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Aims and Scope
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Optimization and Management in Manufacturing Engineering

Resource Collaborative Optimization and Management through the Internet of Things

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Preface

Scientific and technological achievements of the mobile internet, cloud computing, and the Internet of Things (IoT) have emerged with the rapid development and increased utilization of the internet and big data. The emerging information technologies, IoT and big data are comprehensively permeating into manufacturing industries and therefore promoting the industrial development of digitalization, intellectualization, networking, and service orientation. The IoT and big data are involved in various fields, making them very important social resources. This wave of development has brought rare historic opportunities but unprecedented challenges for the transformation and upgrading of traditional modes of engineering and management.

The collection, storage, integration, and sharing of big data, however, face serious security risks during the operation and management processes typically found in the manufacturing industry. Information errors and leakage frustrate both enterprises and customers, and definitely impede the pace of transformation and upgrading of traditional manufacturing industries. Furthermore, traditional organization theory and system evolution theory no longer apply to the evolution of intelligence- and service-oriented manufacturing industries. Self-organizing and intelligent decision modes of innovation in manufacturing units contribute to the improvement of the organizational hierarchical relationships as well as manufacturing and service efficiency. The wide adoption of the IoT and big data in manufacturing industries enhances product life cycle management. Collaborative optimization and scheduling of the manufacturing chain and service chain help to improve the self-adaptive ability and serviceability of manufacturing systems, and can effectively facilitate the value and utility of a manufacturing network. Optimization of manufacturing life-cycle process management is promoted through data integration, fusion, and collaboration, therefore improving the adaptability of the scheduling system, achieving the manufacturing processes of close-loop control and optimization, and collaboratively allocating manufacturing and service resources. Since enterprises' internal and external information can be real-time detected and traced, studies on business process information quality management model and service data quality control theory under the environment of IoT and big data can significantly improve the quality of both life cycle product and service. Manufacturing process information quality management and product quality control have received significant academic and practical attention. Based on the considerations given above, it is important to inspect and verify the application ability of theoretical engineering management systems by evaluating the organizational operation efficiency of service-oriented and networked engineering and manufacturing systems, collaborative optimization utility and value improvement of the supply chain and service chain, self-adaptive dynamic scheduling and collaborative allocation of manufacturing and service resources, and quality of data, product, and services during the manufacturing process.

1. By deploying RFID technologies and sensors in the IoT environment, enterprises can acquire real-time data during business operations. In order to obtain the most value from these data, enterprises need to share some information with each other. Since enormous amounts of data are transmitted through wireless channels in the IoT environment, firms' information systems are more liable to be attacked. Therefore, the application of IoT is inseparable from information sharing and also introduces some information security issues.
2. Structural reorganization and business process re-engineering have significantly improved the operational efficiency of manufacturing enterprises and are crucially important under IoT environment. Specifically, manufacturers should properly reduce their hierarchical levels to make an efficient and flat organizational structure due to the more precise, comprehensive, and faster acquisition of the product life-cycle information inside and among cooperative enterprises. Also, firms' decision-making authority should be reallocated to improve the decision speed and accuracy.
3. The potential of IoT systems to improve the management of manufacturing resources is enormous. The operators and managers of smart manufacturing systems can take corrective and timely actions to avoid damage and inefficiency via the collaborative considerations of allocating and dispatching. A new challenge is how individuals think the IoT will affect the traditional management process of manufacturing resources. Novel models of manufacturing systems can be built based on the combinatorial problem (as traditionally done), by extending beyond the limits of individual factories to connect multiple factories throughout value chain can be a challenge. Specifically, manufacturing jobs like cutting or other batch processes are scheduled integrally and robustly in collaborative manufacturing. Another example is the transportation and storage management of distributed inventories that are optimally coordinated through the monitoring and tracking of convey tools and individual products.
4. With the IoT, companies can monitor real-time product operating information after selling products, and provide customers with personalized service based on

this information. Customer satisfaction with this kind of service has been gradually integrated into the product quality, but it is based on the customer's willingness to establish a long-term relationship with the business. In addition, quality is not just a matter of concern between the enterprise and customer. The sustainability of the product is also a part of its quality. The acquisition and analysis of the full life cycle quality data will drive the further development of the re-manufacturing industry, which is of great importance to a product's life-cycle quality improvement. The development of new information technology requires us to redefine the concepts of quality and quality management to promote the healthy and sustainable development of enterprises and society.

5. The internet and IoT have changed the relationships between humans, organizations, society, and the environment in a product's life-cycle management. The value chain of products has been extended, while big data has improved the life-cycle assessment of a product. In service-based manufacturing, a challenge is how to construct the life-cycle assessment structure based on the massive amounts of complex data being derived from the IoT. Compared with traditional assessments, which are relatively static and closed, the assessment based on IoT data is dynamic and open. In traditional assessments, data must be obtained by the program in advance, while data derived from IoT devices can be extracted in real-time from the massive and unrelated data flow.

Based on the above challenges regarding information security, organizational management, production scheduling, quality management, and the evaluation of manufacturing enterprises, we focused on the core issues of enterprise information and organization with the IoT and big data. We studied the problem of information sharing and risk management, as well the challenge of the optimal allocation of the decision-making authority, in an IoT environment. We then took into consideration the problems of the operation and management of enterprises in three dimensions. We examined coordinated scheduling for parallel-batching machines, hybrid manufacturing distributed inventory management with sharing logistics, and the cutting stock problem. Finally, we proposed the concept and tool of the Life Cycle Assessment and Total Quality Management of the Product Life Cycle to solve the problem of quality management and assessment with the IoT and big data.

In Chap. 1, Xinbao Liu, Jun Pei, and Xiaofei Qian present some valuable insights on information sharing and risk management. Xinbao Liu, Jun Pei, and Zhiping Zhou conduct novel research on the optimal match of information and decision-making power in Chap. 2. A dynamic coordinated supply chain scheduling problem is studied by Jun Pei and Min Kong in Chap. 3. Panos M. Pardalos and Tianji Yang explore the problem of hybrid manufacturing distributed inventory management with sharing logistics in Chap. 4. Chapter 5 deals with the cutting stock problems in the IoT environment, which is investigated by Hao Cheng, Lin Liu, and Siwen Liu.

In Chap. 6, Xinbao Liu, Lin Liu, Shaojun Lu, and Peiya Zhu introduce some novel views on the total quality management of the product life cycle in the IoT environment. Mi Zhou and Xinbao Liu give an elaborate life cycle assessment on mobile phones in the IoT environment in Chap. 7.

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Contents

Abbreviations

1D-CSP	One-dimensional cutting stock problem
2D-CSP	Two-dimensional cutting stock problem
ACOS	Ant colony optimization selection
ADP	Approximate dynamic programming
AHP	Analytic hierarchy process
ALNS	Adaptive large neighborhood search
ASes	Autonomous systems
BFD	Best fit decreasing
BPR	Business process reengineering
BRP	Bin packing problem
BSC	Balanced score card
C&P	Cutting and packing problems
CMfg	Cloud manufacturing
CRM	Customer relationship management
CSP	Cutting stock problem
DPR	Diversity-based path-relinking
ERM	Employee relationship management
ERP	Enterprise resource planning
FFD	First fit decreasing
GA	Genetic algorithm
GPR	Greedy-based path-relinking
GPS	Global position system
HCUS	Heuristic constraining the utilization of the stored bars
HCUSO	Heuristic constraining the utilization of stored and ordered bars
HIE	Healthcare information exchanges
IoT	Internet of things
IRP	Inventory routing problem
IRPSDPD	Inventory routing problem with simultaneously delivery-pickup and purchasing decision
LNS	Large neighborhood search

MES	Manufacturing execution systems
PL	Production logistics
PLC	Product life cycle
PR	Path relinking
QoS	Quality of service
RFID	Radio frequency identification devices
SA	Simulated annealing
SCOS	Service composition and optimal selection
SESG	Synergistic elementary service group
SFLA	Shuffled frog leaping algorithm
SFLA-PR	Hybrid shuffled frog leaping algorithm and path relinking algorithm
SHP	Sequential heuristic procedure
TQM	Total quality management
VMI	Vender managed inventory
VNS	Variable neighborhood search
VRP	Vehicle routing problem
WSAN	Wireless sensor and actuator network