

Implementing Systems Engineering in one of the world's most famous engineering companies



IDC researchers worked with the Defence Aerospace Division of Rolls-Royce to investigate how systems engineering practices are being implemented, to improve knowledge management approaches and foster greater collaboration across the organisation.

Rolls-Royce has been one of the most famous names globally for over 100 years delivering world class engineering across a number of sectors including automotive, aerospace, defence and maritime. The company has developed comprehensive training programmes across its business units to provide its staff with the detailed skills required for a company working in a high precision engineering environment. As part of its drive for continuous improvement, Rolls-Royce has sought to embed Systems Engineering into their organisation to support engineering practice.

What the IDC did

The challenge was twofold, the first challenge was embedding Systems Engineering into a company which is globally recognised for engineering and where existing approaches are commonly viewed as being highly successful. The second challenge was how do you encourage an organisation as large and diverse as Rolls-Royce to fully adopt Systems Engineering approaches?

The IDC researchers applied an Action Research methodology to bring together different groups in an open, inclusive and participative process to understand how to improve the use of Systems Engineering within Rolls-Royce. There was an anecdotal perception that simply putting an engineer on a Systems Engineering training programme and giving them new tools and techniques was not sufficient, further support was needed to apply the training effectively.

Using qualitative and quantitative surveys drawing on grounded theory methodology, system dynamics and group model building, the RE engaged with over 300 participants of systems engineering training. IDC researchers found instances of inconsistent advice being given regarding the approaches and that necessary information resources were not always available. To address this, IDC researchers

worked across Systems Design and Integration and Systems Engineering and Development functions to break down cultural barriers, re-designed digital tools and helped develop an Engineering Tool Guide to provide a single reference point for engineers seeking to apply System Engineering tools.

The Impact

This project has increased support for Systems Thinking / Systems Engineering approaches within Rolls-Royce, and it has also meant that updated Rolls-Royce engineering processes embedded Systems Engineering approaches more explicitly. Specific impacts from the work include:

- Over 2,500 engineers have undertaken systems engineering training and have accessed the training resources.
- The development and publication of an Engineering Tool Guide which provides a single reference about how different toolsets e.g. Systems Engineering, Robust Design etc. integrate and guide how to decide which technique should be applied to a given situation. The page hosting the Engineering Tool Guide is, on average, one of the top 10 most visited pages on the Rolls-Royce engineering intranet site.
- Developing closer departmental relationships and breaking down cultural barriers to enable designers and engineers to work together more effectively together.
- Re-development of internal training websites to support the better communication of Systems Engineering approaches across the company.
- The Research Engineer has been recruited by Rolls-Royce, providing a specialist resource to continue the process of embedding systems thinking within the culture of Rolls-Royce.

The Future

The outputs of the work are continuing to support interventions within the business. Rolls-Royce needs to train the full population of company engineers (currently almost 16,500 people) to provide them with systems thinking competencies so that all engineers adopt a common language which includes terms such as sub-optimisation, system of interest, function, purpose and context. Over 2,500 engineers have been educated with training increasing from 2 courses per year to 15.

The course will support the wider rollout of Systems Engineering across Rolls-Royce and move to Systems Engineering being seen as a core part of the way that the company does engineering. The IDC researcher will continue to support the embedding, follow up and post-training

support and the development of ideas for supporting / follow-up training. The ultimate goal is that through Systems Engineering, technical issues will be discovered earlier or avoided altogether, reducing costs.

Related publications

- Dunford, C.N., Yearworth, M., York, D.M. and Godfrey, P., 2013. A View of Systems Practice: Enabling Quality in Design. Journal of Systems Engineering. 16(2), pp.134-151.*
- Parsley, A., Dunford, C.N., York, D.M. and Yearworth, M., 2013. The use of a Systems Engineering Process Guide to accelerate improvement in Systems Engineering application and expertise. Seventh Annual IEEE International Systems Conference Proceedings, 15-18 April 2013, Orlando, USA. Piscataway, NJ: IEEE, pp.718-72*