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SYSTEMS-THINKING THEORY

Decision-making for sustainable workplace transformations

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1 Background

The idea of 'systems' has been discussed in almost all disciplines since its origin in the 17th century including physics, biology and chemistry, and was eventually used for explanations in ecology, engineering, economics, anthropology, geography, sociology, cybernetics and so on. It has emerged as a meta-discipline and as a meta-language (Checkland & Scholes, 1999). Using the idea of systems, Checkland (1981 to date) provides the seminal work on 'systems-thinking'. 'Systems-thinking' is about consciously organised thinking processes (Arnold & Wade, 2015; Checkland, 1981). Systems-thinking is a world view which allows appreciation of holistic systems, having interconnections between the elements of which systems-thinking is made of, called system-components. This includes human and non-human elements of the system, encompassing physical, natural, social, economic, cultural and cognitive attributes, established in the form of the wider, linked processes between the users (human) and technologies or structures (non-human) of the system (Clegg, 2000). These system-components contribute to properties such as drivers, outcomes and feedbacks, and can be applied to problems of multiple disciplines (Cerar, 2012; Forrester, 1994; Voinov & Farley, 2007). As a core concept, systems-thinking is an idea of the 'adaptive whole'. As a whole, a system has its own emergent properties, layered structure and processes of communication and control (Arnold & Wade, 2015; Checkland, 1981).

Systems-thinking involves several principles, which on their own are looked upon as disciplines of systems-thinking. Anderson and Johnson (1997) provide the basic principles of systems-thinking:

1 The 'Big Picture' principle demands widening one's perspective to find a more effective solution (e.g. in stressful times, one tends to focus on the immediate, most pressing problem and this perceives only the effects of changes elsewhere in the system). Therefore, one should step back to look at the bigger picture and investigate the source of the problem, which would more likely identify a more effective solution.
2 The 'Long Term, Short Term' principle suggests that the best approach to strike a balance about any decision is to consider short-term (e.g., a week, a quarter, a year) and long-term

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(e.g., strategic changes impacting on better overall performance of the business) options and to look for the course of action that encompasses both.

3 The 'Dynamic, Complex, and Interdependent' principle stresses the fact that things change all the time, life is messy, and everything is connected. Essentially, this points out that the world is dynamic, complex and interdependent. The principle also advocates that simplification, structure and linear thinking have their own limitations and thus consideration should be given to a system's relationships both within the system and with the external environment.

4 The 'Measurable vs Non-measurable Data' principle encourages organisations to value both quantitative (measurable, e.g., sales figures and costs) and qualitative (non-measurable, e.g., morale and attitudes) data and challenges the tendency to 'see' only what can be measured.

5 The 'We Are Part of the System' principle highlights that the decision makers are often the contributor to their problems (e.g. a current problem can be the result of unintended consequences of a decision made or a solution implemented previously, including decisions made based on some kinds of mental assumptions, values and beliefs).

Systems-thinking is uniquely placed to use as a language for discussing complex systemic issues. Most importantly, it emphasises that professionals look at the project as a whole, rather than deal with their own familiar confined parts of the system. This essentially brings managers and engineers, emanating from different professions with differing terminology, functions and responsibilities, together. However, the professionals coming from divergent and compartmentalised backgrounds, and comfortable in using the language of their respective subject terminology, can inhibit those involved in the project to think of the project as a system and consequently can fail to 'engineer' or 'transform' the system for improvements in performance. This illustrates a fundamental set of barriers to understanding and applying systems-thinking in a complex multidisciplinary project (Checkland & Scholes, 1999).

Previous studies on decision-making have focused on 'Complex Adaptive Systems' (CAS) framing and made significant contributions to understanding dynamics of decision-making at the organisational level (see also Chapter 8 on decision-making theory). The main properties exhibited by CAS are the 'interaction between the system-components and their environment' in addition to 'adaptive capabilities' and 'responsiveness to feedback' (Choi et al., 2001). CAS systems exhibit properties like self-organisation, emergence and adaptation demonstrating strategic importance of the CAS framework particularly applicable for analysing complex problems in the organisational context (Campbell, 1960; Rhodes, 2008). These properties are important in analysing existing relationships per se, the outcome of which can inform decision makers on how to address a problem (Boston, 2000; Chapman, 2004).

Scholarship on sustainable transformations have focused on the socio-technical systems (see also Chapter 5 on socio-technical transitions theory). The socio-technical system is comprised of three operational levels: macro-, meso- and micro-levels, corresponding to three analytical concepts: landscape, regimes and niches (Geels, 2002). This 'multi-level perspective' of the socio-technical system (Geels, 2002, 2011) provides a framework for analysing institutional (system) innovations and changes (transitions) (Kemp & Rotmans, 2005; Loorbach, 2010), consequentially actualising the potential of transition (Berkhout et al., 2004; see also Chapter 8 on decision-making theory). Equally important, the institutional innovations and changes in core values, policies and practices, occurring at both inter-organisational (landscape or macro) and organisational (regime or meso) levels, must align their context to the individual level (niche or

micro) to allow successful transition. Therefore, governance engaging with dynamic and relational changes occurring at all three levels can contribute significantly to effective sustainable transformations.

Equally important, the emerging theory of sustainability requires organisations to drive their workplace strategies based on the principle of resource efficiency and resilience, using valuable human resources effectively to the path of making a resilient organisation, requiring conservation and management (Pelling, 2010; see also Chapter 6 on resilience). The theory of sustainability also considers the balance between various contextual themes and processes, such as economic activities, ecological constraints, social behaviour and influences, organisational behaviour and growth, cultural influences and the political environment, to move towards a full and effective participation of various organisational system-components in decision-making processes (Mensah & Casadevall, 2019; United Nations, 2012). This requires a holistic approach, and therefore, systems-thinking that is adept in assessing interconnection and multiple mutual relationships between system-components can be pragmatic. However, theories of applying systems-thinking and analyses of workplace performance are not readily available. Therefore, given that both CAS and socio-technical systems can contribute to strategic and dynamic decision-making, the 'Integrated Complex Adaptive and Socio-technical Framing' (Figure 3.1), backed with sustainability science, system innovations and system-transformations, can be adopted to assess both responses at individual and collective levels, and how these collaboratively impact on sustainable transformation (Thakore, 2016). This is explained further in Section 2.

2 Applicability to workplace studies

In a 'traditional (office) workplace' environment, all employees have an assigned desk. Traditional workplace practices are unsustainable, due to cumulative environmental impact on the production process, or as a direct function of consumption levels, having detrimental impacts on the human quality of life (UNEP, 2010). For example, energy use and consumption of resources at the workplace contribute to emissions of greenhouse gases, priority air pollutants, chemical emissions, ozone-depleting emissions and radioactive emissions. These in turn have health impacts such as relatively higher temperature, higher humidity, poor indoor air quality, poor illumination and poor ventilation (Piasecki et al., 2020). Sustainable economic growth therefore depends on how technological advances, inventions and digital innovations – such as technological software, project management systems and various communication devices and channels – are adopted to make both work and workplace practices sustainable (Hansen & Hoffman, 2011; see also Chapter 14 on radical innovation). For example, technology such as connectivity and laptops allow working from anywhere, and there is no longer a need of a fixed desk for each person. Agile workplace concepts often use desk ratios and enable the team to work in the office (at site) or off-site, including at home. This impacts on the organisation's environmental impact and sustainability, importantly, reducing energy consumption per employee (Holbeche, 2015).

Over the last three decades, there have been repeated calls for increasing resource efficiency and sustainability within the development activities of the built environment – particularly in work environments (Harrison et al., 2003; Schmidt-Bleek, 1998; Weizsäcker et al., 1998). Resource efficiency and sustainability policies are promoted at various levels, globally, at the European regional level (European Commission, 2014), nationally, regionally and municipally (Giljum & Polzin, 2009). This is to sustain economic growth while improving environmental performance (Huber, 2000). Nevertheless, increased resource use remains a nascent problem.

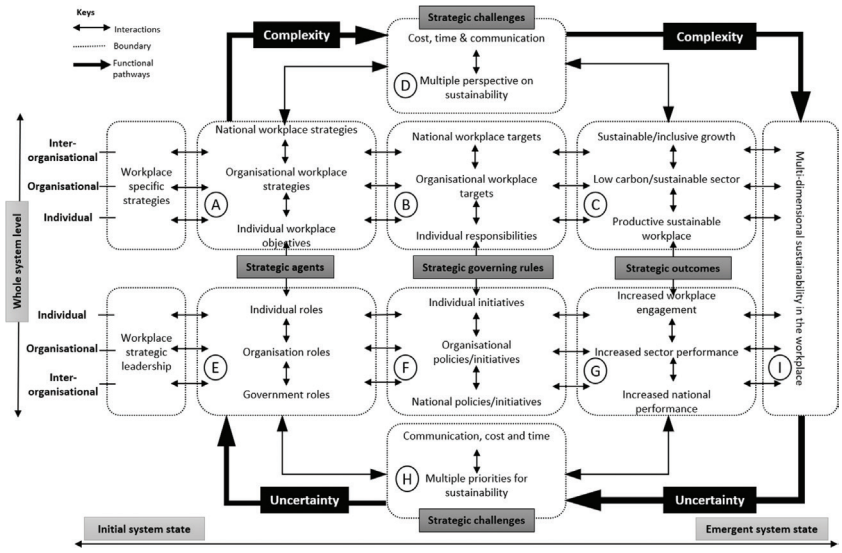

Figure 3.1 Integrated complex adaptive and socio-technical framing

Source: Thakore (2016)

Absolute reduction in resource use is essential (Giljum & Polzin, 2009; PROVIA, 2013). It is important to note however, that only achieving resource efficiency is not enough. 'Despite gains in material efficiency, the global use of materials, and the accompanying impacts of extraction, processing and disposal, continues to increase' (Urban Sustainability Directors Network, 2016). Therefore, sustainable consumption is needed (Jackson, 2016). This should be integrated with ecological consistency and achieving sufficiency in performance levels, primarily with individual action with efforts to advance at the organisational and societal levels (Alcott, 2008).

The integrated complex adaptive and socio-technical framing (see Figure 3.1) offers three main mechanisms: driving, decision-making and evaluation. Boxes A, B, C and D represent non-human elements of the system, Boxes E, F, G and H represent human elements of the system and Box I represents the results of interlinked human and non-human elements. Strategic systems-agents (Boxes A and E) are responsible for the 'driving'; the strategic governing-rules (Boxes B and F) are the basis for 'decision-making'; and other strategic processes such as interactions (double-headed arrows), feedbacks (Boxes D and H), and inputs and outputs (single headed arrows) are responsible for the 'evaluation' process. These mechanisms are interdependent in such a way that the strategic outputs depend on the effective coordination between all mechanisms whilst having every system-component operative in these mechanisms. For example, strategic systems-agents would take actions under the influence/pressure of strategic governing-rules and contribute to the strategic outputs/objectives (see also Chapter 10 on principal-agent theory).

Strategic outputs that are positive could strengthen the overall capability of the system to achieve its objectives (system-objectives) and reduce 'uncertainty' in its functional pathways. Likewise, strategic outputs that are negative could weaken the overall capability of the system to achieve system-objectives and increase 'uncertainty' within the system. These uncertainties are reported or fed back to the strategic system-agent(s) in the form of challenges (Rhodes &

MacKechnie, 2003). These challenges increase 'complexity' in the functional pathways. This situation may require evaluating governing-rules and transforming them for the system to deliver desired objectives. Therefore, iterative visits to these processes could increase capacities for dealing with challenges and increasing the knowledge of 'complexity' in the system. Principally, this framework captures characteristics of systems-thinking and highlights that multi-level system-components need to work in coordination in a long timeframe in order to deliver multi-dimensional sustainability (McCormick et al., 2013).

Box A and Box E represent a range of workplace-related strategies and roles respectively, especially related to improving organisational productivity (performance), energy efficiency and sustainability at all three levels: the objectives of organisational performance associated with the best practices at inter-organisational level (international level or sectoral association level) such as enabling competitiveness and market, attracting talent and conveying brand values (see also Chapter 11 on branding), and associated personal objectives of the employees, such as involvement, satisfaction and wellness. Boxes B and F represent a range of strategic governing-rules that define strategic interventions to achieve strategic outcomes. Strategic governing-rules direct strategic systems-agents to take actions and deliver on productivity (performance), energy efficiency and sustainability. Emerging governing-rules could be both top-down and bottom-up as against the traditional top-down nature of governing-rules. For example, at organisational and individual levels, agile workplace strategies could involve working from home. This can be associated with diverting the time and energy spent in travel and space occupancy to implement more productivity, social and well-being measures, especially beneficial for those struggling with multiple duties of work and home at the same time. At the individual level, it can attract young talent, and better wellness, without having employers invest in extra spaces (Harris, 2015; Skogland, 2017).

Boxes C and G represent strategic outcomes resulting from the interactions between systems-agents and the governing-rules. The outcomes are evident through the change in organisational performance levels including productivity, health and well-being, energy use, and energy security. Boxes D and H represent strategic challenges that constrain the delivery of strategic outcomes – for example, 'cost' could be the most important strategic challenge. Other strategic challenges could include communication, funds/grants and priority. These challenges bring uncertainties at each level. These must be addressed through consultation, awareness and training and eventually embedded into the culture. The role of a workplace strategic leader is very important. Workplace strategies are more likely to succeed with the strategic leadership of senior management (Brunia et al., 2016), yet the senior colleagues can sometimes be resistant to such change (Kavantera et al., 2020). Every effort should be made not only to hit targets, but also to make sure that principles of workplace strategies, organisational productivity, employees' health and well-being, energy efficiency and sustainability are adopted to create a hospitable workplace experience for employees (see also Chapter 17 on hospitality).

Kavantera et al. (2020) analysed Hong Kong workplace practices using systems-thinking theory. This exploratory research investigated the corporate drivers and individual preferences associated with the agile workplace. The study assessed workplace competence and individual and collective outcomes of the agile workplace. It revealed that the changing nature of work, productivity and employee wellness were some of the key drivers for implementation of agile workplace strategies at a corporate level. The preferences at the individual level, on the other hand, were found to be positively associated with an individual's exposure level to agile workplaces (Kavantera et al., 2020). This introductory research provided an early exploration of workplace practices, behaviours and patterns in Asian cities such as Hong Kong, while highlighting the need to carry out further research to study these topics in closer detail.

3 Methodology/research approach

Workplaces involve employees, those holding dignity (meaning) for the work (Hodson, 2001) and significance of the workplace (Eraut & Hirsh, 2010). Therefore, it is important to capture employees' perspectives (Campbell, 2000; O'Connell et al., 2004). A qualitative research technique can be used to uncover the realities lying in participants' experiences – and individual agency. Different patterns of human behaviour are observed in different times and places. The participant's experiences are expressed to the researcher who interprets these experiences based on his/her abilities and perceptions (Merriam & Tisdell, 2015). Adopted by constructivist and interpretivists, this technique helps gain holistic knowledge (Candy, 1991), understanding of the phenomenon in its 'natural settings' (Denzin, 2001) and of the 'native' viewpoints of the research participants, applying a wide- and deep-angle lens (Guba & Lincoln, 1994).

The qualitative research technique applies inductive reasoning for deeper understanding of the context (Tolley et al., 2016) and attempts to answer 'how', 'why' and 'what' questions while conceptualising complex processes contributing to theories (Gray, 2019). Qualitative analysis is used to improve understanding of individual agency, mutual interactions and influences, and to explicate realities based on a reliable database and convincing arguments (Guba & Lincoln, 1994). Qualitative data collection techniques include interviews, observations, documents, focus group discussion, themes and concepts, etc. The purposive sampling technique has the potential to collect a rich information data set and provide a valuable outcome (Patton, 2014). The data analysis includes extraction of important data (data reduction), organisation of data for meaningful constructs (data display) and constructing sensible outcomes (data findings) (Huberman & Miles, 2002).

The workplace can have unique features, such as progressive work practices, productive workplace or appreciated workplace, that promote greater employee involvement in the organisation of work. Training, incentivised reward systems and workplace innovation have all been invoked as potential levers for pursuing high-level organisational policy objectives. The workplace can be a place for private experiences such as job enrichment, participation, empowerment, transformational leadership and many more positive initiatives/practices to expand the employee role. While qualitative research provides a basis for generating theories and concepts belonging to the workplace processes, structures and strategies, objective evidence is needed to support the constructs.

The quantitative research techniques use deductive reasoning to identify social reality and integrate objectivism (Tolley et al., 2016). Commonly based on statistical probability and applying cause-and-effect principles, general patterns of human behaviour are identified (Marczyk & DeMatteo, 2005). Surveys, questionnaires and experiments are used to collect large numerical data which normally measure relationships between two or more variables (van Alphen et al., 1994). The use of Likert scales (Likert, 1932) satisfies the requirement of the scientific reasoning and allows interpretation of the results in a specific context for qualitative researchers (Göb et al., 2007). Further, a range of statistical analytic approaches can be employed in analysing numerical data; for example, descriptive analysis and multivariate analysis (Ngai et al., 2009). These could be useful in making connections between different stakeholders' priorities and perspectives working within the same workplace environment.

Given the complex nature of workplace research, there is a need to incorporate multiple perspectives (individual and collective) to understand workplace processes, challenges of sustainable transformation and multidimensional sustainability, in addition to general organisational functions. An explicit mixed-method design (focal literature review, online survey, interviews) can be used for research to maximise engagement and participation of all relevant stakeholders

as demonstrated by Kavantera et al. (2020). Moreover, a 'grounded theory' approach can be employed to capture the essence of the outcome, evaluate multiple perspectives and contribute to interpretive theories for emergent properties in the workplace.

Workplaces are complicated and dynamic environments. Therefore, they are required to have pragmatic approaches to achieve collective and individual engagement and success. In contemporary workplaces, the workplace leaders are required to have close coordination between internal stakeholders such as employees and external stakeholders, clients and regulators. Everyone engaged needs to be in the same plane of understanding to deliver the organisational (i.e. system's) objectives. This highlights that workplaces are complex, and each component is interrelated and represents a structure that can be investigated applying systems-thinking.

Systems-thinking is a pragmatic approach to deal with problems of societal systems – problems which cannot be solved without considering complexity and interdependence (da Costa Junior et al., 2019). Therefore, integrated research methods such as interdisciplinary and transdisciplinary methods that facilitate transcendence to a new common understanding, whilst considering diverse perspectives and integrating them based on commonality, could be useful for future systems-thinking research (Clarke, 2012; Repko & Szostak, 2020). However, the challenges of integrated research design include ensuring a balance between (a) the participants (elite and ordinary) taking part in the research process; (b) consensus building between different perspectives of participants for a given set of values; and (c) objectivity and subjectivity. These challenges can be addressed by integrating various knowledge domains, including theories, perspectives and practices (Schneider & Rist, 2014). 'Identifying the hidden collective perspective in the relationships' (for example, correlation, regressions, etc.) attached to the hypotheses can help integrate objectivity (Harding, 1992). An equally significant aspect of collective perspective in the new knowledge acquired by the participants is that it engages self-reflexivity (Azeiteiro et al., 2014), where participants reconsider their own values and opinions (Rosendahl et al., 2015).

4 Limitations

Several implications of systems-thinking for sustainable transformational processes are advantageous, such as appreciation of a holistic system or 'adaptive whole' and having interconnections between system-components. The properties of systems-thinking such as drivers, outcomes and feedbacks are applicable to problems of multiple disciplines and possess capacity to transform theoretical framing for sustainable transformations. A number of benefits for sustainable transformations in the workplace can be unveiled through systems-thinking: such as understanding multi-perspectives of the stakeholders, gaining deeper understanding of mutual interactions and influences, impacting on desired outcomes including productivity (performance) and energy efficiency, means to achieve multidimensional sustainability by aligning different levels: individual, organisational and inter-organisational levels (that do not always align; see also Chapter 9 on alignment).

The systems-thinking, however, applied in the context of workplace currently describes only an exploration and observations of workplace strategies and changes, which misses out on the advantages discussed earlier. The reason for this is that systems-thinking has not been able to capture the language/discourse in the workplace. These challenges point to the narrow world view that the managers or senior-level management team held for their workplace or organisation. For systems-thinking to have a greater impact, there is a need to look beyond the external environment and immediate concerns of the internal environment. The principles of systems-thinking must be relayed through different channels, and a common vocabulary should be developed

among the stakeholders, so that all involved in the change can easily participate and contribute to its dialogue. Employees, at the same time, should conceptualise this theory and make it feasible through their workplace objectives or organisational policies. This could be delivered through making the organisation a learning organisation and studying links between practice and learning, agency and change. External consultancy, career professional development programmes or use of master's courses underpinning systems-thinking theories, or related ways to enhance the understanding and application of systems-thinking, could be helpful. Future work can focus on providing an in-depth understanding of each emerging strategic benefit that relate to people management practices and organisational design – such as supporting a high-performance culture, providing flexibility, rapid decision-making and execution of strategic goals.

5 Theory relevance to practice

In the face of contemporary real-world problems of organisational workplaces, managers face difficulties in using traditional management or governance strategies to execute sustainable transformations. Understanding interconnections between each systems-component at every level, recognition of roles and responsibilities and long-term planning should become the central managerial tasks. Managers should take advantage of the characteristics of 'Integrated Complex Adaptive and Socio-technical Framing' (Thakore, 2016).

The 'Integrated Complex Adaptive and Socio-technical Framing' underpinning systems-thinking involves assessing interconnected system-components and multiple mutual relationships between these system-components. Thus, the key creation of this framing is the holistic approach which allows the recognition of individual and collective roles and responsibility, which in turn arise from the decision-making of each one involved. Systemic competence is dependent on stakeholders' positive practical experience, co-operative behaviour, and the rationale of systems-thinking (Harrison et al., 2003). Managers must invest heavily in systems to increase the strategic capacity that the system lacks at individual and collective levels. This could include optimisation of leadership and workplace strategies at individual and organisational levels (see also Chapter 18 on service management); and use of sustainable organisational strategies to move workplace strategic sustainability goals from 'aspirational levels' to more concrete 'implementation levels'.

With several elements such as uncertainty and ambiguities in the face of unknowability, the quality of learning from feedback enables the organisation to take actions that provide a better degree of certainty and deliver better results balancing the relationships among the systems-agents in the system. Organisational decision-making for long-term planning should consider the multi-level system-components' need to work in coordination over a long timeframe to deliver multidimensional sustainability. Managers should take initiatives to help employees by making their tasks as contextual as possible to the changing circumstances. The long-term planning with iterative cycles of assessing drivers, challenges and opportunities periodically in accordance with organisational productivity (performance), energy efficiency and sustainability, when done in conjunction with the employees' participation, allows managers to execute workplace sustainable transformations (see also Chapter 16 on user-centred design thinking).

6 Further reading

Després, C., Vachon, G., & Fortin, A. (2011). Implementing transdisciplinarity: Architecture and urban planning at work. In *Transdisciplinary Knowledge Production in Architecture and Urbanism* (pp. 33–49). Dordrecht: Springer.

Kaspary, M. C. (2014). Complex thought and systems thinking connecting group process and team management: New lenses for social transformation in the workplace. *Systems Research and Behavioral Science*, *31*(5), 655–665. doi:10.1002/sres.2313

McDaniel, R., Jr (2007). Management strategies for complex adaptive systems sensemaking, learning, and improvisation. *Performance Improvement Quarterly*, *20*(2), 21–41. doi:10.1111/j.1937-8327.2007.tb00438.x

Shrivastava, P., Ivanaj, S., & Persson, S. (2013). Transdisciplinary study of sustainable enterprise. *Business Strategy and the Environment*, *22*(4), 230–244. doi:10.1002/bse.1773

7 References

Alcott, B. (2008). The sufficiency strategy: Would rich-world frugality lower environmental impact? *Ecological Economics*, *64*(4), 770–786. doi:10.1016/j.ecolecon.2007.04.015

Anderson, V., & Johnson, L. (1997). *Systems Thinking Basics*. Cambridge, MA: Pegasus Communications.

Arnold, R., & Wade, J. (2015). A definition of systems thinking: A systems approach. *Procedia Computer Science*, *44*(2015), 669–678. doi:10.1016/j.procs.2015.03.050

Azeiteiro, U., Leal Filho, W., & Caeiro, S. (2014). *E-Learning and Education for Sustainability*. doi:10.3726/978-3-653-02460-9

Berkhout, F., Smith, A., & Stirling, A. (2004). Socio-technological regimes and transition contexts. In B. Elzen, F. Geels & K. Green (Eds.), *System Innovation and the Transition to Sustainability: Theory, Evidence and Policy* (p. 336). doi:10.4337/9781845423421.00013

Boston, J. (2000). The challenge of evaluating systemic change: The case of public management reform. *International Public Management Journal*, *3*(1), 23–46. doi:10.1016/S1096-7494(00)00033-7

Brunia, S., De Been, I., & van der Voordt, T. (2016). Accommodating new ways of working: Lessons from best practices and worst cases. *Journal of Corporate Real Estate*, *18*(1), 30–47. doi:10.1108/JCRE-10-2015-0028

Campbell, D. (1960). Blind variation and selective retentions in creative thought as in other knowledge processes. *Psychological Review*, *67*(6), 380–400. doi:10.1037/h0040373

Campbell, D. (2000). The proactive employee: Managing workplace initiative. *Academy of Management Perspectives*, *14*(3), 52–66. doi:10.5465/ame.2000.4468066

Candy, P. (1991). *Self-Direction for Lifelong Learning. A Comprehensive Guide to Theory and Practice*. San Francisco, CA: Jossey-Bass.

Cerar, J. (2012). *Transdisciplinary Sustainable Development* (Master thesis). Univerza v Ljubljani, Ekonomska fakulteta. www.cek.ef.uni-lj.si/magister/cerar773-B.pdf

Chapman, J. (2004). *System Failure: Why Governments Must Learn to Think Differently*. London: Demos.

Checkland, P. (1981). *Systems Thinking, Systems Practice*. Chichester: J. Wiley.

Checkland, P., & Scholes, J. (1999). *Soft Systems Methodology: A 30-Year Retrospective*. Chichester: Wiley.

Choi, T., Dooley, K., & Rungtusanatham, M. (2001). Supply networks and complex adaptive systems: Control versus emergence. *Journal of Operations Management*, *19*(3), 351–366. doi:10.1016/S0272-6963(00)00068-1

Clarke, S. (2012). *Information Systems Strategic Management: An Integrated Approach*. Oxon: Routledge.

Clegg, C. W. (2000). Sociotechnical principles for system design. *Applied Ergonomics*, *31*(5), 463–477. doi:10.1016/S0003-6870(00)00009-0

da Costa Jr, J., Diehl, J. C., & Snelders, D. (2019). A framework for a systems design approach to complex societal problems. *Design Science*, *5*. doi:10.1017/dsj.2018.16

Denzin, N. (2001). *Interpretive Interactionism* (Vol. 16). California: SAGE Publications, Inc.

Eraut, M., & Hirsh, W. (2010). *The Significance of Workplace Learning for Individuals, Groups and Organisations*. Oxford: SKOPE.

European Commission. (2014). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions – A Policy Framework for Climate and Energy in the Period from 2020 to 2030*. Brussels: European Commission. https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014DC0015&from=EN

Forrester, J. (1994). System dynamics, systems thinking, and soft OR. *System Dynamics Review*, *10*(2–3), 245–256. doi:10.1002/sdr.4260100211

Geels, F. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*, *31*(8–9), 1257–1274. doi:10.1016/S0048-7333(02)00062-8

Geels, F. (2011). The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, *1*(1), 24–40. doi:10.1016/j.eist.2011.02.002

Giljum, S., & Polzin, C. (2009). *Resource Efficiency for Sustainable Growth: Global Trends and European Policy Scenarios*. Paper Presented at the International Conference on Green Industry in Asia – Managing the Transition to Resource-Efficient and Low-Carbon Industries, Manila, Philippines. www.academia.edu/190057/Resource_efficiency_for_sustainable_growth_global_trends_and_European_policy_scenarios

Göb, R., McCollin, C., & Ramalhoto, M. (2007). Ordinal methodology in the analysis of Likert scales. *Quality & Quantity*, *41*(5), 601–626. doi:10.1007/s11135-007-9089-z

Gray, D. (2019). *Doing Research in the Business World*. London: SAGE Publications Ltd.

Guba, E., & Lincoln, Y. (1994). Competing Paradigms in Qualitative Research. In N. Denzin & Y. Lincoln (Eds.), *Handbook of Qualitative Research* (pp. 105–117). California: SAGE Publications Ltd.

Hansen, L., & Hoffman, J. (2011). Climate savvy: Adapting conservation and resource management to a changing world. *Oryx*, *45*(3), 456–457. doi:10.1017/S0030605311001232

Harding, S. (1992). Rethinking standpoint epistemology: What is "strong objectivity? *The Centennial Review*. www.jstor.org/stable/23739232

Harris, R. (2015). The changing nature of the workplace and the future of office space. *Journal of Property Investment & Finance*, *33*(5), 424–435. doi:10.1108/JPIF-05-2015-0029

Harrison, A., Wheeler, P., & Whitehead, C. (Eds.). (2003). *The Distributed Workplace: Sustainable Work Environments* (1st ed.). doi:10.4324/9780203616574

Hodson, R. (2001). *Dignity at Work*. Cambridge: Cambridge University Press.

Holbeche, L. (2015). *The Agile Organization: How to Build an Innovative, Sustainable and Resilient Business*. London: Kogan Page Publishers.

Huber, J. (2000). Towards industrial ecology: Sustainable development as a concept of ecological modernization. *Journal of Environmental Policy and Planning*, *2*(4), 269–285. doi:10.1002/1522-7200(200010/12)2:4<269::AID-JEPP58>3.0.CO;2-U

Huberman, M., & Miles, M. (2002). *The Qualitative Researcher's Companion*. California: SAGE Publications, Inc.

Jackson, T. (2016). *Prosperity without Growth: Foundations for the Economy of Tomorrow*. London: Routledge.

Kavantera, A., Thakore, R., & Whitehall, G. (2020). *How do Corporate Drivers and Individual Preferences for Agile Working Meet? Study of Hong Kong Organisations and Employees*. Paper Presented at the The Second Transdisciplinary Workplace Research Conference, 16th–19th of September 2020, Weimar, Germany. www.twr2020.org/Conference-Program/Session-4/

Kemp, R., & Rotmans, J. (2005). The management of the co-evolution of technical, environmental and social systems. In M. Weber & J. Hemmelskamp (Eds.), *Towards Environmental Innovation Systems* (pp. 33–55). doi:10.1007/3-540-27298-4_3

Likert, R. (1932). A technique for the measurement of attitudes. In, *Archives of Psychology* (Vol. 22, p. 55). Virginia: The University of Virginia.

Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. *Governance*, *23*(1), 161–183. doi:10.1111/j.1468-0491.2009.01471.x

Marczyk, G., & DeMatteo, D. (2005). *Essentials of Research Design and Methodology*. Hoboken, NJ: John Wiley & Sons.

McCormick, K., Anderberg, S., Coenen, L., & Neij, L. (2013). Advancing sustainable urban transformation. *Journal of Cleaner Production*, *50*, 1–11. doi:10.1016/j.jclepro.2013.01.003

Mensah, J., & Casadevall, S. (2019). Sustainable development: Meaning, history, principles, pillars, and implications for human action: Literature review. *Cogent Social Sciences*, *5*(1), 1653531. doi:10.1080/23311886.2019.1653531

Merriam, S., & Tisdell, E. (2015). *Qualitative Research: A Guide to Design and Implementation*. California: John Wiley & Sons.

Ngai, E., Xiu, L., & Chau, D. (2009). Application of data mining techniques in customer relationship management: A literature review and classification. *Expert Systems with Applications*, *36*(2), 2592–2602. doi:10.1016/j.eswa.2008.02.021

O'Connell, P., Russell, H., Watson, D., & Byrne, D. (2004). *The Changing Workplace: A Survey of Employees' Views and Experiences*. http://edepositireland.ie/bitstream/handle/2262/72620/NCPP_Research_2_2004_nwses_full_report.pdf?sequence=1&isAllowed=y

Patton, M. (2014). *Qualitative Research & Evaluation Methods: Integrating Theory and Practice*. California: SAGE Publications, Inc.

Pelling, M. (2010). *Adaptation to Climate Change: From Resilience to Transformation*. Oxon: Routledge.

Piasecki, M., Kostyrko, K., Fedorczak-Cisak, M., & Nowak, K. (2020). Air enthalpy as an IAQ indicator in hot and humid environment – experimental evaluation. *Energies*, *13*(6), 1481. doi:10.3390/en13061481

PROVIA. (2013). *PROVIA Guidance on Assessing Vulnerability, Impacts and Adaptation to Climate Change*. Nairobi, Kenya. www.adaptation-undp.org/sites/default/files/downloads/provia-guidance-nov2013.pdf

Repko, A. F., & Szostak, R. (2020). *Interdisciplinary Research: Process and Theory* (4th ed.). California: SAGE Publications, Inc.

Rhodes, M. (2008). Complexity and emergence in public management: The case of urban regeneration in Ireland. *Public Management Review*, *10*(3), 361–379. doi:10.1080/14719030802002717

Rhodes, M., & MacKechnie, G. (2003). Understanding public service systems: Is there a role for complex adaptive systems theory? *Emergence*, *5*(4), 57–85. doi:10.1207/s15327000em0504_6

Rosendahl, J., Zanella, M., Rist, S., & Weigelt, J. (2015). Scientists' situated knowledge: Strong objectivity in transdisciplinarity. *Futures*, *65*, 17–27. doi:10.1016/j.futures.2014.10.011

Schmidt-Bleek, F. (1998). *The MIPS-Concept*. Paper Presented at the Environmental Behaviour and Quality of Life: Ecological, Sociological, Psychological and Communicational Indicators of Sustainability, Stadtschlaining, Austria. https://docplayer.net/37642574-Environmental-behaviour-and-quality-of-life-ecological-sociological-psychological-and-communicational-indicators-of-sustainability.html

Schneider, F., & Rist, S. (2014). Envisioning sustainable water futures in a transdisciplinary learning process: Combining normative, explorative, and participatory scenario approaches. *Sustainability Science*, *9*(4), 463–481. doi:10.1007/s11625-013-0232-6

Skogland, M. (2017). A spatial approach to transformational change: Strategic alignment of the spatial and cultural environment. *Journal of Corporate Real Estate*, *19*(4), 285–299. doi:10.1108/JCRE-09-2016-0030

Thakore, R. (2016). *A Strategic Engagement Model for Delivering Energy Efficiency Initiatives in the English Housing Sector*. University of Central Lancashire. http://clok.uclan.ac.uk/18647/

Tolley, E., Ulin, P., Mack, N., Robinson, E., & Succop, S. (2016). *Qualitative Methods in Public Health: A Field Guide for Applied Research*. Hoboken, NJ: John Wiley & Sons.

UNEP. (2010). *Assessing the Environmental Impacts of Consumption and Production (9280730843)*. www.resourcepanel.org/file/171/download?token=p6YPKaxA

United Nations. (2012). *Report of the United Nations Conference on Sustainable Development*. https://sustainabledevelopment.un.org/index.php?page=view&type=111&nr=1358&menu=35

Urban Sustainability Directors Network. (2016). *Why Efficiency is not Enough*. United States and Canada. https://sustainableconsumption.usdn.org/concept/why-efficiency-is-not-enough

van Alphen, A., Halfens, R., Hasman, A., & Imbos, T. (1994). Likert or Rasch? Nothing is more applicable than good theory. *Journal of Advanced Nursing*, *20*(1), 196–201. doi:10.1046/j.1365-2648.1994.20010196.x

Voinov, A., & Farley, J. (2007). Reconciling sustainability, systems theory and discounting. *Ecological Economics*, *63*(1), 104–113. doi:10.1016/j.ecolecon.2006.10.005

Weizsäcker, E., Lovins, A., & Lovins, L. (1998). *Factor Four: Doubling Wealth-Halving Resource Use: The New Report to the Club of Rome*. Oxon: Earthscan.