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Identifying core engineering activities using exploratory factor analysis

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Summit Theme: Descriptions of Practice

An exploratory factor analysis (EFA) examined the normalised frequency response data for 85 engineering activities among 400 Australian engineers participating in the BeLongEng Project. The EFA used principal axis factoring with oblique (Direct Oblimin) and orthogonal (Varimax) rotations, with Kaiser's Eigenvalue criterion (>1) used as a cut-off. Activities with loading factors <±0.3 and singular correlations between factors and activities were excluded from the analysis. Kaiser-Meyer-Olkin measure (0.855) and Bartlett's test (<0.05) confirmed dataset suitability. No significant correlations (>0.32) were found between factors. Generative AI was used to create factor descriptors, based on the activity descriptions and clusters. The identified factors were

1. 1. Operational and human resource management,
2. 2.Resource planning and coordination,
3. 3. Physical operations and equipment management,
4. 4. Technical systems management and support,
5. 5. Technical and design communication,
6. 6. Information gathering and analysis,
7. 7. Compliance and specification management,
8. 8. Organisational development,
9. 9. Interpersonal communication and coordination,
10. 10. Organisational engagement and networking,
11. 11. Seeking advice from others,
12. 12. Educational and vocational guidance,
13. 13. Environmental assessment and consultation,
14. 14. Design, modelling and visualisation,
15. 15. Professional networking and development,
16. 16. Legal review and investigation,
17. 17. Quality assurance.

These 17 factors explained 51% of variation in frequency response data and align well with existing frameworks (Crossin et al., 2023; IEA, 202; Passow & Passow, 2017;

Trevelyan, 2007). However, the 'Educational and vocational guidance' factor is not in IEA Graduate Attributes. The 'Technical systems management and support' factor negatively correlates with the risk management activity, suggesting a time trade-off between associated activities. The 51% of variation in the frequency captured by the factors likely reflects the diversity of engineering practice; these factors do not represent all activities by all engineers. Nevertheless, this approach has created singular descriptors of core engineering activities in an Australian context, and these could be used to better describe engineering practice.

Bio

Enda Crossin is a Chartered Professional Engineer in areas of Leadership and Management, Project Management, and Mechanical Engineering. Enda's research interests are in engineering practice and environmental life cycle assessment. He leads the BeLongEng Project, a longitudinal study of engineering practice.