Innovation-Based Manufacturing

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Vision
IbM will be recognized as a pioneer in manufacturing innovation by using a radically different cross-functional approach to bridge the gap between conceptual design and producible goods.

Mission
IbM will create a foundation for innovation in manufacturing systems that accelerates commercial development of innovative technologies, advances the United States manufacturing infrastructure by applying innovative methods, and trains the next generation of manufacturing leaders.

Need for Research
The North American manufacturing sector is continually challenged by competition from low-labor-cost countries. Once a product reaches a certain level of maturity, it quickly becomes a commodity that can be produced anywhere in the world at minimum cost. To remain competitive, manufacturers urgently need to bring innovation into their day-to-day operations both in terms of new products as well as new processes and technologies. These market conditions increase pressure for the development of new innovation principles specifically designed for manufacturers. These principles should focus not only on dramatically improving the efficiency of current manufacturing processes but also should enhance the manufacturability of lab-tested technologies for which there are usually no known manufacturing processes at production scale, thus limiting their commercialization potential. This economic scenario demands fundamental research in innovation-based manufacturing which IbM researchers define as a new way of doing manufacturing. This shift may consist of incremental or radical changes in the way manufacturers use machines, tools, and people to make products for sale on a large scale and at a reasonable cost.

The primary goals of innovation-based manufacturing are (i) to boost the commercialization potential of basic research currently constrained by the lack of adequate processes and systems and (ii) to improve current manufacturing processes through either incremental changes or revolutionary new approaches. To achieve these goals, new pedagogical research in innovation principles related specifically to manufacturing is needed. IbM will focus on developing new innovation methodologies and their application to challenging manufacturability problems across multiple areas such as renewable energies, micro- and nanomanufacturing, and medical devices. In addition, IbM will actively work to define the manufacturing concepts of the future.
Current Research Projects

Development of Scalable Manufacturing Systems for Renewable Energy Technologies
Virginia Tech researchers successfully developed the first stable bio-oil from woody feedstock. However, to demonstrate the system on a larger scale outside the laboratory requires that a complete manufacturing system be developed. IbM will concentrate on process design, process scalability, facility layout, and material, people, and information flow design. The main focus will be to enable and accelerate the technology from prototype to mass production.

Implementation of Self-Healing Approach for Smart Assembly Systems
A significant characteristic of future manufacturing systems will be the ability to autonomously correct for faults or apply compensation actions during the assembly process. These systems will not only improve the quality of products, but indirectly will lower scrap rates and increase production efficiencies. Our current research focuses on integrating state-of-the-art sensor-actuator networks to replicate the assembly of compliant or flexible parts for closed-loop control in spot welding.

Additive Manufacturing for Cost-Effective Production of Custom Products
Bicycle helmets remain the most effective safety device available to reduce head injury and death from bicycle crashes. However, for a helmet to be useful, it must be positioned properly and fit securely on a rider’s head. To address this issue, IbM is conducting research into the manufacture of custom-fitting bicycle helmetliners by using additive manufacturing technologies as a cost-efficient alternative manufacturing technique.

Stress Analysis of Aluminum Punching Operations
Compliance with tighter emission regulations has increased the proportion of parasitic weight in commercial vehicles. While significant weight reductions can be achieved by substituting high-strength aluminum parts for steel components, a redesign of vehicle components is necessary to maintain the overall design and safety performance of the vehicles. Working with an industrial partner, IbM is developing reliable process models to be used with complex geometries for finite element analyses.

Guided Cross-Functional and Collaborative Problem-Solving
Building a successful problem-solving team can easily become a hit-or-miss endeavor. In addition, the way a problem is defined and potential solutions selected and then pursued has a detrimental effect on solution quality and time needed to solve a problem. IbM current research focuses on a myriad of factors influencing the problem-solving process, as well as on the sources used for gathering information. In our problem-solving sessions, participants have access to the Internet and build solutions for previously unfamiliar applications in a collaborative, cross-functional environment.

Key Personnel

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