Between Individuals and Teams:
Human Resource Management
in the Software Sector

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As the software engineering field has developed, much attention has focused on improving the associated technology and processes. Comparatively little thought has been given to the issue of human resource management. Some see it as central to productivity and software quality. However, little empirical research has explored the required nature of such management. This paper examines human resource management practices in the software industry in Ireland: An economy that is heavily dependent on the software sector, with a high level of foreign multinational investment. A survey of the 100 largest software organisations reveals the nature of human resource practices, and the relative unimportance attached to the management of human resources. Two of the organisations studied are selected as examples of preferred and poor practice, and more in-depth data was gathered from these companies. The authors consider that this comparative analysis reveals a difference that is central to the design of human resource strategies in the software sector: One company managed software engineers as individuals within groups, while the other focused on the management of teams.

The maturity of software engineering is easily identified. The first ‘wave’ of maturity development was the “Waterfall” method, which was introduced in 1970 (Royce 1970). Recently it has been argued that the field is in the second ‘wave’ of its evolution - a maturity movement. This is where the field is attempting to formally define the process and the best ways to continually improve it (Paulk et al., 1993). There are three components of software engineering; the technology, the process and the people (Humphrey 1989). The first wave of evolution used technology as the means of driving progress in the field, or to spur on improvements (Scaachi 1984). Today, the second wave is concentrating on improving the process (Jones 1991, McGowan and Bohner 1993, Paulk et al., 1993). By simple process of elimination, the remaining component as per Humphrey (1989) is the people or the human resources, on which the software engineering field has yet to focus its attention. The human element is becoming more important as the software industry becomes more global, and the mobility of skilled software developers increases.

This paper is based on a study that used pluralistic research methods to investigate human resource practices in software development organisations in Ireland. The software sector in Ireland is heavily dependent on a highly skilled local workforce to sustain its indigenous software sector as well as to attract overseas investment. In addition, the large number of software engineers leaving the country to work abroad means there is a shortage of skilled people. Nevertheless, the findings of this study demonstrate a low level of support for the human element in software engineering. Human resource practices focus on managing software engineers as individuals and neglect the fact that software development takes place in a team environment. The paper concludes by proposing that the next stage of development within the software engi-
neering field should be centred on team based approaches to human resource management.

**Human Resource Management in Software Engineering**

Software development in the 1990s needs both a revised procedural paradigm and an emphasis on the human dimension (Highsmith 1992). At present the attention of researchers in the software engineering field is oriented towards improving the process - the process maturity movement (Jones 1991, McGowan and Bohner 1993, Paulk et al., 1993). Much of the emphasis on human resource management and the human dimension of software engineering has been directed to this maturity movement, in the hope that process improvement will only take place on a good base of people management within software organisations. However, process improvement has brought its own particular focus to software engineering, which to some researchers will only prove to over-shadow human resource management as a viable means of solving the traditional and perpetual problems of software engineering (Curtis et al., 1988).

The software industry is slowly shifting its emphasis towards the human dimension, with the lead being taken by the U.S. Army and the office of the Secretary of Defense through the sponsorship of people management projects at Carnegie Mellon University (Curtis 1994). People and organisational issues have gained recognition as being at the core of effective software development project management (Semprevivo, 1980; De Marco and Lister, 1987; Boehm and Ross, 1989). 'Peopleware' the singularly apt neologism introduced by Neumann (1976) and permanently ensconced in the lexicon of the software engineering field by DeMarco and Lister (1987) is seen as central:

"Powerful programming languages and fast compilers do not produce good software. Advanced development methods and software engineering practices may help, but offer no guarantees. In the real world of software and applications development, even the most rapid of prototyping takes time and even mildly sophisticated systems need the contributions of multiple developers. Under these real circumstances, how the human resources of programming are organised and managed become the crucial factors in the success or failure of development projects. Only good people well organised and well managed can enhance productivity and produce good software," (Constantine, 1993a).

The software manager has an instrumental role to play in the human resource management of software engineers. It is software managers who are in close contact on an ongoing basis with software engineers. A software manager's role by virtue of his or her management position inherently involves human relations (Yeates 1986). Thus, the software manager has enormous responsibility to effectively manage the human relations of the software team. Previous research has highlighted the fact that software managers are, for the most part, not adept at managing human relations due to their technical backgrounds, (DeMarco, 1994) and because of the emphasis of the software engineering discipline on the technical demands of the software manager's job (DeMarco and Lister, 1987; Thomsett, 1990; Abdel-Hamid and Madnick, 1991), rather than the 'softer' dimensions of the job.

Software teams are a fundamental concern of SEPM and more especially of the management of the human resource component of software engineering projects. The objective of supporting the software team should prescribe the direction of the management of software projects. It is generally accepted that a software engineering team needs to be more than a mere collection of individuals if it is to be truly effective (Semprevivo, 1980; DeMarco and Lister, 1987; Constantine, 1993b). The problem for software teams lies in that (1) few organisations institute an organisation-wide program to ensure team effectiveness and (2) little if any resources are allocated by organisations to team development (Dyer, 1987).

Human resource practices cover issues of recruitment, team building, compensation, performance appraisals, and career development. These practices are tangible evidence of the human resource strategy used by a software organisation. The human resource practices of the software organisation should be made to fit the unique characteristics of the software engineering profession. This would conform with level three of the People Management Capability Maturity Model (PM-CMM), which is the standard level of the model at which human resource practices are tailored to the programming profession (Curtis et al., 1988).

It is clearly evident from a review of the literature that human resource management is of crucial importance to software organisations, in that their end products ultimately depend on how well they manage their human resources (Yourdon, 1992). Boehm (1981) concludes, from a study of sixty three software development projects, that 'personnel attributes and human relations activities have by far the largest source of opportunity for improving software productivity.' This is supported by Thomsett (1990) who reports that productivity gains of 200 percent following a people management programme. Thus, it is important to identify the kind of human resource strategy software organisations employ to manage human resources. The literature has identified the complexities involved in managing the human resource within a software engineering environment. It is equally important, however, to examine how the human resource practices of software organisations support the functioning of the software team. Clearly, any evaluation of the human resource strategy of a software organisation would be based primarily on the level of support given to the software team. The human resource strategy that an organisation adopts underlines its attitude and commitment to human resource management and also ultimately underlines its attitude to the people it employs. In effect, the human resource strategy of the software organisation underlines its under-
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