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"Virtual Engineering Supporting Integrated Product Development"
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Ford Motor Company is a worldwide organization operating in a global environment. Ford maintains global infrastructures at all locations of operations. Ford's worldwide activities consist of 179 wholly owned or joint venture plants operating in 38 countries on 6 continents with over 340,000 employees. Ford also has 15,800 dealerships in 200 countries. The product development segment of the business has six major engineering sites along with 8 separate design studios. The CAD/CAE infrastructure consists of three major CAE sites with multiple CAD facilities worldwide.

Integration technologies for product development consist of asynchronous and synchronous factors. Asynchronous activities include messaging through electronic mail, voice mail, hard-copy mail, faxes, and pagers. In addition, product information management (PIM) systems, and document management systems are also classified within this context. Synchronous activities involve traditional face to face contact, and multimedia interactive conferencing through audio, data and video communications. The main business drivers of virtual product development are global integration, concurrent engineering, investment and total cost efficiency, and knowledge capture abilities. The technology of virtual engineering has seven main benefits: (1) Reduces problem resolution cycle-time. Ford experienced a 5-fold reduction. (2) Increases productivity. A 5 - 15% gain was realized. (3) Reduces necessary travel. A reduction of 20% in required travel was experienced. (4) Integrates engineering and business environments. (5) Enables more timely and effective interactions. This results in more meetings, but of shorter duration. (6) Improves resource management including reductions in personnel relocations. (7) Facilitates and fosters creative innovations.

The most critical media element of interactive conferencing is audio, which is utilized almost 100% of the time. This is followed by data transmission with an 80% usage rate, and video for approximately 20% of the communications. Data conferencing is used to enrich the information that is conveyed between groups. Video is used to transmit real images during problem-solving sessions where an understanding of the motion is necessary.

Ford's objective is to align people, processes, and technology to enhance virtual engineering and foster high performing teams. The virtual engineering movement is progressing forward within distinct industry trends. Proprietary standards are being formed as the technology develops. Networks are converging from standard telephone and ISDN systems to IP platforms. Desktop PC's and workstations are evolving from data manipulating devices to a means for complex communications. Extended enterprise communications are increasing the usage of IP systems for better quality and reliability. In addition, there is a divergence between voice over IP platforms and H.323 for data/video usage.

There are four main types of data conferencing architecture: (1) Whiteboard is classified as a utility type of media with a distributed data system. (2) Application sharing is a utility media type with a centralized data system. (3) Application synchronization simultaneously links computer systems for simulations and other real time operations. This type of function is also classified as a utility media type with a distributed data system. (4) Synchronous protocols provide the most robust features out of all function types. These are embedded media types with distributed data

systems.

Ford's collaborative experiences with virtual engineering evolved through several iterations of evaluations and pilot test systems. These tests involved proprietary and standard type systems on both Unix and PC platforms. Virtual co-location engineering systems increase efficiency and greatly reduce development time. These systems enable engineers to have immediate access to each other, and to one another's resources. Personal experiences and resources from around the world can be combined to enhance product development.

Virtual engineering reduces program investments, increases shared components, and increases product quality. These combined efforts resulted in higher customer satisfaction, and quicker decisions pertaining to worldwide applications.

Ford's pilot program for a virtual co-location global design studio resulted in an increase of knowledge through learning experiences. The program resulted in more productive meetings, higher quality decisions, and more timely direction. Several needs also became apparent during the program's implementation. These needs included a requirement for shared applications to satisfy diverse user's requirements, better bandwidth management tools, and need for the development of a multi-cast enabled network. The program also resulted in unsuccessful platform interoperability due to a lack of system standards.

The pilot program for virtual engineering also resulted in new learning experiences. Face to face team building was determined to be essential at the start of a project. New team members first met in person to build relationships and trust before beginning to work virtually. The work in the program was successfully structured for team integration on a daily basis. The virtual program resulted in being 65 to 70% as effective as physical co-location of the team members. The pilot program recognized the need for proper facilities for group-to- group interactions. The performance of shared applications was poor due to a lack of necessary interactivity. There was also a need for cross-platform interoperability.

The automotive network exchange (ANX) is driven forward by a need for a quality of service that is predictable and sustainable, support that is reliable, security with confidentiality and integrity, and a simplification of supplier communications. ANX systems permit access from one trading partner to another within two hops, while encrypting data through the gateway for security. The move to an ANX operating environment is seen as helping Ford Motor Company reach their goals of striving towards excellence, and providing economic benefits to the organization.

The virtual engineering system is confronted with multiple challenges for successful and continuous operation. There needs to be continued improvements with the quality, support, and security of the system. Real-time collaboration requires additional service enhancements. CAD/CAE applications require the refinement of low bandwidth capabilities for application sharing. Time dependent data traffic needs to be closely managed in an effective manner, and the tools and infrastructure require a degree of scalability. In addition, challenges from the business perspective of the system are presented in the form of accountability of network usage costs, and a low cost of entry. Further development of the integration of the people, processes, and technology needs to continue to evolve. Coordination of multiple time-zone operations is also a factor for consideration.

There are many possible future opportunities for virtual engineering. Several of these opportunities include the development of synchronization for high context applications such as virtual reality, and seamless integration of process information and tools. In addition, there are also opportunities for integrated knowledge bases, extended virtual enterprises, and high performance virtual teams.

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