Title: **Smart Manufacturing for Indian Industries**

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Write-up:

Globally, manufacturing is moving towards the next industrial revolution called Industry 4.0 or Smart Manufacturing– the application of Cyber-Physical Systems (CPS), Industrial IoT and Computer Optimization Techniques in manufacturing enterprises. The proposed project aims to enable the recognition and adoption of the smart manufacturing paradigm within the manufacturing sector in India. The challenge is that most industries in India and even globally do not have all of their manufacturing equipment equipped with embedded sensors or external sensors for data acquisition. They rely mostly on manual data and non-standardized collection. Thus, one of the challenges for widespread adoption of smart manufacturing is to enable such legacy equipment with intelligence capabilities. In line with this, the smart manufacturing research project which is being carried out at IIT Indore, focuses on enabling embedded intelligence in manufacturing equipment through effective data gathering, communication, analytics and decision making capabilities. The research is divided into three parts: Development of cyber twins of the physical entities in the industry; development of a framework for communication; and utilizing the communication for autonomous decision making within the industry.

A ‘cyber twin’ is a software representation of an actual machine tool that is able to replicate the machine behavior and can make decisions on behalf of the machine through embedded data analytics and optimization algorithm. The cyber twin captures all relevant events of the machine either through manual but standardized data interface or through externally mounted sensors, embedded sensors and machine controller. The manual inputs can be easily replaced with sensor based data collection system, as and when the machine is upgraded. The noticeable feature of a cyber-twin is its ability to predict future performance based on reliability, prognostics and performance models embedded in it. This helps the cyber twins in autonomous decision making. In addition, a Bayesian approach is included in cyber twin models to update the prediction with every new data set. This makes the cyber twin evolving in nature.

An effective communication algorithm forms the basis for operations planning within a complex network of production machines in any industry. A social network based communication algorithm, inspired by the new-generation human interaction mediums such as ‘Whatsapp,’ ‘Google+ Circles,’ or ‘Facebook’ is proposed for a generic, self-sustained system for autonomous and goal-oriented communication between cyber-twins. An operations planning view point of smart manufacturing is important but often neglected by the research community. Distributed operations planning algorithms are developed and currently being tested in laboratory environment at IIT Indore. The results are breakthrough in terms of computation time, quality of solution and scalability.

It is expected that the proposed approach will help in in realizing the benefits of the smart manufacturing approaches in India,, especially for Small and Medium Scale Enterprises (SMEs) having varying degree (0 to 100%) of intelligence in their equipment.