Design process robustness: A bi-partite network analysis reveals the central importance of people

Design processes require the joint effort of many people to collaborate and work on multiple activities. Effective techniques to analyse and model design processes are important for understanding organisational dynamics, for improving collaboration, and for planning robust design processes, reducing the risk of rework and delays. Although there has been much progress in modelling and understanding design processes, little is known about the interplay between people and the activities they perform and its influence on design process robustness. To analyse this interplay, we model a large-scale design process of a biomass power plant with people and activities as a bipartite network. Observing that some people act as bridges between activities organised to form nearly independent modules, in order to evaluate process fragility, we simulate random failures and targeted attacks to people and activities. We find that our process is more vulnerable to attacks to people rather than activities. These findings show how the allocation of people to activities can obscure an inherent fragility, making the process highly sensitive and dependent on specific people. More generally, we show that the behaviour of robustness is determined by the degree distributions, the heterogeneity of which can be leveraged to improve robustness and resilience to cascading failures. Overall, we show that it is important to carefully plan the assignment of people to activities.

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