Planning with ERP: A Case Study from Large scale manufacturing sector

Seema G. Bhol[*], Arun Mishra[**],Srikanta Patnaik[***]

[*] (Sambalpur University, burla, Odisha, INDIA
Email: seemaguptabhol@gmail.com)
[**]**(L&T,Kansbhal, Odisha, INDIA,**
Email:arun-kbl@kbl.ltindia.com)
[***](Department of Computer Science and Engineering, ITER, Bhubaneswar
SOA University, Odisha, INDIA
Email: patnaik_srikanta@yahoo.co.in)

ABSTRACT
Manufacturing companies need powerful planning systems for managing resources and processes. These systems enable manufacturers to complete customer's requirements on exact dates. With the help of ERP Planning module, planning from Sales until Production will be available to the Management. This paper is aiming to throw new light on importance of planning in manufacturing industry by presenting a caste study on development and implementation of planning module in a large scale manufacturing company. The paper covers the methodology adopted in implementing the planning module in ERP apart from explaining the Planning process in L&T. The paper includes the Data Flow Diagram and Business Mapping Report of the processes involved and describes each activity in detail and its solution in ERP. The paper also highlights the configuration and technical implantation of the solution and post implementation experiences. At the end the paper discusses the limitations and the future directions.

Keywords - Available-to-Promise (ATP) ,CTN (Casting Transfer Note), Material Requirements Planning, MTN (Material Transfer Note), PTN (Parts transfer Note), SWO(sales work order).

1 INTRODUCTION
To remain competitive in today's market, companies need to increase efficiency of their business processes .Enterprise Resource Planning (ERP) systems are integrating all data and processes of an organization into a unified system using different modules. In addition to providing the linkage and integration of various enterprise segments, ERP systems decrease the cost and time of data exchange, likely enhancing firm performance as a result (Hitt et al., 2002; McAfee, 1999).

Planning module of ERP has product lifecycle planning for forecasting new product demands and integrates different departments or even different companies. A supply network planning module is the main coordination tool. It integrates purchasing, manufacturing, distribution, and transportation for the entire supply chain The main task of supply network planning is to propagate the demand from the end of the supply chain (customers) to the factories, make sourcing decisions, generate production proposals, and generate distribution plan proposals. After supply network planning has determined the allocation of the demand to the various factories and a rough production plan is generated, the main task of a production planning and scheduling module is to generate proposed feasible production plans for each of the factories. Order fulfilment module sets a proposed date and quantity for the customer during sales order entry. The confirmation of the sales order is based on the check for available quantities, i.e. ATP (Available-to-Promise) check [9].

The scheduling capability concentrates on the resources, such as the plant and equipment required to convert the raw materials into finished goods. Production planning optimizes the utilization of manufacturing capacity, parts, components and material resources. Material Requirements Planning can organize, schedule and reschedule materials and projects inventory investment levels, as well as projected new purchases in accordance with the organisation's plan. MRP module can provide the basic needs of keeping inventory levels low and fulfilling customer expectations for on time delivery. The outbound- and transportation planning module generates a proposed distribution plan..

Meeting the business goals requires detailed production planning and effective execution control. ERP gives the company full control with flexible scheduling and sophisticated shop floor functionality. ERP checks and validates every order based on the available capacity and thus allows performing backward schedule or forward schedule. Capacity Management capability helps the scheduling department allocate resources as needed, accounting for factors such as delivery dates, production rates and equipment needs. The business processes and information systems (IS) are tightly linked together, business processes need to be reengineered during information systems planning [15].

2 BRIEF INTRODUCTION OF L&T'S IM BUSINESS

Larsen & Toubro Limited (L&T) is a technology, engineering, construction and manufacturing company. Kansbahal Works, a unit under the Machinery & Industrial Products Division of L&T, is an Integrated Machine Building Centre with facilities for Casting, Fabrication, Machining and Assembly, with design, engineering, quality control and logistics support. The business portfolio includes Crushing and Screening systems, Pulp & Paper machinery, Wind mill components, Cast products and various other industrial products. L & T Kansbahal has two Business Units based on two different lines of businesses. These units are:

Industrial machinery – Manufactures heavy engineering equipment and machinery.

Foundry – Manufactures casting of different grades and patterns for customers.

Various departments in IM are marketing, Enginering, enginering Design and Research, Estimation, Planning, Purchase, shops, Stores. Planning department carries out the planning activity both long term and short term. All orders are routed through this department for macro planning as well as other co-coordinating activities

3 SCHEMATIC PROCESS FLOW OF IM MANUFACTURING

Manufacturing process follows different routes for products depending upon availability of capacity and other resources required for manufacturing. The following diagram illustrates the flexible manufacturing path followed in IM. Different routes are depicted by different types of lines.

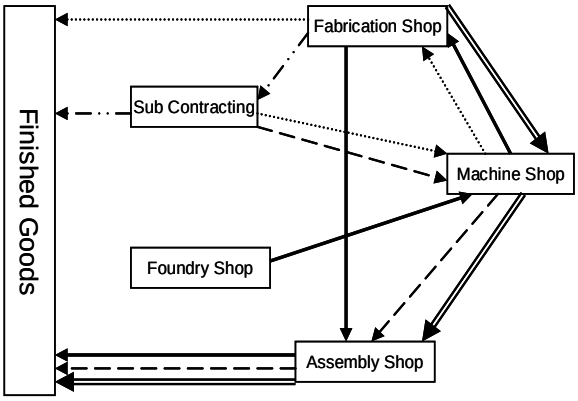

Fig.1 Process Flow of IM Manufacturing

4 DETAIL OF PROCESSES IN PLANNING DEPARTMENT

Planning department is broadly bifurcated into two sections:

- **IM-Planning**
- **IM-Sub contracting**

IM Planning takes care of planning activities to meet the customer delivery date for products. It tries to align all the resources required for completion of SWO and delivery of the product to customer on time. Planning department decides the priority of customer delivery based on contractual delivery date, available resources, and status of job in shop floor. IM Planning takes decision for the items to be subcontracted for some operation. To mange subcontracting activities a cell works in tandem with IM planning. This cell carries out vendor negotiation, releasing of PO, Managing vendors etc.

Inputs for planning

- Sales Works Order
- Drawings
- Parts List

Activities carried out for planning

- Preparation of Macro Plan
- Preparation of Execution Plan
- Preparation of three months store crediting forecast
- Preparation of Invoicing Target Plan
- Monitoring and control
- Releasing of Drawings and Parts List
- Co-ordination among different agencies for execution of plan
- Setting up priorities of orders
- Deciding the scope of sub-contracting
- Follow up for engineering, Raw Material
- Assessment of Shop capacity and Vendor Capacity

- Keeping tab on progress of shop manufacturing as well as Vendor Manufacturing
- Keeping tab on status of all purchased items.

Outputs for planning

- Macro Plan
- Execution Plan
- Monthly Invoicing Plan

4.1 Preparation of Macro Plan

On receiving SWO planning starts making Macro Planning. The macro plan is a tentative plan and is not linked with invoicing plan or execution plan. This plan is prepared for some bigger projects to have visibility of start and end date of different activities. After deciding work break down structure, duration and dependency of activities are decided. Start date and end date of all activities are also decided taking into consideration for parallel activities. At the time of preparation of Macro plan capacity is not considered to be a constraint. This plan is prepared keeping in mind contractual delivery date. Once the plan is prepared and finalized it is sent to EDRC and all PG's.

For preparing Macro Plan the whole project is divided into WBS up to 3 to 5 or 6 levels depending upon size of the project. Presently this activity is carried on MS project.

4.2 Preparation of Execution Plan

Execution plan is firm order backlog plan. It is a rolling plan of 12 months. On receipt of the SWO, planning puts the order in Execution Plan keeping in mind the contractual delivery date. The order is scheduled in plan in terms of value in Rs. Although data is entered in plan as soon as SWO comes to planning but this plan is released to all PG'S and shop heads once in every 2 months. The planning activities are carried out based on this document. Execution plan is normally done according to the billing plan i.e. the distribution is done as per the billing break up.

The plan includes all PG's (PG1, PG2, PG3 and PG4) separately. Under each PG there are three completion

- Product Group Completion
- FAS Completion
- Assembly Completion

Product group completion center signifies for those orders, where shop does not interfere in the processing of an item, it is called a PG completion center. E.g. bought out items. Foundry may be completion center for PG3. Similarly yard may be completion center. PG1, PG2 and PG3 all can be completion center for resale items.

Resale items - Items that are bought and forwarded to a client as part of the order without any value addition done to the item in any of the shops is called a resale item.

The execution plan as shown in table shows completion center wise sales work order numbers, contractual delivery date, Sales Value or Transfer price for the order and month wise planned invoicing break up for orders. It also provides month total for each product group. On the basis of this sheet a summary of execution plan is prepared. In this summary month wise individual PG's order backlog in terms of Rs is mentioned. It also shows the total of all PG's Order backlog.

Quarterly Plan - Planning prepares quarterly plan also. Quarterly Plan is similar to execution plan but it is released once in three months. Quarterly plan does not contain stock orders like Execution plan. Quarterly Plan is made keeping in mind to achieve revenue budget target fixed in the beginning of year.

4.3 Preparation of Monthly Invoicing Target

On each Wednesday of week there is a inter shop meeting of planning with Shop floor planning to find the status of each job on item level. In this meeting status of each item of a job is reviewed. On the basis of the status of job in shop floor and contractual delivery date requirement planning prepares a Monthly invoicing target plan. The monthly invoicing target shows sales work order wise break up of invoicing to be done for each week of that month. The following table shows an example of invoicing target plan prepared by planning each month. This plan contains sales work order wise invoicing plan. This Monthly Invoicing Plan works as input for Shop level Micro planning. On the basis of this invoicing target plan each shop prepares its own monthly and weekly Plan.

4.4 Monitoring and Control

Planning keeps track of progress of an order through meetings and getting feedback about the status of jobs from different shops as well as other departments. Presently they don't have such a system to see the status of material required for a job, status of different operations for an item. Planning has to depend on physical verification at shop floor or follow-ups. Presently there are three meeting conducted for feedback, monitoring, and control.

Inter shop Meeting – This meeting is held on each Wednesday among all the shop planners and planning department. IM Planning gets the status of each and every item level status from shop people. On the basis of feedback obtained from shop people

about status of an item, planning takes the decision to subcontract.

Production Meeting – This meeting is held on every Friday. All the shops heads and material heads review the progress of current month job. The feedback obtained from Inter shop meeting is the basis of taking decision for changing the priority of orders in Invoicing plan as well as shifting of order from current month invoicing plan to next month invoicing plan.

CTN, PTN and MTN – Casting Transfer Note (CTN), Parts transfer Note (PTN) and Material Transfer Note (MTN) are used to get the status of jobs moving from one shop to another shop.

- CTN - This is used to transfer castings for machining from foundry to machine shop. Foundry sends CTN for this.
- PTN - This is used to transfer parts between FAS and MAS. The shop sending the material sends PTN for this.
- MTN - The material transfer note is used by IM to send machined items to foundry.

4.5 Releasing of Drawings and Parts List

After receiving the Parts list and drawing, IM planning raises subcontracting PR as well as they enters routing in parts list against each item of parts list

4.6 Decision on Sub Contracting and In-house manufacturing

After internal reviews and discussions with the shop personnel, a decision is taken by planning on whether to manufacture in-house or sub contract the activity. Resource availability and Capacity availability, capability and conversion costs are the factors considered for the same. If the decision is taken to sub contract an item, Planning generates a sub contracting PR and hands it over to the IM-Subcontracting section of planning.

4.7 Codes for Routing

Routing or operation sequence are indicated in parts list using the following codes for workstations

Code	Work Station
F	Fabrication Shop
M	Machine Shop
A	Assembly Shop
G	Foundry
S	Sub-contracting

E.g. If a work order is routed through an operation sequence like Foundry, machining and finally Assembly, it is coded as G-M-A. Here the completion center is Assembly

4.8 Concept of Completion centers in IM

Completions centers are centers where the work order is completed and the finished goods note (FGN) is prepared. There are three completion centers in IM as indicated below

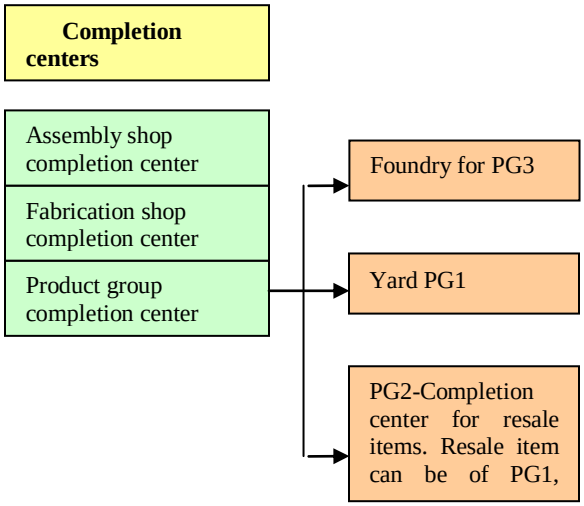

Fig2: Completion centers

4.9 List of Documents used for planning

SOURCE	DOCUMENTS	DESTINATION
Marketing	Sales Works Order	Planning
EDRC	Parts List +SWO	Planning
Estimation	Estimated cost break up sheet	Planning
Marketing	Billing Break Up	Planning
Planning	Execution Plan	
Planning	Monthly Invoicing Target	Shops (Fab. M/c, Assy.)
Planning	Purchase Requisition (For Subcontracting PR)	Purchase Dept., Q/A
Planning	Despatch Request	Store
Q/A	Rejection Report	Planning
Finishing shop	Finished Goods Note	Planning

5 IMPLEMENTATION

The most important part of ERP implementation is business process re-engineering phase. During this phase the processes of organization are mapped with ERP standard processes .These standard processes, defined after multiple implementations in various companies and sectors yield best results [3]. But adoption of such external processes is little difficult. Hence customization of ERP package is needed. The optimum exploitation of the results, the maximization of the benefits and the achievement of the farthest goals leads to the development/ implementation (or adaptation) and installation of an ERP system [19].

The implementation phase represents the fundamental challenge: this is where it shows whether the realization of the concepts produced in the previous strategy and design phases is actually successful, with the result that an improvement in processes has actually taken place. Thus, the key to success lies in a neat, methodical approach, which seamlessly translates into the actual workmanship [20].

The studies showed that different stages of the ERP journey required different competences from the managers. A different blend of competences is essential to manage various parts of the system. Hence a wide range of competences are required: personal, business and technical [21]. Maximum effort in implementing ERP systems puts into achieving increased levels of organizational integration as indicated by estimates suggesting that the cost of ERP software is only around 30% and remaining 70% of this amount is thought to be for the ERP implementation and business process reengineering expenditures [1].

6 CONCLUSIONS AND FUTURE DIRECTIONS

Currently, L & T is not having proper integrated system and business performance data to the top management is not available on line. L & T Management wants to have data on line so that they shall be able to monitor the performance of the business. There are following performance issues with JD Edward ERP package.

i. The ERP package, JD Edwards provide less number of reports which are not enough to carry our data query efficiently.
ii. The people of costing department found documentation of JD Edward complex and not user friendly.
iii. The through put time is very high.
iv. Security needs to be provided to ensure that once status changed can not be changed to a lower status. This was not dealt during CRP. For example, engineering department should not be able to change status from 110 to 105 for a released PR.
v. As PR can be prepared in JD without making supplementary parts list, hence shops will not be able to know the relation between the Parts List and the PR seeing a Parts List already released to shop by Planning. In view of this, it was decided that a comprehensive report is needed for the shops/Engineering to correlate between the PRs released and their link between the Parts List items based on the JD item number and the source type (BUPR, BOPR, ICPR etc.) of the P/L.

When the business condition change, the system may not guarantee that the process embedded in ERP is still best. Hence an innovative, concurrent design effort is needed for success of ERP coupled with synchronized industry and academia collaboration[22].The improvement in inventory management can be achieved by using wireless manufacturing (WM)—an emerging advanced manufacturing technology (AMT). WM relies substantially on wireless devices such as RFID (radio frequency identification) or auto-ID sensors and wireless information networks for the collection and synchronization of the real-time field data from manufacturing workshops. This approach provides operational flexibility while improving efficiency and capacity. Representative WIP logistic processes will be used to demonstrate how production and logistic operators and their supervisors accomplish their tasks in a WM shop-floor [20].

A successful ERP implementation requires knowledge on both ERP systems and business management. In implementing ERP, the business processes of those enterprises adopted ERP systems need to be examined [14].ERP has evolved from legacy implementation to more flexible tiered client-server architecture [12]. Semantic web technology can be used in the context of an ERP to enable the lacking automation process [17] .The web-based ERP software connects the departments, branches, customers, suppliers, agents under a central system. Web-based ERP solution significantly reduces the overhead expenses.

ERP is providing organizations with the strategic insight, ability to differentiate, increased productivity and flexibility they need to succeed. ERP helps drive innovation and supports future of the organization. Real-time and paperless manufacturing processes are reality in a few well-established manufacturers. Enterprise can maximize utilization of resources, and minimize the total costs by streamlining and

optimizing the order cycle and manufacturing processes. Long and expensive customization efforts often result the pass of release deadline and budget overrun. Customizations make the software more fragile and harder to maintain when it finally goes to production. Major changes may be required in the later stage of the implementation as a result of incomplete requirements and power struggles within organizations. The ERP's planning module provides an added dimension of visibility for directing the planning focus on the most significant areas of company's investment [8].

7 GLOSSARY OF TERMINOLOGY

Abbreviation / Terminology	Description
SWO	Sales Works Order
EDRC	Engineering Design & Research Center
P/L	Parts List
IM	Industrial Machinery
MTN	Material Transfer Note
CTN	Casting Transfer Note
STORES CREDITING	Sending to finished goods inventory
FGN	Finished Goods Note
FGI	Finished Goods Inventory
PMIN	Production Material Issue Note
PR	Purchase requisition for Non Stock Item
MPR	Material Purchase requisition for Stock items
MTR	Material Transfer Request
MDR	Material Despatch Request
Stock	All the inventoried items
Non-Stock	All Non-inventoried items

REFERENCES

1. Anderegg, Travis, *MRP/MRPII/ERP/ERM — Confusting Terms and Definitions for a Murkey Alphabet Soup* , retrieved on 2007-10-25
2. Esteves, J., and Pastor, J., *Enterprise Resource Planning Systems Research: An Annotated Bibliography, Communications of AIS*, 7(8) pp. 2-54.
3. *What is ERP*?, http://www.tech-faq.com/erp.shtml
4. *CRITICAL ISSUES AFFECTING AN ERP IMPLEMENTATION*, http://carl.sandiego.edu/gba573/critical_issues_affecting_an_erp.htm
5. Turban et al. (2008). *Information Technology for Management, Transforming Organizations in the Digital Economy*. Massachusetts: John Wiley & Sons, Inc., pp. 300-343. ISBN 978-0-471-78712-9
6. "*Requirements Engineering for Cross-organizational ERP Implementation: Undocumented Assumptions and Potential Mismatches*", University of Twente. http://www.vital-project.org/papers/Daneva-Wieringa-Camera-Ready-RE-Paper.pdf.
7. Walsh, Katherine, "The ERP Security Challenge*". CSOonline. CXO Media Inc*.
8. F. Wu · H.Z. Li · L.K. Chu · D. Sculli · K. Gao, *An approach to the valuation and decision of ERP investment projects based on real options*, Ann Oper Res (2009) 168: 181–203, DOI 10.1007/s10479-008-0365-7
9. Stephan Kreipl, Jörg Thomas Dickersbach, *Scheduling coordination problems in supply chain planning*, Ann Open Res (2008) 161: 103–122, DOI 10.1007/s10479-007-0293-y
10. Kreipl, S., & Pinedo, M. (2004). *Planning and scheduling issues in supply chains—an overview of issues in practice. Production and Operations Management*, 13, 77–92.
11. http://www.eresourceerp.com/Material-Requirement-Planning.html
12. http://www.sysoptima.com/erp/erp_modules.php
13. Research and Practical Issues of Enterprise Information Systems II Volume 1 , IFIP International Federation for Information Processing, DOI 10.1007/978-0-387-75902-9, ISBN 978-0-387-75901-2
14. Li Zhang, Shuojia Guo, Yanping Liu and Jung Choi , *Study of Systems Methodology in ERP Implementation in China* , IFIP International Federation for Information Processing, DOI 10.1007/0-387-34456-X, ISBN 978-0-387- 34345-7
15. Chiwoon Cho and Nam Wook Cho, *Design of a BPR-Based Information Strategy Planning (ISP) Framework*, DOI 10.1007/b136271, ISBN 978-3-540-25862-9.
16. Kai Mertins, Markus Rabe and Pavel Gocev, *Integration of Factory Planning and ERP/MES Systems: Adaptive Simulation Models*, DOI

10.1007/978-0-387-77249-3, ISBN 978-0-387-77248-6.

17. Amin Anjomshoaa, Shuaib Karim, Ferial Shayeganfar and A Min Tjoa, *Exploitation of Semantic Web Technology in ERP Systems*
18. Hammer, M. and Champy, J. (1993): *Reengineering the Corporatio*n, New York 1993.
19. Young B. Moon , *Enterprise Resource Planning (ERP): a review of the literature*, International Journal of Management and Enterprise Development 2007 - Vol. 4, No.3 pp. 235 – 264
20. Shankarnarayanan S, ERP Systems -- *Using IT to gain a competitive advantage*
21. Wikipedia, the free encyclopedia
22. Injazz J. Chen (2001), *"Planning for ERP systems: analysis and future trend"*, Business Process Management Journal (MCB UP Ltd) 7: 374-386, ISSN 1463-7154
23. Patnaik Srikanta, *The First Text Book on Information Technology*, Dhanpat Rai and Sons Publication New Delhi, 2000.
24. Bi-Huei Tsai, *Exploring the influence of enterprise resource planning(ERP) implementation on corporate performance using modified data envelopment analysis (DEA) approach.* African Journal of Business Management Vol. 5(14), pp. 5435-5448, 18 July, 2011, ISSN 1993-8233 ©2011 Academic Journals.
25. Rameshwar Dubey, Sadia Samar Ali, *Study on Effect of Functional Competency on Performance of Indian Manufacturing Sector* Int. j. eng. bus. manag., 2011, Vol. 3, No. 3, 1-15
26. Andreas I. Nicolaou, Lawrence H. Bajo: *ERP Systems Implementation and Firm Performance.* The Review Of Business Information Systems Volume 8, Number 1
27. M. Asif Rashid, Hammad Qureshi, Muiz-ud-Din Shami,ERP *Life-cycle Management for Aerospace Smart Factory: A Multi-disciplinary Approach* ,International Journal of Computer Applications (0975 – 8887), Volume 26– No.11, July 2011
28. Henri Barki , Alain Pinsonneault, *Explaining ERP Implementation Effort and Benefits With Organizational Integration* , ISSN 0832-7203