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Collaborative Technologies in New Factory's Certification Process

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Abstract: The present study has demonstrated how collaborative technologies with the support from the fundamentals of Copy EXACTLY! (CE) methodology could be utilized to ramp-up manufacturing capacity within a shortest possible time. As a result of globalization the start-up teams that are geographically disperse are gathered to collaborate using shared critical information. It becomes more apparent and this model proves to be a forerunner in streamlining business process, reducing product time to market and developing sustainable competitive advantage.

Key words: Technology transfer, new factory start-up, collaborative technologies

INTRODUCTION

The technology certification process is a tool to gauge the readiness and competency of new manufacturing sites. A start-up team or better known as a collaborative team is assigned to establish operational framework, develop in-house training programs and facilitates the setting up of equipment, processes and supporting infrastructure. Proven methodologies such as the Copy EXACTLY! methodology has been well accepted in the field of collaborative technologies-allowing new manufacturing sites to quickly attaining all essential competencies within shortest period possible. Figure 1 shows that the process of technology certification requires integral support from various fields of engineering to provide groundwork and develop all necessary competencies in order to qualify the new factory.

Of course, one cannot deny that there are other fields of engineering that are equally important such as material engineering, test engineering and product engineering. Some may be more important than the others depending on the nature of the business or the product in which it is being manufactured.

Collaborative tools and methodology: Most established manufacturing sites use extensively Failure Mode Effect Analysis (FMEA) as a tool for proactive or reactive and analytical risk assessment techniques intended to identify potential failure modes. FMEA is an integrated component of the technology certification process to assure that adequate resources have been properly allocated to sustain and improve the process. It is also an established reliability engineering activity that also supports fault tolerant design, testability, safety, logistic support and related functions. In the technology certification process, FMEA is used to analyze the process characteristics relative to the planned manufacturing standards and requirements. It identifies ways in which failures could occur, estimate the effect and seriousness of the failure and to recommend corrective design actions and control to eliminate or reduce the risks of failures[1,2]. Again the cross-functional approach brings greater expertise and synergy into the process of establishing a complete and effective FMEA. The team may consist of manufacturing engineers, quality engineers, production supervisors, facilities engineers, process engineers as well as sub-contractors and equipment vendors. As illustrated in Fig. 2, the collaborative approach is needed to establish a comprehensive and reliable FMEA.

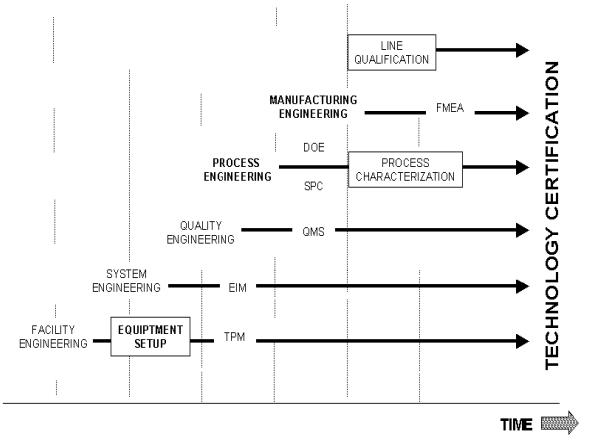

Fig. 1: Collaborative engineering in technology certification

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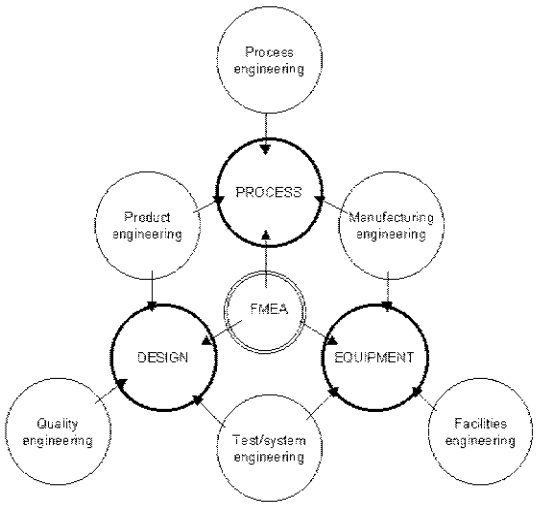

Fig. 2: FMEA collaborative network

Collaborative technology in information system: Collaborative information system is not new in global manufacturing environment. Enterprise Information Management (EIM) collaborative network (Fig. 3) is transforming the organization model for producing and communicating information, which significantly reduces the cost and time. EIM strengths are in its ability to provide collaborative engineering, project management and dissemination of real-time information. Secured documents (passive or interactive) can be transmitted to team of engineers and managers across the globe closer to real-time. EIM infrastructure expands productivity, reducing time to start-up and minimizing costs. Collaborative technologies incorporate wide spectrum of manufacturing systems, including design and development, computer-supported collaborative work, virtual enterprises, concurrent engineering, computer-integrated manufacturing, supply chain management and business process reengineering.

Technology advancement has brought about solid modeling software and object oriented code. Today's 3D digital models are portable, easy to generate and manipulate. Object-based models contain smart elements, or objects, that inherit characteristics of real-world objects. In addition to geometry, models can include non-graphical information like specifications, cost data, bill-of material, assembly instructions, material data sheets, project and maintenance schedule and so forth. Moreover, design data can be shared and collaborated with team members, vendors, customers and partners. Designs include embedded links and allow integration to other drawings and databases. Figure 3 is a good illustration of how an information collaborative network works. Each system is linked through an integral network, for example Microsoft Exchange Server.

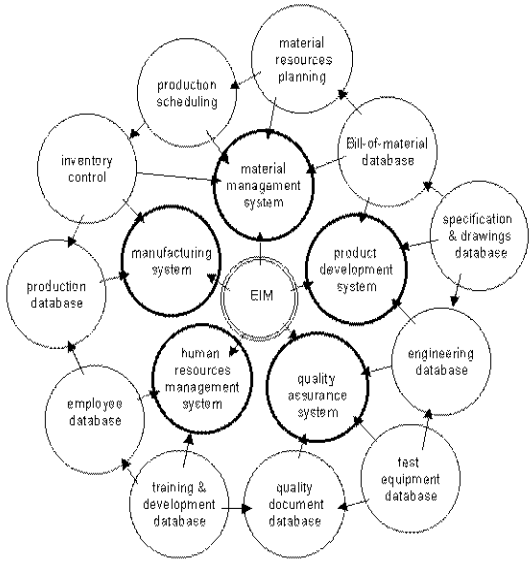

Fig. 3: Enterprise Information Management (EIM) collaborative network

Encompassing an organization's entire array of information systems, in-house practices and human capital, successful knowledge management transcends application categories to simultaneously reflect and redefine the role of every employee. Collaborative Groupware, databases, Customer Relationship Management (CRM), Enterprise Resources Planning (ERP) and supply chain management (SCM) applications are all components of a knowledge management solution[3]. To act as a functioning knowledge management system however, they must work together in a way that quantifies, reflects and improves the organization's effectiveness. In decision-making scenarios associated with enterprise resource planning (ERP) there are opportunities for the use of collaboration technologies. These are situations where, as a result of some unique customers' demand, a group of stakeholders must quickly meet to make a decision. Is the present capacity sufficient to meet those demands? Is there a need to build additional lines/capacity? Will there be sufficient lead-time for securing supply line/materials? What will be the best commit date for delivery? What would be the impact on the present orders/schedule?

By optimizing designs for identifiable parameter ranges, engineers could better detect and avoid costly mistakes when committing resources to production. Despite this awareness, manufacturing sites rarely engage in these practices due to the overwhelming time and expertise commitment. The resources required to plan, execute and verify the large sequence of finite element analysis ultimately undermine management's confidence

in the timeliness of the study. Often spreadsheets such as Microsoft Excel could easily be deployed to conduct performance trend studies. Quick to build, such spreadsheet models prove to be effective in assessing overall characteristics of a new design and its key parameters. It is simple, easy to understand and widely utilized. However, such spreadsheet models have limitation and cannot match the finite element method to capture the impact of geometry details, complex environmental conditions, or dependent material behavior.

Although collaborative applications like Groupware that sometimes referred to as collaboration technology, shares many characteristics of information technology systems and office systems contain information that has flowed down the business information value, there is also a considerable amount of work group-generated information in a collaborative system that is independent of the business information value chain. Groupware is used primarily for communicating, problem solving or troubleshooting and decision making. Products such as Lotus Domino and Notes and Microsoft Exchange and Office-managed this type of workgroup information. For instance, there are many scenarios, factors and parameters repeated or similar throughout the process of surface mounting or wire bonding. Collaborative tools would be useful to troubleshoot the problem. Team of "process specialist", including operators and engineers are assembled but not necessarily co-located. They need to communicate regarding the problem, symptoms, past history before suggesting and experiment with alternatives. Integrated simulation tools and essential data are shared through e-conferencing tools.

Collaborative application like TeamReview, works with Lotus Notes, Lotus ccMail and other e-mail applications that support Vendor Independent Messaging (VIM), Messaging Application Programming Interface (MAPI), or Common Messaging Call (CMC). TeamMail™ provides enhanced electronic mail support that allows users to distribute data to team members - from a message to an entire 1-2-3 workbook, Word Pro document, Approach database, or Freelance Graphics presentation. Users can send data to a group of people simultaneously, or route the data sequentially from one individual to the next in a mailing list (Fig. 4). It also tracks the progress of a routed message by having a mail message sent to the initiator each time a recipient forwards the document to the next recipient. After reviewing the data, individuals can incorporate their updates and comments before routing the data to the next recipient.

Like TeamMail, TeamReview™ lets users distribute a range of data to team members simultaneously or individually (Fig. 5). When users have received changes

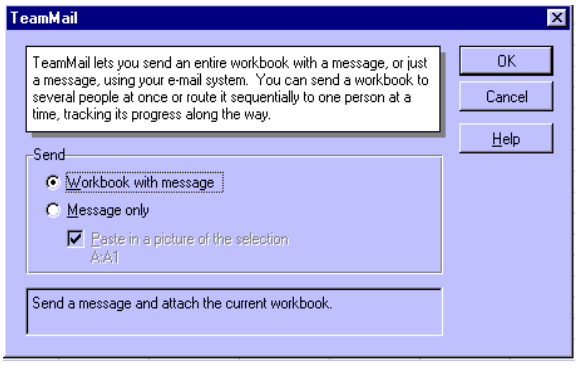

Fig. 4: TeamMail Toolbox

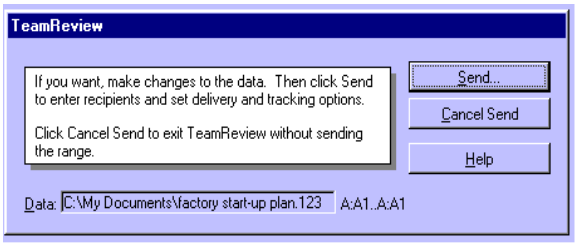

Fig. 5: TeamReview Toolbox

and comments from the recipients, the original data can be placed with the new, or merge the changes into the source as range versions. Using e-mail system, TeamReview sends a range of workbook data to other 1-2-3 users, collects team inputs and have it returned to the originator automatically. Recipients make their changes, add comments and return the range to the originator. The changes can then be merged into the original workbook. For example, suppose the Project Manager need figures from several different departments to complete factory start-up budget. The Project Manager determines whom to send the budget to and in what order and specify the range to be returned. Team members add their figures to the range and 1-2-3 automatically routes it to the next person on the list. When the range returns to Project Manager, 1-2-3 remembers where the range came from and can merge the updated range into the original workbook. After team members had received an e-mail containing a routed range (attached in a workbook), they can add or change data, make comments and add drawings or charts. Subsequently, members can then send the workbook along to the next recipient on the list. If the originator granted permission, members can edit the routed list before the completed workbook returns to the originator.

Collaborative team in new factory start-up: The collaborative team (Fig. 1) pulls together resources for a goal of starting up a new factory. By adopting a project

management process, it provides a paradigm for planning, organizing, directing and control of the start-up project. When such a team is assembled and superimposed on the existing structure, a matrix organization is formed. Since new factory start-up requires long hours and meticulous effort, the project objectives could easily be deferred. The role of project or program management brings forward seamless integration of resources into a synergistic form. The collaborative team pulls much needed resources from functional departments with specialized capability to nurture and to leverage on technological know-how to support project goals. Each department within the function performs its work needed to ensure input into the project. The functional managers or their delegates maintain necessary contribution towards the accomplishing key deliverables and project goal, while the program manager oversees the coordination and integration of various input and their interdependencies.

There are other options to organizational designs but project organization matrix is known to be more cost effective yet reliable, particularly for Small-medium Enterprises (SMEs) as a way of sharing scarce resources. Functional departments with core competency share their resources with the project organization to provide needed technical capability while the project manager provides direction and coordination to ensure flawless execution of plan on timely basis. The project tasks are identified, assigned to specific functional department with specific objectives and goals, which are measurable and to detailed task descriptions, specification, milestones, budget for work package and so forth[4]. This will ensure that key expectations are well defined and agreed upon by all stakeholders in ensuring timely execution of plan according to the Master Gantt chart (Fig. 6). In every sense, the functional departments are committed and held accountable for delivering results.

Collaborative team in product transfer: Among the many benefits collaborative technologies are improved communication and more efficient and effective processing and feedback of information among different organizational strata. It strengthens the horizontal and vertical interrelations among different organizational levels and facilitates company-wide communication. It also provides numerous benefits such as improved employee relation management; enhanced communication

FEM6 MOTHERBOARD PRODUCTION START-UP
MATERIAL MANAGEMENT (MAP DAY gantt)

		AR	Status	Flag	ww06				ww07				ww08	ww09					ww10						ww
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	**Establish Intel/FEM6 material team matrix**																									
1.1	set-up communication matrix	quik	done	G																						
1.2	communicate Intel's commoditG group/buGer/planner	quik	done	G																						
1.3	distribute security tag/pass to Intel team	quik	done	G																						
2	**Material system management/training**																									
2.1	BOM (level, alternate, etc.)	mei ping	done	G																						
2.2	AML (A, D, C, N, X, E, etc.)	mei ping	done	G																						
2.3	generate material hot list	mei ping	done	G																						
2.4	procurement during NPI phase (E status)	mei ping	done	G																						
2.5	Intel's allocation process	mei ping	done	G																						
2.6	FEM's standard procedures/instructions	quik	done	G																						
3	**Consigned materials management/training**																									
3.1	tag control, cycle count & reconciliation	mei ping	done	G																						
	-book-book & floor-book																									
3.2	HVU/UI (walkthru)	debbi	done	Y																						
3.3	raw materials receiving	mei ping	done	G																						
3.4	finished good shipping	mei ping	done	G																						
3.5	raw materials/finished good physical scrap/bonepiles	mei ping	done	G																						
3.6	material shortage disposition	quik/mei p	done	G																						
3.7	material transfer to resolve shortage	quik/mei p	done	G																						
3.8	turnkey to consign & vice versa/effective date	mei ping	done	G																						
3.9	line scrap tracking/control (0.2% charge back)	mei ping	done	G																						
3.10	materials movement to/from KDC/MIW	mei ping	done	G																						
4	**Turnkey materials management/training**																									
4.1	excess/obsolesce disposition/claims	mei ping	done	G																						
4.2	material transfer to resolve shortage	quik/mei p	done	G																						
4.3	indirect material (packaging) procurement	mei ping	done	G																						
4.4	disposition of turnkey to PO to p-sites	mei ping	done	G																						

Fig. 6: Sample of new factory start-up: Master Gantt chart

across organization. It also cultivates problem solving skills; strengthens the sense of teamwork; helps in acquisition of new skills and knowledge and develops more cooperative attitude.

Collaboration technologies allow product design and development sessions, engineering reviews, supplier meetings and customer's requirements reviews to be conducted at remote sites. Users see the same screen and in most cases each can be given the ability to interact and manipulate the data being viewed. Design specification, parametric model and assembly drawings can be viewed, manipulated and modified in an interactive session via Intranet protocol. Some systems use a web cam to allow work in conjunction with a teleconference. Collaboration technologies enable the following:

- Designed project team(s) no longer needs to be co-located. They can collaborate on a design online in a virtual meeting with their geographical disperse counterparts.
- Suppliers and vendors can join collaboration sessions to discuss pilot production, materials availability, parts or tooling directly with customers from respective manufacturing sites.
- Improve product development, shorten design cycles and reduce time to production and market by improving communications without requiring travel.

Figure 7 shows a basic new production introduction process flow. Notice that in each stage of the process beginning from strategic planning until High Volume Manufacturing (HVM), an equal effort is being made to ensure all new standards, requirements and process parameters are provided and clearly communicated throughout the process. The responsibility is not solely placed upon the function of production planning. However, it requires inputs from product engineering team to define specification, process and critical quality parameters and human resources department to provide manpower resources and training. Test engineering will define and establish test and inspection plan. Quality engineering will qualify the first product samples/lot based upon the pre-defined specifications before proceeding with proto-build and production run. More importantly at the end of stage 'F' a thorough operational review is conducted with all stakeholders confirming the results and hence qualifying the production for High Volume Manufacturing (HVM). It is a single-minded team effort, which greatly contributed towards the successful factory start-up or new product certification.

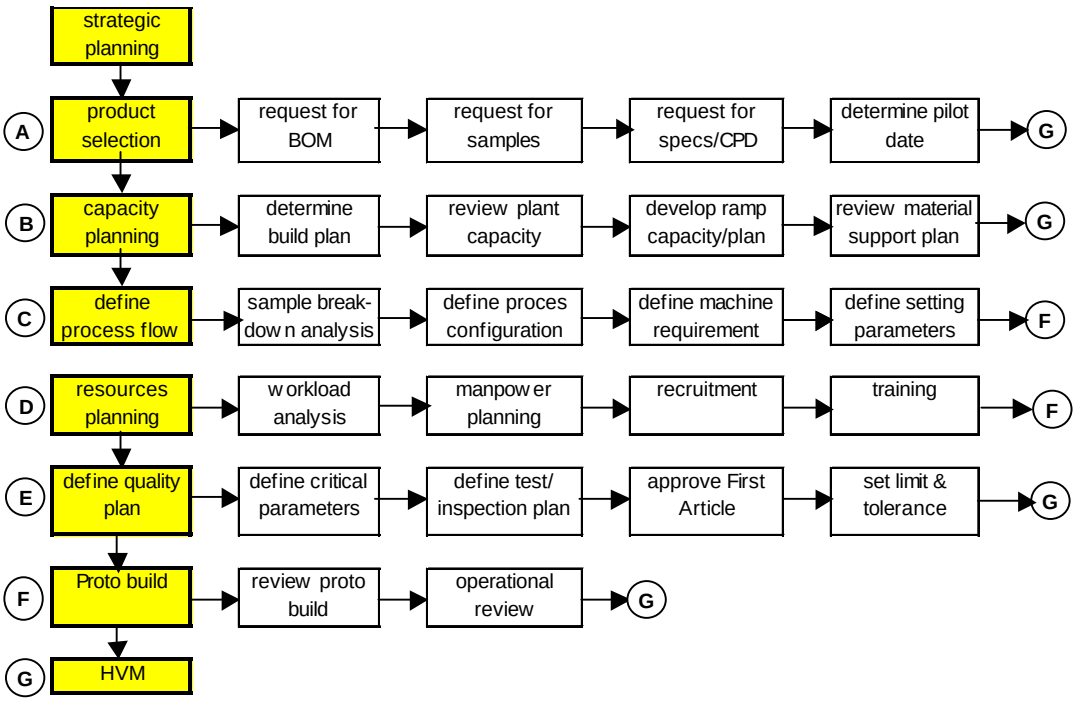

Fig. 7: New Product Introduction (NPI)

CONCLUSION

This study concludes that collaborative technologies is becoming more apparent and is playing significant role in global manufacturing. Geographically dispersed manufacturing sites and limited resources of specialists further justify the needs for collaborative technologies. However, the cost of deploying such technology could be well managed if properly planned and executed. One may still argue that it would be sensible to adopt mainstream technology such as Microsoft applications or dedicated high-end technology. However this paper has proven that simple and yet cost effective application such as TeamMail and TeamReview, could still be use for information collaboration. With the right tools and methodology, coupled with enabling information system and well supported by collaborative team, the new factory certification process is right on track.

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