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TECHNICAL NOTE

User behavior in Smart and Sustainable Offices (SSO)

Comportamiento del usuario en Oficinas Inteligentes y Sostenibles (SSO)

M. W. Kozusznik (*), A. Soriano (*), J. M.ª Peiró (*)

ABSTRACT

Smart and Sustainable Offices (SSO) require synergies between technologies and users behaviors. The sociotechnical approach considers users' motives, attitudes, cognitions and behaviors when designing work environments. This note will describe those phenomena in office environments. It will also present a set of tools to assess those phenomena and will provide guidelines to improve them.

Keywords: Smart and Sustainable Offices, work environment, sociotechnical approach, motives, attitudes, cognitions, behaviors

RESUMEN

Las oficinas inteligentes y sostenibles (SSO) requieren sinergias entre las tecnologías y los comportamientos de los usuarios. El enfoque sociotécnico considera los motivos, las actitudes, las cogniciones y los comportamientos de los usuarios al diseñar entornos de trabajo. Esta nota describirá esos fenómenos en entornos de oficina. También presentará un conjunto de herramientas para evaluar esos fenómenos y proporcionará pautas para mejorarlos.

Palabras clave: *Oficinas inteligentes y sostenibles, entorno de trabajo, enfoque sociotécnico, motivos, actitudes, cogniciones, comportamientos.*

(*) Universidad de Valencia (España).
Persona de contacto/*Corresponding author*: malgorzata.kozusznik@uv.es (M. W. Kozusznik)
ORCID: http://orcid.org/0000-0001-7961-8345 (M. W. Kozusznik); http://orcid.org/0000-0002-9565-1599 (A. Soriano); http://orcid.org/0000-0001-5293-0355 (J. M.ª Peiró)

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1. USER BEHAVIOR IN SMART AND SUSTAINABLE OFFICES (SSO)

Recently, we are witnessing an increasing number of technological advances and sustainable solutions in the office buildings aimed at energy use reduction. These advances make the workplace environment constantly changing and the introduction of technology into work-life seems inevitable. However, the adoption of technological advances in organizations is not simple and even the most promising sustainable solutions may fail if the process of change neglects human or psychosocial aspects. The socio-technical approach takes an ecological view to these issues and proposes that, when modifying the environment, it is not enough to merely impose the new technologies, but it is necessary to take into account the employees, the machine-human fit, or the complexity of psychosocial phenomena at work. Thanks to these features, the psychosocial system can help to maximize the opportunities for introducing sustainable solutions and changes in organizations oriented at decreasing energy consumption.

The core of the BTA Climate-KIC Smart and Sustainable Offices (SSO) project is the assumption that the link between innovative and sustainable building systems and technologies with improved indoor environmental quality (IEQ) involves human factor at work. Thus, SSO adopts a user-centered approach that considers office users. Especially, it considers such psycho-social aspects as the office users' technology-related perceptions (e.g., of control), their attitudes related to energy-conservation, habits, self-efficacy for energy-saving behaviors, information about energy-saving options in the building, incentives, and goal conflicts. All these factors are considered in the SSO project as decisive for an efficient environmental user behavior in office buildings. In this way, the SSO project proposes that it is possible to decouple office users' comfort from the increase energy consumption, by taking into account psychological determinants of the office users' energy-relevant behaviors.

In the present technical note, we will present the method used in the SSO project to evaluate these phenomena that might serve as an assessment tool to improve the process of implementation of sustainable technology and solutions in office buildings and the positive energy-related outcomes of this implementation.

2. THE NEED FOR A TECHNOLOGY-USERS' FIT FOR SUSTAINABLE SOLUTIONS

Technology developments have contributed to fast workplace changes (Lee & Brand, 2005) and often led to transformations in basic office functions (Turner & Myerson, 1998). There is a number of existing, relatively practical building technologies stemming from advances in sustainable technologies, such as increased ventilation, reduced air recirculation, improved filtration, ultraviolet disinfection of air, reduced space sharing, and reduced occupant density that can have positive consequences on workers (Fisk, 2000). Other recent popular attempts aimed at reducing costs and often introduced in the office setting include such energy-efficient solutions as occupancy sensors that control automatic lighting, automatic blinds systems, or central HVAC systems, drastically limiting the control of the office user over his/her working environment. This physical context with new technologies being introduced may constrain people's choices and the perception of control over their environment. According to the reactance theory (Brehm, 1966), such limitations to freedom may give way to psychological reactance, that is, a "motivational state hypothesized to occur when a freedom is eliminated or threatened with elimination" (Brehm & Brehm, 1981, p. 37). In turn, reactance may involve behaviors aimed at reestablishing the threatened freedom through the tendency to engage in the prohibited actions (Brehm, 1966). That is how new sustainable solutions may provoke an effect opposite to the expected one and incite non-sustainable or undesirable energy-related behaviors: office workers may carry out modifications to working environment (e.g., blocking sensors, leaving open doors that are not meant to be open) or bring to work and connect personal devices, such as heaters, or fans that, in the end, produce more costs and energy consumption. Indeed, there are several examples of a failure to adopt highly cost-effective solutions for energy conservation in the research literature (Office of Technology Assessment, 1982; Ross & Williams, 1981; Solar Energy Research Institute, 1981).

Thus, "achieving energy conservation is a twofold challenge, partly technical and partly human" (Constanzo, et al., 1986, p. 521). The development of sustainable and energy-conserving technologies is necessary to decrease energy consumption; however, unless adopted by its users, the impact of these technical innovations will be insignificant (Constanzo, et al., 1986, p. 521). This is why, in case of energy consumption-related issues, in order to address the human aspect of energy saving, more consideration should be given to its social-psychological dimension and aspects (e.g. Constanzo, et al., 1986; DeMeo & Taylor, 1984), to consider a broader social context, as well as improve communication between decision-makers, technical experts, and other stakeholders (e.g., office users), and ensure a more inclusive participation (Owens & Driffill, 2008). In other words, in the presence of an increasingly complex technology, it is necessary to ensure the machine-human fit (Peiró, 1991).

3. THE SOCIO-TECHNICAL APPROACH TO INTRODUCING TECHNOLOGY IN ORGANIZATIONS

The presence of an increasingly complex technology highlighted the necessity of developing human engineering and stressed the need to ensure acceptable ergonomics and adapt the technology to the worker (Peiró, 1991). These significant developments in technology triggered the emergence of the Socio-Technical approach (Mumford, 2006) that becomes an increasingly popular design conceptual framework for examining and changing the workplace environment over the last decades (van Eijnatten, 1992).

In contrast to the techno-centric perspective that exclusively focuses on technology, the Socio-Technical approach also focuses on people (Rice, 1958), and it considers that technological instruments (hardware) affect workers behavior through the organization and the work planning (software), and it proposes that there are several possibilities to carry out this work planning (Peiró, 1991). This theory considers every organization to be made up of the social (i.e., the people), the technical (e.g., the tools, techniques and knowledge people use to produce a product or a service), and the environmental (e.g., the users of the product) subsystems, the compatibility

among which determines the success of an enterprise (Pasmore, 1995).

It is important to highlight that, although in some occasions technology imposes a specific social organization, in general terms, and according to the concept of equifinality, there are always more than one way of adopting and implementing a technological solution. Along these lines, it is key to choose the most adequate psychosocial alternative of organization to ensure increased workers' productivity and satisfaction (Peiró, 1991). The Trist and Bamforth's (1951) studies in the British coal mining industry provide a vivid example of the impact of equifinality. These studies describe the situation in the mines where, keeping up with the technology development, coal extraction methods were introduced. The improvement included specifically for he replacement of the hand got method by the longwall method. Despite the technological improvements, in some mines, performance of the miners decreased and the workers expressed complaints about the new work organization, the separation of the existing groups of workers and the disintegration of the work cycle and of the control of the workers in the arrangements to carry on their work, increased conflicts and absenteeism, clearly indicating the workers' preference for the previous system. In contrast, smaller mines did not show these kind of problems. The difference consisted of the fact that the smaller mines introduced the new method but, in contrast to what the bigger mines did, considered and maintained a number of previous human and social features of the work in the workplace. According to different studies, the fact of taking into account both social and technological dimension by considering the existing traditions in the mines ensured the success of the new method (Peiró, 1991). In conclusion, the extent to which labor organization considers social factors and makes them compatible with the new requirements imposed by technological dimensions is likely to determine the success of the organization (Peiró, 1991). All this makes the socio-technical perspective an adequate approach for introducing technological changes, since it highlights that, although technology and organizational structures may change, the employees' rights and needs must be given as a priority, and given that an important socio-technical value is democracy, as it encourages employees' participation, influence, and decision-taking on the issues that concern them.

4. SOME PSYCHO-SOCIAL DETERMINANTS OF SUSTAINABLE BEHAVIOR

Following the socio-technical approach, in order to take the most benefit from the technology introduced in the organizations (e.g., oriented at diminishing energy consumption), it is key to focus on the worker. Indeed, such outcomes as decreased energy consumption may depend heavily on office users' behaviors that can be shaped by different psychological factors, some of which can be attitudes, perceived self-efficacy, knowledge, goal conflicts, or incentives. In this way, there can be several determinants of efficient or inefficient energy-related user behavior in office buildings. First, research shows that environmental attitude, a construct in environmental psychology, is a powerful predictor of ecological behavior (Bamberg & Möser, 2007; Hines, Hungerford, & Tomera, 1986/87; Kaiser, Wolfing, & Fuhrer, 1996). In this way, attitudes related to energy-conservation are suggested to determine the extent to which user behavior in office buildings is efficient (Windliger, Janser, Feige, & Wallbaum, 2012). Other determinants of user energy-related behavior can include habits (Steg & Vlek, 2009), self-efficacy for energy-saving behaviors that refers to the evaluation of a person of whether he/she has the necessary resources, knowledge, and/or skills to reach a specific goal (Lo, Peters, & Kok, 2011), and goal conflicts (Lindenberg & Steg, 2007). Environmental knowledge is also a significant predictor of ecological behavior intention that, in turn, predicts general ecological behavior (Kaiser, Wolfing, & Fuhrer, 1996). Information about energy-saving options in the building influence also energy-related office user behavior (Brown & Cole, 2009). Simultaneously, behavioral change can sometimes take place through economic instruments such as incentives (Owens & Driffill, 2008) offered by the organization.

Finally, in line with the demand-control model of occupa-tional stress (Karasek, 1979), the perception of control (e.g., over different environmental characteristics in the office such as air temperature, noise, outside view, and lighting) is con-sidered an important job resource that may help employees to deal with demands (Vischer, 2007). There is vast literature that shows that employees' control over their physical envi-ronment is beneficial for their well-being and performance (e.g., Boyce et al., 2006; Linhart & Scartezzini, 2011; Rashid & Zimring, 2008; Veitch & Newsham, 2000; Veitch, Newsham, Boyce, & Jones, 2008; Veitch, Stokkermans, & Newsham, 2013). Well-being can be understood from both hedonic (conceptualizing well-being as global evaluations of satisfaction such as job satisfaction) and eu-daimonic perspective of meaning at work (Rosso, Dekas, & Wrzesniewski, 2010). In fact, the recent advances in meas-urement of subjective well-being (OECD, 2013) distinguish between those activities that people find 'pleasurable' as com-pared to the 'worthwhileness' (reward) associated with these activities (Dolan, Layard, & Metcalfe, 2011; White & Dolan, 2009). Simultaneously, job performance can be operation-alized as including different facets, such as in-role performance (intrinsically related to the activities included in the job description), extra-role performance (behaviors that are not directly related to the tasks included in the job descrip-tion), and creative performance (carrying out activities that are both creative and useful for the organization). Increased well-being and performance can both be beneficial for the whole organization since they may lead to economic gains.

5. BRINGING SOCIO-TECHNICAL APPROACH INTO PRACTICE: THE SSO IEQ MODEL

The SSO project is grounded in the socio-technical approach as it proposes that it is necessary to take into account the active role and the psychosocial aspects of the office users. In this way, the SSO project aims at providing better performance than a conventional office or one in which technology has been introduced from a deterministic perspective. In order to do it, the SSO model allows for a greater chance of introducing technology-related changes in the organization, taking into account the psychosocial characteristics of the office users, as well as by optimizing their well-being and performance.

The conceptual model of the SSO project is depicted in the Figure 1.

First, the SSO model considers that, according to previous studies, some factors of the office design used in smart and sustainable offices may positively affect health and well-being (e.g., DeCroon, Sluiter, Kuijer, Frings-Dresen,2005;

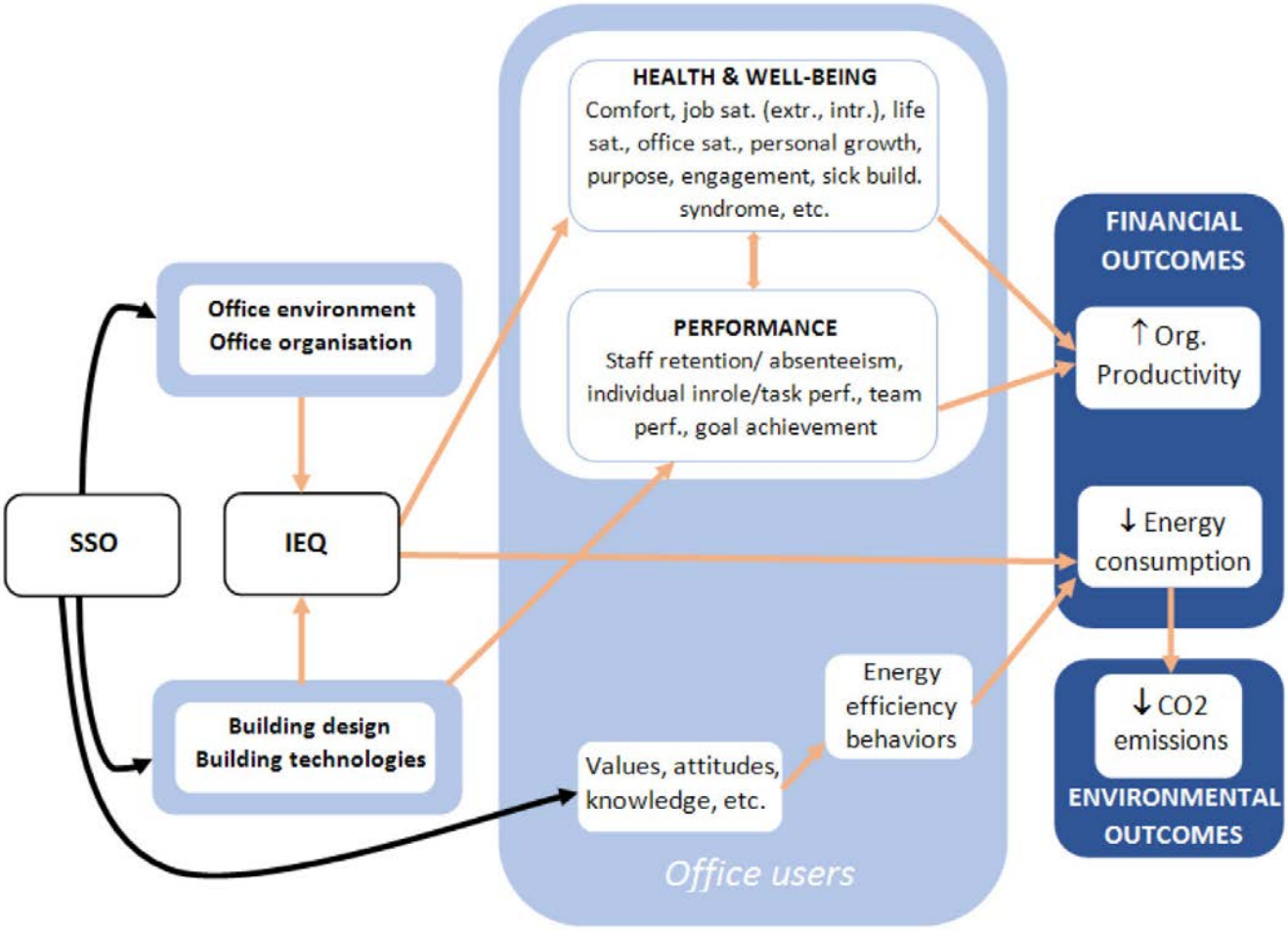

Figure 1. The conceptual model of the SSO project.

Vilnai-Yavetz, Rafaeli, & Yaacov, 2005). In turn, improving health and wellbeing in the office (e.g., job satisfaction, work engagement) may result in productivity gains (e.g., increased individual and team performance and decreased absenteeism), producing economic benefits for the organization.

Second, the SSO model considers that the energy efficient behaviors because of an appropriate usage of sustainable technological solutions will depend on users' values, attitudes, habits, knowledge, perception of control, and perception of self-efficacy regarding energy saving. The SSO IEQ model takes into consideration that people interacting with technology in their offices, have margin of action, and do not lose their control.

Finally, the SSO project proposes that contributing to the sustainability of the office by reducing energy consumption will not necessarily lead to decreased comfort for the office users. If this decoupling between energy consumption and comfort occurs, organizations will be able to take benefit from lower energy costs, as well as from increased well-being and performance of the office users that will lead to greater organizational gains.

6. THE SSO OFFICE-USER-ORIENTED MEASUREMENT TOOL

Within the framework of the SSO project, in order to evaluate the constructs explained above, we propose to use several scales such as sustainable behaviour, reasons for sustainable behaviour, perception of environmental stressors, well-being (hedonic and eudaimonic), occurrence of health-related symptoms, and performance (in-role, extra-role, and creative). In the following section, we will describe the scales comprised in the survey questionnaire.

6.1. Sustainable Behaviour

The sustainable behaviour scale takes into account different aspects of sustainable behavior, such as: a) Use of personal electronic devices brought to the workplace (e.g., fan, heater), measured with an 8-item scale developed by Windlinger et al. (2012), $\alpha = .70$; and b) Modifications of the work environment understood as the frequency with which employees use actions at the workplace aimed at modifying the working environment (e.g., leaving open doors or windows that are not intended for ventilation), and measured with 5 items developed by Windlinger et al. (2012), $\alpha = .79$. We also control for the use of special clothing and/or earplugs, using 3 items elaborated by the research team).

6.2. Reasons for Energy-Related Behaviour

This scale was developed by Windlinger et al. (2012) and it includes 6 aspects of occupant behavior relevant for energy consumption and sustainable behaviour, such as: a) Energy-consumption habits that refer to being conscious of the consequences of ones' energy-related actions versus uninten-

tional energy waste (1 item); b) Users' knowledge on energy efficient behaviour in office buildings that includes information about energy-saving opportunities exhibited in the employee's capability of indicating effective actions to reduce energy consumption as well as in his/her perception of the quantity of information provided in the company about the opportunities to save energy (α = .71); c) Attitudes toward saving energy that refer to consideration of energy conservation as useful, desirable, and compatible with goals to be carried out at work (α = .61); d) Self-efficacy regarding energy saving behavior (1 item); e) incentives regarding energy conservations (α = .71); and f) Goal-conflicts (α = .81).

6.3. Perception of Environmental Stressors

This scale refers to user's perception of the existence of physical stressors in the work environment such as room temperature too high, office temperature too low, draught, noise, unpleasant odour, etc. This scale is composed of a list of 11-items based on Anderson (1998) and has α = .80.

6.4. Hedonic Well-Being

Hedonic well-being scale is composed of 5 sub-scales that refer to different aspects of the construct such as: a) Job satisfaction that refers to the extent to which a person is satisfied with both intrinsic (e.g., task variety at work) and extrinsic (e.g., salary) aspects of his/her job. It has been measured using a reduced version of The Job Satisfaction Scale (IJSS) (Warr, Cook, & Wall, 1979), composed by 9 items (α = .74); b) Satisfaction with work environment, composed of 19 items that measure the extent to which a person is satisfied with such aspects of working environment as lighting, noise, air quality, distractions or privacy (α = .92); c) Life satisfaction that includes global cognitive judgments of satisfaction with one's life, measured with the "Ladder of life" (Cantril, 1966) composed by a single item with a response scale ranging from 0 "the worst possible life" to 10 "the best possible life"; d) Satisfaction with control over office environment, that is, the extent to which an employee is satisfied regarding his/her personal control over 7 aspects of his/her working environment: temperature, ventilation, exposure drafts, natural lighting, artificial lighting, exposure to distractions and noise (α = .98); e) Positive and Negative affect, understood as the extent to which a person experiences positive (e.g., happiness, flow) and negative (e.g., anxiety, frustration) emotions at work. It has been measured with 13 items developed by White and Dolan 2009 on the basis of the Day Reconstruction Method (DRM) of Kahneman, Krueger, Schkade, Schwartz and Stone (2004) and has α = .83.

6.5. Eudaimonic Well-Being

In this project we measure eudaimonic well-being using the following scales: a) Purpose in life and personal growth. This scale was developed by Ryff (1989) and adapted to Spanish by Diaz et al. (2006). It measures beliefs that give one the feeling there is purpose in and meaning to life, a sense of directedness, and intentionality (6 items), as well as perceptions of a continuous development of one's potential, growth, and expansion as a person, and a constant actualization of oneself and realization of one's potential (6 items). The global score α is .87; and b) Activity 'worthwhileness' that is understood as conviction that the activities carried out are worthwhile, useful to other people, have greater meaning, and serve higher purpose. This 3-item scale was developed by White and Dolan (2009) and has α = .81.

6.6. Occurrence of Health-Related Symptoms

This scale measures the existence of health symptoms (e.g., respiratory problems, headaches, difficulties concentrating) due to one's work environment. It is composed of a list of 10 symptoms adapted from Anderson (1998). The global score a α is .92.

6.7. In-Role Performance

This scale measures the extent to which an employee carries out tasks that are expected from him/her in his/her job. It is composed by 3-items reformulated from the scales by Mackenzie, Podsakoff and Podsakoff (2011) and by Williams and Anderson (1991), α = .79.

6.8. Extra-Role Performance

With this tool we aim to measure the extent to which an employee carries out tasks that are not directly requested from him/her (extra-role performance). To do so, we use a 3-item scale constructed on the basis of items proposed by Mackenzie, Podsakoff and Podsakoff (2011) and by Williams and Anderson (1991), α = .78.

6.9. Creative Performance

This scale measures the extent to which an employee perceives himself/herself as original and practical at work, as a person that develops creative ideas, methods or products that are novel and useful for the organization. Creative performance is measured with a 3-item scale developed by Oldham and Cumminngs in 1996 with α = .84.

7. CONCLUSIONS

In the present technical note, we have discussed the importance of a socio-technical approach to ensure an adequate adoption and use of technological advances oriented at reducing energy consumption. This approach emphasizes that psychsocial aspects of the users individually and collectively is key to obtain the machine-human fit when modifying the environment to maximize the opportunities for introducing sustainable solutions and changes in organizations oriented at decreasing energy consumption. As such, different psychological determinants of energy-related behaviors in office buildings can include: attitudes, perceived self-efficacy, knowledge, goal conflicts, incentives, or perception of control.

In the present work, we have described the main assumptions of the SSO project. We have explained that the SSO project considers as key the link between innovative and sustainable building systems and technologies with improved IEQ involves human factor at work. Also, we have presented the method used in the SSO project to evaluate the psychosocial phenomena considered in the model. The information obtained may help to improve the process of implementation of sustainable technology and solutions in office buildings.

Also, in the SSO project we propose that contributing to the sustainability of the office by cutting energy costs will not necessarily lead to decreased well-being and performance of

the office users. This decoupling will allow the organizations to take benefit from lower energy costs, as well as from increased well-being and performance of the office users that will lead to greater organizational gains.

To conclude, SSO project aims to promote an appropriate and sustainable usage of technology by acknowledging the central role of office users in sustainable offices. To this aim, it proposes a sustainable office assessment tool that can support the planning as well as decision-making process during the design and implementation of new offices or for retrofitting existing ones. This assessment tool can help to diagnose the possibilities for improvement in the IEQ that could be optimized using appropriate design, and, as a result, help the organizations to build innovative workplaces that support employees' well-being and productivity.

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REFERENCES

(1) Anderson, K. (1998). Epidemiological approach to indoor air problems. Indoor Air, 4, 32-9. http://dx.doi.org/10.1111/j.1600-0668.1998.tb00005.x
(2) Bamberg, S., & Möser, G. (2007). Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psychosocial determinants of pro-environmental behaviour. Journal of Environmental Psychology, 27, 14-25.
(3) Brehm, J. W. (1966). A theory of psychological reactance. San Diego, CA: Academic Press.
(4) Brehm, S. S., & Brehm, J. W. (1981). Psychological reactance: A theory of freedom and control. London, UK: Academic Press.
(5) Boyce, P. R., Veitch, J. A., Newsham, G. R., Jones, C. C., Heerwagen, J., Myer, M., & Hunter, C. M. (2006). Lighting quality and office work: two field simulation experiments. Lighting Research & Technology, 38(3), 191-223. doi: 10.1191/1365782806lrt1610a
(6) Brown, Z. & Cole, R.J. (2009). Influence of occupants' knowledge on comfort expectations and behavior. Building Research & Information, 37(3), 227-245.
(7) Cantril, H., 1966. The Pattern of Human Concerns. Rutgers University Press, New Brunswick, NJ.
(8) Constanzo, M., Archer, D., Aronson, E., & Pettigrew, T. (1986). Energy conservation behavior. The difficult path from information to action. American Psychologist, 41(5), 521-528.
(9) DeCroon, E., Sluiter, J., Kuijer, P. P., Frings-Dresen, M. (2005). The effect of office concepts on worker health and performance: a systematic review of the literature. Ergonomics 48(2), 119-134.
(10) DeMeo, E. A., & Taylor, R. W. (1984). Solar photovoltaic power systems: An electric utility R&D perspective. Science, 224(4646), 245-251.
(11) Díaz, D., Rodríguez-Carvajal, R., Blanco, A., Moreno-Jiménez, B., Gallardo, I., Valle, C., Van Dierendonck, D. (2006). Adaptación española de las escalas de bienestar psicológico de Ryff, Psicothema, 18(3), 572-577.
(12) Dolan. P., Layard. R.. & Metcalfe. R. (2011). Measuring subjective wellbeing for public policy: Recommendations on measures. Office for National Statistics.
(13) Fisk, W. J. (2000). Health and productivity gains from better indoor environments and their relationship with building energy efficiency. Annual Review of Energy and the Environment, 25(1), 537-566.
(14) Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1986/87). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. Journal of Environmental Education, 18, 1-8.
(15) Kahneman, D., Krueger, A.B., Schkade, D.A., Schwarz, N. & Stone, A.A. (2004). A survey method for characterizing daily life experience: the day reconstruction method. Science, 306, (5702) 1776-1780. http://dx.doi.org/10.1126/science.1103572
(16) Kaiser, F. G., Wolfing, S., & Fuhrer, U. (1996, August). Environmental Attitude and Ecological Behavior. Paper presented at the 104th Annual Convention of the American Psychological Association (APA), Toronto, Ontario, Canada.
(17) Karasek, R. A. (1979). Job demands, job decision latitude, and mental strain: Implications for job redesign. Administrative Science Quarterly, 24(2), 285-308.
(18) Kolodny, H. F., & Dresner, B. (1987). Linking arrangements and new work designs. Organizational Dynamics, 14(3), 33-51.
(19) Lee, S. Y., & Brand, J. L. (2005). Effects of control over office workspace on perceptions of the work environment and work outcomes. Journal of Environmental Psychology, 25(3), 323-333.
(20) Lindenberg, S. & Steg, L. (2007). Normative, gain and hedonic goal frames guiding environmental behavior. Journal of Social Issues, 63(1), 117-137.
(21) Linhart, F., & Scartezzini, J. (2011). Evening office lighting – visual comfort vs. energy efficiency vs. performance? Building & Environment, 46(5), 981-989. doi: 10.1016/j.buildenv.2010.10.002
(22) Lo, S.H., Peters, G.J., & Kok, G. (2011). Energy-related behaviors in office buildings: A qualitative study on individual and organisational determinants. Applied Psychology: An international review, online first.
(23) Mackenzie, S. B., Podsakoff, P. M., & Podsakoff, N. P. (2011). Challenge-oriented organizational citizenship behaviors and organizational effectiveness: do challenge-oriented behaviors really have an impact on the organization's bottom line? Personnel Psychology, 64, 559-592.

(24) Mumford, E. (2006). The story of socio-technical design: Reflections on its successes, failures and potential. Information Systems Journal, 16(4), 317-342.
(25) Office of Technology Assessment. (1982). Energy efficiency of buildings in cities. Washington, DC: Office of Technology Assessment.
(26) Oldham, G. R., & Cummings, A. (1996). Employee creativity: personal and contextual factors at work. Academy of Management Journal, 39(3), 607-634.
(27) OECD (2013). OECD Guidelines on Measuring Subjective Well-being. OECD Publishing. doi: 10.1787/9789264191655-en
(28) Owens, S., & Driffill, L. (2008). How to change attitudes and behaviours in the context of energy. Energy Policy, 36, 4412-4418.
(29) Pasmore, W. A. (1995). Social science transformed: The socio-technical perspective. Human Relations, 48(1).
(30) Pava, C. H. (1983). Managing new office technology: An organizational strategy. Free Press, New York, 1983.
(31) Peiró, J. (1991). Psicología de la Organización 2-1 y 2-2. Unidad didáctica IV. Universidad de Valencia.
(32) Petch, J., & Reeve, D. E. (1999). GIS, organisations and people: A socio-technical approach. CRC Press.
(33) Rice, A. (1958). Productivity and social organization: The Ahmedabad experiment. London: Tavistock Publications.
(34) Rashid, M., & Zimring, C. (2008). A review of the empirical literature on the relationships between indoor environment and stress in health care and office settings problems and prospects of sharing evidence. Environment and Behavior, 40, 151-190.
(35) Ross, M. H., & Williams, R. H. (1981). Our energy: Regaining control. New York: McGraw-Hill.
(36) Rosso, B. D., Dekas, K. H., & Wrzesniewski, A. (2010). On the meaning of work: A theoretical integration and review. Research in Organizational Behavior, 30, 91-127.
(37) Ryff, C. D. (1989). Happiness is everything, or is it? Explorations on the meaning of psychological well-being. Journal of Personality and Social Psychology, 57, 1069-1081.
(38) Solar Energy Research Institute. (1981). A new prosperity: Building a sustainable energy future. Andover, MA: Brick House.
(39) Steg, L., & Vlek, C. (2009). Encouraging pro-environmental behavior: an integrative review and research agenda. Journal of Environmental Psychology, 29, 309-317.
(40) Trist, E. L., Higgin, G. W., Murray, H., & Pollock, A. B. (1963). Organizational choice: Capabilities of groups at the coal face under changing technologies: The loss, re-discovery & transformation of a work tradition. London: Tavistock.
(41) Trist, E., & Bamforth, K. (1951). Sorne social and psychological consequences of the longwall method of coal-getting. Human Relations, 4, 3-38.
(42) Turner, G., & Myerson, J. (1998). New workspace, new culture: office design as a catalyst for change. Gower Publishing, Ltd.
(43) Van Eijnatten, M.F. (1992). An Anthology of the Socio-Technical System Design Paradigm. Eindhoven: Eindhoven University of Technology Press.
(44) Veitch, J. A., Newsham, G. R., Boyce, P. R., & Jones, C. C. (2008). Lighting appraisal, well-being and performance in open-plan offices: A linked mechanisms approach. Lighting Research & Technology, 40(2), 133-151.
(45) Veitch, J. A., & Newsham, G. R. (2000). Exercised control, lighting choices, and energy use: An office simulation experiment. Journal of Environmental Psychology, 20(3), 219-237. doi: 10.1006/jevp.1999.0169
(46) Veitch, J. A., Stokkermans, M. M., & Newsham, G. R. (2013). Linking Lighting Appraisals to Work Behaviors. Environment & Behavior, 45(2), 198-214. doi: 10.1177/0013916511420560
(47) Vilnai-Yavetz, I., Rafaeli, A., & Yaacov, C.S. (2005). Instrumentality, aesthetics, and symbolism of office design. Environment and Behavior, 37(4), 533-51.
(48) Vischer, J. C. (2007). The effects of the physical environment on job performance: towards a theoretical model of workspace stress. Stress and Health, 23, 175-184.
(49) Walker, C. R., & Guest, R. H. (1952). The man on the assembly line. Cambridge: Harvard University Press.
(50) Ward, A., Jones, A., & Hopper, A. (1997). A new location technique for the active office. IEEE Personal Communications, 4(5), 42-47.
(51) Warr, P., Cook, J., & Wall, T. (1979). Scales for the measurement of some work attitudes and aspects of psychological well-being. Journal of Occupational Psychology, 52, 129-148.
(52) White, M. P., & Dolan, P. (2009). Accounting for the richness of daily activities. Psychological Science, 20(8), 1000-1008. http://dx.doi.org/10.1111/j.1467-9280.2009.02392.x
(53) Williams, L. J., & Anderson, S. E. (1991). Job satisfaction and organizational commitment as predictors of organizational citizenship and in-role behaviors. Journal of Management, 17(3), 601-617.
(54) Windlinger, L., Janser, M., Feige, A., & Wallbaum, H. (2012). The role of office users in the sustainability of office buildings–an empirical investigation and implications for FM. In 7th international conference on improving energy efficiency in commercial buildings, April 2012, Frankfurt.

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