ABSTRACT

Product development process (PDP) architecture holds the key to the management of New Product Development (NPD). A lot of care is exercised in managing the NPD to reduce risk and uncertainties. There exists potential scope for improvement both in initial planning as well as execution of the NPD program by studying the PDP architecture. This research work seeks to taps this potential and presents an analytical tool to aid the NPD Managers.

In this research work Design Structure Matrices (DSM) are used to represent the PDP architecture. The Work Transformation Matrix (WTM) is a kind of DSM and it was introduced for the analysis of concurrent task structures. However a generalized task structure has not been studied analytically in the literature. In order to study a generalized task structure we add two new matrix types to the WTM set to represent the task network interconnections and the task interdependence. First we study the pure sequential task iteration structure for NPD and show that it has lower engineering effort (cost and time) than the concurrent task iteration structure previously discussed in literature. Next we study the generalized task iteration structure and derive the expressions for total work and cost vectors. This is a major research contribution since only simulation based methods are currently available for studying generalized task iteration structures. The optimization of sequencing interdependent tasks is a well known NP hard problem in NPD literature. For small sized task sets, exhaustive enumeration of all possible sequencing and their corresponding time or cost vectors can be computed to determine the optimal sequence. However for large sized task networks, only heuristic methods are deployed. Using the closed form expression for cost and time vectors for a pure sequential task iteration structure derived earlier in this research work, we attempt to devise a method to optimally sequence the design tasks. We develop new matrix combining both the node and link weightages of task network. Using the time vector relationship between sequential and concurrent task structures, it is shown that the optimal task sequence corresponds to the reordering of this combined matrix whose “Dominance index” (sum above the diagonal) is minimum. Finally, we use some of the standard test cases from the PDP literature to demonstrate our research findings.