



Research Letters

Towards a cyber-physical-social-connected and service-oriented manufacturing paradigm: Social Manufacturing

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Abstract

Manufacturing industry is heading toward socialization, personalization, servitization and mass collaboration. Motivated by the infiltration of Cyber-Physical Systems (CPS) and social media usage in manufacturing industry, this paper addresses a new Social Manufacturing (SocialM) paradigm and provides a theoretical basis for future production organization. Definitions and organizational logic of SocialM are given. Three core aspects of SocialM are addressed from the configuration, operation and management perspectives. It is expected that SocialM would contribute to the production mode transformation and social innovation.

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1. Introduction

Under socialnomics, manufacturing is heading toward socialization, personalization, servitization and mass collaboration [1–4]. Many small- and medium sized producers, e.g., SMEs, workshops, small factories, and even individuals, spring up with socialized resources and participate in different market segments. They provide various service-oriented capabilities to satisfy customers' personalized requirements, evolving into socialized production service providers (PSPs). Besides, PSPs aggregate and self-organize themselves into dynamic communities to win bargaining power and efficiency. Small modular infrastructure for production is therefore burgeoning, stimulating big enterprises to “think small” for flexibility benefits [5]. Meanwhile, the role of customer is changing from buyer to “prosumer” (producer + consumer) [1]. They widely infiltrate in the product lifecycle activities, and collaborate with PSPs to improve the development,

production and usage of products. Social media like Facebook, Quirky, GrabCAD, LinkedIn and Kenandy's cloud ERP provide possible solutions. These trends are changing the manufacturing philosophy and production mode into a socialized and collaborative one. Socialized resources utilization, social community-based resources self-organization, cyber-physical-social interconnection, social media-supported communication and social business relationship management have become the key factors.

Manufacturing paradigm should adapt to these trends. Emerging information technologies will give a solid support. From the physical aspect, Internet of Things and Cyber-Physical Systems (CPS) under industry 4.0 facilitate the intra- and cross-enterprise integration for effective communication and transparent management [6,7]. From the social aspect, social network and social media stimulate PSPs and prosumers to produce products collaboratively and co-create value. A study conducted by McKinsey in 2013 revealed that almost every company uses social technologies to communicate with their customers. From the cyber aspect, cloud/social computing and big data analytics help to analyze the industrial and social big data for sharing

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and decision making [8]. Thus, collaboration performance is improved, business management becomes efficient and flexible, and production control becomes intelligent, real-time and all-around. Extending CPS into the social aspect, cyber-physical-social systems/network (CPSS) [7,9,10] should be implemented to support the socialized resources utilization, mass collaboration, flexible production control and efficient social relationship management.

Combining the current trends with the informatics support, this paper initiates a Social Manufacturing (SocialM) paradigm and discusses its core aspects and future directions.

2. Clarification of Social Manufacturing

2.1. Definition

Manufacturing paradigm has evolved from mass production, lean production to mass customization [11]. Now, it is heading toward SocialM. An example is Haier, a household electrical appliance manufacturer in China, which has flattened its original pyramid-shaped organization into an open platform organization. That means its employees and social individuals are mobilized as independent social micro-entrepreneurs to compete for its crowd-sourcing orders [12]. Another example is Quirky, which transforms lead users’ ideas into actual products by using socialized resources and creates a marketplace for them [13]. Social communities are formed for interactions among people in the Quirky platform and other social media. In

our previous work, concepts and framework [14–17], methods and enabling technologies [18–20] of SocialM have been discussed. According to them and other relevant research [3,7,21–23], we define SocialM as: “A new cyber-physical-social-connected and service-oriented manufacturing paradigm that drives distributed PSPs to self-organize into dynamic resource communities (DRCs) through social network, provide the production- and product-related services to prosumers, and collaborate with prosumers through CPSS. It promotes socialized resources configuration, social interaction, business collaboration and all-around production management to accomplish product lifecycle tasks efficiently and flexibly.” The “social” meaning in SocialM exists in three aspects: socialized resources utilization, social community-based resource self-organizing and social media support, which are the main factors driving SocialM forward. The logic framework of SocialM is illustrated in Fig. 1.

2.2. Organizational logic

As shown in Fig. 1, the organizational logic clarifies how PSPs and prosumers collaborate for production, which includes four main steps:

- *Self-organizing*: Scattered PSPs interact with each other within a global social relationship network (SRN1), and self-organize themselves into different DRCs autonomously, providing service capabilities such as blade designing, shaft machining, and so on. Based on the

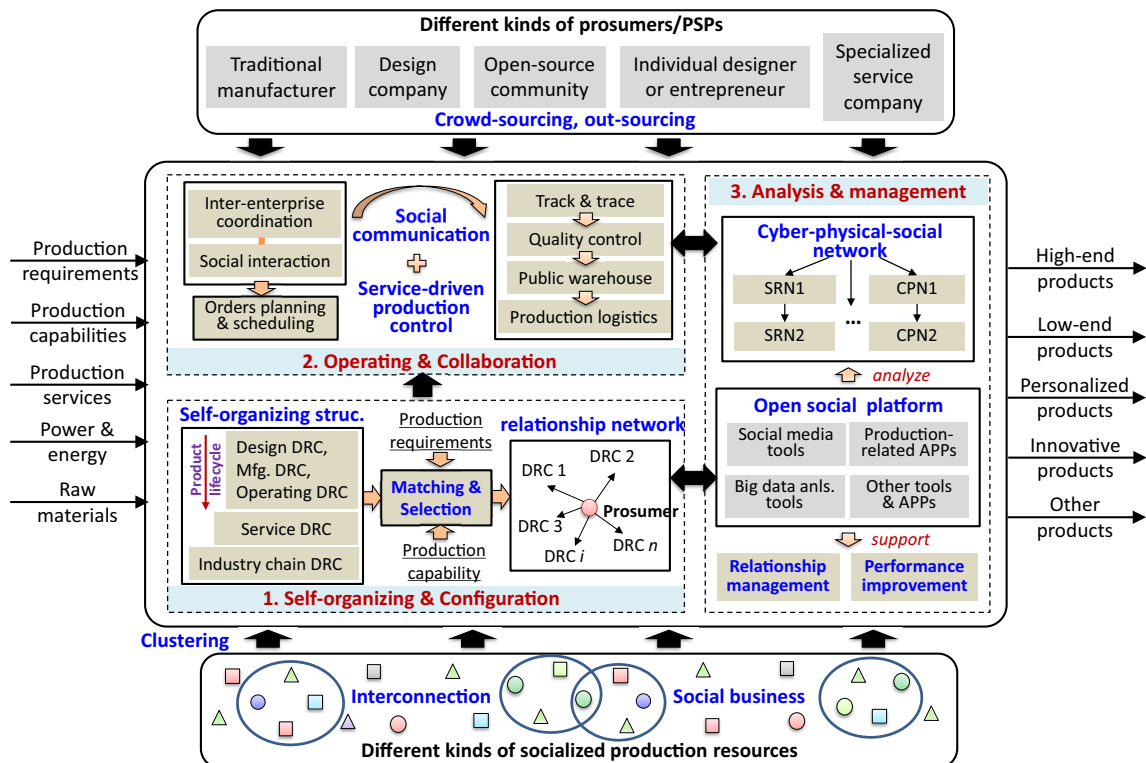


Fig. 1. Logic framework of SocialM.

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