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QUALITY ANALYSES OF TERTIARY EDUCATION FACILITIES: VIRTUAL UNIVERSITY AND THE REAL PHYSICAL BUILT ENVIRONMENT – AN ATTEMPT AT DETERMINING THE INTERRELATIONS BETWEEN THEM

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Abstract

The relations between distance learning processes and the real, physical built environment constitute the scope of the paper. Quality analyses, spatial and functional programming issues are discussed, as well as the holistic approach towards architectural designing perceived as the process of accumulating knowledge about innovative solutions for the built environment. Attempts at determining the direction for the development of the physical structure of an e-learning institution and the systematization of its functions were made.

So far modern IT and organizational solutions connected with e-learning have not been reflected in functional and spatial aspects that would support and facilitate such type of instruction provided by universities, as the development of distance learning progresses much faster than the advancement of the knowledge on the quality of the built environment. According to forecasts, distance learning shall play an increasingly more important role in the educational offer of tertiary schools, leading to the creation of a model of a "virtual university". The main challenge is to define the nature of space that could accommodate the functions involved in distance learning, on the grounds of the analyses of spatial requirements, correlations and proper proportions between the types of instruction offered by universities. The methodology of quality analyses used in architecture may be successfully applied in such studies.

Streszczenie

W opracowaniu zostało podjęte zagadnienie określenia zależności występujących pomiędzy procesami zdalnego nauczania a realnym, fizycznym środowiskiem zbudowanym. Przybliżono problematykę badań jakościowych, programowania przestrzenno-funkcjonalnego oraz holistycznego podejścia do projektowania jako warsztatu budowania wiedzy na temat nowatorskich rozwiązań środowiska zbudowanego. Podjęto próbę określenia kierunków rozwijania struktury i środowiska fizycznego jednostki odpowiedzialnej za *e-learning* oraz wyszczególnienia i usystematyzowania funkcji w niej występujących.

Dotychczas nie podjęto próby przełożenia pojawiających się rozwiązań technologicznych i organizacyjnych w *e-learning'u* na rozwiązania przestrzenno-funkcjonalne wspierające i ułatwiające prowadzenie tego rodzaju kształcenia na wyższych uczelniach, gdyż rozwój zdalnego nauczania przebiega zbyt szybko w porównaniu z procesem budowania wiedzy na temat jakości środowiska zbudowanego. Istniejące prognozy wskazują, że udział *e-learning'u* w całościowym procesie kształcenia będzie stopniowo się zwiększał, na niektórych uczelniach proces ten doprowadzi nawet do ukształtowania się modelu „uniwersytetu wirtualnego". Głównym wyzwaniem jest określenie charakteru przestrzeni, które pomieściłyby funkcje zdalnego nauczania, przeanalizowanie ich wymagań powierzchniowych, powiązań i wzajemnych proporcji. Pomocą w realizacji tego celu może służyć metodologia badań jakościowych w architekturze.

Keywords: **Quality analyses; Spatial and functional programming; Distance learning; E-learning; Tertiary schools.**

1. INTRODUCTION

Distance learning is a relatively new concept, dynamically and rapidly expanding along the waves of technological breakthroughs, and occurring so fast that it is very hard to respond to the changes with sufficiently updated knowledge about the quality of built environment. Therefore, it is not surprising that so far there have been very few attempts at translating the technological and organizational proposals of

distance learning to spatial and functional solutions that would support and facilitate such mode of study at universities. No measures have been undertaken to detect the relation between e-learning activities and the space in which they occur and if so, to assess its importance. Apparently, it seems that the interrelations between distance learning and physical space are not essential, or even, that they are non-existent, as e-learning takes place in virtual space. However, after deeper consideration, one may think of a number of facilities that must be available at universities to conduct distance learning: video-conference rooms, studios where educational materials are recorded, archives of teaching aids made available to students. So far no systematic set of activities involved in e-learning has been designated, not to mention any spatial and functional requirements of the facilities that could accommodate the e-learning activities.

2. QUALITY ANALYSES, ARCHITECTURAL PROGRAMMING AND HOLISTIC APPROACH AS A KEY TO THE EMERGENCE OF INNOVATIVE BUILDINGS

The creation, modernization and adaptation of the built environment for distance learning purposes is an issue that has only recently reached the awareness of design architects and that cannot be addresses by relying on previous professional experience, as the required information is not available and there are only few successfully implemented projects. In the design of such environment a great number of new technical, functional and behavioral problems will be encountered. In consideration of such condition, the only reasonable manner of conduct seems to be the foundation of the design workshop on three bases:

– quality analyses,
– spatial and functional programming,
– holistic approach – multi-sector, interdisciplinary research and development team.

The basic task of pre-design quality analyses in architecture is the detection of the functional, behavioral, technical, organizational and economic needs of the prospective users of buildings to be designed. This process should be an inseparable element of the investment planning stage, preceding the stage of spatial and functional programming, and the design making as such. Quality analyses, as any other research process, should have clearly specified tasks: problem formulation, basic objectives, activities undertaken to achieve them. In the course of the analyses, data are collected, interrelations recognized and concepts developed and tested. Quality analyses play a crucial role in design solutions that shall be verified from the point of view of users' needs or structural and technical requirements.

To collect the most important information on the needs and requirements of the users administering e-learning activities a preview analysis of the quality of the built environment in use should be conducted (such analysis was based on the POE method) [1] [2] with regard to the facilities created so far at Polish tertiary schools. Such studies are grounded on basic techniques of data collection [3] [4]:

– interviews with users and facility managers,
– surveys of users,
– walkthrough inspections.

The following structure may be assumed for the studies:

1. Introductory meeting (which should be attended by the users and facility administrators/managers):
– discussion on the issues involved in the project: research program, time, objectives, advantages, predicted scope of cooperation;
– appointment of people participating in the study who are the users' representatives.
2. Focused interviews: conducted individually with selected users, the interviews enable the identification of the most essential issue to be analyzed in further part of the study.
3. Walkthrough inspection – the research team conduct detailed inspections of the rooms, interviews with randomly selected users, enabling the identification of solutions that work in everyday use and collect examples of solutions that are definitely bad.
4. Data analysis: the information collected in the course of the walkthrough inspections and from technical documentation provided by facility administrators.
5. Supplementary walkthrough inspections: at least 3 visits to each facility should be made.
6. Preparation of research results: the conclusions shall be drawn in the form of a report presenting the course of the research process and its outcome. The results should be used to set directions for further more detailed research tasks in the future.

7. Presentation of the results: the conclusions are presented to the users. Discussions initiated to explain possible cases of misunderstanding, inconsistencies or erroneous conclusions mark a step forward in subjective knowledge accumulation process. After the report is accepted by the authorities of the analyzed buildings, its final form is drawn up.

Functional and spatial programming serves the role of translating the conclusions drawn up in the research into strictly defined guidelines and design recommendations [5] [6]. Some key steps should be followed to ensure the accurate determination of the design guidelines [7]:

– the activities and processes taking place in the organization should be analyzed in terms of basic objectives, together with their course in time, duration and effectiveness,
– spatial and functional requirements should be defined to secure the provision of the rooms and equipment essential for the performance of specific activities,
– the functional interrelations between the programmed sections of space should be correctly comprehended,
– the required installations, maintenance and operational activities, changes and adaptation works for better space use, future configurations and equipment arrangements should be envisaged,
– the solutions should be adjusted to ICT requirements and to other intelligent systems in the building,
– the utility and durability requirements should be predicted.

One of the most important objectives in innovative buildings design, such as, for example Distance Teaching Centre is the organization of multi-sector, interdisciplinary research and design team. The cooperation of specialists, being an outcome of integrated, multi-disciplinary and holistic approach to the process of design, is the best way to achieve the set objectives and criteria, making and maintaining communication between the representatives of different disciplines and securing instant solutions to problems that may occur in the whole life cycle of the building [8]. The cooperation should take place on all levels, involving all participants. The information flow, both vertical and horizontal should be unlimited. When key decisions concerning the quality of the build environment are to be made, all the stakeholders should be given an opportunity to express their views, substantiated by practical examples; whereas the final decision should be made on the grounds of the analysis of the discussion results. In comparison with traditional buildings, the society that takes advantage of distance learning is highly complex, and there are a lot of factors to be considered in creating a comprehensive picture of its performance. Many systems and solutions inserted to such spaces utilize innovative, pioneering technologies. None of the participants of the construction process is able to guarantee how the innovative systems, their elements and solutions shall function altogether. One thing seems certain. Accurate integration of the systems of the building, supported by performance analyses of each separate element and of their combined functionality, leads to a final result, indicating that the performance of the built environment as a whole exceeds the expectations based on summing up the performance of its particular components [8].

The research team should engage representatives of all parties, who should contribute to planning, designing, constructing and using the building, and all the people involved in the life cycle of the building should be committed. This is a very difficult undertaking. So far, a typical cooperation model was linear. Groups of specialists preformed special tasks, the outcome of which was next transferred to the next group of specialists, for example: the architects who have completed the conceptual design passed their foredesigns to the team of construction engineers, the completed design documentation was forwarded to the contracting/developing company. The philosophy of integrated, multi-disciplinary and holistic approach to the design process is completely different. All participants of the investment process should cooperate, from the earliest stages, and should accept commonly agreed key assumptions. Such early understanding makes it possible to integrate and maintain good communication channels. Apart from traditional participants of the construction process: the investor, architect, construction engineer, systems and installations engineers, contractor – other participants come to the scene: users, service providers, facility managers, representatives of local governments and local communities.

The above-mentioned, interdisciplinary and holistic approach to the design involves additional responsibilities that need to be met at the design stage. One of these include financial charges (fees for extra

specialists, costs of performance analysis), time constraints (accurate and reliable analyses and simulations of the building performance require time), organizational loads (coordination of the interdisciplinary team). In view of fierce competition, enhanced efficiency, cost effectiveness and tight schedules, the implementation of the proposed approach is a big challenge calling for a lot of determination, willingness to cooperate, broader awareness as to the importance of the high quality of the built environment on the part of all participants of the investment process.

3. REAL, PHYSICAL SPACE OF VIRTUAL EDUCATION

The deliberations presented below are speculations, they are not founded on research into the existing built environment offering e-learning options, nor on the analysis of the implementation of e-learning in the physical space of universities in Poland and worldwide.

There are forecasts specifying that the proportion of e-learning in the overall educational offer shall increase gradually, and that at some universities this will lead to the formation of the "virtual university" model [9]. Accordingly, it may be assumed that distance learning, due to state-of-the-art technologies that need to be employed, is a considerable financial burden to tertiary schools, consuming a significant amount of their budget. The degree of innovation, modernity, technological advancement should be emphasized materially, not virtually. Such physical prominence could be the university's business card and its best symbol.

From the organizational and economic point of view, a unit chiefly responsible for e-learning should be clearly identified, also rendering services for other university units – faculties, institutes and departments. Let us call such unit: "Distance Learning Centre". It seems probable that the following two basic concepts of creating the Centre will develop:

– virtual structure – network of facilities dispersed around the university premises, connected by ICT,
– physical structure – a central unit performing the function of representation, promotion of technological and organizational innovation, conference, training and exhibition rooms.

The first concept is purely based on **virtual structure**. The network of physical rooms (facilities) located at different faculties, campus sections, or even subsidiaries scattered all around the world, shall constitute a whole only in the Internet. Such scenario may be supported by the present state of insufficient knowledge and ad hoc decisions concerning this issue. ICTs are not properly managed. Let me give some hypothetical examples, yet typical of many Polish universities:

– A set of super servers is purchased at the beginning of the academic year, the unit is commissioned to operation at the turn of the year and in the summertime it turns out that further use of the facilities may result in serious damage, as no air-conditioning has been provided in the server room;
– Substantial software is purchased for operating the personal data concerning university students and staff members, however poor capacity of the university computer infrastructure hinders effective use o the system;
– The implemented electronic recruitment system does not include the specifications of all faculties and requires "manual corrections";
– Software for the creation and presentation of multimedia educational materials is consistently purchased, yet there is no centrally available information on its utilization and location of installation carries, making it inaccessible;
– Computer networks of some university units are incompatible, therefore it is impossible to implement a uniform system of data protection and accessibility.

Accordingly, such is the way in which future virtual universities are organized. Ad hoc decisions lead to provisional solutions and adaptation measures, resulting in temporarily efficient e-learning management.

The second concept assumes the construction of a cohesive, well-balanced physical structure of Distance Learning Centre, which is located in a newly constructed building that could be a landmark of the university, its most technologically advanced facility and serving the functions of:

– representation;
– promotion of technological and organizational innovation;
– conference facilities;
– training facilities;
– exhibition hall.

The main challenge is to determine the nature of space that could accommodate the above mentioned

functions, their floor area requirements, interconnections and proportions. Distance Learning Centre should include the following sections:

– representative,
– conference,
– training,
– office,
– technical service,
– laboratory of modern multimedia technologies.

The office section – in response to the changing needs of societies, distance learning may require alternative office work strategies, for example: non-territorial offices, work in facilities at a remote distance from headquarters, work from home [10] [11]. The main feature of "non territorial offices" is the absence of individually assigned desks, i.e. the so called "hot desking". The employees use available desks and rooms to accomplish specific tasks and projects. The main advantage of the application of such strategy is maximal use of floor area, equipment and fittings at the organization's disposal, as well as flexibility in work organization. So far, four models have been elaborated [12]:

– Free Address, Hot Desking and Red Carpet;
– Just in Time and Hotelling;
– Shared Assigned, Desk Sharing;
– Drop In.

The idea behind these modern modes of functioning is the provision, at the company's headquarters, of a place for the exchange of experiences, ideas, concepts, learning new skills and making contacts. Accordingly, in the modern office work environment the most important emphasis is put on team work. Space must be designed to provide the conditions that will stimulate team work and exchange of ideas. It may take the form of confined rooms, but their arrangement and fittings should be adjusted to facilitate the tasks of holding informal meetings, internet cafes, atria, clubs. However, open-space offices are nowadays becoming more popular.

The training section – the space is utilized for giving lectures to small groups, exercises, panel discussions, video conferences. The following issues should be considered in designing the space of the training section:

– flexibility – the requirements of the users of such space change on day-to-day basis, therefore it should be possible to join rooms by moving the walls and relocating partition walls;
– special requirements as to installations – the training section shall be used at different parts of the day, above the usual working hours schedule, thus the HVAC, electrical, access control installations should be flexible in their operational parameters to enable easy adjustment;
– fixtures and fittings – should be characterized by above-average durability, the standard version should include: light furniture systems enabling free arrangements and efficient storage rooms, mobile screens and projection systems, anti-solar radiation protection systems, partitions securing good acoustic insulation;
– ICT integration.

4. CONCLUSIONS

The analysis of the distance learning concept in view of the physical space available reveals the following two key issues: continuous change and latest ICT technologies application. The author of this paper claims that the process of the architectural design associated with the provision of distance learning conditions, in consideration of the high quality of the built environment should entail:

– functional solutions enabling the introduction of alternative office work strategies;
– selection of proper structural solutions, fulfilling the following requirements:
  – repeatable system of structural supports, based on the binding design module (15 cm; 30 cm);
  – uniform height of floors, in consideration of future needs for installations layout;
  – location of the poles should not hinder free arrangements of the office space;
  – abandonment of the solution of sub-routes set diagonally towards the main route of the building (as this hinders the running of the installations in suspended ceilings);
  – elimination of excessively complicated elevation of the building and avoidance of arch walls and sharp corners to provide maximal adaptability;
– designing the functional modules of buildings, independent units/section, equipped with independent:
  – entrance zone,
  – vertical communication,

  - auxiliary and technical rooms,
  - systems and installations.
- flexible solutions concerning installations and systems:
  - easily accessible spaces for installation layout with sufficient capacity, the main priority should be given to data transfer and to electrical systems, enabling easy operation, maintenance, repairs, replacement and adjustment to new functions;
  - vertical installations should be densely and evenly arranged in relation to the plan of the building (at least one for the described functional module;
  - installation sockets should be selected accurately, enabling free changes in location and addition of new terminals.
- solutions consistent with the sustainable development principles, enabling the provision of high-quality internal environment (the parameters of which are directly controlled by its users) and, at the same time, securing low emission of pollutants, high energy-efficiency and reduced material consumption intensity.

REFERENCES

[1] *Baird G., Gray J., Isaacs N., Kernohan D., McIndoe G.*; Building Evaluation Techniques, The McGraw – Hill Companies, Inc., New York, 1996

[2] *Preiser W. F. E., Rabinowitz H. Z., White E. T.*; Post-Occupancy Evaluation, Van Nostrand Reinhold, New York, 1988

[3] *Masły D.*; Badania jakościowe w architekturze – moda czy konieczny element procesu projektowania? (Quality Researches in Architecture – an Fassionable Issue or the Indispensable Part of Design Process?) [in]: Żmudzińska-Nowak M. (red.), Moda w architekturze, Materiały VI Sympozjum w Rybnej, Wydawnictwo Sympozjalne KUiA PAN, Gliwice, 2001 (in Polish)

[4] *Masły D.*, Cztery metody badawcze dla architektów (Four Research Methods for Architects) [in]: Niezabitowski A., Żmudzińska-Nowak M. (red.), Architektura a nauka, Materiały VII Sympozjum w Rybnej, TaP – Teoria a Praktyka w Architekturze Współczesnej, Wydawnictwo Sympozjalne KUiA PAN, Gliwice, 2002 (in Polish)

[5] *Sanoff H.*; Integrating, Programming, Evaluation and Participation in Design. A Theory Z Approach, Avebury, Ashgate Publishing Group, Brookfield, USA, 1992

[6] *Duerk D. P.*; Architectural Programming. Information Management for Design, Van Nostrand Reinhold, New York, 1993

[7] *WBDG Functional-Operational Committee*; Account for Functional Needs, Whole Building Design Guide, ww.wbdg.org/design/account_spatial.php, 2006

[8] Guidelines for Creating High-Performance Green Buildings, Pennsylvania Department of Environmental Protection, (www.gggc.state.pa.us), 1999

[9] *Wheeler S.*; The Traditional University is Dead: Long Live the Distributed University, Keynote address for The European Universities Continuing Education Conference, University of Bergen, Norway, 4-7 May, 2000

[10] *Niezabitowska E.*; Projektowanie obiektów biurowych. Część 1: Historia. Rodzaje obiektów biurowych (Office Buildings' Design – History. Types of Office Buildings) Wydawnictwo Politechniki Śląskiej, Gliwice, 1997 (in Polish)

[11] *Masły D.*; Jakość środowiska wewnętrznego w architekturze na przykładzie nowoczesnego środowiska pracy biurowej (Quality of Indoor Environment in Buildings Based on Examples of Modern Offices) [in]: Problemy jakości powietrza wewnętrznego w Polsce 2005 (praca zbiorowa pod redakcją T. Jędrzejewskiej-Ścibak i J. Sowy), Wydawnictwa Instytutu Ogrzewnictwa i Wentylacji Politechniki Warszawskiej, Warszawa, 2006 (in Polish)

[12] *Sims W., Becker F., Quinn K.*; Organizational Workplace Analysis for Selecting and Designing Alternative Workplace Strategies, [in]: Baird G., Gray J., Isaacs N., Kernohan D., McIndoe G., Building Evaluation Techniques, The McGraw – Hill Companies, Inc., New York, 1996