ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 1, Issue 2, November 2012

Solution to Challenges Faced by Indian industries: Designing with Multi-Enterprise Partnership

K.S.Seetharama
Faculty, Engineering Department, Ibra College of Technology, Ibra, Sultanate of Oman

Abstract--One of the advantages, the Indian industries had, was the quality combined with low cost. In recent years, this advantage is waning away because of the invasion of world market by cheaper products from China. This challenge can be overcome by producing quality products at reduced costs, which in turn requires faster and efficient design and manufacturing methods. This paper presents the concept of involving different enterprises for designing and manufacturing. The basic approach is to include the strength, efficiency and the resources of different enterprises for the successful design and manufacture of new products to face the challenges of high global competitions. Present day machines invariably include components of automation and smarter operations which are basically specialized by some electronic industries, who can be partnered in the design stage itself. Similarly enterprises which have expertise in various mechanical fields like casting, forging and fabrication can be included as partners from the design stage itself. This paper discusses in detail, the various aspects of design such as automation, process planning, evaluation and structure under a multi- enterprise environment for manufacturing. The multi enterprise approach necessitates solving of integrated problems that were previously solved as independent sub problems. Object oriented approaches in solving such problems are discussed in detail.

I. INTRODUCTION

Present day world manufacturing scenario stresses for the increasing of competitiveness of the Indian industries. Increasing of competitiveness includes fast response to market needs, for new designs and ability to manufacture high quality goods in right quantity at competitive price. The industries are required to depend on multi-enterprise partnerships [1], which combine the strength of different enterprises in product design, production, after sales support and customer service.

To support effective partnership, new approaches are required for integrating the activities of design, planning and production. It is important to address the design modeling, process planning and production planning in ways that suit the capabilities of potential manufacturing partners and developing optimization procedures to suit the decision making. The various approaches on these issues are discussed in this paper.

II. DESIGN AUTOMATION WITH COMPUTER SUPPORT.

The two main activities in the design process are: Synthesis and Analysis. Most of the CAD tools are useful in analysis. Researchers are looking on automating some of the synthesis aspects as well. These synthesis activities can be classified as follows:

1 ***Catalog Searching*****:** The problems which require selection of standard components. Considerable automation has been achieved in this regard

2 ***Parametric Design:*** Physical configuration of the design can be easily obtained from the functional requirements [2] and the designer is mainly concerned with choosing the appropriate parameter. Sufficient automation is still required in this field.

3 ***Creative designs:*** The physical configuration is not known and the designer must start from scratch. Some progress in automation is made in the design of electronic products [3] and there is lack of sufficient automated design techniques in mechanical field.

In multi-enterprise partnership, products are often designed by one company and are manufactured jointly with other companies. Sometimes even portions of the design task may be subcontracted to the manufacturing partners. Thus Design-analysis systems will be required at two stages: one at the preliminary design stage and second at the manufacturing stage.

As designers make use of designing and analyzing at different stages, there will be problems in coordinating these tools [4]. For example a design which is easiest to assemble may not be a design which is easiest to

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 1, Issue 2, November 2012

machine. It will be necessary to develop ways to reconcile such conflicting objects to avoid giving the designer contradictory advice.

III. PROCESS PLANNING

For multi-enterprise partnership design, the traditional approach of programming all planning functions into a computer aided process planning (CAPP) system which is used for after design and before production activities will not work well. Simply interfacing results from the existing CAD systems will not yield any useful tools for concurrent product development. In this paper a new approach namely, aggregate level planning is introduced.

The process planning is usually done at two level:. The factory level planning detailed planning. However, to take the capabilities of the potential manufacturing partners, the process planning need to incorporate an additional level called aggregate level. The traditional process planning specifies operations to be performed on certain machine classes whereas, the multi enterprise aggregate process plan defines operations to be performed by factory classes. The potential manufacturing partners will be identified and evaluated at the aggregate level. Just as factory level planning is done before detailed planning, aggregate level planning will be done before factory level planning.

The two primary techniques in doing process planning are: the variant approach and the generative approach. Both of these have some limitations. Therefore a hybrid approach which incorporates the elements of both variant and generative process planning approaches is suggested in this paper for multi enterprise product planning. The hybrid approach would use the variant techniques to retrieve process plan for existing designs that are similar to the new one, and use these plans as a starting point for synthesizing the final plan for the new design. The synthesis will be based on an analysis of the manufacturing process involved and could also be used to provide feedback about the manufacturability of the design.

IV. EVALUATION OF MANUFACTURABILITY

The concept of design for manufacturability is in use since around world-war II [1], but progress in developing scientific methods has been slow. One of the goals of concurrent engineering is to identify design elements that pose problems for manufacturing and provide feedback to the designer so that manufacturability can be assured during the design stage. It is important to develop accurate models of manufacturing process behavior. This can be done in two ways:

- Integrating deterministic and stochastic aspects to formulate modeling strategies to predict process performance. If such an approach is used online while design process is going on , it provide a powerful tool for evaluating manufacturability.
- Evaluating the manufacturability of a proposed design involves estimating the production cost and quality associated with its manufacturing. It is important to select the best one among the several ways to manufacture a proposed design which meets the manufacturing objectives. As a first step, we have to develop a methodology for systematically generating and evaluating alternative operation plans during manufacturing.

Evaluating the economic aspects of manufacturing helps the designer to make the necessary compromises and adjustments that will enable the best possible process plan to be achieved. In a multi enterprise partnership, the manufacturability evaluation gains new dimensions. The partnership will be able to multiply the effectiveness to harness the resources to satisfy the product realization process in terms of men, machines and materials. It also helps in achieving maximum financial success through proper planning and coordination.

V. MULTI- ENTERPRISE PARTNERSHIPS

The concurrent engineering teams have to tackle the issue of synthesizing the optimum network of partners that will achieve the realization of the proposed product design. Partner selections should be based on an analytical foundation within the emerging partners. The manufacturability evaluation approach described in section 4 enables the concurrent engineering team to evaluate the manufacturing complexity, manufacturing cost , cycle time and achievable quality of their design within the capabilities of the potential manufacturing partners. This evaluation will be based on the alternative process plans developed by the methodology described in section 3. Selecting an aggregate process plan should be done concurrently with partner selection since merits of a process plan can only be evaluated relative to the manufacturer who will carry it out. Clearly there is a need for new models to support these decision problems. Such models will select an aggregate process plan and would assign activities to either in-house plants or specific partners. In addition, the sequence of activities and flow of materials among the plants and partners have to be determined. In assigning an activity to an in-house plant or a partner, two criteria have to be considered.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 1, Issue 2, November 2012

1. *The merits of assigning the activity to a particular plant or partner:* The cost, quality and cycle time are the considerations in analyzing the merits of assigning an activity to a particular plant or partner.
2. *The overall merits of the activity assignment when vied as an integral system:* The issues like transportation and logistic requirements between partners, the capacity of individual partners relative to the overall requirement and system reliability are to be considered. To reduce overall system complexity, restrictions may be imposed on the maximum number of partners and the geographic area within which the partner plants should be located.

Solution should accommodate a variety of measures of system quality and qualitative nature of some criteria. In cases of cost overshoot or time delays, during execution of the preferred production plan an assessed alternative production plan should come into action. If such deviations are excessive, then re-planning may be necessary and the remaining alternative should be re-examined. The production state and the cost and time limitations should be considered in this case. Planning using Petri nets [5] is suggested for such a situation.

VI. MANUFACTURING DATABASE

The multi enterprise approach necessitates solving of integrated problems that were previously solved as independent sub problems. Such integrated models require ability and efficiency to acquire and dissipate data required in a common format. Thus there is a need for research into database technology specifically oriented towards manufacturing technology. The object oriented (OO) data model and database environment are well suited for manufacturing -system management. Object oriented modeling that allows broad classes of manufacturing design data suits well for the multi enterprise manufacturing. This requires the definition of structural and behavioral aspects of manufacturing data within the OO paradigm. Since the OO database system store both the process of the modeled system and the data, it will be necessary to model manufacturing design process and the manner in which the process interact with the data. The impact of this work on the manufacturing are:

1. Integrated models can have easy access to data sources which will reduce the overhead of constructing interfaces for a variety of data sources and sinks.
2. There is rapid technology development both on group decision making tools and high speed communication systems.
3. Feedback systems can be efficiently and accurately implemented.
4. OO database systems would not only improve manufacturing control and manufacturing design systems individually but also provide an environment for integration between them.

VII. CONCLUSION

In order to address the research directions discussed in this paper, it is necessary to solve fundamental questions in database planning and optimization. In addition to allow for the possibility of partners carrying out details of manufacturing task, new aggregate levels of design, process plans and production plans will be needed. This research will provide basis for powerful concurrent engineering tools for providing feedback on design performance and manufacturability, and for evaluating production alternatives, taking into account the capabilities of potential partners. Tools of this type combined with advances in the fields of communication and database systems would provide an infrastructure for fast, effective formation of multi-enterprise partnerships that could provide a significant competitive advantage for the Indian industries.

REFERENCES

[1] J. Nevins and D whiteney, concurrent design of products and processes, Mc Graw-Hill, 1989.

[2] C.A. MacMahon, K.Lehane, J.H.S.Williams and G. Webber, “observation on the application and development of parametric programming techniques.” Computer Aided Design, 24(10) October 1992.

[3] K. Sycara and D. Navinchandra” Retrieval strategies in a case-based design system.” Artificial Integelligence in Engineering Design, Vol.II, Academic press 1992.

[4] M.Klein, “Supporting conflict resolution in co-operative design systems.”IEEE Trans.Systems, Man and Cybernetics 21(6) :1379-1390, December 1991.

[5] G. Harlankis, J.Proth and X. Xie, “ A comprehensive approach to planning and scheduling based on Petri Nets, Jour. Applied Stochastic Models and Data Analysis, December 1998.

[6] Teague, P.,”What is enterprise partnership”, 12:567, Sage publications 2005.

ISSN: 2319-5967
ISO 9001:2008 Certified
International Journal of Engineering Science and Innovative Technology (IJESIT)
Volume 1, Issue 2, November 2012

[7] Teague, P. 'Converging Divergences and European Industrial Relations', Industrial and Labor Relations Review 54(3): 688– 94, 2001.

[8] Soskice, D. (1999) 'Divergent Production Regimes. Co-coordinated and Uncoordinated Market Economies in the 1980s and 1990s',

[9] H. Kitschelt, P. Lange,G. Marks and J. D. Stephens (eds) Continuity and Change in Contemporary Capitalism, pp. 101–34. Cambridge: Cambridge University Press.1999.

AUTHOR BIOGRAPHY

Dr.K.S.Seetharama, B.E. (Mechanical) 1985, M.E.(Machine Design) 1991, Ph.D. (Product Design) 2011,is presently working as a member of faculty of engineering at the Ibra College of Technology, Ibra, Sultanate of Oman from the past 3 years. Having worked in different parts of India, Ethiopia and Oman, has a total teaching experience of 27 years in the field of Mechanical Engineering.