How design engineers spend their time: Job content and task satisfaction

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This research examined the full range of tasks and activities that design engineers perform, how their working time is distributed among these, and how these issues influence their satisfaction with their work. Seventy-eight design engineers each carried a personal digital assistant (PDA) for twenty working days. Once every hour, they entered data into their PDAs concerning their current work tasks and satisfaction levels, using a work sampling approach. Work tasks were explored from multiple perspectives, yielding highly extensive and detailed results. A key finding was that design engineers' work involves considerable technical engineering work (62.92% of time) and socially collaborative work (40.37% of time). The results were discussed in terms of their implications for academic theory and organizational practice.

Keywords: design activity, design behaviour, design cognition, psychology of design, social design

The design engineering role is of central importance to organizations engaged in product development (Pahl & Beitz, 1996), particularly as 80–90% of production costs are determined at the conceptual design stage (Barbeau, 1998). Research examining this pivotal role is therefore crucial, particularly to identify the range of tasks and activities that design engineers perform, how their working time is distributed among these, and how these issues influence their satisfaction with their work. However, relatively little research has examined these topics, and much that has is now outdated (e.g., Hales, 1986; Webster & Higgs, 1973), especially given the dynamic and rapidly changing nature of the design engineering role (Blackler, Crump, & McDonald, 1999; Robinson, Sparrow, Clegg, & Birdi, 2005). The current paper therefore seeks to address these omissions by reporting an empirical study of design engineers' work that was conducted using a novel and effective research method.

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1 The design engineering role

The earliest major research in this area was Webster and Higgs's (1973) observation-based work-sampling study of 180 design engineers in the

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drawing offices of nine organizations. Work tasks were classified using 21 categories and the present author's secondary analysis of the reported results revealed that most time was spent engaged in conversations about work (11.3%), drawing (10.9%), thinking (10.0%), education (7.7%), and leave and illness (6.8%). Clearly, though, the design engineering role has advanced rapidly in the four decades since that study, particularly with the development and widespread uptake of information technology (Crabtree, Fox, & Baid, 1997), and today's results would likely differ substantially.

Traditionally, it was believed that the work of design engineers is predominantly technical in nature, with 100% of their time being spent within the design process steps (Pahl & Beitz, 1984). However, subsequent research has indicated that such work also involves substantial non-technical elements. For instance, Hales (1986) observed the work of 27 design engineers working on a gasifier test rig and found that only 45% of their time was spent working within these same design process steps. More specifically, 35% was spent clarifying the task, 4% searching for solutions intuitively, 2% combining solution principles and selecting qualitatively, and 1% each on establishing functional structures, searching for solutions discursively, firming up into concept variants, and evaluating concept variants. The majority of time – the remaining 55% – was accounted for by work of a less or non-technical nature: 28% was spent reporting or reviewing, 12% cost estimating, 6% planning personal work, 6% retrieving information, and 3% engaging in social contact. Interestingly, Hales also re-classified the data using an alternative set of categories related to the techniques that the design engineers employed during their work. This subsequent analysis revealed that 22% of their time was spent using design-related techniques (i.e., methods and aids), while 74% was divided between the use of working techniques (essentially project management), communicating techniques, and motivating techniques (essentially leadership). However, the stringent criteria employed in the study – only hours directly attributable to the design process were included, and management roles were excluded – probably underestimated the true extent of the non-technical aspects of design engineers' roles.

More recent research tracked thirty engineers of differing experience levels involved in collaborative design in an aerospace company (Crabtree et al., 1997). A survey was completed over the course of a working week, thereby mitigating the memory biases that can affect self-report survey data collected at a single time-point. The results revealed that the engineers spent 28.0% of their working time engaged in problem solving and thinking, 23.5% producing documentation, 17.1% in support and consulting, 13.7% gathering information, 7.8% planning, 7.6% negotiating, and 2.3% in other activities.

The most recent research in this area involved a questionnaire survey of 223 design engineers, of different seniority levels and roles, working across different