarını incelemek üzere hazırlanmıştır.

Soru 1: Sizce "akıllılık" nedir? Akıllılığı size göre hangi kriterler belirler ? Akıllılık sadece bilgisayar teknolojisinin bir ürünü / sonucu mudur ?

Soru 2: Akıllı bina üretim sürecinde, yaşanacak hayata dair ana kararlar; bir başka deyişle "senaryo" mimarlar mı mühendisler tarafından mı üretidi? Akıllı bina tasarım sürecinde mimarın rolü nedir ?

Soru 3: Akıllı bina tasarım sürecinin konvansiyonel bina tasarım sürecinden farklı olarak girdi / çıktıları nelerdir ?

Soru 4: Mevcut bir binanın akıllandırılması mümkün müdür ?

Soru 5: Akıllı binalar ile konvansiyonel binalar arasında maliyet bakımından ne gibi farklar vardır?

Soru 6: Disiplinler arası süreci nasıl açıklarsınız ?

Soru 7: Binalardaki akıllılığın derecelendirilmesi sizce mümkün müdür yada doğru mudur?

Soru 8: Akıllı binaların yararları ve neden olduğu sorunlar nelerdir ? Akıllı bina yaklaşımının mekansal kalite üzerindeki etkileri nelerdir ?

Soru 9: Türkiye'de akıllı binaların yaygınlaşmasını nasıl değerlendiriyorsunuz ?

Soru 10: Akıllılık sıfatı Türkiye'deki uygulamalar açısından değerlendirilecek olursa ne derece doğru seçilmiş bir sıfattır?

QUESTIONS

These questions are prepared to examine the intelligent building applications in Turkey.

Question 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

Question 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

Question 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

Question 4: Is it possible to make intelligent an existing building?

Question 5: What is the difference between an IB and conventional building in terms of cost issues?

Question 6: How do you elaborate on trans-disciplinary process?

Question 7: Is it possible to classify the intelligence level for buildings or is it logical?

Question 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

Question 9: How do you evaluate spreading of IBs in Turkey?

Question10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

APPENDIX C

QUESTIONNAIRES

QUESTIONNAIRE WITH DOĞAN TEKELİ

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

Intelligence is the quality of the brain, and to be able to take decisions and to be adaptable to the situation. There is a confusion and conflict about this concept. For instance, the energy conscious design is not enough to be intelligent; it just makes the design more economic. The ordinary works are automatically done via electronic systems. But there is no “architecture”!

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the “scenario”? What is the role of the architect in the design process of an IB?

The contribution of architecs is in terms of energy conservation in design process of IBs. However, the intelligence completely depens on electronic controls so that there is no real architectural contribution. Due to intensive technical knowledge, architect’s responsibility turns out to be space arrangement for hiding cables and canals aesthetically.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

There is not so much influence of intelligence on design process. This depends on the measure of the intelligence of building and the money that wanted to be spent.

QUESTION 4: Is it possible to make intelligent an existing building?

This is not much easy and in this situation, you should be agree about some befits and some problems. On the other hand, there is no any problem on new designed buildings.

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

QUESTION 6: How do you elaborate on trans-disciplinary process?

Automation is consisted of % 98-99 engineering and % 1architecture. However, the engineers make a complaint about architects because of their ignorance on building systems and they are usually right.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

Because as I said before, this is just an accoutrement problem that depends on the measure of the intelligence of building and the money that can be spend.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

The human always demand more comfort and different criteria. But both of the efforts are just extra expenses, leaving the nature, imitation and bring a point that can be passed. The imitation materials-shell constructions, sandwich panels that are used in intelligence buildings cannot give the comfort of the natural materials. For instance; as a result of searching for a new things in engineering sector, in 1950's bare concrete was used, but when buildings started to have corrosion in the beginning of the 1980's they have stopped using bare concrete. Same as this, when first started to use the BTM facing material it really attracts people but when time goes on it shows that it can be affected by the outer factors. You cannot see these results without any try. It is really natural to see the disadvantages of the IBs by time.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

This approach is a result of marketing and propaganda of contractors and salesman who sell the electromechanical devices. The intelligence of building have been started widespread and become fashion in the last years, thus concept intruded in the every part of our life. Although this manner provides easement in marketing (easy sell, easy rent) it's not appropriate in terms of ethical meaning.

QUESTIONNAIRE WITH CÜNEYT ÇÖMEZ

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

With the help of software, controlling the building systems properly, automatically and without needed any person, is one of the criteria of intelligence. In addition to that, intelligent equipments such as intelligent refrigerator, intelligent dishwasher, etc. are not enough to make a building intelligent.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

The scenario is written by us, the engineers, in the frame of the program according to the user's demands. Actually, this scenario is software written by us and in fact, the creating of this scenario is not much easy. By the gaining of intelligence to the buildings, in reality, the architects have not too much contribution, because they are mostly concentrated on the esthetical aspects of the buildings. For example, architects of the Polat Tower attempted to paint the detectors, on which it was written the warning of "Do not paint", just to suit to the colour of suspension ceiling. Whereas the Russian architects precisely pay much attention regarding the fire instructions and have a very good knowledge thereof and they design their constructions according to these standards.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

The architectural project should be formed in coordination with the mechanical and electrical projects. We, as engineers, enter in the project after a certain stage. For example, place of the detectors or the airing channels do not require a special architectural detail within the architectural design, because the standard heights of the suspension ceilings are generally sufficient.

QUESTION 4: Is it possible to make intelligent an existing building?

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

For example, the cooling system of the İş Bankası Towers are provided via Chiller system. Amount of the energy loss as a result of 1°C failure, which you may make, will be almost as much as the energy consumed by a village. That means a loss of million dollars for the budget of İş Bankası. Therefore, even the simplest sensors, which will use on the buildings, should work very precisely. Even if the investment, which you give during the establishment of the system, is too high, the system amortizes itself within a very short time period and then, you start to make profit of it.

QUESTION 6: How do you elaborate on trans-disciplinary process?

But, it has not been possible in Turkey, yet. However, in some projects with foreign partners –such as İş Bankası Towers-, this type of cooperation could be achieved. They have very special and detailed contract conditions for their construction works under very strict controls. The engineers and architects do not enter in dense discussions and communications on the design stage. In other words, they keep themselves out of it. Of course, this situation varies due to the projects and architects. Mechanical project has a very big importance. For that reason, the mechanical engineer should have a very good knowledge about automation. If the mechanical design did not prepared properly, the system will not operate in the expected condition, even though the positive control results of the electrical engineers. It is also same for the architectural design, for example, if the air conditioning channels do not enable enough spaces, additional split conditioners or cooling towers should become necessary to be used on the surface of the building and these are the elements, which cause esthetical damages to the building.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

It seems little bit impossible. For example, if you have established only a mechanical system but don't have any fire detection system, this cannot be evaluated as IB. According to my opinion, fire detection system is one of the elementary components that should available. Together with this, the main factor, which determines the intelligence, is the number of the points that are controlled. 40.000 points are controlled in Polat Tower and much more points in İş Bankası. Surely, the technologies used within the buildings are also very important. In brief, the technologies of today and the one of three years ago are completely different. Therefore, the Polat Tower shows more intelligent properties in compare to a building with a capacity of 50.000 points due to the technology of three years ago. The latest technology and developed protocols, which enables the communication between the systems, are used in this building. In the meantime, some special equipment designed for this project was used beside the standard products and systems. The architectural details are not accepted in the mean of intelligence grade.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

There are many measures, in order to be taken to achieve the accessibility problem. If you do not give possibility to access, nobody can enter into your system. Anyway, there are also many access levels. It is obvious, at which level the operators may work and what they may do and all of these performances are recorded. Being a disadvantage for IB is not possible. With the help of the automation, the comfort conditions can be controlled with a period of 2-3 seconds. This kind of a control is not possible for human beings. It enables a great deal of operational personnel decrease and energy saving.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

In Turkey, the project designs on site. The Europeans work for a project during a year and they finish the building in two years. The Americans work for a project during two year and they finish it in a year. On t he other hand in Turkey, there is no any work for project before but building is finishred in three years as other countries.

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

This concept is new for Turkey so that there is not a certain definition and criteria for these buildings.

QUESTIONNAIRE WITH HALUK TÜMAY

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

Buildings cannot be considered as intelligent; only the mankind can be defined by the term intelligent.
The criteria for an IB easement in use and operate, modest in design and should not express its technology. Intelligence of the building could be adequate if the building system could control the building without any intervention, if it could warn in case of any failure, if it could decrease the operation costs, and if it could offer alternatives. In addition to these, intelligence does not mean electronic systems. Building could not be defined as intelligent if materials are not chosen intelligently.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

The role of an architect on design is knowledge is similar to a book on a bookshelf to an engineer; architect is the one who takes and utilizes them. To design the projects is not an architect's single duty; he also must be knowledgeable on static, mechanic and electronic at least as he is on design. In other words, he should have the ability to add aesthetic values to alternatives that functionally recommended by engineers. The consultant manager presents you an offer package, however, does not state how to deploy it. Architect plays the role at that point. If both the scenarios are well prepared and the people who work together are selected fastidiously, then results will be satisfactory. Otherwise, building itself becomes the design of the person studied the building on static, mechanics or electronics aspect. Human has a single mind, if an idea cannot come to true even smartest people cannot do it. However if it can, an architect should figure out the one already possible. Some of Turkish architects, unfortunately, are easy-going on this issue.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

The all systems applied to the building, must be shaped as the building is designed. Systems that are foreseen at the beginning, work in the same productivity until if work is done right. Here architects are charged with important duties. An architect must think about everything, including operation and maintenance of building that he designed, in design process

QUESTION 4: Is it possible to make intelligent an existing building?

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

The reflection of the investment to the architectural project is calculated according to some questions: What kind of savings do we have when using this technology? What is gained and what is lost?

The cost issues are very important and everything has a cost. More importantly, designers must be thrifty when spending client's money. In this sense, task of the architect must be to find out the needs and the demands in a sound way and implementing the systems needed to the building according to these demands. It is not more than to make investment unconsciously because of the ability of consumption. Property owners try to decrease the building costs usually if they are going to sell the building, and they pay more attention if they are going to use it personally. In this point of view it is necessary to inform both the designers and the property owners in this issues.

QUESTION 6: How do you elaborate on trans-disciplinary process?

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

The intelligence, which is mentioned, is proportional to whether the systems that are loaded to the building are determined according to the needs or not.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

A man cannot think as comprehensive as machines. Machines think and produce various scenarios, bring practical controls to life and find the most optimal solutions that man cant think. Having for a healthy life people need comfort and HVAC systems is a part of that comfort. On the contrary HVAC systems needs periodical maintenance in order to get rid of sick building syndrome. If mechanical systems and aesthetics join together that must be done in a really good sense. For instance; a lighting system, which could manage the indoor light level due to outdoor light level, adds the building more aesthetic.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

It is more realistic and will be better to call them as "usage of right system at the right place".

QUESTIONNAIRE WITH MEHMET KONURALP

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

Intelligence is to perform the program that loaded the system before automatically. Intelligence is also a result of human development process. A building should have physiological, economical and flexible characteristics for calling it as intelligent.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

An architect should have the knowledge both to organize all space features and to get into dialog with all technical disciplines. The architect also prepares the scenario that is suitable to programme thus directs the engineers.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

The design period is not depends on the building's intelligence.

QUESTION 4: Is it possible to make intelligent an existing building?

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

IBs bring high amount of cost at initial investment, but brings low life cycle costs.

QUESTION 6: How do you elaborate on trans-disciplinary process?

Architect as an organizer invites the whole-engineering units that effects space to the design process. In addition to this, inviting the property owner or the user to this group would obtain taking more healthy decisions. With this approach, individuals would have an opportunity to improve themselves in other issues.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

Level of intelligence is proportional with the services provided by the building and a classification is made on a scale of one to five.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

These kinds of buildings have the capability to respond user comfort, besides the need for flexible life and study places.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

The concept of building intelligence is in an early period in Turkey; firstly technological information has to be reached to the industry.

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

Calling these kinds of buildings "contemporary buildings" will be more realistic.

QUESTIONNAIRE WITH AHMET YAĞCIOĞLU

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

The concept of "intelligence" is a quite pretentious to use in buildings. A building could operate just as it is programmed. Not more or less could happen or expected. However, human keep the situations in the memory and act in order to them, but even in case of unexpected situations people can act flexible.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

More than the IB term, owner's point of view to the building, and architectural possibilities bring about the constraints and opportunities. Exploring a solution in between those aforementioned and owners tolerance is now that the architects responsibility. Engineers, on the other hand, within possibilities inform architect on the feasibility of scenarios, ensures development of decisions made as well.
Architecture itself is not pure art as in other arts; rather it is a profession that offers entire opportunities of the technology to human beings in accordance with human beings' needs. Economy, technology, sociology and even psychology are important aspects to an architect, and an architect deploys these to meet human needs. An architect is an organizer at the heart of all these. That is why, instead of "role of an architect" term, "how successfully has an architect utilized these or have them utilized" question is more important. Thus, complete list of systems applied to buildings must co-ordinately be integrated under the architectural project discipline.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

It is not too much easy to perform the changes related to the functions or to the requests onto the buildings and it had been faced with similar problem at the ARKAS Building.

QUESTION 4: Is it possible to make intelligent an existing building?

In ARKAS Holding Company Building there is a similar case. Buying a semi-completed building and converting it into an IB, brought up serious problems such as pre-defined floor heights are not appropriate for cable and HVAC channels. Because of these problems, a way for search of new systems is determined and for cables channel system application is chosen. But for the HVAC system–though by consulting the static engineers- a solution of piercing the beams has been an obligatory way.

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

The VRV/HRV system, although the cost of its investment is high, has been applied to this building for the first time in Izmir, through convincing to the building owner about its usage advantages and more economical costs as a result of energy protection in compare to Chiller system.

QUESTION 6: How do you elaborate on trans-disciplinary process?

For example, at the same ARKAS Building, after having understood that the channel application in the Chiller system cannot be performed because of the insufficient flat height at, at that time they thought about solution proposals and agreed with Genta as Consultant Company. After having determined the system and as the result of discussions with the statistician, it has determined that the copper pipes can be passed through boring the beams. In brief, this was the result of cooperation between architects and engineers.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

Our building is the first project in İzmir that used much of latest system and technological support while trying to solve design problems.

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

It is quite exaggeration to call them intelligent, buildings that is managed with the given data must be called "robot buildings".

QUESTIONNAIRE WITH BÜLENT ONUR

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

The intelligence is understood only as automation until the recent times. In other words, the systems, which electromechanically perform more than one work by itself, are called as automation. In order to be able to call a building as intelligent, it should firstly have “the ability to give logical decisions”.

According to my opinion, the buildings that we called as intelligent are just a protocol that is changeable in empty pipes. We buy a new tool instead of changing its intelligence because of its high cost. Buildings are stabile and not just a shell for the technology, because, technologies change continuously within the buildings. In brief, intelligence of the building and equipments has not the same meanings.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the “scenario”? What is the role of the architect in the design process of an IB?

I, as an architect, cannot produce the automation, but, able to use it. The architects are “voluntary work developers” within the technological development. The process, where there is not sufficient architectural support available, cannot be called as a “building technology”. The reason for this is not only belong to the understanding of the architects, but, also their “superposition” ability. If you have not the conceptual power on the subject, your building can be out of date at the end of building’s production period or its failures could be found out in a laboratory test. The architectural duties are generally consisted of performing the superposition and gathering the products of different companies having their own protocols within the scope of a plan and having the awareness about flexibility of the used systems and providing the harmoniously work of all these in building disciplines.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

If the technologies are not proposed on the infrastructure stage, it will be too difficult to adapt these thereafter. It occurs a design problem here. Actually, “infrastructure” is just an empty pipe. Because, the high technologies are furnished firstly and then, they used. If necessary, they can remain empty forever. These empty pipes should be established due to the final scenario. As result, the initial investment of technology its not too much high as expected. Another problem is that we do not prefer the use of standardized items and we always try to design special products. However, the products belonging to the building systems are standardized according to customer demands.

QUESTION 4: Is it possible to make intelligent an existing building?

The building electronic is not a technology that is just used for new buildings. It also put into practise for existing buildings and this is just a modification problem.

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

There are only one or two companies, whose production field are only consisted of automation, in the world and these provide only very limited production. The annual turnovers in the field of building electronics are very low in compare to other sectors.

QUESTION 6: How do you elaborate on trans-disciplinary process?

Technology continuously changes and develops day bay day. In the mean time, no company has a product range that is enough to cover all needs of a building. In this regard, the companies are in a position to find strategic partners to work together in harmony.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

Intelligence is a concept, which is very relative, which its limits cannot be defined and pointed out that there is no parameter to define that concept. In addition to that, the building that uses the advantages of the latest technologies is the most IB. On the other hand, it is another important factor, whether the used technology covers the requirements or not. We are able to control the heat or light with a few sensors, but these are not an indication of intelligence solely.

According to my opinion, a classification could be possible, if you are able to determine the amount of your annual benefit or capacity increase of your personnel with the system. However, it will not be right to compare a building with others, because each building has its own location, program, investors and users.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

The benefits of IBs are the comfort and economy provided by HVAC systems. He maintains the view that the first reason to produce these kinds of systems is economy and secondly taking control without human interruption. According to daily mental manner, human could do mistakes easily, besides that machine operates your command without compensation.

Above all this it has reduced personnel need. For example, the architects lead the design according to the contribution of latest technologies on spatial quality.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

Normally, first the demand and then supply comes in question. But, supply comes before the demand in our country. We, the specialists, are able to understand and imagine these systems and therefore, we are able to explain these to the others, that if they start using these systems, they will gain more benefits. This concept is strengthened with the commercial wordings such as "live in future now".

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

I approve that to call IBs "e-place".

QUESTIONNAIRE WITH EMRE ÖZMEN

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

The concept of IB has more than operating the building from a center. From now on IBs are those that are being operated by different BAS and also whose systems could communicate to others at the centre. This is the real intelligence and IBs in Turkey are not yet a part of that system.

All of the sub systems are gathered under a main SCADA system on management level. The processes perform by Process Data Manager (PC) of each subsystem. In this stage, all data are gathered, processed, and transferred to the main software. Nevertheless, the users, who are included to the system as operating stations and viewers, may be in Process Data Manager (PC). As a property of the Scada system, the Process Data Managers are protected with backup copies. The system may also have the web access property. The users may communicate with the system over intranet or Internet. All of these properties are related to the main software of the IB system. In some cases, when there are numerous buildings dispersed to different locations such as the university buildings, they could also be gathered under one center. For example, Sauter enables the interactive connection of 220 buildings together with all subsystems of totally 60.000 points for Zurich University.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

The scenario is determined by designers and consultant managers who are worked independently..

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

There should be different solutions that depend on the function of building. This is the most appreciated side of this work. There is much kind of sensors that change according to process.

QUESTION 4: Is it possible to make intelligent an existing building?

For instance, Istanbul Profilo Shopping Center is in fact designed as a factory building. Because of the limited spaces, computer command center accepted as the heart of the building is placed in the basement where also car park exists and so the access to this center is quite difficult, the place has no spatial quality. In the same way, the boiler group, which are supposed to be placed in the building, are parted into two because of limited space problem and the connection between the parts are tried to be provided with giant tubes. These conditions affect the system's output in a negative way.

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

It is not possible to figure out how long it takes for an IB to pay back the cost of the initial investment, because it varies from building to building. Even if we built two buildings, which are the same, but only if one of them has different thermal insulation, the amount would change. For this it is necessary to make very serious simulations. Additionally, investment made for building management systems saves from %30 to %40 and even up to %50 when the building is in operation.

QUESTION 6: How do you elaborate on trans-disciplinary process?

There is usually a dissension between architect and engineers. For instance, when 10 m^2 area needed for an air conditioning terminal which mechanical engineer designed, and when the architect reserved only 5m^2 for this system then the mechanical engineer has to divide the whole system into parts and this results in unproductive operation of the system. In addition to this, the main subject that architect difficult me is the location of equipment. There are important criteria for determining the location of electronic equipments like sensors. For example, heat sensor should not be located in the door entrance because there it would effect from the airflow. In the same manner, it would cause unhealthy results locating it to a place where it would directly affected by the sunlight. Equipments in the living areas are assembled by the demand of the architect to the unseen technical areas like the spaces above the suspended ceiling. Yet, the design of air quality sensor, fan coil sensor and humidity sensor should be aesthetic and between the alternatives the aesthetical option, which is more likely for the architect's aesthetic demands, should be preferred.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

A building is intelligent as the number of points, which can be controlled. I do not know a classification on this theme but in my opinion there will be. Because building intelligence is a trendy concept that spreading all over the world quickly.

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

The benefits of IBs are the comfort and economy provided by HVAC systems. The first reason to produce these kinds of systems is economy and secondly taking control without human interruption. According to daily mental manner, human could do mistakes easily, besides that machine operates your command without compensation. Above all this it has reduced personnel need. One disadvantage of this is the management becomes much harder as a building becomes much complex. However, a stranger or a hacker cannot enter the system easily. There are 4 levels of entry to the system. Alternative strategies can be applied if plan 'A' doesn't work you can use plan 'B'." And even if the computer shuts down the system runs. System runs in 3 levels; "data collection, process operation and communication". Even if the 3rd level shuts down the first and second levels run. Only visual connection can be lost. In this situation user may operate small hand panel sand second level bulletin board switch the help of the jacks user can plug in to the system and make connection. Furthermore in case of earthquake when the first and second levels shut down there is a bypass system that controls the system manually.

If the system is not designed hygienic and economic, and if the fresh air intake of the building is not properly calculated and designed, it cannot intake enough fresh air, because of not enough fresh air availability, even though the management systems gives continuously fresh air intake alerts. Anyway, there are very serious securities in the system. For example, the A. Bank has numerous branches in Germany and they should speak each other. This cannot be only enabled with arranging a visible wiring and that can also be provided via special phone lines. We call this as Wide Area Network (WAN). With the help of WAN, a person from the general center can trace the whole system. The mini systems enabled with wiring are called as Local Area Network (LAN). On the top point of these systems, where they communicate on highest level, it has generally been put two additional computers as a protection measure against the possibility of computer's collapse. The "Shared Tenant Service (STS)" is a system, which has numerous users and numerous viewers. But, we are able to arrange and to determine the authorizations of these users. For example, we are able and have the right to determine that the general manager can view everything and the technical manager may also view, but, he cannot be able to change the set values – format values -.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

The concept of the IB means the computer controlled buildings or the buildings that are under service of a building management system. Nowadays, we do not call these as IBs: Now, imagine a building and its all systems are under service of different building management systems and you enable their communications on the top. This is what we call as an IB today. There is no building due to this system in Turkey, but there are thousands of buildings similar to those you told. On both of industrial and semi industrial and domestic means...

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

The investors, owners or contractors named their buildings as intelligent accordingly the money that they spent.

QUESTIONNAIRE WITH ERTAN ANIL

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

Intelligence is a qualification to maintain ordinary workflow without any hesitation.

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

Tasks of architects are satisfying sufficient coordination between disciplines, placement and shaping of IB control centers, which might be of several in number for multi-storey buildings, resolving details to hide equipments of an IB in the design stage and modification of spaces to fit human needs.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

The most important difference between the design process of conventional and IBs is to determine the principles of automation system in design phase, so the design work is made appropriately.

QUESTION 4: Is it possible to make intelligent an existing building?

This process is more complicated and expensive than designing and constructing a new IB.

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

IBs cost from %1 to %10 more than conventional buildings. This amount changes according to the level of the intelligence. Although this amount looks like a serious amount of cost, when the energy savings that are gained by this technology and additional costs that are gained by well management considered, it is understood that this numbers aren't so frightening.

QUESTION 6: How do you elaborate on trans-disciplinary process?

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

By means of intelligence of buildings, the problems that can occur during operation are minimized, life quality is increased and energy is saved. Comfort of IBs is higher than the conventional buildings. And also IBs are more useful and safer than conventional buildings.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

Growing demand on a high standard living, growing need for multi-storey housing because of high lot prices, demand for economy make IBs obligatory.

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?

QUESTIONNAIRE WITH HALİT YÜCE

QUESTION 1: What does intelligence mean in terms of a building? What kinds of criteria are considered as the intelligence? Is the intelligence just an end product or a result of the computer technology?

QUESTION 2: In the IB design process, are they architects or engineers who took the main decisions about the life style; in other words who decides the "scenario"? What is the role of the architect in the design process of an IB?

The main decisions about scenario are determined by architects. Than, engineers are developed them. In addition to that, I am as an architect, continiously looking for more economic, more quality and more effective materials, systems, etc.

QUESTION 3: What are the differences in terms of inputs and outputs if you consider the IB design process with the conventional building design process?

QUESTION 4: Is it possible to make intelligent an existing building?

QUESTION 5: What is the difference between an IB and conventional building in terms of cost issues?

QUESTION 6: How do you elaborate on trans-disciplinary process?

When we were starting the automation applications, we meet with a number of automation companies. Accordingly its service, reference and finance, we choose the most suitable one. Than, engineers and architects produce scenarios.

QUESTION 7: Is it possible to classify the intelligence level for buildings or is it logical?

QUESTION 8: What are the benefits and problems related to IBs? How does IB approach effects on spatial quality?

User can see with a monitor where the damage is. Thus, IBs are advantageous in terms of interrupting the system immediately and providing safety, saving money and also saving time. For instance, in case of a ventilation system trouble at indoor car park, people can be poisoned by carbon monoxide. The importance of urgent self-response and early warning systems are seen in such situations. In another benefit of building intelligence for instance, the reason for Turkcell/Digiturk to rent the building built in Yıldız by Kemal Celal Polat Construction is because of a well-defined and constructed infrastructure system. Because of its function, this enterprise, which has many automatic control systems, has chosen this building by taking into consideration, the existing infrastructure in the building and location criteria.

QUESTION 9: How do you evaluate spreading of IBs in Turkey?

QUESTION 10: If you think of the applications in Turkey, how suitable is the word "intelligence"?
This adjective use on buildings for easy marketing...

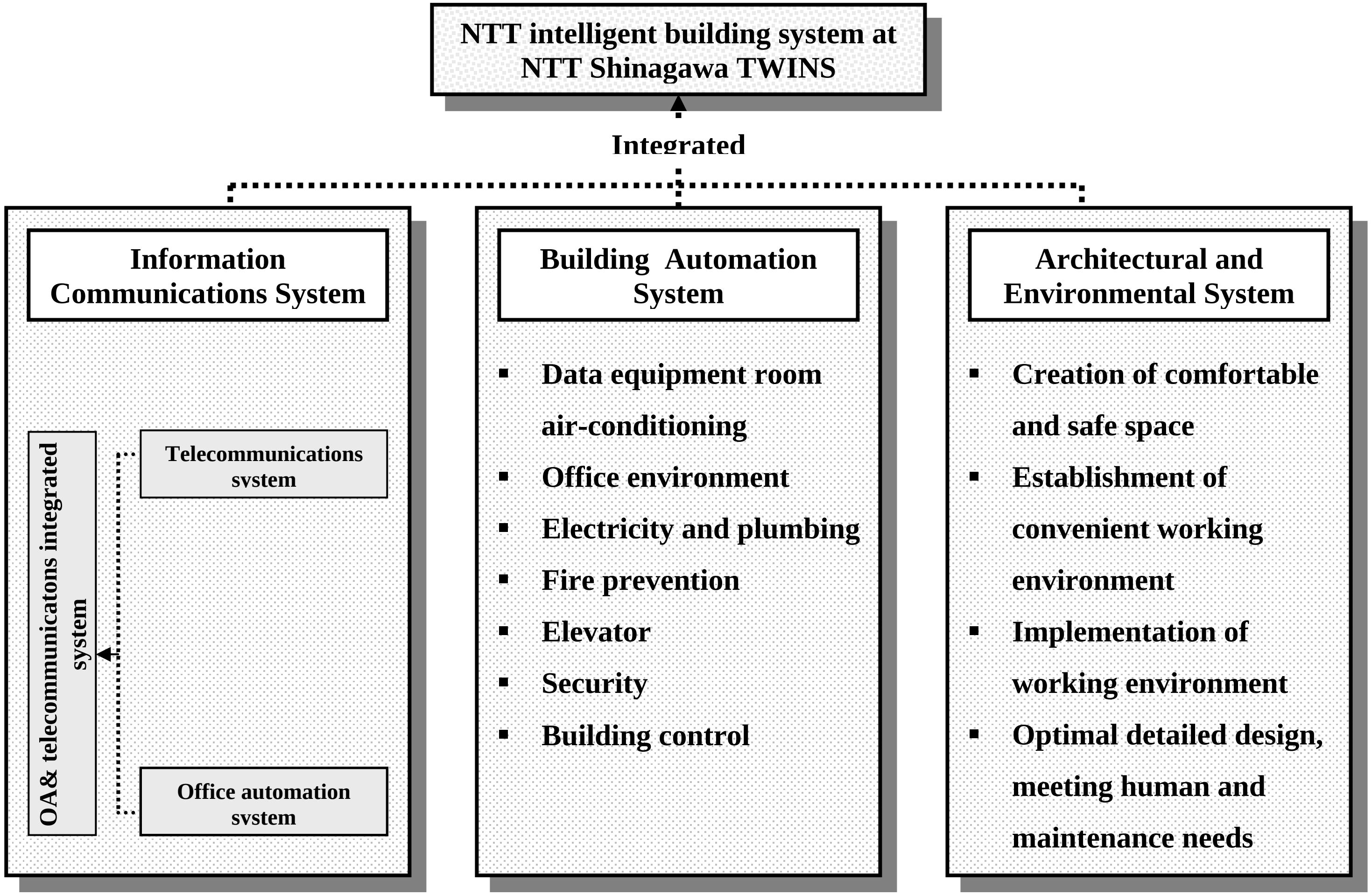

Fig. 2.3. NTT Intelligent Building System At NTT Shinagawa Twins (Source: Matsumoto, 1988)

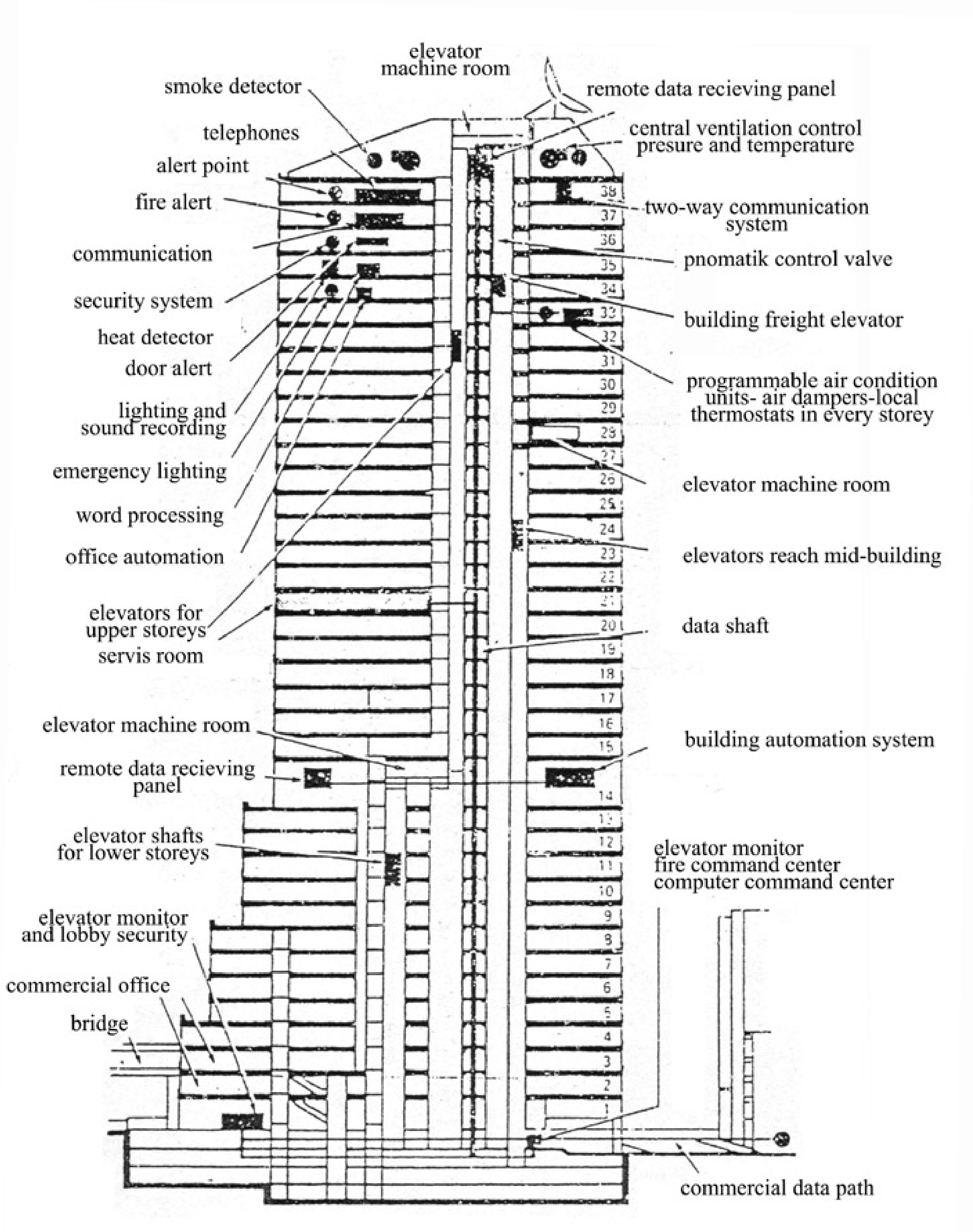

Fig.2.1. First Intelligent Building, Connecticut, USA, 1981 (Source: Özer, 1996)

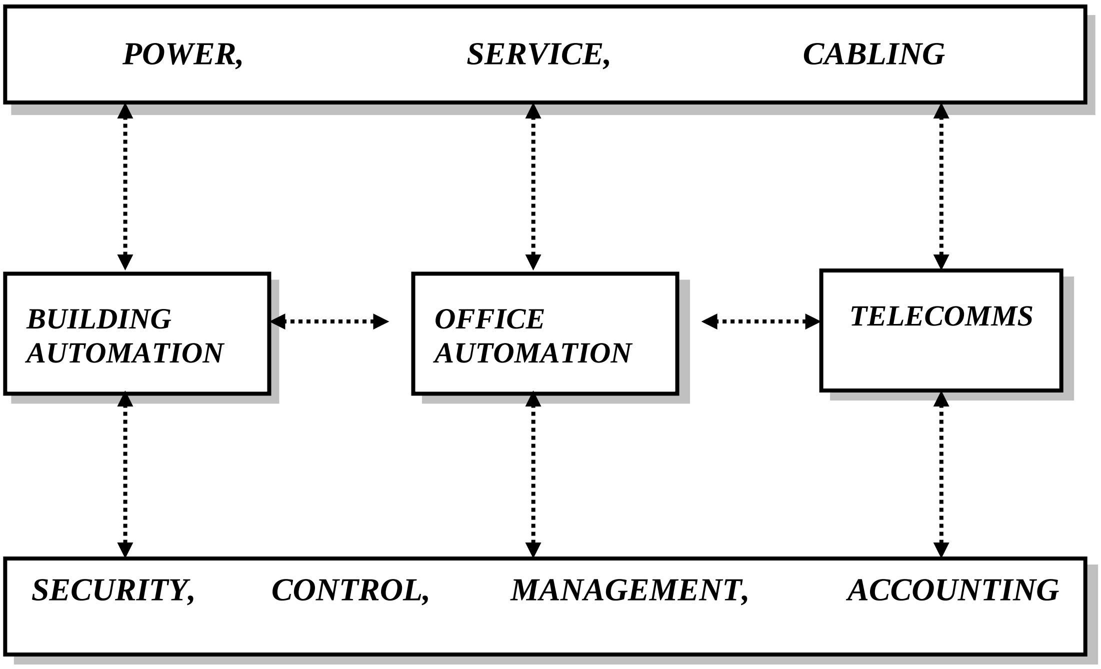

Fig.2.2. Intelligent Building Systems
(Source: Chalmers, 1988)

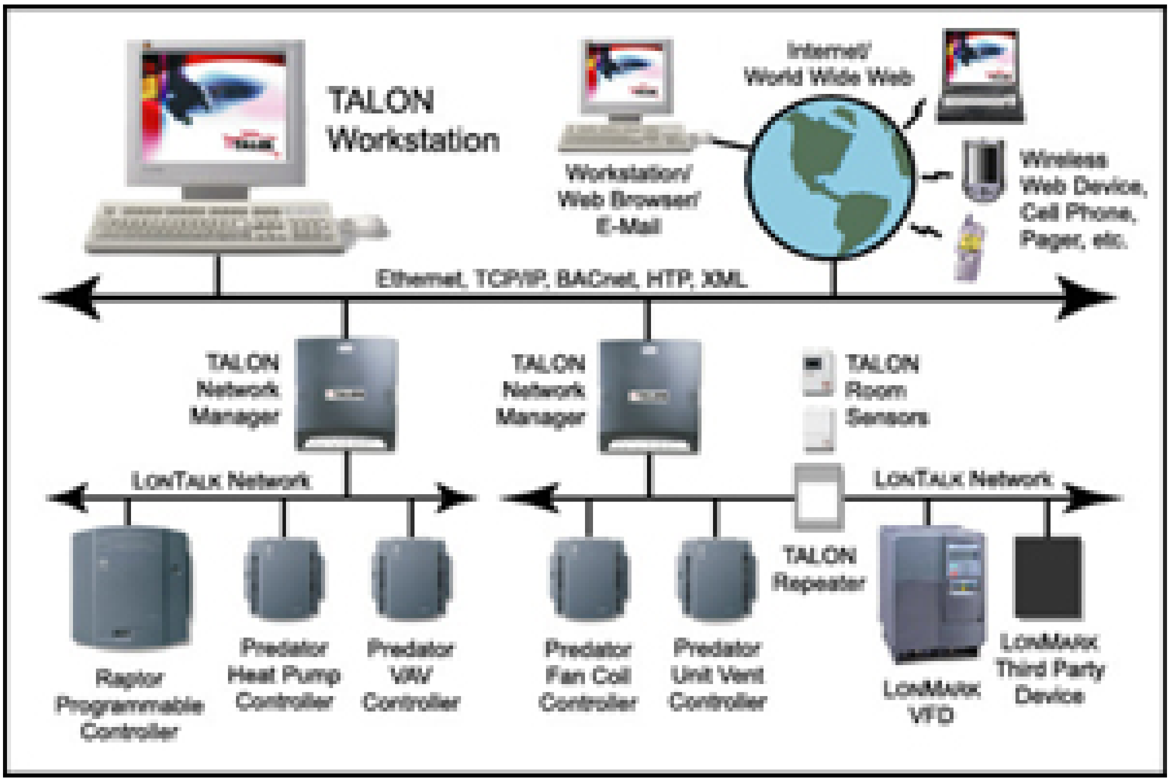

Fig. 2.4. The Diagram of Intelligent Building Systems

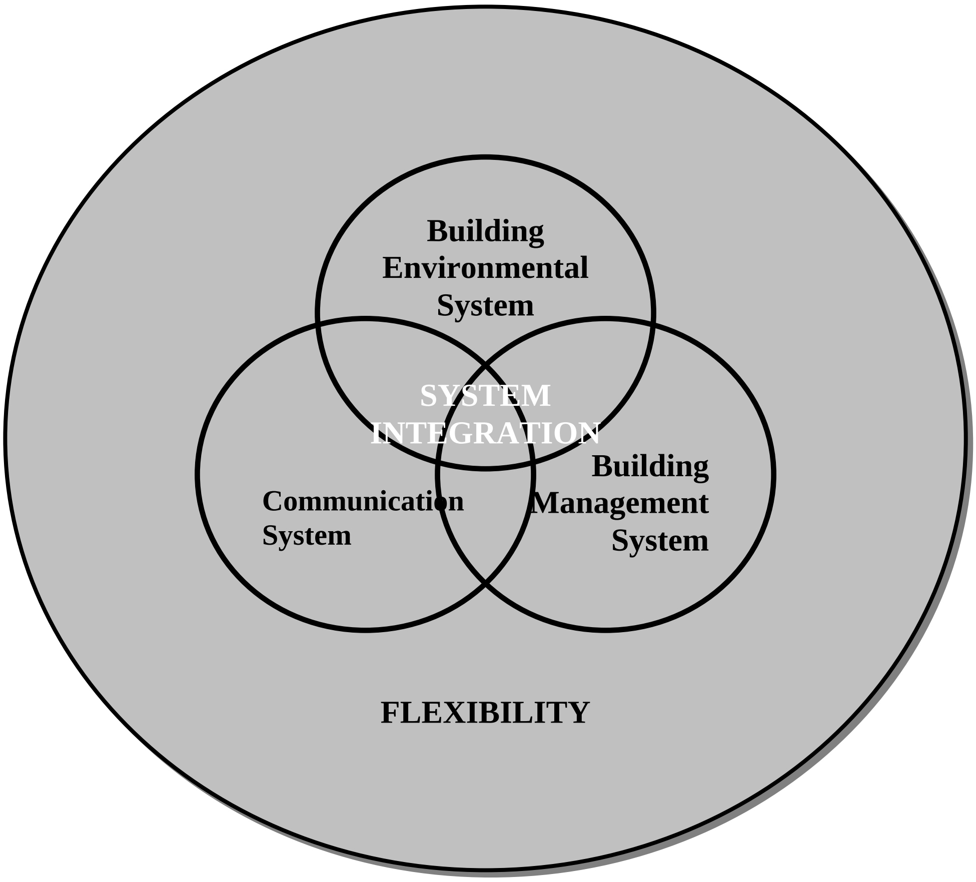

Fig. 2.5. Concept of Intelligent Buildings (Source: Fuji and Mikami, 1991)

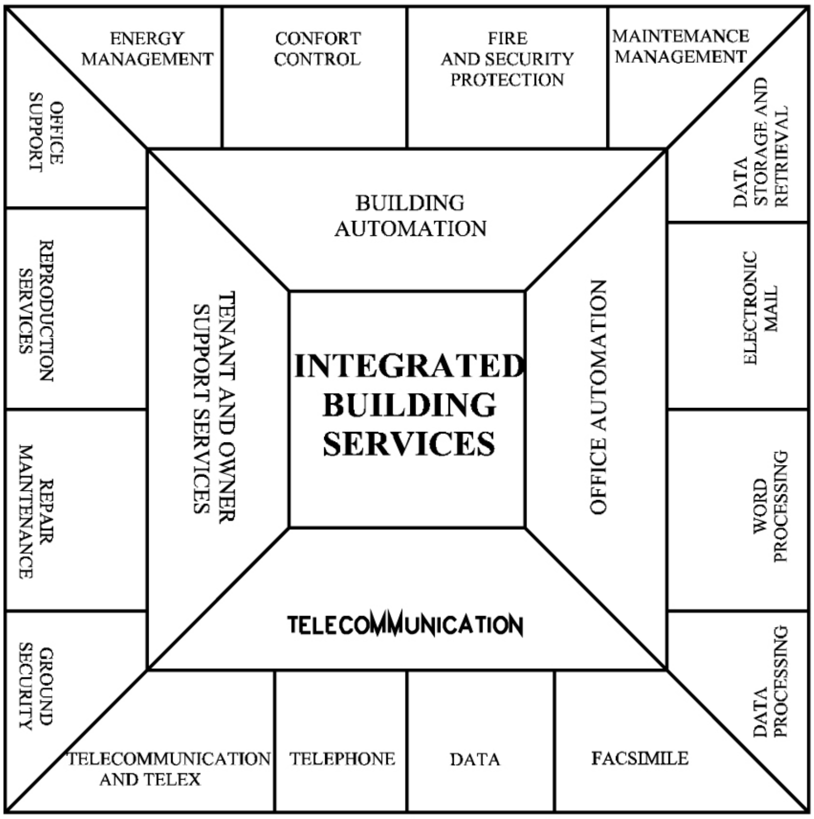

Fig.2.6. Integrated building services model
(Source: Klein, 1988)

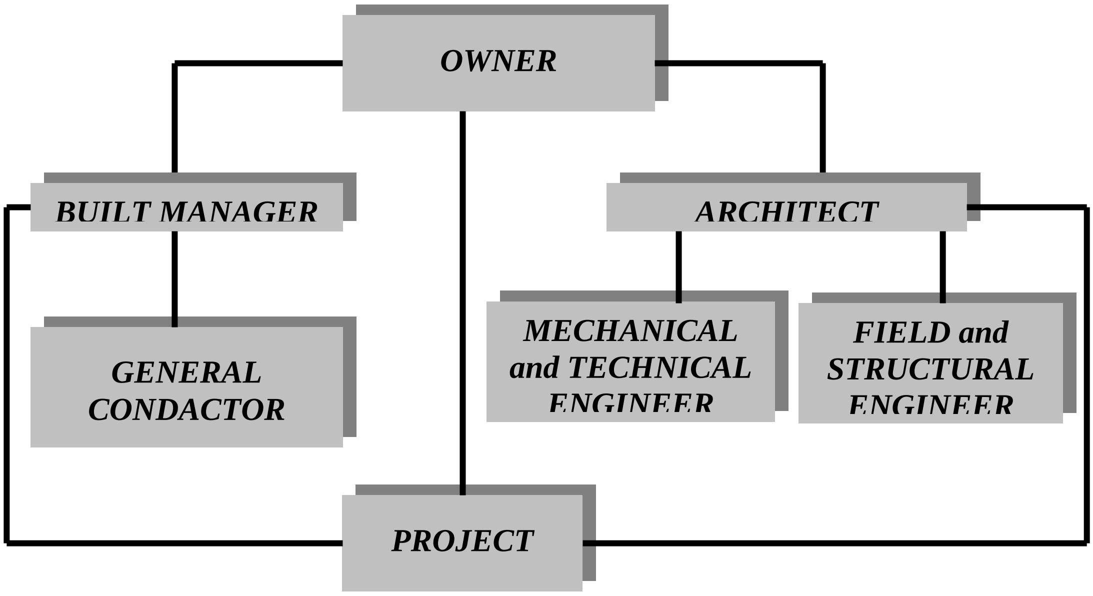

Fig. 3.1. Traditional Organization of Project (Source: Özer. 1996)

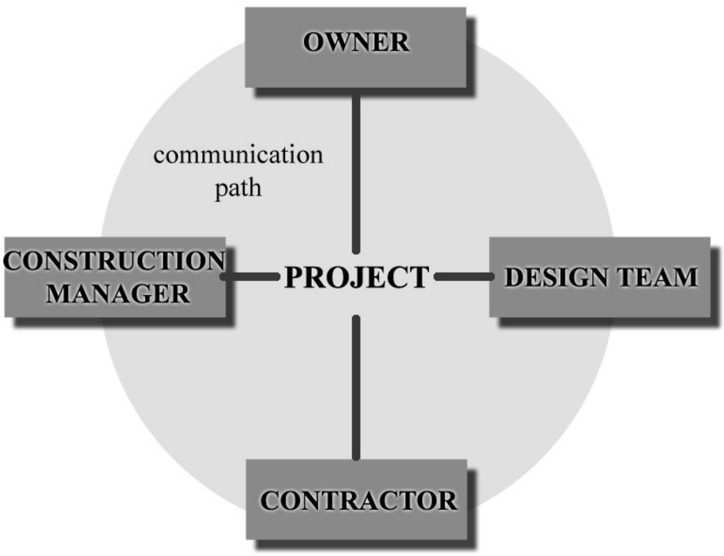

Fig 3.2. TIE Organization Scheme (Source: Özer, 1996)

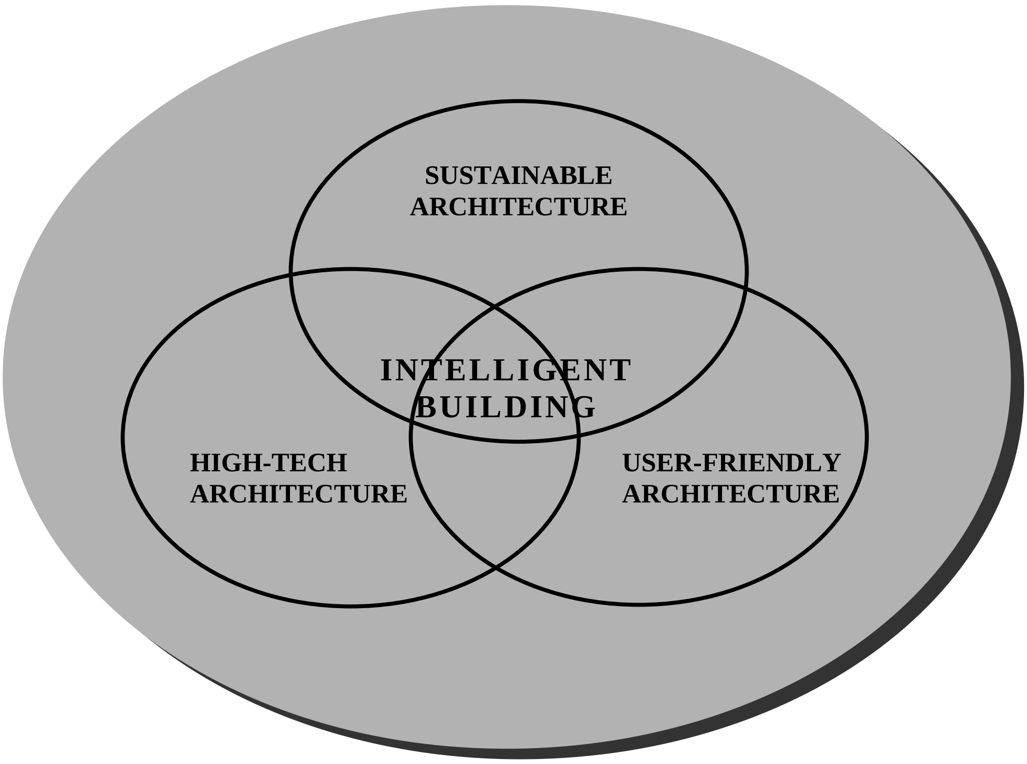

Fig.3.3. Trio of Intelligent Buildings

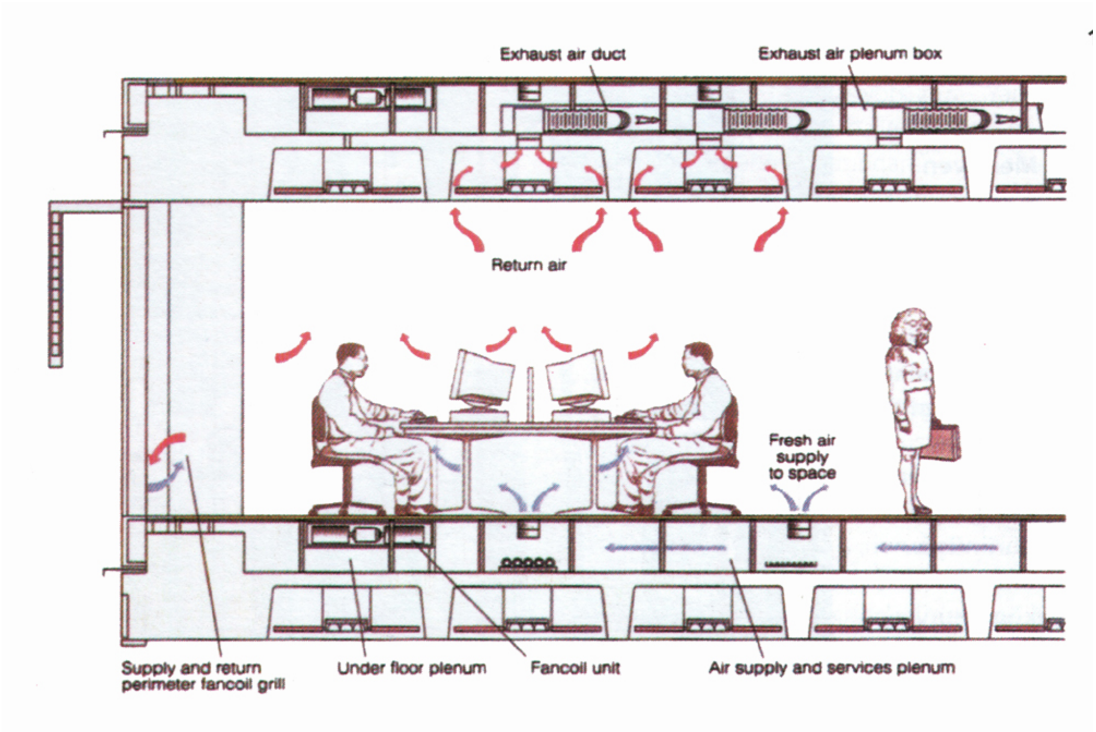

Fig. 3.4. Section from an Intelligent Office Building

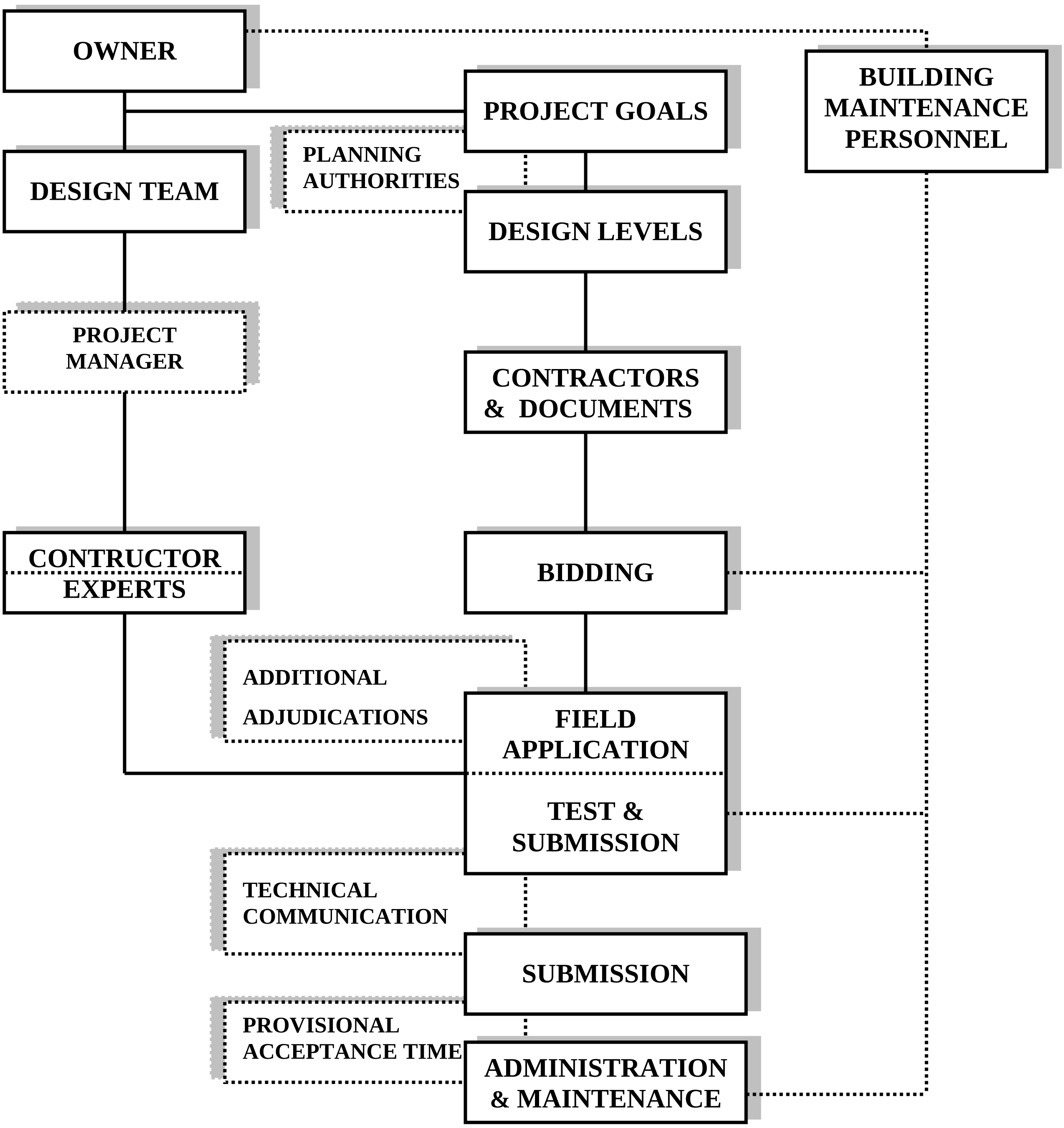

Fig. 3.5. The Communication Of Superstructure Of Building From Pre-Decision Phase To Management Phase (Source: Özer, 1996)

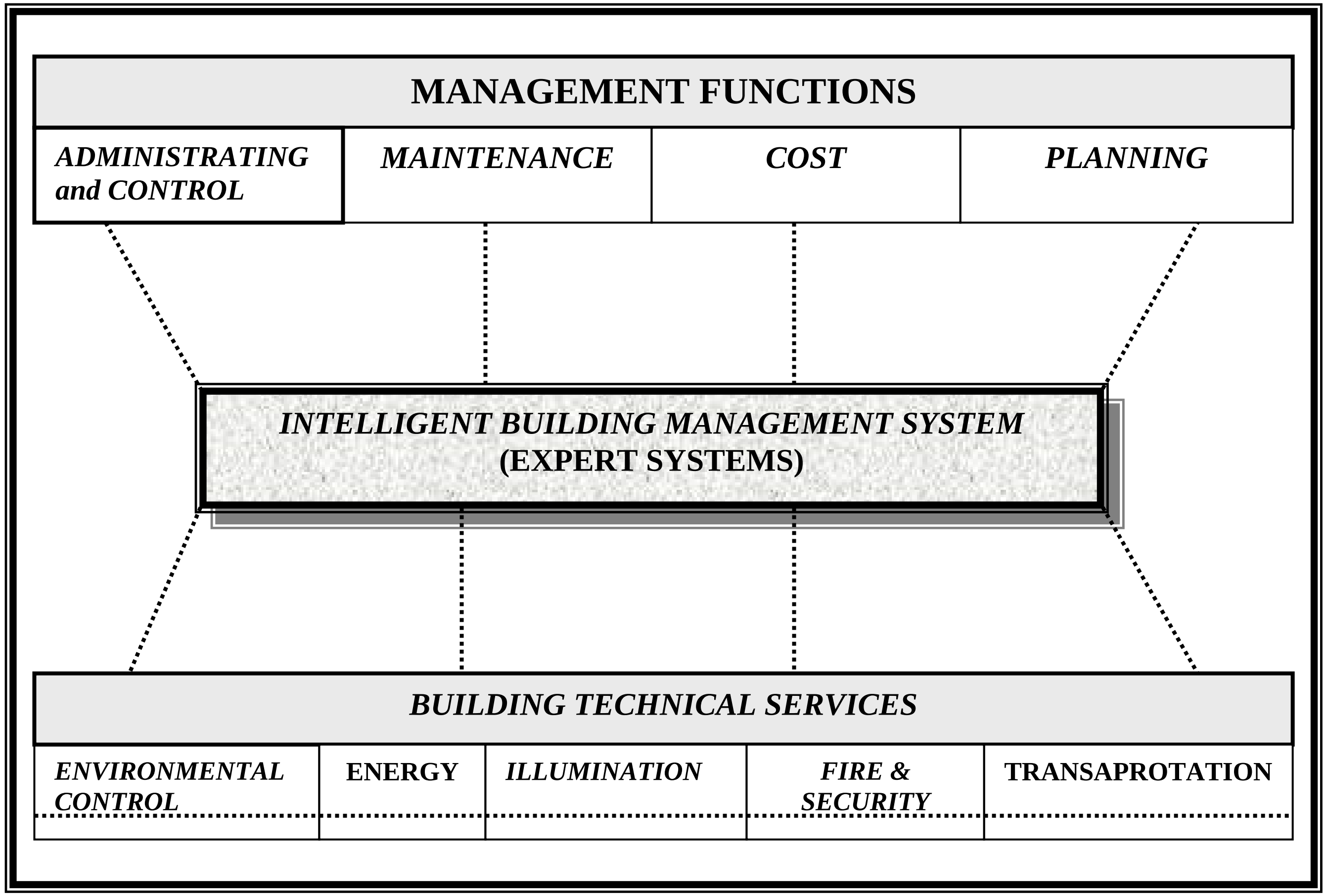

Fig.3.6. Intelligent Building Management System (Source: Özer, 1996)

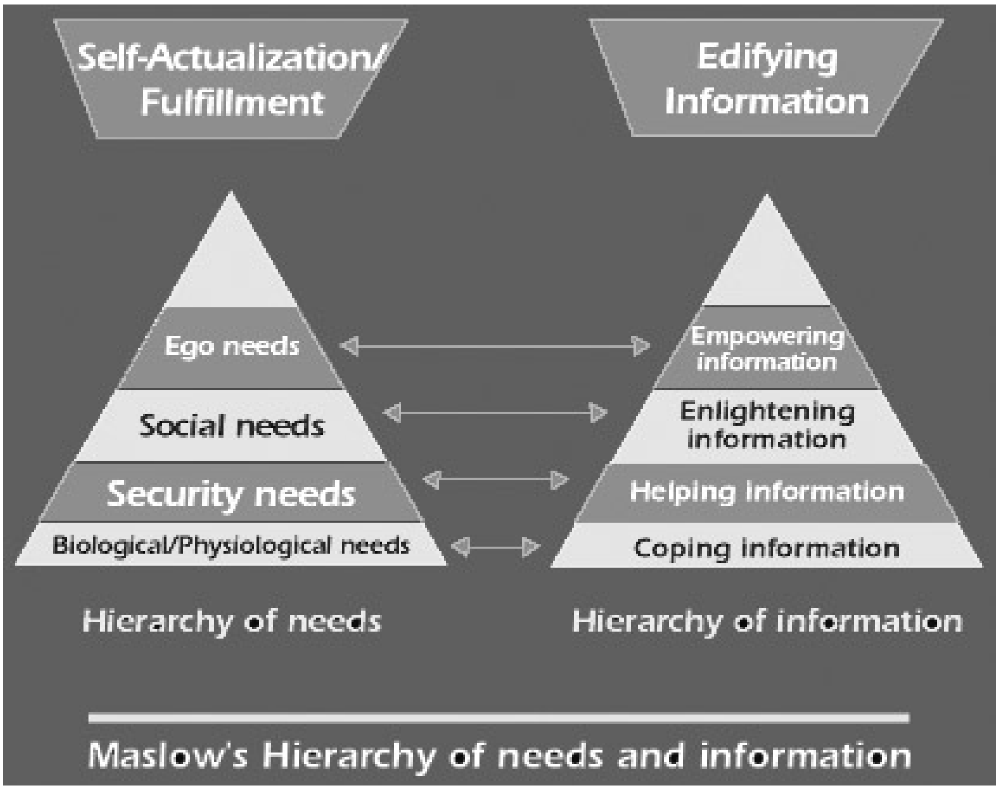

Fig. 3.7. Maslow's Hierarchy of Needs and Information Technology

Table 2.3. Technologies for Furthering The Progress of Intelligent Buildings

Intelligent Building System	Technologies
Office Automation systems	Office document architecture (ODA)
	LAN network management software
	RICS architecture
	Multitasking OA/Multimedia OS
	Intelligent expert systems
	Multimedia LANs (FDDI-II)
	Natural language programming
	Iccard systems
	Multimedia relational databases
	Fifth generation computers
Communication Systems	B-ISDN
	Multimedia multiplexer
	Speech synthesis/speech recognition
	Multimedia PBX
	Private networks
	Multimedia communication Protocol
	Intelligent communication services
Building Automation Systems	Integrated Facility Management Systems
	Emergency measures control systems
	Fault warning/diagnosis systems
	Standardization of transmission methods
	Multi-vendor systems
	Open protocol/object oriented technology
	PMV control
	Long-range radio alarm/surveillance systems
	Facial recognition systems
	Intelligent sensors
Building Engineering&	Multifunction raised flooring
Environmental Planning	Predictive integrated wiring system
	Highly reliable wave supply systems
	Co-generation ceiling systems
	Personal under the floor air conditioning systems
	Atrium/toplighting
	Isolation/vibration control from earthquake
	Electromagnetic shielding systems
	Fuel cell systems
	Garbage conveyance systems
	Flexible office partitioning systems

(Source: Kujuro and Yasude, 1993)

Table 3.1. Most important user trends in IB (Future Technology Surveys (FTS) Panel)

Most Important User Trends

- Networks
- Office automation
- Integration
- Protocol discussions
- Telecommunication adoption
- Fiber optics
- EMS and energy management HVAC systems and equipment
- The push for integrated data from related building systems and access to the information from multiple locations
- Systems integration of distributed “smart” controls like boiler room or process systems
- Use for interdisciplinary functions
- Security environment
- HVAC control
- Lighting
- Comfort
- Air pollution (indoor air quality)
- Energy
- Building flexibility —— lower costs
- Faster construction
- Less labor intensive
- Modular equipment
- Telephone voice interface
- Building in energy conservation
- Multiple operator stations with multiple access levels
- Integrated safety, security, DDC
- Open protocol
- The change in the way offices communicate with the outside world
- The changes in the availability of alternate communications network
- Also the availability of dual telecommunication networks
- Facility management systems (to include security and fire, communications, etc.)
- Equipment and sensor history
- Building Managers
- Graphics at every workstation
- Possibly full motion colour video
- Integrated-building systems with occupant comfort designed into the system

(Source: Miller and Rupnow, 1991)

Table 3.2. The Parts of CBI Test

Carlini Building Intelligence (CBI) Test	
Communication Technology	Telecommunications (Voice, Data and Video) Local Area Networks (LAN) Cabling Distribution Roof-top Communications Security/Elevators
Information Technology	General Information/Building Characteristics Office Automation Information Processing Document/Records Management
Building Automation Technology	Environmental Systems Temperature Control Systems Building Automation Systems Life/Safety Systems Lighting Control Systems Elevator Systems Emergency Power Systems Building Operation Radio Systems

Table 3.3. Levels of Building Intelligence

LEVEL 0	Provides non-computerized control for energy management and elevators, It may or may not have any lifesafety or security systems, This buildings has no intelligent amenities, This buiding does not qualify for an IB classification
LEVEL 1	Provides an infrastructural core, Including computerized systems for energy management for HVAC, elevators, lifesafety and security systems
LEVEL 2	Share conference/meeting room space, photocopying facilities, word processing centers.
LEVEL 3	Telecommunications services including long distance voice, some data communications and basic plain old telephone service utilizing its core cabling system.
LEVEL 4	Sophisticated office automation and information processing services including wide-band communications for video conferencing, high speed voice/data communications

(Source: Carlini, 1988)

Table 3.4. Building IQ Factors

Individual users needs	Organizational needs
Air quality	Change in total staff size
Noise control	Attraction / retention of workforce
Thermal comfort	Communication of hierarchy, status and power
Privacy	Relocation of staff
Lighting comfort	Maximizing informal interaction
Spatial comfort	Human factors (well-being of employees)
Building noise control	High status image
Amenities	Security to outside
Health	Security to inside
Motivation	Connecting equipment and changing location of cables
	Adding or relocating environmental demanding equipment
	Protesting hardware operations
	Demand for electric power
	Telecommunications
	Productivity
	Morale
	Health
	Attendance
	Work facilities

Local environmental needs	Global environmental needs
Site wind effects	Greenhouse gas emission
Site noise effects	Low energy design
Site day lighting effects	Minimization of air conditioning required
Site shading effects	Use of low-emission energy source
Harmonization with local planning	Optimal control
Reuses of existing site	GPO emission
	Absence of CFCs it refrigeration cycles
	Absence of air conditioning
	Absence of GPO expanded foams
	Use of sustained material resources
	Total building energy consumption
	Climate factor

(Source: Boyd & Jankovic 1992, FRA/DEGW 1988, Vischer 1989, BRE 1991)

Table 3.5. Intelligent Building Fourth Utility Needs

Service Interconnections	Weight
Telephone	5
Telex, fax	4
Computer terminal	4
PC	5
Computer main-frame	4
Word processor	2
Optical disc filing	3
Image filing	
Electronic mail	4
Message service	5
Photocopying	3
Database	3
Videophone	2
Video monitoring	4
Access control	5
Thermostat	5
Heating control	5
Humidity control	3
Air conditioning	5
Lighting control	3
Elevator control	
Public address	4
Paging	4
Smoke sensing	5
Temperature sensing	5
Load management	3
Cable TV	5* residential
Burglar alarm	5

(Source: McClelland, 1988)

Table:2.1. Some IB Examples Abroad

USA

- Associates Tower, Chicago, Illinois
- One DTC Building, Denver, Colorado
- PRC Headquarters Buildings, McLean, Virginia
- The Smart House, NAHB, Washington, DC
- West Bend Mutual Ins. Co, West Bend, Wisconsin
- TRW Headquarters, Cleveland, Ohio
- The Honeywell Metro Center, Costa Mesa, California
- Epcot Center, Orlando, Florida
- GE's Plastic House, Pittsfield, Massachusetts
- Four Times Square, Manhattan

GERMANY

- Colonia Insurance Headquarters, Cologne
- Nixdorf Regional Offices
- Gartner Industries R&D Building, Gundelfingen
- Media Park, Cologne
- Daimler Benz Headquarters
- Institute for Applied Microelectronics, Braunschweig
- Technology Park, Duisburg
- Deutsche Bank, Ulm
- New German Parliament,Reichstag, Berlin
- Commerzbank Building, Frankfurt

JAPAN

- Toshiba Headquarters, Tokyo
- Ark Hills, Tokyo
- Sumitomo Building, Shinjiko
- NTT's Tokyo Twins Building, Shinagaw
- Takenaga's Komuten Regional Headquarters, Osaka
- Honda Headquarters, Tokyo
- Telecom Center, Tokyo

ENGLAND

- United Distillers, London
- Lloyds of London Headquarters, London
- The Grinian, Dundee High Technology Park, London
- Milton Keynes Energy Park

CHINA

- Hong Kong Shanghai Bank

SPAIN

- British Pavillion, Seville, Spain

FRANCE

- Lycée Albert Camus, Fréjus, France

ITALY

- The Olivetti Research Centre, Italy

Table 2.2. The Buildings that called as Intelligent in Turkey

- Metrocity Millenium, Levent, İstanbul
- Polat Tower &Residence, Beşiktaş, İstanbul
- Türkiye İş Bankası Towers, Levent, İstanbul
- Sabancı Center, Levent, İstanbul
- Yapı Kredi Plaza, Levent, İstanbul
- Elit Plaza, Şişli, İstanbul
- Sabah Press Center, Güneşli-İkitelli, İstanbul
- Yapı Kredi Bankası Operation Center, Gebze
- Aqua Manors Houses, Çekmeköy, İstanbul
- The Flora Digital Houses, Şile, İstanbul
- The addition of Dr. Siyami Ersek Hospital, İstanbul
- BJK Plaza, İstanbul
- İSTEK Plaza, Atışalanı, İstanbul
- Haydar Akın Holding, Merter, İstanbul
- İstanbul Science Center, Ayazağa, İstanbul
- Prestij Music Building,İstanbul
- World Trade Center, Basmane, İzmir
- ARKAS Holding, Alsancak, İzmir

Table 2.4. Intelligent Building Industries

INTELLIGENT BUILDING INDUSTRY

Intelligent Building Management

* On-line administration and financing
* Computer-aided design for space management
* Online facilities management and planning

Intelligent Command and Control

* Life-support and comfort-personal comfort environments
* Wire management- Building and Local Area Networks (BAN/LAN), Computer, Telephone
* Maintenance, Repair and diagnostics
* Security, Access and reporting, Protection
* Traffic, Flow, Accounting and control

Intelligent Resources

* Conference and “war rooms”, On-line room scheduling
* Temporary services, Leased staff
* Package, mail-room, courier and delivery services
* Travel, conference and meeting planning services
* Day-care and health recreational gyms
* Print/copier/office supplies/services
* Interior design services, Computer-aided design (CAD)
* Educational/training services

Information Technologies

* Shared-tenant telecommunications
  Video teleconferencing
  Audio bridging services
  Audio-graphic presentation equipment
  Computer-generated slides
  Sale, rent, lease of telephone station equipment
  Sale, rent, lease of data communications systems
  Sale, rent, lease of computer and office systems
  Intercom-only calling service
  Standard and advanced calling features
  Installation of systems
  Maintenance of systems
  Authorization codes
  Toll restrictions
* Messaging
  Electronic text messaging and network interface
* Network interface-carrier and bypass
  Access to CATV networks/programming
  Remote-access ports
  Modern pooling
  Packet network interface
* Paging
  Speaker
  Pocket pager
  Cellular telephone
* Tenant/Test-building directory and information systems
  On-line concierge
* Archival storage
  On-line storage
  Vault storage and document shredding
* Intelligent/movable/programmable office environments
* On-line word/data/info processing
  OCR/facsimile/telex
* Tenant support and training
  Computer-aided instruction (CAI)
* Encryption
  Systems security

(Source: Cross, 1988)