A Planning and Readiness Framework for Organisational Systems Change within Human Systems Integration

Grace A.L. Kennedy [1,2]

[1] Acmena Group Pty. Ltd., PO Box 230,
Ashgrove West, QLD4060, Australia.
grace.kennedy@acmena.com.au

[2] University of Wollongong, School of Health & Society,
Northfields Avenue, Gwynneville, NSW2525, Australia.
galk884@uowmail.edu.au

Abstract. Human Systems Integration can be seen as the nexus between the human factors/ergonomics and systems engineering activities undertaken during the development of a system, with the entire systems lifecycle in mind. Human factors/ergonomics has three recognized domains; the physical, cognitive and organizational – whilst the physical domain is stereotypically most associated with the term *ergonomics*, and the cognitive domain has a well-established set of methods and tools, the consideration of the organizational domain lacks agreement in terms of the scope of both the organization in or as a system and the scope of activities. Whilst the exploration of human activity systems and envisaged organizational structures are performed early in the conceptual systems development stage, there exists a challenge in planning, synchronizing and positioning an organisation to adapt for the planned technological system change. This paper explores the dual challenges in planning for the evolution of the organizational system as well as the considerations for organizational change that can and should feed into system design and development. A triple-axis framework is proposed that will enable HSI practitioners to consider the evolution of the organizational system and the extent of organizational change planning alongside the phases of the system lifecycle.

Introduction

The planning and implementation of organizational systems change presents two major challenges for Human Systems Integration (HSI) practitioners; firstly how can we ensure that the organizational design component of the sociotechnical system (STS) is considered adequately at the appropriate level of maturity as the technological system design is maturing? and secondly how do we measure the organizational change to ensure that the organizational system will be synchronized to accept and fully utilize the new technological system at the deployment stage?

Complex adaptive sociotechnical system design is not a straightforward system development exercise. Whilst systems engineers have traditionally designed to the envisaged "ideal" STS of future operational scenarios, the socio or organizational aspect of the design is at best a general direction for transformation. *Human Systems Integration* is defined as an approach of systems engineering (SE) that integrates technology, organizations and people effectively (INCOSE, 2023), meaning that the scope of the system of interest for HSI practitioners is always the sociotechnical system. However, within the SE discipline the use of the term *sociotechnical system* can be variable, although it is generally acknowledged that in fact all engineered systems are STS (by virtue of the fact that they have both technical and social/human elements involved at some point in the systems lifecycle) there exist two distinct theoretical traditions in the nuanced use of the term (Polojärvi et al., 2023); 1) the

STS comprises networks of people interacting with technologies and is based on STS theory which has its roots in the ergonomics and safety science field, and 2) STS from the stance of systems science where human and technical agents are interacting forming complex systems that are recursive, display emergence and are adaptive. This second use of the term stems from the philosophy of engineering.

This duality of STS definitions neatly demonstrates the difficulties that HSI practitioners, who sit at that nexus of both human factors/ergonomics (HF/E) and systems engineering (SE), face and therefore require both perspectives to be considered. Recent advances in HSI have seen the coining of the term *socio-ergonomics* which extends the epistemological descriptors of the levels of ergonomics beyond the micro-, meso- and macro-, outwards to the broader sociological perspective; that which considers the behavioral science of communities, organisations and society itself (Boy, 2023).

This paper is structured as follows. A methodology is provided to outline the process under which the framework was developed, a brief background to the problem is provided in the form of a literature summary that provides the theoretical backbone to the framework and potential instruments for measuring organizational readiness. The proposed framework is then presented alongside theoretical situations that describe possible uses of the framework. The paper concludes with a brief discussion around limitations and validation needs.

Methodology

The study takes an exploratory research approach to the problem of synchronizing the organisation with the technological system development. Figure 1 shows the overall framework development methodology. The scope of this paper covers the first activities shown in **blue** to explore the problem, the body of knowledge and potential dimensions for the framework. A mixed methods application of the framework to an existing organizational system, integration of organizational models into MBSE, and the refinement of the framework will be covered in other publications. This paper seeks to present and disseminate the initial framework concepts and potential measures.

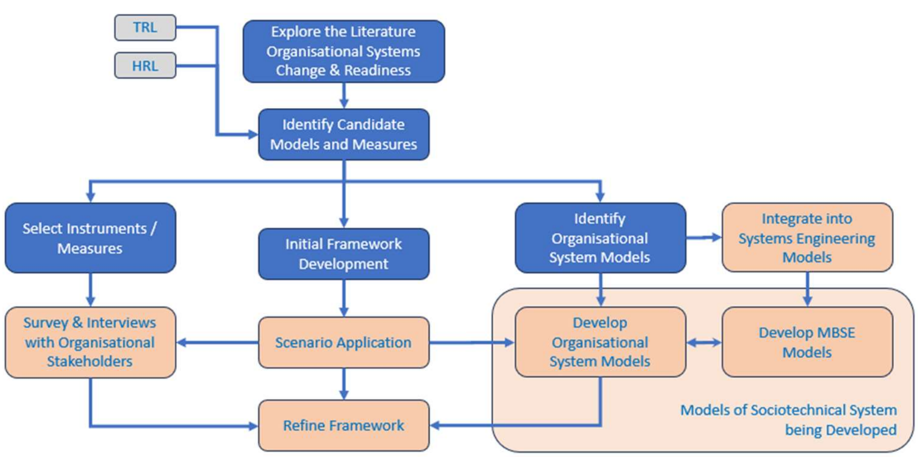

Figure 1: Framework Development Methodology

Given that the realm of the research lies in the HSI field, recent progress in Human Readiness Levels (HRLs) are utilized as a starting point. ANS-HFES 400-2021 outlines the HRLs in addition to guidance around how the levels are assessed (HFES, 2021). In effect the activities discussed within the HRLs are the HSI activities. In addition, aligned work on models that include the Human View (HV) within SE have been evolving over the last 15 years (Handley, 2022), with the human elements being given more mature consideration within architecture frameworks and model-based systems engineering. As the organization is one of three domains of HF/E, it can be argued that any extensions to the organizational aspects should fit within the schema of the HRL and HV work (rather than compete with), therefore the Technology Readiness Levels (TRLs) and HRLs are pre-selected as an input into the models and measures.

Literature

Two separate literature reviews were undertaken during the research; the first a systematic review that sought to understand what is known around the field of organizational systems through the lens of organizational change from papers published in the academic corpus from 2010-2020, the second a scoping review that explored specific candidate scales for the measurement of organizational readiness levels from 2013-2023. Due to the brief nature of this paper, it is not the author's intention to report formally on the full literature review, but to provide a summary that will provide sufficient background to understanding the proposed framework.

Organizational Systems and Change

A *system* is an *interacting* combination of *system elements* to accomplish a defined *objective*(s). The system interacts with its *environment*, which may include other systems, users, and the natural environment (INCOSE, 2021). The definition seems innocuously simple. However, when organisations are viewed as systems there is no single definition because it depends on the perspective of the viewer/observer. When viewing an organisation as a system there can be many ways to decompose the system into sub-systems (or entities) (Bednar & Welch, 2020). For example, Carmichael (2018) suggests that an organisation is a group of at least three people, working towards some common purpose and that the elements of the organizational system are the people, whilst other researchers consider the elements to be the sub-units within a broader organisation (e.g., Urban, 2017). Multiple levels of decomposition have been traditionally used to describe the organizational system (individuals, groups, and organisation) (Robbins & Judge, 2007; Schein, 2010) and have more recently been applied in studies on organizational learning and evolution (Annosi et al., 2020). Ainsworth and Feyerherm (2016) build on this three-level notion, by adding a fourth supersystem level, the "trans-organizational" system that is composed of multiple organisations.

A transverse view of organizational systems where subsystems each with a function or intended purpose was also found in the literature, for example; production subsystem, quality management subsystem, and communication subsystem (Khan, 2015) and operational excellence systems being used synonymously with an organizational system (Yeo, 2019). Others take a more systems theoretic view and define the organizational system not in terms of its entities, but as an emergent property of the interactions between the people and technology (Bednar & Welch, 2020), or as a result of the impact of the environment on the organizational system (Lenartowicz, 2018).

The Viable System Model (VSM) (Beer, 1984) is the basis of much of the literature found and encompasses many of the ideas above. The VSM expresses an organizational system as being comprised of five interacting systems: 1) operations (the viable system itself and its recursions), 2) coordination, 3) delivery, 4) development, and 5) policy. The dynamics of these subsystems together enable the system to adapt and remain viable in changing environments. Hoverstadt (2020) focusses on the applications of VSM to human activity systems, in terms of using VSM to diagnose gaps in real-world organisations, subsequent design to improve the situation, and finally self-knowledge of the validity of the model itself. As an organisation's environment is constantly changing, adaptation in response to change can be seen as a futile endeavor (Donaldson, 2017). Organisational systems should be designed and changed over a period to be able to adapt as the environment changes. If you wait until the change is needed, the rate of organizational change may be too uncomfortable for the organisation, or worse still, once the organisation has changed it's too late to derive value from the stimulus of that change (potentially even threatening the viability of the organisation) because the next wave of changes in the environment have arrived.

A further common approach is to consider the organizational system expressed as causal relationships. The Burke-Litwin causal model of organizational performance and change (Burke & Litwin, 1992) provides useful meta-objects that comprise the relationships between the external environment through to the individual and organizational performance via transformational factors (mission and strategy, leadership and organizational culture) and transactional factors (structure, systems-processes, management practices, work climate, task and individual skills, individual needs and values and motivation. Since the 1990s this model has been used to derive assessment methods and tools such as the Burke-Litwin Organizational Assessment survey (Stone, 2015), for diagnostics in assessing organizational readiness (Blackman et al., 2013) and for identifying required change (Boone, 2012).

Organizational Readiness Levels

A search of academic databases (Scopus, Google Scholar, ABI Inform Complete, ScienceDirect, IEEE Explore and Web of Science) was undertaken using the search string <*organi*ational readiness level*> from 2013-2023. A total of 74 results were found, of which 30 were excluded as repetitions/unretrievable, and a further 11 excluded as they only mentioned the keywords in passing. This left 33 results in the set of interest. The majority of results used the term "organizational readiness level" as part of the prose to denote an unspecified quantity of sufficiency. There were also differences in which aspects the organisations were ready for. Table 1 summarizes these different groupings around organizational readiness.

Table 1: Applications of Organisational Readiness

Organizational Readiness Groupings	Scope (Source)
Factor Affecting Organizational Readiness	• Customer satisfaction (Durant-Tyson, 2022) • Organizational climate (Manik & Ginting, 2019) • Knowledge management (Ezeruigbo, 2023; Rusly et al., 2015)
Change to Paradigm or Process	• Internationalization (Siriphattrasophon & Saiyasopon, 2013) • Circular supply chain implementation (Kayikci et al., 2022) • Lean transformation (Prasad & Vasugi, 2023) • eCommerce practices (Kurnia et al., 2015)
Change to a Technology	• A new technology (Vik et al., 2021) • Open data (Wang & Lo, 2016) • IoT (Ancarani et al., 2020; Viamianni et al., 2023) • Cloud computing (Al Mudawi et al., 2020) • Digital technologies (Bruno et al., 2020)
Organizational Readiness Level (ORL) Scale	• Balanced readiness level assessment (Vik et al., 2021) • Organizational impacts of testing/adopting innovation (Bruno et al., 2020) • Proposed ORL within socioergonomics (Boy, 2022)
Readiness for Change / Instruments for Assessment	• Organizational Readiness for Implementing Change (ORIC) (Shea et al., 2014) • Organizational Readiness to Change Assessment (ORCA) (Crittendon et al., 2020) • Diagnostic tool for assessing organizational readiness for complex change (Blackman et al., 2013)

The latter two groupings are of most interest to this research. The established TRL and HRL scales provide a graduated system for maturity measurement, it is evident that a single scale ORL whilst useful for measuring how well the organisation dimension has been included within the development activities of the technological system, seems incongruent to not also consider that the organizational system is something that needs to be evolving as well as the technological system, therefore some aspect of measuring readiness for change evoked from the planned introduction of the technological system is also required.

Reflecting on the initial search string, there were only three published scales for ORL. Coincidentally, all three were published between 2020-2021. Table 2 shows the alignment against the numerical level for the three candidate ORL scales.

Table 2: Candidate Organizational Readiness Level Scales

Vik, 2021		Boy, 2021		Bruno, 2020	
		0	About first principles where potential organizational models are explored		
1	The technology represents a fundamental break with existing work processes or organizing	1	Goal-oriented research that requires making choices from first principles to practical fully digital organizational setups	1	Identification of the organizational need (infrastructures, capabilities, skills) and associated organisational readiness aspects
2	Unclear how the technology might be adapted to existing work processes/organization	2	Proof of principle development and active R&D is started in a virtual environment	2	Formulation of proposed solution concept and potential impacts; appraisal of organisational readiness issues; identification of relevant roles, processes, functions and structures for the solution
3	An idea about integration domestication exist	3	Virtual agile organizational prototype development and first HITLS (virtual HCD)	3	Comprehensive description of proposed solution's impacts within the organisation in terms of roles, competences and skills, physical infrastructures required
4	Integration with work processes/organization is formulated	4	Proof of organizational concept development using concrete scenario-based design from fully virtual to more tangible environments	4	Solution validated through simulation of major induced changes to substantiate proposed impacts and organisational readiness: the organisation which is developing the solution starts to acquire roles, competences and skills, physical infrastructures required
5	A concrete plan for integration with existing work processes is formulated	5	Assessing organization capability in terms of authority sharing (responsibility, accountability, and control), trust, collaboration and coordination, for example	5	Proposed solution validated through pilot testing in real or realistic organisational environments: the organisation which is developing the solution achieves roles, competences and skills, physical infrastructures required
6	Large/fundamental organizational changes are needed in order to use the technology	6	Real-world use-case tests in a wider variety of situations – tangibilization continues	6	Solution demonstrated in real world environments and in cooperation with relevant stakeholders to gain feedback in order to improve roles, processes, functions and infrastructures required
7	Small organizational changes are needed in order to use the technology	7	Practical integration with respect to criteria such as safety, efficiency and comfort, at various levels of granularity of the organization – tangibilization continues	7	Refinement of the roles, processes, functions and infrastructures required and retesting of the solution in relevant organisational environments
8	Technology is adapted to work processes and/or existing technology	8	Readiness for effective implementation on a real site (fully tangible) based on personnel feedback for deployment approval	8	Targeted solution, as well as a plan for organisational embedment, complete and qualified: roles, processes, functions and infrastructures are available
9	The technology works seamlessly with existing technology	9	Deployment involving both personnel and real machines	9	Actual solution proven in relevant organisational environments: roles, processes, functions and infrastructures are correctly used for the solution on the market

Vik et al. (2021) ORL scale is focussed mostly on the work processes and the integration with existing technologies organizations are utilizing. Vik's scale is the only one of the three that is not loosely aligned to the TRL scale; however, it does include the consideration of large and smaller scale change from the mid-levels. It is reassuring that the scale emphasizes that the technology will need to be adapted as well as organizational change, however it is concerning that the technology adaptation for the organization does not happen until relatively late (Level 8), thus reducing the opportunities for changes in technological design earlier in the development. Boy (2022) ORL scale looks at the maturing of the concept of the organization from a virtual perspective through to increasing levels of tangibility into the real world, one in which the organization is comprised of multiple agents that can be tested and simulated alongside the virtual then tangible technological design. In many ways Boy's scale offers that elusive structure in which the organization design and technological design can be tested together and changes required (from either part) can then be evidenced and iterated. Finally Bruno et al. (2020) ORL scale focusses on the maturity from the organizational design view, taking into account specific aspects of the organizational system (roles, processes, structures, etc.) that HF/E practitioners would be most familiar with.

Each of the ORL scales is slightly different and provides insight into different aspects, and hence have different benefits. It is clear that there are two dimensions to organizational readiness that need to be considered during system development: 1) the maturing of the organizational system design and transition of the organisation to that state and 2) the readiness of the actual organisation in its current state to change.

Introducing the Framework

The purpose of the proposed framework is to provide a simple structure in which HSI practitioners can map out and evaluate organizational system design and planned organizational change that is aligned to the technological system development. The target type of organizational system is those that will be receiving, operating and maintaining the new technology (not the organisation developing the technology, although this could be the same organisation in some cases). It does not establish the methods or mechanisms for the decisions made around the actual design or planned change but gives a set of constructs around which activities should be performed. Figure 2 shows the framework as a cube, however it is more akin to a set of *Cuisenaire* rods; the TRL/HRLs have clear scale levels that aligned with each other, and the maturity of the organizational system design may have clearly defined phases, the organizational change readiness is better represented as rods of different lengths. Because the organizational system design and maturity is evolving, the extent of the change is also not static during the development of the system, therefore any change readiness measures will be for a limited change from each stage of maturity to the next. In effect there will be a stagger due to lag as the decisions around organizational design are enacted in an organization and any changes will take time to happen, subsequently requiring the next change readiness assessment to have to pause. How often and how long the duration between change and next assessment will depend on the enterprise and the development cycle length.

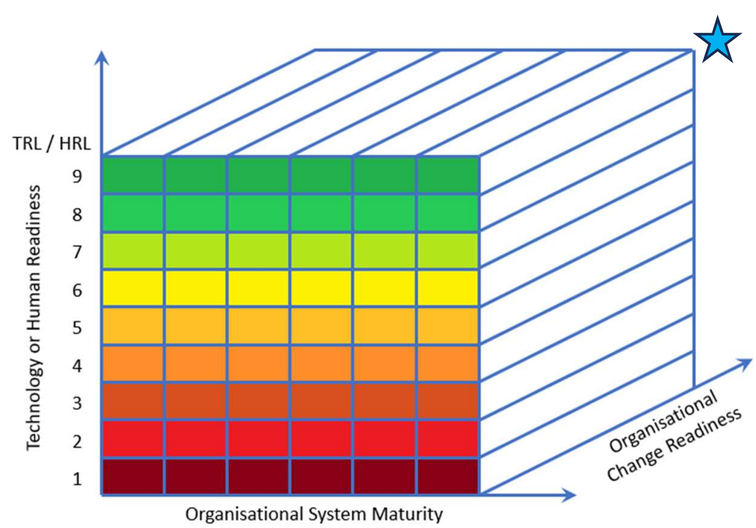

Figure 2: Framework for Organisational Readiness & Organisational Systems Change

The x-axis, Organizational System Maturity and z-axis, Organizational Change Readiness are logically interrelated (i.e. in order to mature the organizational system, some change must occur). To progress through the cube, it is envisaged that, for a given step in the framework, the following events would occur:

1. The technological design meets a maturity point.
2. The organizational system design meets an appropriate maturity to match the technological design.
3. At a planned level of change granularity, the readiness of the actual organization is confirmed.
4. A change is implemented in the actual organization.
5. The maturity of the actual organizational system to be able to receive and operate the technology increases.

This paper considers organizational design and readiness for change but does not cover the implementation or management of actual organizational change itself. Given that organizational systems are complex and adaptive, it is expected that designs or plans in their entirety are not what changes an organization, and although it is condensed simply into point 4 in the list in the previous paragraph, the viability and dynamics of the organizational system should be considered.

Ultimately, to introduce a new technology, system developers will seek to move from the bottom left of the cube [*coordinates* 0,0,0] to the top right diagonal of the cube (marked with a star) [*coordinates* TRL/HRL9, the planned organizational system fully mature to use the technology, the organisation ready for the final change].

Consider three situations:

The first situation: the technology has been developed in isolation from any organizational planning. The framework then assumes a step change that is the entire cube in one go. The risks are high as the organization may not be ready for the change, and the technology may not be fit for purpose for the organization. There may be inertia to change and confusion in the organization around operations, in essence the organization must now fit around the technology. Decision makers are surprised that the technology is not producing the expected gains.

The second situation: the organization is not considered until the technology has reached a tangible prototype (TRL 6+), at this point, although the users' needs have been designed for, the organization is not positioned to use the technology and the organization's constraints for change and adoption then become clear, at which point redesign may be required.

The third situation: the technology and organization develop at a similar maturity, evolving the tangibility of both together (Boy, 2022). The organizational system has been designed in tandem with the technological system and step changes have occurred to bring the actual organization and its readiness for change to full maturity.

All three situations fit within the framework, with pros and cons. Situation 1 involves no investment up front from the organization in time or development funds, however, it is likely to involve an extended period of transition, teething troubles, or even rejection of the technology altogether. Situation 2 is the most common in contemporary technology adoption. Organizations are unlikely to contemplate technological solutions until they have reached a certain level of tangibility. Technological development failure pre TRL6 is high so investing in the future organization at these early stages is risky. Situation 3 is the mostly costly upfront but may reduce overall development costs as design changes can be made whilst it is still flexible. As with SE, situation 3 derisks the development and transition. Care however must be taken to not overburden the organization with change initiatives. There is no implied correct situation, organizations should decide the strategy that fits best with their needs and resources.

Conclusions

The initial framework presented in this paper represents a broader view of organizational readiness that accounts for both the design and maturity of the organizational system as well as its readiness for change. At time of writing, the framework has been applied to an example case study organization with a selection of change metrics, and a range of organizational system models from different stages of maturity have been developed based on concepts from the candidate ORLs, these will then be used to refine the framework and address its utility. This will provide an initial validation of the framework against a real organization; however further applications will need to be considered to check for its utility within a broader spectrum.

The body of knowledge around organizational readiness and design is profuse, due to the concise search string selected (<organi*ational readiness level>) and the context of organizations as systems, this limited the results. It is acknowledged that there will be alternative theories, models and instruments that could have been used, however the framework is aimed at a conceptual level and selection of models, readiness levels and metrics is open.

The pace of technology advancement outstrips the pace of STS advancement, and the gap between the two widens (Pasmore et al., 2019). As we move towards integrating the STS aspects during systems development this will bring (at least for each system it is applied to) the maturity of both socio and technological together. The final point to consider is who the stakeholders and designers are, unlike technological system development where the developers are mostly separate (albeit gathering requirements) from the customers or end users, the organizational system design team should include the stakeholders within the STS (Carayon, 2006), the leaders responsible for the strategy and direction, and the managers responsible for enacting the change. As HSI practitioners have been described as transdisciplinary we bring together and integrate a significant set of disciplines (SE, HF/E, information technology and operational domain (INCOSE HSI WG, 2023)), perhaps our knowledge set needs to also broaden to these business and leadership disciplines in order to integrate these viewpoints into the SE approach.

References

Ainsworth, D., & Feyerherm, A. E. (2016). Higher order change: a transorganizational system diagnostic model. *Journal of Organizational Change Management*, *29*(5), 769-781. https://doi.org/http://dx.doi.org/10.1108/JOCM-11-2015-0209

Al Mudawi, N., Beloff, N., & White, M. (2020). Issues and challenges: Cloud computing e-government in developing countries. *International Journal of Advanced Computer Science and Applications*, *11*(4), 7-11.

Ancarani, A., Di Mauro, C., Legenvre, H., & Cardella, M. S. (2020). Internet of things adoption: a typology of projects. *International Journal of Operations & Production Management*, *40*(6), 849-872.

Annosi, M. C., Martini, A., Brunetta, F., & Marchegiani, L. (2020). Learning in an agile setting: A multilevel research study on the evolution of organizational routines. *Journal of Business Research*, *110*, 554-566. https://doi.org/https://doi.org/10.1016/j.jbusres.2018.05.011

Bednar, P. M., & Welch, C. (2020). Socio-Technical Perspectives on Smart Working: Creating Meaningful and Sustainable Systems. *Information Systems Frontiers*, *22*(2), 281-298. https://doi.org/http://dx.doi.org/10.1007/s10796-019-09921-1

Beer, S. (1984). The viable system model: Its provenance, development, methodology and pathology. *Journal of the operational research society*, *35*(1), 7-25.

Blackman, D., O'Flynn, J., & Ugyel, L. (2013). A diagnostic tool for assessing organisational readiness for complex change.

Boone, J. B. (2012). Improving employee engagement: Making the case for planned organizational change using the Burke-Litwin model of organizational performance and change. *Information Management and Business Review*, *4*(7), 402-408.

Boy, G. A. (2022). Socioergonomics: a few clarifications on the technology-organizations-people tryptic. INCOSE International Symposium,

Boy, G. A. (2023). An epistemological approach to human systems integration. *Technology in Society*, 102298.

Bruno, I., Lobo, G., Covino, B. V., Donarelli, A., Marchetti, V., Panni, A. S., & Molinari, F. (2020). Technology readiness revisited: a proposal for extending the scope of impact assessment of European public services. Proceedings of the 13th international conference on theory and practice of electronic governance,

Burke, W. W., & Litwin, G. H. (1992). A causal model of organizational performance and change. *Journal of management*, *18*(3), 523-545.

Carayon, P. (2006). Human factors of complex sociotechnical systems. *Applied Ergonomics*, *37*(4), 525-535.

Carmichael, D. G. (2018). Organisations as systems–difficulties in model development and validation [Article]. *Civil Engineering and Environmental Systems*, *35*(1-4), 41-56. https://doi.org/10.1080/10286608.2019.1577395

Crittendon, D. R., Cunningham, A., Payton, C., Mills, G., Kelly, S., LaNoue, M., & Arenson, C. (2020). Organizational readiness to change: quality improvement in family medicine residency. *PRiMER: Peer-Review Reports in Medical Education Research*, *4*.

Donaldson, W. (2017). *Simple_complexity: A management book for the rest of us: A guide to systems thinking*. Morgan James Publishing.

Durant-Tyson, A. (2022). Communication Satisfaction and its Effects on Organizational Readiness to Change: A Quantitative District-Wide Study of Employees from a Technology Center.

Ezeruigbo, C. F. S. (2023). Evidence-Based Practice Among Psychiatric Nurses. *Journal of Psychosocial Nursing and Mental Health Services*, *61*(9), 47-55.

Handley, H. A. (2022). A retrospective of the human viewpoint and its applicability to future systems. *Systems Engineering*, *25*(1), 91-103.

HFES. (2021). ANSI/HFES 400-2021 Human Readliness Level Scale in the System Development Process. In: Human Factors and Ergonomics Society.

Hoverstadt, P. (2020). The Viable System Model. In M. Reynolds & S. Holwell (Eds.), *Systems Approaches to Making Change: A Practical Guide* (pp. 89-138). Springer London. https://doi.org/10.1007/978-1-4471-7472-1_3

INCOSE. (2021, 19/05/2021). *Systems Engineering Body of Knowledge*. https://www.sebokwiki.org/wiki/Guide_to_the_Systems_Engineering_Body_of_Knowledge_(SEBoK)

INCOSE. (2023). *Systems Engineering Handbook: A Guide for System Life Cycle Processes and Activities* (D. D. Walden, Ed. 5th ed.). Wiley.

INCOSE HSI WG. (2023). *Human Systems Integration - A Contemporary Primer*.

Kayikci, Y., Kazancoglu, Y., Gozacan-Chase, N., Lafci, C., & Batista, L. (2022). Assessing smart circular supply chain readiness and maturity level of small and medium-sized enterprises. *Journal of Business Research*, *149*, 375-392.

Khan, M. M. S. (2015). The longevity of large enterprises. A study of the factors that sustain enterprises over an extended period of time. *The Journal of Developing Areas*, *49*(5), 41-52.

Kurnia, S., Choudrie, J., Mahbubur, R. M., & Alzougool, B. (2015). E-commerce technology adoption: A Malaysian grocery SME retail sector study. *Journal of Business Research*, *68*(9), 1906-1918.

Lenartowicz, M. (2018). Financing organizational changes from without. *Journal of Accounting & Organizational Change*, *14*(1), 99-116. https://doi.org/http://dx.doi.org/10.1108/JAOC-12-2016-0083

Manik, J. B., & Ginting, E. D. J. (2019). Impact of Organizational Climate on Readiness for Change in Belawan Marine Police Personnel. *International Research Journal of Advanced Engineering and Science*, *4*(3).

Pasmore, W., Winby, S., Mohrman, S. A., & Vanasse, R. (2019). Reflections: sociotechnical systems design and organization change. *Journal of Change Management*, *19*(2), 67-85.

Polojärvi, D., Palmer, E., & Dunford, C. (2023). A systematic literature review of sociotechnical systems in systems engineering. *Systems Engineering*.

Prasad, K. V., & Vasugi, V. (2023). Readiness Factors for Sustainable Lean Transformation of Construction Organizations. *Sustainability*, *15*(8), 6433.

Robbins, S. P., & Judge, T. A. (2007). *Organizational Behavior* (12 ed.). Pearson Prentice Hall.

Rusly, F. H., Sun, P. Y.-T., & Corner, J. L. (2015). Change readiness: creating understanding and capability for the knowledge acquisition process. *Journal of Knowledge Management*, *19*(6), 1204-1223.

Schein, E. H. (2010). *Organizational culture and leadership* (Vol. 2). John Wiley & Sons.

Shea, C. M., Jacobs, S. R., Esserman, D. A., Bruce, K., & Weiner, B. J. (2014). Organizational readiness for implementing change: a psychometric assessment of a new measure. *Implementation Science*, *9*(1), 1-15.

Siriphattrasophon, S., & Saiyasopon, K. (2013). Firm readiness to internationalization of Thai SMEs towards the ASEAN Economic Community. Conference Proceedings. The 2 International Conference on Business and Management, Chiang Mai-Bangkok,

Stone, K. B. (2015). Burke-Litwin Organizational Assessment Survey: Reliability and Validity. *Organization Development Journal*, *33*(2).

Urban, W. (2017). Amoeba Management System Transformation in the Light of Organisational Change Literature [Article]. *Management and Production Engineering Review*, *8*(1), 16-23. https://doi.org/10.1515/mper-2017-0002

Viamianni, A., Mulyana, R., & Dewi, F. (2023). Cobit 2019 Information Security Focus Area Implementation For Reinsurco Digital Transformation. *JIKO (Jurnal Informatika dan Komputer)*, *6*(2).

Vik, J., Melås, A. M., Stræte, E. P., & Søraa, R. A. (2021). Balanced readiness level assessment (BRLa): A tool for exploring new and emerging technologies. *Technological Forecasting and Social Change*, *169*, 120854.

Wang, H.-J., & Lo, J. (2016). Adoption of open government data among government agencies. *Government Information Quarterly*, *33*(1), 80-88.

Yeo, R. K. (2019). From operational excellence to organizational significance: setting the tempo for change. *Strategic HR Review*, *18*(4), 142-149. https://doi.org/http://dx.doi.org/10.1108/SHR-04-2019-0027

Biography

Grace A.L. Kennedy is a Principal Consultant in Human Factors at Acmena Group where she specialises in the integration of human factors and systems engineering in safety-critical industries. With over 15 years' experience in industry and academia across rail, defence, healthcare, manufacturing and utilities infrastructure she relishes using her sociotechnical perspective to solve industry's problems. Grace is co-chair of the INCOSE HSI Working Group and is an inducted member of the INCOSE Technical Leadership Institute. Grace is a chartered engineer and Certified Systems Engineering Professional. She has a Masters in Systems Engineering from Loughborough University and is in the final year of her PhD in Organisational Systems Engineering at the University of Wollongong.