An approach for modelling sociotechnical influences in mixed human-artificial agent workforce design

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THE WORK IN CONTEXT

Advances in intelligent technologies have made it feasible to consider future workforces with a mix of human and sophisticated artificial actors. During periods of significant societal transformation, organisations must be responsive to a range of public and governmental concerns in order to remain viable or effective. The sociotechnical influences space (SIS) models the social, psychological, cultural, and technological factors that must be considered in designing a future workforce that is not only safe, productive, and healthy, but also one that is acceptable to society. While these factors are largely studied in isolation by specialists in different disciplines, this model considers how the confluence of factors can shape the outcomes that are reached. The model utilises a representational scheme that captures the relevant sociotechnical factors at different levels of the societal system, highlighting the stratum at which individual factors are open to modification and should therefore be addressed. The model also captures links or influences between sociotechnical factors, both within and across system levels, identifying how factors interact to produce desirable workforce outcomes of safety, productivity, health, and acceptability. A proof-of-concept study demonstrates how the SIS could be utilised to model sociotechnical influences of significance in mixed human-artificial agent workforce design, focusing on the Royal Australian Air Force as a hypothetical example. If such an approach is utilised, it should provide organisations with a systematic basis for informing policy development and for identifying organisational bodies and actors who, through their spheres of influence and responsibility, can shape the outcomes that are reached. Through these avenues, the range of sociotechnical issues can be addressed, preparing people and processes to capitalise on the benefits of a novel technological future rapidly and successfully—in a way that is safe, productive, healthy, and acceptable to society.

KEYWORDS

Workforce design, sociotechnical influences, artificial agents

A brief outline of the work carried out

Building on Rasmussen's (1997) model of risk management for accident analysis and safety improvement, an approach for modelling sociotechnical influences in workforce design was developed in response to the long-term possibility of introducing sophisticated artificial actors into predominantly human workforces. In contrast to Rasmussen's model, which maps potential causes of accidents, the sociotechnical influences space (SIS) maps potential influences on desirable workforce outcomes relating not only to safety, but also to productivity, workers' health, and acceptability to society. A proof-of-concept study was conducted to demonstrate how the model could be utilised to model sociotechnical factors relevant to the design of a hypothetical future workforce, focusing on the Royal Australian Air Force as an example. A narrative literature review

was used to identify the potential factors of relevance and to identify empirical and theoretical relationships between the sociotechnical factors and the outcomes.

Findings/solutions (the outcome)

The SIS provides a structured framework for identifying how the set of sociotechnical influences relevant to the design of a mixed human-artificial agent workforce are interrelated and how they collectively contribute to desirable workforce outcomes, ultimately enabling their integrated implications for design to be considered systematically. Figure 1 presents an extract of the model developed in the hypothetical case of a future workforce for the Air Force, showing the levels of the societal system that are relevant and providing some examples of the sociotechnical factors and links in the model. The links depict how factors interact to produce the outcomes of safety, productivity, health, and acceptability. For example, the model portrays that, for the successful design of a mixed human-artificial agent workforce, should this option be contemplated in the future, the Air Force would need to consider:

- Public concerns relating to human dignity, social responsibility, and environmental sustainability.
- Government policies relating to employment, wealth and resource distribution, and education and public awareness.
- Regulatory standards, legislation, and compliance and auditing processes.
- Organisational recruitment, selection, and training practices.
- Technological design criteria such as explainability, transparency, and reliability.
- Human performance criteria such as trust, competency, and job satisfaction.

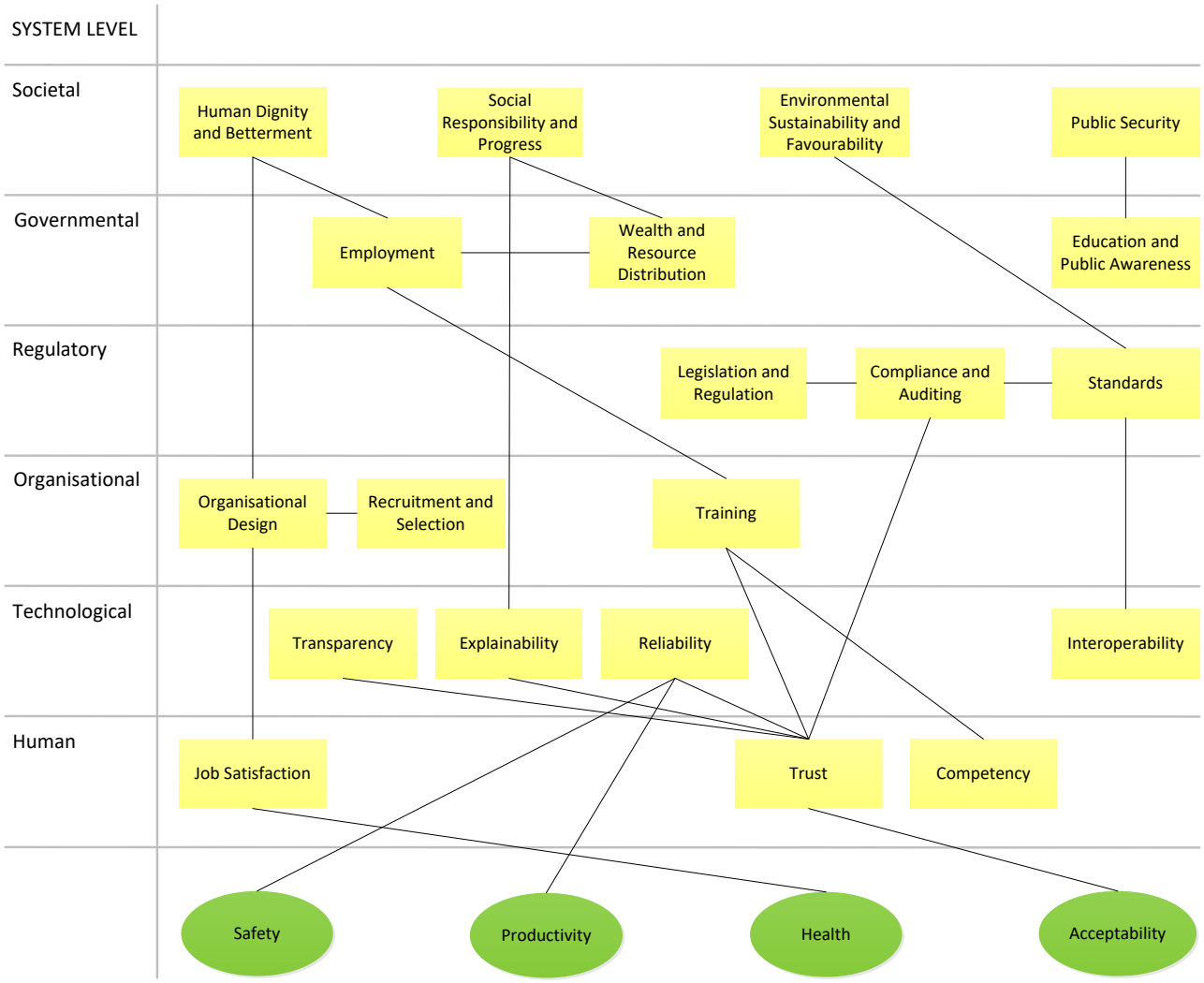

Figure 1. An extract of the SIS developed in a proof-of-concept study, focusing on the Royal Australian Air Force as a hypothetical example.

Impact

This work provides a structured, integrative framework for viewing the sociotechnical influences to be considered and addressed for successful outcomes to be achieved in the design of mixed human-artificial agent workforces. In contrast to Rasmussen's risk management model, the SIS views the sociotechnical work context not simply as "the landscape in which accidents may unfold" (Svedung and Rasmussen, 2002, p. 398), but as the landscape in which a range of desirable workforce outcomes can be cultivated. The SIS provides a means for informing organisational policy development and for identifying organisational bodies and actors with the capability and authority to shape future outcomes through their spheres of influence over certain sociotechnical factors. This work also has broader implications for workforce design in that it takes a holistic approach that considers sociotechnical influences and their implications at different societal levels, extending well beyond the work system under study. In an era where the social and environmental performance of organisations is becoming of increasing importance to society, a holistic approach to workforce design is essential.

Rasmussen, J. (1997). Risk management in a dynamic society: A modelling problem. Safety Science 27(2-3), 183-213.

Svedung, I., Rasmussen, J. (2002). Graphic representation of accident scenarios: Mapping system structure and the causation of accidents. Safety Science, 40, 397-417.