# *Exploring knowledge and information needs in engineering from the past and for the future – results from a survey*

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*This paper presents the results from a UK survey about the knowledge and information requirements of managers and engineers in design and service. The survey aimed to gather requirements regarding the needs for retrieval of previous designs and the needs to capture knowledge and information from current designs to support future engineering tasks. The survey nature, method and instruments are described with the information and knowledge categories identified. The findings are analysed and contrasted with the results of other empirical studies. Notable results include the variety of information needs, unexpected absences and low frequency categories, the expectation of practitioners that tomorrow's needs will be similar to today's, the apparent failure to satisfy those needs, and suggestions from respondents for improvements.*


*Keywords: design knowledge, design rationale, design research, design practice, information needs*

Engineering design has been defined as a 'process performed by humans aided by technical means through which information in the form of *requirements* is converted into information in the form of descriptions of *technical systems* (…)' (Hubka & Eder, 1987). In engineering, knowledge is considered as the basis for rational thinking and problem solving (Spur, 1989). Organizations in general are processing information (Daft & Lengel, 1986). Engineering function has been described as the main 'junction' of information processing within a company (Erlenspiel, 2007) and engineering has always been an information-rich activity (Anthony, 1985; Filer, 1996; Hicks, 1996). The efficient provision and organisation of knowledge and information for product development is seen as an important enabler for competitiveness and business success (Grabowski & Geiger, 1997) and innovation (Faulkner, 1994). Designers are challenged in order to find the 'right' balance between experiences or knowledge and information (Lera, Cooper, & Powell, 1984).

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'*The life-blood of the designer is the information at his disposal when he creates his designs*' (Corfield, 1979, cited by Court, 1995).

Design research has investigated the handling of knowledge and information within design and product development from different angles. One main concern has been to improve the understanding about the nature of knowledge and information needs of engineers and designers (Ahmed & Wallace, 2004; Court, 1995; Court, Culley, & McMahon, 1993; Kuffner & Ullman, 1991), including the capture of experiences in engineering design (Marsh, 1997), and the reuse of information and experiences (Ahmed, 2000; Baya, 1996). This research area has largely focused on the identification of what knowledge should be captured by employing laboratory experiments in combination with protocol analysis and using discourse analysis with observational methods. Questions that engineers ask were regarded as the main items which identified and described their knowledge needs. Although the methods applied in these studies were focussing on a very detailed level of knowledge and information handling like questions and conjectures in discourse, the classifications schemes derived from these studies were very high-level aggregations with a limited number of categories. Kuffner and Ullman (1991) used protocol analysis of a re-design task carried out by three design engineers and derived a classification scheme from the questions and conjectures related to the design artefact and its requirements with eight sub-categories describing the nature, the '*what*' of the information requests. Ahmed (2000), (Ahmed & Wallace, 2004) identified eleven topic areas from discourse analysis between two trainees and eleven designers.

Due to the shift in business models away from manufacturing of products and selling spare parts towards the delivery of products and services like maintenance and provisioning of capabilities, the engineering designer needs to pay more attention to overall product life performance. Therefore information about the in-service behaviour, the performance and experiences of the product in the field are of increasing criticality for design engineers. Recent studies have addressed the information and knowledge needs of design engineers from service (Jagtap, Johnson, Aurisicchio, & Wallace, 2007). This study used semi-structured interviews with three designers and three service engineers and comments on a set of 39 typical questions derived from a review of literature regarding in-service information.

Previous studies have focused mainly on the information and knowledge needs of design engineers in design. There has been little attention given to the knowledge needs of managers involved in the design process – our study was widely targeted to include managers *and* design engineers among other roles. No studies are known which have attempted to cover the knowledge and information needs throughout the whole product life cycle from initial concepts via manufacturing and deployment to the disposal of the product. Through its diverse audience and open-ended questions, our study enabled