70 years of sociotechnical systems (STS) principles for systems design: A review and reassessment of their relevance for the 21st century

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THE WORK IN CONTEXT

In the last couple of years two separate groups of researchers (Waterson and Eason, 2018; Imanghaliy et al., 2019) have worked on reviewing and reassessing a variety of principles for sociotechnical systems (STS) principles which have been developed for systems design. The principles date back to work carried out in the 1950s by a group of researchers at the London Tavistock Institute of Human Relations. The work of Eric Trist and Fred Emery for example, initially focused on understanding the role of human skill and methods of working (for example team working) on productivity within coal mines (Trist and Bamforth, 1951). One of the primary motivations for the STS principles was to underscore the role of choice and organisational design in the interaction between people (the social system) and tools, technologies and techniques (the technical system; Weisbord, 2012; Eason, 2014). A core value embodied in the principles is that, given the right choices, social and technical systems could be harmonised and balanced such that productivity, worker satisfaction and safety could be optimised in parallel (Cherns, 1976, 1987; Clegg, 2000). It is perhaps fair to say that the fortunes of sociotechnical theory have ebbed and flowed over the past seventy years, but the value of sociotechnical principles has remained. In our paper we argue that they are increasingly relevant to a host of distinctly 21st century problems (for example, automation and robotics, globalisation, climate change), all of which share a common imperative to effectively integrate people, technology and complex systems.

KEYWORDS

Sociotechnical systems, systems design, macroergonomics

A brief outline of the work carried out

The research described in the paper involved three main activities which covers the work of the two research groups on STS principles: firstly, a literature review of the various STS principles which have been developed over the last 70 years; secondly, an assessment of the relevance of the principles for carrying out STS analysis using a set of contemporary human factors case studies (healthcare information technologies, sustainable cities and human factors methods); and thirdly, a redesigned set of principles based on the outcomes from the first two activities.

Findings/solutions (the outcome)

In the paper we first provide an historical background for the development STS principles. Our findings then summarise the main STS principles which have been developed in eight different publications by various authors over the period 1951-2015. We also examine in detail citation patterns for these papers in order to assess levels of impact and outreach (for example, types of disciplines citing the principles and using them to carry out system design). Based on the literature review we present a revised set of synthesised and integrated STS principle and then use these to analyse three different case studies (telemedicine in the NHS, the 2017/18 Cape Town drought and human factors methods). The outcomes from this analysis are then used to design a final set of STS principles which can be used to evaluate a range of current and future 21st century system designs.

Impact

Based on our literature review and citation analyses we would argue that STS principles have had considerable impact upon how work, technologies and large-scale systems have been designed in the past. We would also argue that due to changes to the nature of work and technology (for example, digitalisation, autonomous systems, new forms of work organisation such as distance and flexible working arrangements) that these principles need to be updated. We fill this gap with a set of new revised and refreshed STS principles that can be applied to future scenarios in the 21st century.