INTERACTION OF VISUALIZATION SYSTEM FOR ANALYSING DIGITAL & COLLABORATIVE TRAINING FOR INDUSTRY AND ACADEMIA

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Abstract - In Digital & Collaborative training, participants interact with other members by exchanging information not only through verbal communication but also through nonverbal communication, In order to utilize such non-verbal information to analyse digital & collaborative training method. The experiments were conducted to collect non-verbal information of the participants.

Training programs have been established and are conducted by a well planned calendar in a tightly packed schedules & course contents. The Industry/Academia finds these schedules/calendars highly elaborative, tedious and has to forgo the services of employees for a long time which is costly and causes sufficient amount of work hamperage and push the Industry down the line due to time factor.

This research paper propose a visualization method of digital & collaborative training in Centre of Excellence. The method intuitively visualizes the training & interaction with respect to digital & collaborative platform of each participant. A prototype system is introduced in Automation Lab, interfacing with different technologies. It is high time that due to the emerging technologies, advances in software's, systems & high-speed networking ambience, the need for devising high performance online digital & collaborative systems must be of high priority.

1. Introduction

This paper aims to demonstrate that academic education is compatible with the training system characteristic to the Industries because it emphasizes the needs imposed by the Indian markets.

Training programs have been established and generally used within company's personal development alternatives starting from the employee's performance assessment to processes. The current century requires a different way of approaching academic education, starting from the employer's observation, in reference to the lack of the graduate's key competencies in the hiring process. Employee training[1].

The objective of getting this short period Industrial training is to get acquainted with the practical working of the things, what is learnt in Classroom till date. Also this training is aimed at, how different Engineering Branches works together to achieve one sole objective.

One more objective of this training is to get acquainted with the organization structure of the industry/academia and its Work Culture.

2. Collaborative Learning – Verbal & Non – Verbal

In collaborative learning, participants interact with other members by exchanging information through, not only verbal communication but also through, nonverbal communication, such as looking at other participants and passing information with the help of eye contact, body language, gestures , chronemics and discussing/writing on the paper, which plays an important role in facilitating effective learning. In order to utilize such non-verbal information to analyse collaborative learning interaction, some experiments were conducted to collect non-verbal information. Employee training & development [1].

In this research, collaborative learning is being distinguished among participants in groups (Five to Twelve participants) who study/discuss face-to-face (F to F) conversation. Each participant has notebook for writing the details of discussion and ideas. Through collaborative learning, they discuss and try to share their knowledge of the subject. In collaborative learning, participants enhance their knowledge, not only individually, but also by looking around at others, listening to what someone is saying.

We conducted experiments to collect multiple information during collaborative learning. For the experiments, batch of 20 participants participated in collaborative learning. These were divided into four groups. Each group was given a set of experiment, and the study part, ie in first part they had to analyze about equipment performance & to prepare notes. In second part participants has to discussed and shared experience with others.

A Prototype system, visualizes learning in collaborative platform by loading a video, Visualization system [2]. The video displays the action perform in the system and audio ie. Speech explains that how the system gives performance. Even this can be observed in the lab by placing a camera, while experiments are performed to watch and record activities of the participants. Every activity can be analyzed for the collaborative learning.

3. Tools & Systems.

Many processes, tools & systems were developed mainly to reduce the time and investment involved in training, maintenance and manufacturing. Below are the highlights of few of them.

a) AAA - Aigle Assembly Architecture

In recent years, manufacturing companies have faced enormous difficulties meeting cost, schedule, and quality objectives. New product introductions are increasing at a rapid rate, and global competition has accelerated, AAA for mini factories [3].

The parts which make up these kinds of products are getting too small to be effectively handled and placed by humans, and current manufacturing automation is becoming inadequate to do the job at low enough costs. AAA can achieve all the above requirements which are needed for the current manufacturing industries.

AAA is an architectural framework which will allow manufacturers, to rapidly design, program, deploy and operate automated assembly systems.

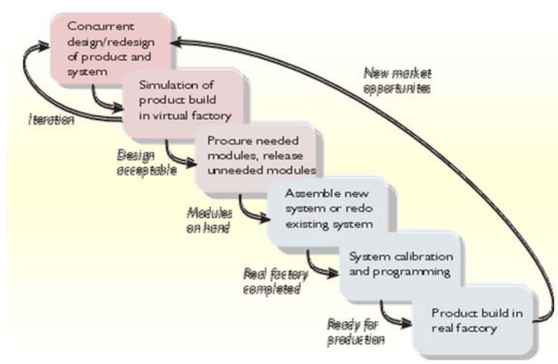


Figure.1. AAA Life Cycle

- Factory Design

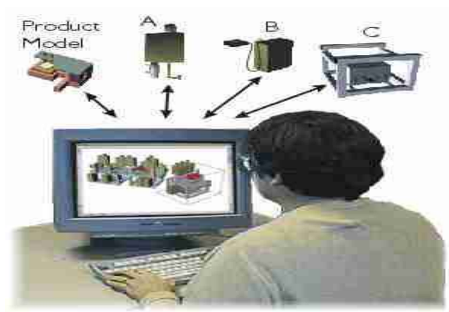


Figure.2. Factory Design

- Factory Programming and Simulation

Figure.3. Programming & Simmulation

- Module Procurement

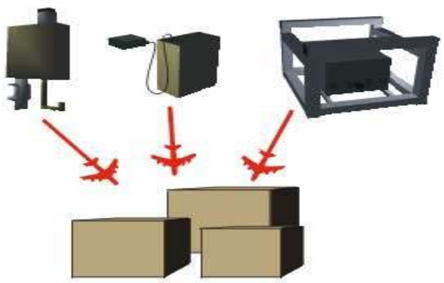


Figure.4. Procurement

- Factory setup

Figure.5. Set-up

- Automatic Calibration

Figure.6. Calibration

- Final programming and debugging

Figure.7. Programming & debugging

- Distributed execution

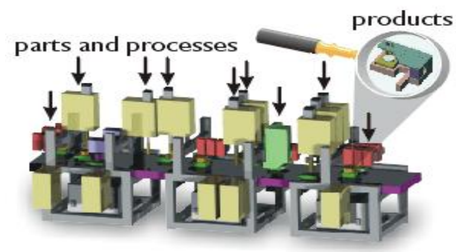


Figure.8. Execution

- Rapid changeover

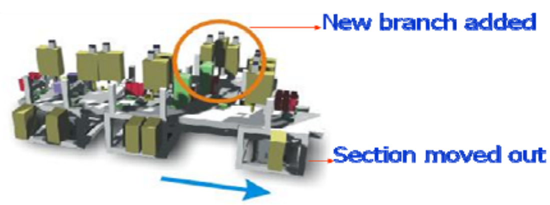


Figure.9. Changeover

Conclusion

- The Architecture for Agile Assembly (AAA) aims to reduce the time to deploy a new assembly factory from months to weeks, with adjustment to product changes in less than an eight-hour shift.
- It will enhance product quality in several ways including reducing parts-workpeice alignment errors to micrometer levels, and substantially reduce the floor space required for product assembly.
- By standardizing these interfaces and producing devices that recognize their need to cooperate with their peers from the outset, AAA enables the rapid design, deployment, and reconfiguration of automated assembly systems.

b) AI (Artificial Intellegence)

"Artificial Intelligence is the attempt to build computational models of cognitive processes. Artificial Intelligence is about generating representations and procedures that allow machines to perform tasks that would be considered intelligent if performed by a human." AI for computer integrated manufacturing [4].

- Diagnosis and troubleshooting of Devices and Systems of all kinds
- Planning and Scheduling
- Configuration of Manufactured Objects from subassemblies
- Financial Decision Making
- Knowledge Publishing

Case study:

- Sekisui Chemical created the Heim division to build modular houses
- Modular houses are semi-custom houses designed and constructed out of modules

Promised to have a house ready for occupancy in two months from the time a customer signs a contract with a design on hand.

- 40 days are allocated for on-site work from ground breaking to completion with a five-man crew.
- More than 80 percent of the house is built in a factory.
- Each factory complete enough components for a house every 40 minutes
- Builds about 20,000 houses per year.
- Class of houses is designed by the Sekisui architects
- An average house requires about 5000 unique parts.
- Sekisui has 300,000 different parts in stock.

Problems:

- Every time a new house design was introduced, there was an error rate in parts selection of about 30 percent for the first six months.

The first expert system to be put in routine use, HAPPS, identifies and selects the necessary parts for a given house design and schedules the delivery of the parts to the right place on the factory floor at the right time.

- Entry way and stairs: the shape and location of the entry-way, the shape and position of the stairways, step-down location, if any; type of windows, rooms to be soundproofed, etc.
- Interface between units (such as doorways) and corridors
- Other information, such as the order in which the units are to be manufactured

Benefits!

- 0% error rate!!!
- Could offer competitive rates of $45/sq.feet or even less ($56,000 for 1600 sq.feet flat).

c) RMS(Reconfigurable Manufacturing Systems)

A TOOL FOR FLEXIBLE AUTOMATION

- Large fluctuations in product demand.
- Shorter product life time (*automotive, semiconductors, electronic equipments).*
- Harder to predict if a new product will be successful.

A RMS is a system designed at the outset for rapid changes in structure and its components, in order to rapidly adjust production capacity and functionality (within a part family) in response to market changes.

Reconfigurability is defined as to adjust the production capacity and functionality of manufacturing systems to new circumstances through rearrangement or change of the system components. Tool for flexible automation [5].

Objectives of RMS :

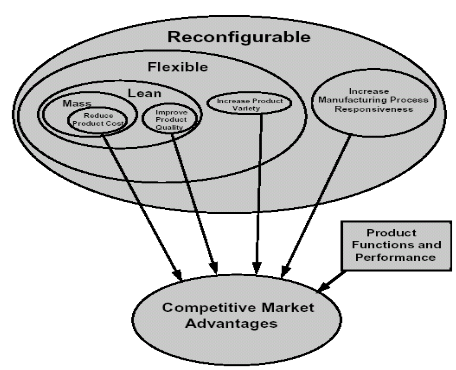


Figure.10. Objectives

Key Characteristics of RMS

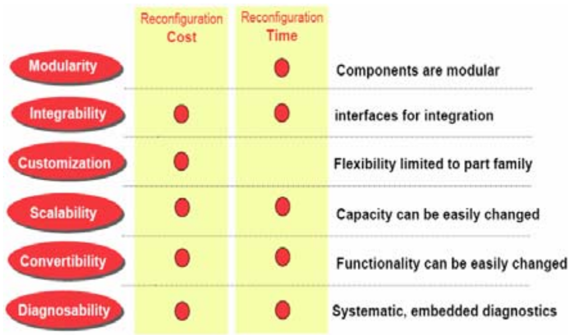


Figure.11. Characteristics

Conclusion

RMS is viewed as a promising technology and with its features, that it has inherent capabilities for capacity adjustment, product variety and shorter changeover time.

RMS, because of its modular structure and ease of integration, can complement other production systems and has the potential to address some of their shortcomings.

Finally to stay in this competitive world manufacturing companies of this century have to be adaptable by embedding RMS technology.

d) VR (Virtual Reality)

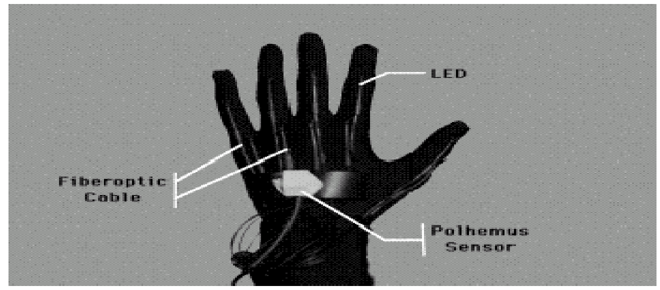
"A technology which is capable of shifting a subject into a different environment without physically moving him/her" VR – Concurrent engineering [6,7].

Concurrent Engineering:

- Processes run in parallel as opposed to sequentially
- Multi-Disciplinary Teams
- People from downstream and upstream operations included.
- Man's perception is dependent on his five sense organs.
- Inputs into the subject's sensory organs are manipulated
- Manipulation process is controlled by a computer model that is based on the physical description of the Virtual Environment

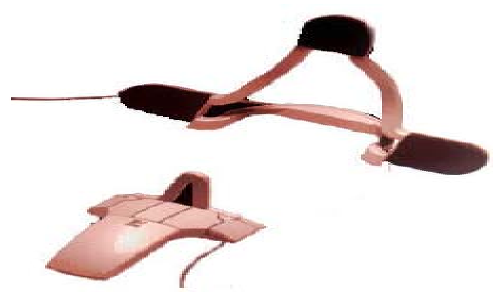
VR devices

- DataGloves
- 3D Mouse and SpaceBall
- Head-Mounted Displays
- Magnetic position/orientation trackers
- CAVE



The DataGlove

Figure.12. Devices. a) Gloves



Logitech 3D mouse

Figure.12. Devices. b) 3D Mouse.

Head-Mounted Display

Use of CyberTouch

Figure.12. Devices. c) Displays.

Case Studies

a) Leyland Trucks
b) Canon Inc.

a) Leyland Trucks

Latest 18 tone truck prototype designed entirely with the use of advanced simulation and Virtual Reality (VR).

Leyland's design team

- Were using PTC's Pro/ENGINEER
- Needed to do more than just model

- Wanted to see a whole vehicle on the screen
- Be able to move around it to discuss particular design issues, as they would have done using the traditional physical mock-up approach

Previously, Leyland Design Team built physical mock-ups of the trucks. Two days before new truck variants were scheduled to go down the production line, workers from the shop floor were shown the model and taken through the 40 stage manufacturing process. This familiarized them with the new parts and their new roles in a single session.

b) Canon Incorporated, Japan

Company's Design Center has been working to streamline the design development process for cameras, printers, and copiers using a "Design VR System"

New Design VR System

- Enables the Canon Design Center to improve the efficiency of conventional design reviews
- Has created the company's unique "Take-out VR" system.
- Take-out VR system is built using SGI Visual Area Networking (VAN) technology
- Allows wide variety of participants from development and sales organizations in remote locations to review product designs in collaborative environment.

Benefits of the new remote and collaborative design review process using Take-out VR :

- Large reduction of the time and expense associated with design reviews because participants no longer need to travel to the Design Center Site.
- Shorter product development cycles and the potential for greater profitability.
- Improved data security and management
- Allows Canon Design Center to conduct design reviews using full-sized digital mockups at the remote locations with only a notebook PC connected to the company's WAN and a small projector.
- Inclusion of remote collaboration within the design process changed the design methodology
- Designers could know what their product, such as their printer, would look like if it was placed in the office or in the study room
- How attractive their product would be, if placed at the shelf space of the computer shop along with the competitor's products
- Extended the design review into the field of environmental simulation
- Design VR System improved the quality as well as the speed of each design process.
- Currently striving to enable this state-of-the-art simulation anywhere at any time.

4. Cross-Training: Improving Efficiency and Effectiveness

To meet unexpected business demands, One of the most effective ways to build a more flexible team is to cross-train the employees. The cross-training philosophy involves educating employees in different functions and positions of the company. While training an employee in another field, a temporary worker is managing that employee's workload. This allows the team to develop new skills to handle critical conditions. Improving efficiency [8].

Benefits :

- Protecting company from turnover and absenteeism.
- Giving employees a better understanding of company operations.
- Providing staff with a holistic view of an organization.
- Improving team's proficiencies and abilities in multiple disciplines.
- Obtaining new insight for problem solving.
- Building interdepartmental appreciation and employee morale.
- Increasing long-term efficiency, effectiveness and productivity.
- Gaining fresh perspectives and suggestions on streamlining assignments

Cross-training employees is a strategic long-term commitment to improving the efficiency and effectiveness of an organization.

5. Conclusion

In this research paper, a visualization system to analyse collaborative learning is proposed. The system displays participants real time actions ie. Discussions, writing notes and sharing knowledge among each other.

Future work is focussed on interactions by involvement of every participant and work on digital & collaborative platform.
More focus on cross trainings in various technologies and designing a system on digital and collaborative platform for Industries & Academia.

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