PAPER • OPEN ACCESS

Innovation In Academic Workspace Design: The Implication For Sustainable Effectiveness

View the article online for updates and enhancements.

INNOVATION IN ACADEMIC WORKSPACE DESIGN: THE IMPLICATION FOR SUSTAINABLE EFFECTIVENESS

Adenipekun, M.T., Ajibola, M.O. and Oluwunmi, A.O.

Department of Estate Management, College of Science and Technology,
Covenant University, Ota, Nigeria

Corresponding email: martinsadenipekun@yahoo.com,
moajibola@covenantuniversity.edu.ng,
olufunkeoluwunmi@covenantuniversity.edu.ng

Abstract. This paper aims at discovering sustainable academic workspace design that can match the technological changes arising from emergent innovation for effectiveness in the contemporary time world of work. More often, innovation becomes disruptive to effectiveness in a short period of time. The objective of the paper illustrates the point that effectiveness of workspace influence space utilisation. Space utilisation and values determination are derivatives of design and sustainable effectiveness. The paper considers current thought in this area and presents a literature review. Emergent work modes from changing technology and innovations in workspace design for universal effectiveness were holistically considered. 5 factors were discovered to be essentially important to the sustainability of workspace design in order to sustain effectiveness of workspace and that of the worker. This implies that design of workspace imperatively need to insert some elements of flexibility; otherwise, the time scale major refit benefits of designs for office of the future may turn around to become hindrances to effectiveness. 109 key variables were generated from literature review as very cognate for academic workspace design.

Keywords: Innovation, Academic Workspace, Design, Implication, Sustainable Effectiveness.

1. Introduction

Innovation begets technological development and this underlines advancement in scientific and accelerated breakthroughs for cost savings, increasing comfort, efficiency and effectiveness of operations. However, innovation and technological changes impact the existing plans and designs in one way or the other. Therefore, different problem is found to be associated with design of academic workspace in the contemporary time context of changing academic activity modes and the fluidity nature of its basic functions. This study aims to improving the design of academic workspace to accommodate the changing academic work modes and the fluidity of academic functions at any time [4]. The objectives of the study focused on the physical design adequacy of academic workspace for effective utilisation and sustainability of worker's effectiveness. Among the emphasized factors globally acceptable to measure effectiveness of design are satisfactory performance of building services, the comfort provided by academic workspaces and the general work environment condition [34]. Design variables such as the noise levels, distractions, privacy, and level of hotness during the dry season, level of coldness during raining season, ease of internet access, and ergonomic level of office furniture are required to measure effectiveness of workspace and its layout design.

The issue of consideration in this study is therefore grouped into 5 factors for discussion: the general work environment condition ([12]; [53]; [5]); the office space design and layout [55]; the comfort of workspace ([50], [51], [52]); the workspace furniture ergonomics ([22]; [37]); and the emergent innovations in Information and Communication Technologies ([25]; [31]).

2. Review of Literature

Changes in the contemporary time world of work have caused changes to the emergent work setting and styles. Studies indicated that this was due to innovations in communication technologies ([14]; [13]; [29]; [40]). In order to plan for the learning spaces and office of tomorrow, it is required that dynamic, fluid nature of academic work, work force diversity, virtual work setting, work flexibility, office sound control and the spatial layout be considered in sustainable and effective workspace design ([45]; [10]; [49]; [35]; [19]; [42]; [16]; [48]; [15]; [11]).

Debate on workspace design has attracted global interest and is no longer limited to commercial buildings, discussion on academic buildings are currently increasing throughout the world ([38]; [25]; [8]; [43]; [1]). Three instruments fundamentally determine the change patterns of workspace design. First, the ways of working, culture, behaviours and work processes, the second involve relationship between technology, infrastructure and the core business systems; and the third involve the workspace layout and facilities in the work environment [58]. These instruments are responsible for fixing the fit-for purpose work environment in all facets of activities required within available organisational resources. Changes in workspace design are therefore driven by changing space demands arising from contemplated and unforeseen circumstances of emerging situations in the work environment [44]. Other drivers include the financial implication of maintenance and repairs and the sustainability of new information and communication technologies [23].

2.1. Emergent changes in Innovative Technologies

The learning environment setting of the recent time is the cause of changes to the approaches to learning of the past ([25]; [41];[43]). For this reason, a sustainable and effective workspace design for the modern time academic activities is necessary. Academic workspace design for effectiveness ought to consider the inclusive role of academics in the following capacities as lecturer, teacher, researcher, entrepreneur, social commentator, administrator, mentor and colleague. The average typical effective space utilization for worker's effectiveness at work needs to be redefined [58]. More apparent is how rapidly evolving is work life in the present time changing academic in terms of how works get done, the breadth and geography of work location and the expectation of future office requirement for dynamic and fluid nature of work [35]. Technologically, design matrix of academic activities through innovations has classified academic activities into routine and non-routine nature of work. This has led to a low change and high change nature of work characteristics ([17]; [24]). It has transformed the old traditional method of teaching into new and modern methods. For example, the mobile technology has created a multiplying effect on virtual workspace design and usage in the learning sector. In effect, the rise in the use of virtual workspace has reduced the demand for physical workspace in academic buildings [27].

Similarly, mobile technology has increased team work collaboration and social interactions [21]. As a result, there is in teaching, a paradigm shift from the conceptualized rigid academic, practical and vocational knowledge to a new virtual-based student-centred self-development approach by using the collaborative and interactive work modes [25]. In other word, workspace design requirement in recent time is focussing on issues of flexible work setting. However, this is challenging because there is yet to be a unifying design principle put in place to direct planning [31]. Nonetheless, the model of integrated work was developed. The model operates within three work modes (focus, share and team work) with a social component [38] cited in [35]. [21] critically expanded the work modes into four; focus, learn, collaborate and socialise as capable of enhancing effectiveness. Nevertheless, these work modes according to the author are not created equal.

Five patterns of workspace designs have emerged over a period in response to flexibility in work setting ([25]; [43]). The first workspace design pattern was the private cellular office space. The space is between 17m² to 20m². The design became inadequate overtime and was faulted for its rigidity to readily adjust to culture in organizations. The space in the second pattern is between 12m² to15m² for open plan layout. It has advantage of increased efficiency in office space use. The size of the third open plan design span between 10m² and 12m². The design included communal spaces carved out for relaxation, break-outs and meetings. The forth design pattern provided increased office efficiency advantage because it is relatively smaller in size. The size between 9m² and 10m² was further separated by creating individual workstation for collaboration in shared work areas and the additional advantage of privacy in combi-offices [41]. The fifth design pattern emerged from the impact of technology on the changing modes of work generally. New network information and technology has broken down many of the barriers that existed before in academic environment and has further separated the old time traditional academic procedures by turning the environment along the clearly new definition of academic activities. These evolutionary changes led to the demand for full non-territorial collaborative knowledge-based work environment. Consequently, the workspace required in recent time has reduced in areas to 7m²- 9m².

Study indicated that academic building designed with full compliance for ICT, has advantage of more office space effectiveness [34]. Similarly, the development of virtual workspace has a positive impact on Alternative Workplace Arrangement (AWA). The hot-desking and hoteling are two types of arrangements with increased benefits of space utilization in organizations. The use of Workplace Performance Index (WPI) and Workspace Utilization Index (WUI) are two metrics of decision taking in organisation in recent time ([26]; [21]; [43]; [57]).

2.2. The physical and psychological work environment

The work environment is defined in various ways by different authors. [12] defined work environment as the environment in which people work in its diverse aspects of settings. The physical setting of work environment encompasses the required physical environmental attributes that ensures effectiveness, satisfaction and wellbeing at work. It also encompasses the elements of job in the workplace; workload, work pattern, task complexity and the wider organisational culture, structure, history, norms and ethics. Other extra organisational work environment setting includes the work-home relationship, social welfare of workers, the Quality of Work Life (QWL) and the Quality of Life at Retirement (QLR) [53].

The psychological work environment defines the behaviour of workers. This is discerned by the affective phenomena like emotions, mood, and other affective disorders; cognition attributes like attitudes, perception, decision-making; and the attributes of behaviours like effectiveness, absence, punctuality, honesty, devotion, etc. [9], emphasizes the importance of work environment in organisational productivity by defining it as the place where people work to achieve organisational goals. The work environment is viewed in this context as systems, processes, structures, tools and all other things which interact with employees and impacts performance positively or negatively. The psychological environment is less transparent; it however indirectly exerts pressure on productivity because of its effect on psychological wellbeing [12]. Psychological wellbeing is derived from attributes of the work environment provided by the nexus between the physical, functional and psychological comforts. The work environment comfort is often associated with adequacy of the physical internal environmental conditions of workspace. This is perceived on the degree of temperature, ventilation, air speed, relative humidity, circulation, brightness, thermal and lighting comforts enjoyed.

Functional work environment comfort considers the impact of workspace on work performance of individual tasks, team works and organisational performance rather than individual worker's wellbeing. Workspace satisfaction, effectiveness and productivity therefore depend on the functional comfort of the workspace [54]. Psychological work environment comfort is the third arm of the nexus. It however derives its attributes from the psychosocial elements of the work environment design and management using workspace territoriality, privacy, personalisation, sense of belonging, and collaboration [43]. These are attributes that will go a long way in determining the design of sustainable workspace emphasized in this study. This is further expressed in the next topics.

2.3. Workspace Satisfaction and Workers' productivity

User's satisfaction of office space is a relative measure of good feeling derived from the use of workspace. This impacts workers' productivity at all levels (the individual, group and organisational levels). According to [54], user satisfaction of space and its attendant productivity is difficult to measure. Nevertheless, self-reported survey responses from POE ratings of space use and the effects on productivity are accepted as *de facto* measure of satisfaction [2]. If users feel positive, it is assumed the workspace is satisfactory, but if they are dissatisfied, it means that the workspace, its design and the ambient environment has failed and therefore unproductive.

User's preference in assessing workspace satisfaction has in recent time moved beyond the choice between the open plan and the cubicle designs [30] because many workers are dissatisfied with the designs due to the various disadvantages associated with them. Consideration of user satisfaction extends far beyond the internal environmental conditions of workspace. The consideration further involves the complex models of user-environment interaction assessment attributes such as the workspace type and collaboration; workspace for learning and mentoring [30], how well can users of space access needed tools or perform certain tasks, involve in effective communication, identify territory for required enquiry into organisational performance, and the ability to discover the effectiveness of workspace as a primary objective to support the performance of work [55]. Within this context, the workspace is seen beyond a backdrop but a passive setting for work [54]. Consequently, it is logical for design of workspace to keep

changing in line with the changing world of work caused by time bound innovation in technologies.

2.4 The Comfort of workspace

Workspace comfort is derived from the comfort in the work environment [51]. This is very significant to organizational efficiency, effectiveness and productivity. Workspace comfort summarises the quality of health and wellbeing of users of workspace in all ramification of "quality of work life" and the "quality of life" of workers during active service and at retirement [53]. This opinion was conceptualised into the basic habitability model of workplace [50]. The model explains the level and amount of energy inflow (comfort) and outflow (discomfort) at the functional comfort stage of a workspace; and anything below the habitability threshold meant discomfort. The concept of comfort is associated with the physical, functional and psychological conveniences of workspace to the user. The physical comfort dwells within the Health and Safety standards of the work environment ([22]; [18]). The Quality of Work Life (QWL) of workers is apparently determined by the quality of the physical environmental variables such as the level of heat, cold, noise, light, glare, air quality, ventilation, smoothness of the floor finishes, etc. of a workspace. It is further determined by workers' perception and assessment of the psychosocial elements of the environmental design and management of workspace at the territorial level (department, school or unit) in terms of the level of privacy, control, sense of belonging, security of employment, scale and structure of social networks at work, employer-employee relationship, demandingness of the job, elements of rewards for performance and recognition for innovation [50]. In the opinion of the author, psychosocial discomfort may however be experienced if there is lack of privacy, poor acoustic conditions and neglect of confidentiality. The functional comfort situates between the physical and psychological comforts. This determines workers' productivity as indicators of how effective workspace in is assisting users of workspace to perform their tasks, particularly with the contemporary time high rate of change in academic work modes [25]. The overlap of the three forms of comfort is essential in the assessment of users' satisfaction of workspace and the wellbeing required for maximum productivity.

2.5 The Workspace Ergonomics

Issue of ergonomic is another area of physical environmental convenience expected in the design of academic buildings in recent time ([33]; [44]; [23]). This is determined with such variables like the type, size, height and other features of workspace furniture configuration. Ergonomic assessment is based on the level of discomfort (stress) experienced in the use of workspace furniture. If workspace is a tool for getting work done [50], it shows that office workspace furniture in its configuration impacts greatly on comfort, satisfaction, efficiency, effectiveness and productivity of users of workspace. The comfort and stress level of workspace furniture configuration is measured by the ease at which occupants can move around within the office space and in seated anthropometric parameters ([3]; [37]).

Studies have discovered that work modes are not created equal; therefore, there cannot be one size fit-all workspace design for all job activities as the case in academics ([25]; [21]; [58]). This indicates that different setting is required for different categories of workspace designs. [52] illustrates the importance of human capital collaboration setting in the concept of organization-accommodation within the social context of employee's interaction, support networks, norms among groups and the type of socialization in a workplace. The concept connects the human-capital and organization relationship together in the creation of knowledge, skills, creativity and interaction among co-workers. The concept identified a gap in shared workspace which was used in providing opportunity for inevitable knowledge-generating cycle in organizational workspace design. The knowledge-generating cycle evolved from Socialization, Externalization, Combination and Internalization (SECI) concepts of organizational interactive. To fill the gap, [52] developed a matrix that focuses on analysis of the implications knowledge creation workspace design could have on organization. This is illustrated in Table 1.

Table 1: Stages of Knowledge-Generating Cycle in Organization

Design Objectives	Socialization	Externalization	Combination	Internalization
For Awareness	Use Open office team-space concept.	Use Shared space and meeting rooms.	Use Information on screens and displays.	Use Open office team-space concept.
For Brief Interaction	Use Co-located teams.	Use Informal and formal places to meet.	Use Information exchanged while crossing paths, meeting,	Use Team shared spaces.

			getting coffee.	
For Collaboration	Use Communications tools.	Use Project and war-rooms.	Use Shared group facilities.	Use Training rooms and work rooms.

Source: Adapted from Vischer (2010).

SECI knowledge creation concept is illustrative and required in academic buildings for effective and efficient collaborative workspace design consideration. The first stage of the cycle is designed for Socialization. In this stage, individual worker is focussed to share expression with another worker. This requires interaction. Stage two is the Externalisation phase. This requires joining knowledge together using discussion that others can comprehend and use. The workspace is designed for dissemination of knowledge and is inevitable and ideal for growing academic organization. The third stage of the cycle is the Combination stage. The third stage provides a shared workspace where the appearance of new knowledge that is not known to individuals or focussed group is diffused to all members of the organization by physical and virtual opportunities. This emphasizes the fact that acquisition and sharing of knowledge transcends territorial boundaries. The last stage is the Internalization stage. In this stage, the workspace is designed to provide facilities for acquisition of knowledge by training, learning and doing exercises. These knowledge acquisition activities involve many categories of workers; therefore, takes place in places designed for that purpose. SECI knowledge-driven concept impacts entrepreneurially on organizational sustainability. Organizational success and sustainability in academics go beyond financial returns but include meeting organizational goals and objectives.

The present state and design conditions of many Higher Education Institutions (HEIs) in developing countries of the world is outdated, lack flexibility, poorly maintained and have a lot of shortcomings besetting effectiveness and sustainability ([7]; [39]; [3]; [28]; [6]; [5]).

3. Design Trends of Educational Buildings

The changing academic profession in recent time is not constrained to the UK HEIs alone [32]. It has spread into all nations of the world. Evolutions into innovatively standardised designs for schools are recorded between 1960 and 1980 across Organisation for Economic Co-operation and Development (OECD) countries: Australia, Brazil, Belgium, Canada, Ireland, Mexico, New Zealand, Portugal and Serbia [36]. The standardised designs were created in terms of template and repeat design simply of a singular design solution for widespread implementation for the benefit of saving time and costs. However, the standardised design was criticised for its inflexibility to address diverse academic and community needs of the present time and the learning environment supports for the development of 21_{st} century knowledge, skills, work modes and attitudes. It was discovered that standardised design could not be a model of the future and therefore not effective and sustainable design model [36]. Nonetheless, variables of the contemporary time and future workspace design are discovered from different approaches used in the six-member countries of the OECD Centre for Effective Learning Environment.

In Victoria Australia, bespoke designs to meet unique needs of relocatable buildings were used for classrooms, libraries, multipurpose centres, gymnasium, science centres and other facilities. Although the tailor-made design has the advantage of reduced design and construction costs, it however lacks flexibility for its repetition of features of earlier designs. The template design empirically achieved objectives such as: promote active, student-centred learning using flexible and functional spaces that supports learning and teaching in modern time; promote student health, wellbeing and social interaction between students and staff; articulate high quality, durable and adaptable buildings capable of been expanded and be reconfigured at a later date; easily integration of ICT into learning and teaching; insertion of environmental sustainability principles, safety, security and risks; and the ability to offer a range of spaces for community use.

In Flemish Community Belgium, the standardised modular system solution was used for school buildings using the prefabricated construction system based on its fast delivery, sound and affordable solution for replacing and extending school buildings. The standardised modular system construction has the advantages of factory controlled, ensured quality, highly seasoned materials, construction, finishing and occupation of buildings by users. However, the major disadvantage inherent in the system is that manufacturers often meet only the minimum legal requirements relating to energy performance, fire safety, security, accessibility, etc. at the expense of meeting requirements for future needs in the design. In other word, flexibility is compromised in the design.

In Alberta Canada, the use of standardised core design concept for school predominate for purpose of saving time and cost over the life of school facilities. The standardised core school design was combined with factory-built modular classrooms to enable expand capacity and possibly relocate as needs requires. The combination of the two design systems ensured quality, cost-benefit analysis, cost-effectiveness, and adaptability of school facilities. However, a significant trade-off is found in reduced design flexibility.

In Ireland, the Generic Repeat Designs are used as the innovative school delivery methods that save project delivery time and overall energy consumption.

In Mexico, the use of prefabricated materials such as welded metallic elements, windows and furniture were common. Other building systems such as reinforced concrete structures, one, two, three-storey buildings were also prefabricated to allow time and cost reduction. In order to give flexibility to the method, typical plans for different spaces were introduced for classrooms, laboratories, workshops, administration, etc. for different level of education. From the new approach, a great variety of layouts and typical model emerged and could be easily adapted. A typical model is therefore to contain: all necessary architectural drawings; detailed working plans for each type of space (classrooms, laboratories, workshops, etc.); detailed working plans for each type of space according to different building systems; detailed list of furniture and equipment for each type of space; mechanical guides for each typical model (electricity, sanitary, hydraulic, gas, and other special installations); site guidelines, characteristics of the site, dimension, location, orientation, etc.; and the building materials specification (walls, floors, roofing, etc.).

In Portugal, between 1960 and 1980, several patterns of designs evolved from standardised design concepts of multiple pavilions (pavilionar) to the project-type. This was characterised by modular design and standardisation of components suitable for prefabrication. The combination of the modular design and the multiple pavilion led to the project-type. In the 1970s, standard design was structured based on a set of autonomous blocks connected by covered exterior passageways. The project-type adopted the use of light modular components to allow for efficient assembly in-situ. By 1980s to 1990s, the design for industrialised systems of construction emerged using the pavilion concept mixed with new standard designs. Elements of previously defined models were combined to create blocks of different educational spaces within a modular grid using pre-fabricated construction components. However, as at the end of the 1990s, standardisation could only address the problem of quantity of accommodations, schools were not able to meet requirements of flexibility and quality. The Parque Escolar design (The Federal Government Agency) came up with a strategy of including the users in design by identifying their needs. The Parque Escolar design strategy was based on "customised solution model". This resulted into effective use of resources and achievement of highly efficient solution from the use of criteria of suitability, robustness and cost effectiveness. Despite all these attempts, the design for the office of the future work pattern, style and modes is elusive and at the expense of highly changing innovation into new technologies.

Similarly, elaborate studies were carried out in UK and US on HEIs especially around space utilisation, efficiency, management, allocation, costs and benefits with respect to designs for different categories of activities, users, with respect to the impact of changing technology and determination of benchmarks for space allocation ([14]; [25]; [41]; [23]; [58]).

Contemporary research agitation for Academic Workspace Evaluation (AWE) is one of the current issues in global academic debates [59]. This is to further extend sustainability of academic workspace effectiveness for all times, ages and users. The connectivity of basic elements and the constituent 109 variables were generated in this study as being germane to sustainable academic workspace design. This is shown in Figure 1.
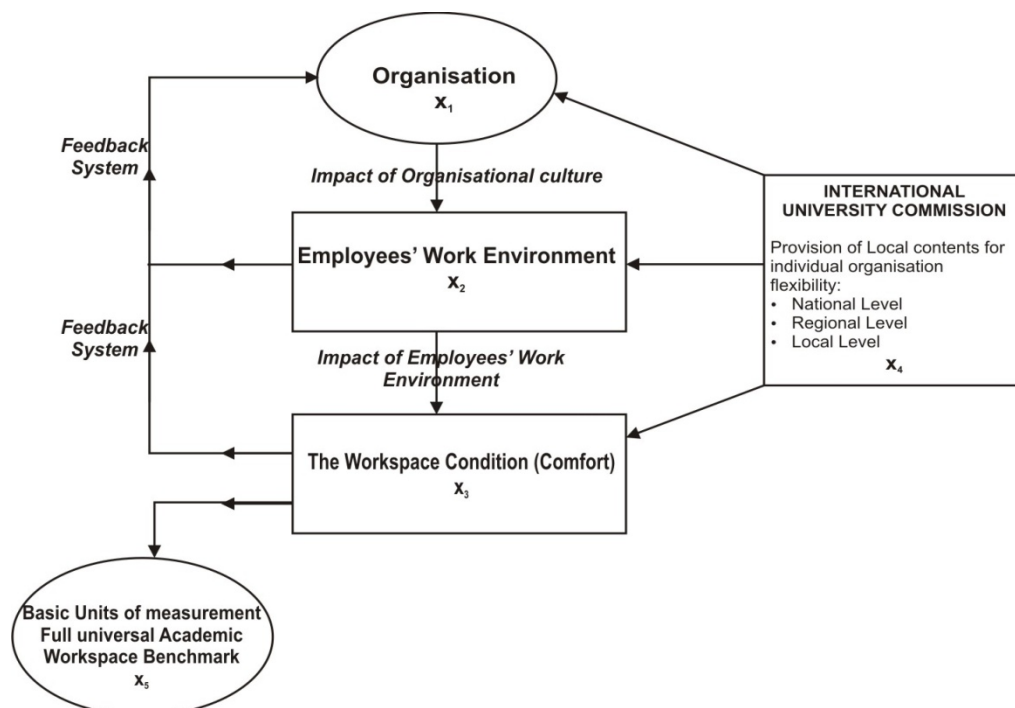
Fig.1: Author's structure of academic workspace evaluation framework indicating the articulation and connectivity of variables used as basic elements of measurement.

4. Implication

The implication on design, of innovation in technology is the tendency there would be high rate failure of purpose of existing facilities in a very short period. Technology has indirectly input element of timescales into designs of academic workspaces in the contemporary time. Hence, academic buildings occupied in 2016 should expect at least a 25-year life before a major refit. Designs now should therefore consider year 2040 future space use. This in other words means that academic space designs should give room for flexibility for contemplated and unforeseen future changes to space use. Otherwise, functionality and effectiveness of workspace may be lost because of new technology. The relatedness and fluidity of activities in academics and the inter-link of programmes' footprints in universities is defined by contemporary technologies. The flexibility in design of academic workspace is imperative to further meet the changes going on due to changing practices and priorities in academics.

5. Conclusion

This study has identified in various ways, the importance of flexibility in designs of educational buildings for sustainability, functionality, effectiveness, cost-benefit issues, etc. The emerging areas for innovative technology creation in academic workspace design consideration is in recent time more of the virtual, adjustable workspaces and furniture designs. Studies have shown that expandable workspaces can be created particularly in seminar and lecture spaces by using appropriate room dividers with good sound attenuation. Similarly, more space benefits could be enjoyed if furniture is designed to be adjustable and collapsible for multi-purpose use. All aspects of academic workspace designs are very important, however, the design of Internal Environmental Condition (IEC) of academic workspace is more crucial to workers' sustained functionality and effectiveness. It deals directly with workers' wellbeing, comfort and health at work. The effectiveness of design may fade out as innovation and technology change.

References

[1] Abisuga, A.O., Famakin, I.O., & Oshodi, O.S. (2016). Educational Building Conditions and the Health of users. Construction Economics and Building, 16(4), 19-34.
[2] Abisuga, A.O., Wang, C.C. & Sunindijo, R.Y. (2019), A holistic framework with user-centred facilities performance attributes for evaluating higher education buildings, *Faculty of Built*

Environment, University of Bew South Wales – Kensington Campus, Sydney, Australia. Retrieved from www.emeraldinsights.com/0263-2772.htm DOI 10.1108/f/072018-0083.

[3] Adeniran, A. J. & F. J. Akinlabi, (2012). Work environment and Productivity: A Post Occupancy Evaluation of LAUTECH Senate Building, Ogbomoso, Nigeria. *Architecture Research*, 2(2), 14-19.

[4] Adenipekun, M.T, Ajibola, M.O. & Oluwunmi, A.O. (2019). Effective workspace design: imperative in resolving problem of increasing fluidity of knowledge-based academic activities in universities, 3rd International Conference on Science and Sustainable Development, Covenant University, Ota, Nigeria (icssd2019@covenantuniversity.edu.ng).

[5] Aderonmu, P. A., Awoyera, P. O., Amole, S. A., Olofinnade, O. M. & A. W. Adekeye, (2016). Parametric measures for design workspace adequacy of selected institutions in Nigeria. *Journal of Engineering and Applied Sciences*, 11(3), 2105-2119

[6] Adeyeye, J.O., Adeniji, A.A., Osinbanjo, A.O. & Oludayo, A.O. (2015). Effects of Work environment Ethics on Employees and Organisational Productivity in Nigeria, Proceedings of the 2nd International Conference of African Development. Ota, Nigeria. 267-273

[7] Ajayi, I.A., Awosusi, O.O., Arogundade, B.B., & Ekundayo, H.T. (2011). Work environment as correlate of academic staff job performance in South West Nigerian Universities. *European Journal of Educational Studies*, 3(1), 1-9.

[8] Alexi Marmot Associates (AMA, 2013). *Reimagining Academic Workspace*, Seminar Report.

[9] Awan, A. G. & Tahir, M. T. (2015). Impact of working environment on employee's productivity: A case study of Banks and Insurance Companies in Pakistan. *European Journal of Business and Management*, 7(1), 329-345.

[10] Ball, S. (2012). Learning Spaces of Tomorrow, Woods Bagot, Deakin Uni Burwood Highway Frontage Building I, Melbourne

[11] Barkman, P. & Walton, E. (2019). Open plan acoustics. @soundmanagementgroup.com

[12] Briner, R. B. (2000). In-depth Review: Relationships between work environments, psychological environments and psychological well-being. Great Britain. *Occup. Med.* 50(5), 299-303,

[13] Brown, M., Cevetello, J., Dugdale, S., Felix, E., Holeton, R. & Meyers, C. (2014). Learning space rating system. Retrieved from http://www.educause.edu/eli/ initiatives/learning-space-rating-system%0A

[14] Commission for Architecture & the Built Environment (CABE, 2005). The impact of office design on business performance. Retrieved from http://www.cabe.org.uk and http://www.bco.org.uk

[15] Caramela, S. (2018). A Work environment that Works: Designing a Productive Office. @sammisays.org.

[16] Daniels, K. (2017). Issue brief WORK ENVIRONMENT FLEXIBILITY INITIATIVES. US Department of Labour 200 Constitution Avenue, NW Washington, DC.

[17] Duffy, F., & Chandor, M. (1983). *The Orbit Study-Information Technology and Office Design.* DEGW/Eosys. London.

[18] European Agency and Safety at Work (EU-OSHA, 2014). Wellbeing at work: creating a positive work environment – Literature review (http://osha.europa.eu/en/oshnetwork/local-points).

[19] Fields, B. (2017). DEGW Report: The Impact of Change. PDF_files/saved_resource (10).html.

[20] Fisher, K. (2005). Linking Pedagogy and Space. Retrieved from http://www.sofweb.vic. edu.au/knowledgebank/pdfs/

[21] Gensler (2012). What we've learned about focus in the work environment. Retrieved from http:// gensleron.com/work/2012/1/24/focu-on-focus.html

[22] Government of Alberta, ERGO 15 (2010). Workplace Health and Safety Bulletin – Fatigue, Extended Work Hours, and Safety in the Workplace. www.worksafe.alberta.ca; http://employment.alberta.ca/whs-ohs.

[23] General Services Administration (GSA, 2011). *Workspace Utilization and Allocation Benchmark*. GSA Office of Governmentwide Policy, Office of Real Property Management, Performance Measurement Division. Washington, DC 20405. Retrieved from https://www.gsa.gov

[24] Harbinger Group (1986). Orbit2 - Executive Overview, Harbinger Group, Norwalk, CT

[25] Harrison, A., & Cairns, A. (2008). The Changing Academic Work environment, DEGW, UK Ltd.

[26] Heerwagen. J. H., Kampschroer, K., Powell, K. M., & Loftness, V. (2014). Collaborative Knowledge Work Environment. In Building Research and Information, Span Press, 32(16), 510-528. Retrieved from https://wwwresearchgate.net/publication/240803011.

[27] Hyrkkanen, U. & Nenonen, S. (2011). The virtual workplace of a mobile employee – How does Vischer's model function in identifying physical, functional and psychosocial fit? Human-Computer Interaction, Part III, HCII, Jacko, J.A. (ed.), LNCS 6763, Springer-Verlag Berlin Heidelberg, 69-75.

[28] Inua, O. I. & Maduabum, C. (2014). Performance Efficiency Measurement in the Nigerian Public Sector. *Mediterranean Journal of Social Sciences,* 5(20), 838-847.

[29] Kim, T.W., Cha, S.H. & Kim, Y. (2018). Space choice, rejection and satisfaction in university campus. *Indoor and Built Environment,* 27(2), 233-243

[30] Knoll Workplace Research (2008). Open plan and Enclosed private offices: Research, Review and Recommendations, Knoll Inc., knoll.com/research/index.jsp

[31] Lee, D. (2017). Knoll Work environment Research: Adaptable by Design-Shaping the Work Experience. Knoll, Inc. PDF_files/saved_resource(9).html.

[32] Locke, W. (2007). The Changing Academic Profession in the UK: Setting the Scene. Universities UK, London, UK.

[33] Michigan State University (MSU, 2016). Support Staff Ergonomics Policy and Procedure, Michigan State University Wordmark, msu.edu

[34] Mohammad, S., Sapri, M., & Sipan, I. (2014). Academic Buildings and Their Influence on Students' Wellbeing in Higher Education Institutions. *Social Indicators Research,* 115(3)

[35] Murphy, B. (2017). Implementing Integrated Work to Create a Dynamic Work environment. Research, Strategy, Media Knoll, Inc.

[36] Organisation for Economic Cooperation and Development, Centre for Effective Learning Environments (OECD CELE, 2011). International web conference seminar series: Standardised design for schools Old solution, new context? 2 rue Andre Pascal, France http://www.oecd.org/edu/facilities.

[37] Ogedengbe, T. I. (2015). Ergonomic Appraisal of a Nigerian University Library, *International Journal of Science and Technology*, 4(2), 57-64.

[38] O'Neill, M. (2008). Open Plan and Enclosed Private Offices: Research Review and Recommendations, Knoll Work environment Research knoll.com/research/index.jsp

[39] Oyenuga, S.O., Akinsola, O.E., Hussaini, P.O., & Fatokun, A.O. (2012). Maintenance of University Facilities in Developing Country: Case Study of Lagos State University, Ojo, Nigeria. *Mediterranean Journal of Social Sciences,* 3(11), 69-75.

[40] Philip, A., Ileanwa, A.C., & El-Hussain, A.M. (2018). Post-occupancy evaluation of students hostels facilities in Federal universities in North Central, Nigeria. *Architecture Research,* 8(4), 123-128.

[41] Pinder, J., Parkin, J., Austin, S., Duggan, F., Lansdale, M., Demian, P., Baguley, T., & Allenby, S. (2009). *The Case for New Academic Workspaces*, Leicestershire: Department of Civil and Building Engineering, Loughborough University, UK. Retrieved from www.academicworkspace.comm/content/view/35/48/

[42] Poole, B. (2017). Flexible Work Options (FWO): Supervisor Tool Kit. PDF_files/saved_resource(8).html.

[43] Sheahan, M. (2014). The Future Academic Workspace: A Literature Review, *EcoSciences Precinct,* Brisbane, Queensland, Australia, 1-12.

[44] Space Management Group (SMG) (2006). UK Higher Education Space Management Project: Promoting space efficiency in building design.

[45] Toker, U. & Gray, D.O. (2008). Innovation spaces: Workspace planning and innovation in U.S. university research centres, Research Policy, 37, 309-329.

[46] University of Notre Dame (UND) (2014). Facilities Design and Operations: Workspace and Office Furniture Standards.

[47] University of Cincinnati (UCC, 2003). Design GuidANCE: Office Space. Division of the University Architect, Ohio.

[48] Victoria, C. (2017). Diversity and the Work environment. The Lindenberger Group, LLC.

[49] Virtual Workspace Limited (2016). User Environment Management, Kemp House, 152 City Road, London ECIV 2NX.

[50] Vischer, J. C. (2007). The concept of environmental comfort in work environment performance, Ambience Construido, Porto Alegre, 7(1), 21-34

[51] Vischer, J. C. (2008). Towards a user-centred theory of the built environment. *Building Research and Information*, (36), 231-240.

[52] Vischer, J. C. (2010). *Human Capital and the Organisation-Accommodation Relationship*: *In Handbook of Human Capital*, U.K. Oxford University Press.

[53] Vischer, J. C. (2015). *The Effect of Work environment Design on Quality of Life at Work: In Handbook of Environmental Psychology and Quality of Life Research.* G. Fleury-Bahi., E. Pol., & O. Navrro. (Eds), London: Springer.

[54] Vischer, J. C. (2017). *User-Centred Workspaces Design: Applications of environmental psychology to space for work*: *In Creating the Productive Work environment. Places to work creatively* (3ᵈ ed.), London: Routledge.

[55] Vischer, J. C. (2018). *Building-in-use assessment: Foundation of workspace Psychology: In Chapter 9 Building Performance Evaluation*, W. F. E Preiser., A. Hardy., & U. Schramm (Eds.), Springer Publishing.

[56] Von Krogh, G., Ichijo, K., & Nonaka, I. (2000). *Enabling knowledge creation*: *How to unlock the mystery of tacit knowledge and release the power of innovation*, Oxford, UK: Oxford University Press.

[57] Walsh, J. (2015). Knowledge Management: Collaboration versus Concentration in Open Plan Workspaces, *Dublin Institute of Technology,* DIT 3(12).

[58] Workspace Overview (2013). Workspace https://dit.ie/media/granggorman/ HEFCE.

[59] LEaRN (2019). Academic Workspace Evaluation (AWE). University of Melbourne.