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**A Lean Microfactory for Micro Motor
Manufacturing**
精益微型工廠在微電機生產中的應用

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Abstract

With the rapid development of the micromechanical and micro electron-mechanical devices, demands for the miniature components with micro-scaled features are increasingly required. The miniaturization of the products has not yet led to miniaturization of the production equipment. Microfactory represents an entirely new approach to designing and development the miniaturized production systems to match the size of the parts they produce, to decrease floor space requirements, to reduce energy consumption and to improve material resource utilization.

Since micro-lathe, the first component of a microfactory, was developed in Japan, there are many microfactory prototypes, such as the micro machining factory and the micro assembly factory. The majority the developed microfactories are still in a non-commercialization stage. The microfactory development is facing the challenges in costs and applications.

Lean manufacturing or lean production is a production practice that considers the expenditure of resources for any goal other than the creation of value for the end customer to be wasteful, and thus a target for elimination. Basically, lean is centered on creating more value with less work. Applying lean concept to optimize the process, the layout and the configuration of the microfactory should be a key factor to develop a cost effective microfactory. But till now there are no systemic study on lean microfactory development.

With the market becoming fragmented into lower volume and customer-driven products, the product life-cycle has been significantly shortened. The factory has to be highly flexible and re-configurable to support the efficient production of small-batch, highly varied and highly customized products, while keeping costs to the level of mass-produced items. The goal of the Mass Customization Manufacturing (MCM) is to build such a factory. While modular design is the most effective way to achieve MCM. Therefore, applying modular design to improve the reconfigurable of the microfactory is a way to ensure the microfactory to applicable to the future market.

First, this dissertation presents our latest efforts in applying the microfactory concept to micro motor manufacturing integrating the lean production concept and the module design technology. The efforts are to apply microfactory concept in micro motor manufacturing, miniaturize the production systems through the microfactory design technologies, configure the microfactory through a lean way and improve the configurability and applicability of the developed microfactory through module design technology. The objective of the work is to find the feasible ways to realize the application of microfactory in micro motor manufacturing.

Second, a prototype microfactory is established for a micro motor production line in Johnson Electric Manufacturing Ltd. A systemic study on the microfactory configuration and multidisciplinary is performed. How to integrate the relevant technologies, the multidisciplinary microfactory, the lean production concept and the module design concept and how to solve the encountered technical barriers are discussed in the dissertation.

Finally, we demonstrate the effectiveness of the microfactory prototype in micro motor production system, and concluded that the application of microfactory to micro motor manufacturing is feasible and profitable. The application of the microfactory concept can dramatically decrease the floor space, and the energy consumption, and improve the productivity. While to make this application profitable, the lean production concept and modular design implementation are two critical issues.