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What can we learn from a *soft sister*? A complementary lens to the systems engineering approach in medical education research

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Few situations in life teach humility more effectively than fatal or near fatal disasters. Throughout history, the desire and ambition of humans to stretch the limits of nature have led to very important advances in engineering. However, that same ambition has also brought about the biggest flaws in such developments, forcing us to step back, adopt different perspectives and embrace the bigger picture.

Systems engineering is a discipline that emerged from such stepping back.[1–4] The introduction of systems engineering signified a change of paradigm from *isolated design* (i.e. design carried out by discipline-based teams, such as electrical, mechanical or civil engineering teams) to *design as a dialogue* (i.e. design carried out by multidisciplinary teams). In the Apollo 13 disaster, for instance, the task at hand was to fit a square peg into a round hole, but the big picture goal was to bring three astronauts back to Earth. Dialoguing made the endeavour possible –just watch the movie to see how the conversation evolved!

I applaud Anna Cianciolo for paving the road for systems engineering in the medical education research community. In her paper 'Deciding what to teach health professionals: a human-centred systems engineering perspective',[5] Cianciolo introduces us to the notion of person–environment interactions by explaining how environmental conditions constrain and afford goal-directed behaviour.[5] When the system has a definable set of objectives and goals, *hard* systems engineering helps us identify the solutions that will help us reach those goals.[6] As Cianciolo discusses, a focus on productivity, efficiency and safety (rather than knowledge, skills and abilities) determines the sufficiency of a systems theory (compared with a learning theory) and consequently allows systems engineering to 'prioritise environmental attunement and adaptive action' when designing interventions.[5]

The design of interventions epitomises any engineering endeavour. However, as systems engineers, we should not forget that *design as a dialogue* begins with a problematic situation. Engineers – and educators! – love finding solutions, and hard systems engineering can help with this. However, if we want to maintain our focus on efficiency and safety, we must also attend to what the problem looks like and how different people define it. For this goal soft systems engineering[7,8] is an important complement; it is the *soft sister* to the approach Cianciolo[5] introduces.

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If *interactions* are the core of a hard systems approach, *perspectives* are at the heart of its soft sister. Together, interactions and perspectives constitute the discipline of systems engineering inquiry.[9] However, the two sisters do not normally grow up together. When training to be an engineer, I became closely acquainted with the *hard* sister, only bumping into the *soft* sister by chance. In my early years as a technology designer, I became intrigued by how often two clients would make completely different recommendations on a design because they viewed the problem differently; this is what soft systems engineering is about.

Multiple actors with multiple perspectives and conflicting interests abound in complex situations. Thus, the understanding of a problem may change as the situation evolves.[10–12] As people see and interpret situations differently, in soft systems engineering, problem definition is not straightforward but problematic. Problem definition attains 'design as a dialogue'. Consequently, the soft sister's dialogue depicts models (e.g. rich pictures[13]) as ways of generating debate, not as representations of the real world. The goal is negotiated, not taken for granted. Hence, the situation becomes a chance for people to learn how to cope with complex circumstances so that their performance is improved.[12] Checkland calls it a learning cycle[7] through which the knowledge gained from trying to understand a complex situation will itself change that situation, and the cycle will repeat itself.

As a learning cycle, the *system* (i.e. situation) in soft systems engineering should not be viewed as something to be engineered or optimised. Instead, it should be viewed as a process of inquiry.[13] A change in view calls for a different epistemology. In soft systems engineering, the researcher engages in the situation as a moderator or discussant (as opposed to a 'scientific' observer) while helping people delve into their perspectives. Thus, soft systems engineering's concern on defining the problem, as a subjective process, positions it within an interpretivist paradigm.[14,15]

Systems engineering is the product of a historic evolution of engineering as a discipline. It emerged by learning from disasters and 'successful failures', such as Apollo 13,[16] when people realised that traditional engineering disciplines (electrical, mechanical, civil, etc.) could only partially deal with complex situations. One needs the other in order to maintain the focus on the big picture. Pursuing such a big picture view urges an appreciation of both what constitutes a problem for different people,[17] and how the environmental conditions afford and constrain potential solutions.[5] Research questions spanning issues ranging from how clinicians conceptualise complexity, professionalism, ethics, clinical reasoning, teamwork – as examples of complex phenomena in medical education research – to designing curricular interventions can be approached using the complementary nature of *soft* and *hard* systems engineering. I invite medical education researchers to consider the place and value of these two systems engineering lenses in the quest, suggested by Cianciolo,[5] to transform medical education into an improvement science.

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