

Enterprise Systems Engineering (ESE) & Systems of Systems (SoS): Integration vs. Differentiation

[Novel, Beginner or Expert (both), Practical, Generic]

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The subjects of Enterprise Systems Engineering (ESE) and Systems of Systems Engineering (SOSE) have grown up separately and are now the subject of fast-growing literature, each for example featuring in the latest version of the SE Body of Knowledge (SEBoK).

[In simple terms, Enterprises are combinations of resources which work together to fulfil a common purpose, and Systems of Systems are groups of systems which may have separate goals but are capable of operating together when required. Both are recognised as the context in which many of the advances in system engineering will be shaped, with the MOD's SOSA programme as a clear current example.]

Because of this increasing significance, the ESE Interest Group has been exploring the overlaps and differences, through workshops and group discussions, supported by review of published material. It has found a number of common features which include:

- Concern with both social and technical dimensions and the interactions between them.
- Recognition of the fundamental and transformational contribution of information - and its sharing through increasingly agile networks – as means for forming both Enterprises and Systems of Systems, and allowing them to achieve purposeful action.
- Interest in processes in the *Enterprise of Development*, and how they work towards the satisfaction of goals in the *Enterprise of Operations*, with the two becoming more closely linked.
- Recognition that architecture plays a pivotal role - both in the design of systems and enterprises, and relationships between the two
- Concern with integrated management and decision-making, and issues of centralised vs decentralised responsibility for both.

There are nevertheless significant differences, at least in the way in which practitioners see them, with a tendency for ESE to emphasise the social and organisational issues (albeit with a technical dimension) and SOSE the technical/engineering aspects (albeit with a social one). These may be largely cultural but point to separate and legitimate concerns.

Perhaps most fundamentally, we find a shared belief that Enterprises and Systems of Systems are both essentially *Systems*, and therefore capable of being studied and designed through some combination of *Systems Engineering* and *Systems Thinking*, augmented where necessary by Systems Science, Management Science and other allied disciplines.

This paper will present its conclusions, illustrated with pictures and diagrams, in a way which should provide deeper insight into the issues and the state of the art, and equip delegates with a stronger understanding of where ESE and SOS approaches may be best deployed within organisations. There are also implications for further development of the underlying science.

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