The configuration of social manufacturing: a social intelligence way toward service-oriented manufacturing

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Abstract: The goal of manufacturing no longer lies in making products in a system level but extends to the systematic processing of information and resources to create more flexible and timely service for mass individualised needs of customers in a global level. As new materials, new technology such as social computing and new configurations for the manufacturer emerge, the distinctions among mechatronics, manufacturing, and service industries become blurred. Consequently, it is expected that the definitions of manufacturing become even broader. This paper presents a novel concept of social intelligence way toward service-oriented manufacturing termed social manufacturing. The social intelligent techniques are introduced as embedding knowledge in the configuration outsourcing and crowdsourcing-oriented social manufacturing for the whole life cycle of mass individualisation process. As a result, the social manufacturing with advanced characteristics such as distributed, intelligent, and self-organisation is developed in which a novel approach for enabling mass individualised production is proposed.

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1 Introduction

Starting from Taylor production mode, emerging economies, social and political transitions, and new ways of doing business are changing the production organisational structures of manufacturing dramatically. To be successful in this competitive climate, various advanced manufacturing models have been considered by scholars to solve the problem. However, over the past decade, information and communications technology (ICT), especially social media (e.g., blog, LinkedIn, Facebook), has fundamentally changed how we live, work, and interact with each other. Changes in manufacturing happen more pervasively than it once seemed:

1. On the internet, things that were historically scarce are now available abundantly (i.e., new ideas, existing knowledge, and socialised manufacturing resource as well as its' productive capacity), and what was formerly abundant is now scarce (i.e., high margin, low volume products and services, stable partners).

2. The use of new materials, completely new and highly flexible processes, ease of access and novel collaborative services are turning manufacturing away from operating at mass scale. Individualised and market-of-one production is the new game.

3. Prosumers (i.e., a dual-role of producers and consumers) have focused on outsourcing and crowdsourcing, a form of distributive problem-solving, for the systematic processing of information and resources to create better service and more value for customers.

4. The intensive integration of the manufacturing and service greatly enhance the complexity of the manufacturing system due to the immedicable, dynamic, distributed, and invisible characteristics of production service among prosumers.

It could be concluded that the distinctions among mechatronics, manufacturing, and service industries become blurred. The idea of production automatically adapting to changing environments and varying process requirements with less supervision and assistance from operators are supposed to be border. The goal is now extending to the systematic processing of information and resources to create more flexible and timely service for mass individualised needs of customers, which could be called service-oriented manufacturing. Current advanced manufacturing concept have emphasis more and more on taking advantage of computing performance of computer technology rather than the communication function which is believed as the core value of computer as Licklider’s (1960) opinion. Human is supposed to play the leading role in the intelligent manufacturing progress, whereas the computers are supposed to assist human as a communication and computing device in the manufacturing.
Although the computer intelligence performs much better than human’s intelligence in many situations, characters’ lack of human-like intelligence is the biggest obstacle to create engaging on-demand customer services during the product manufacturing progress. However, social intelligence, a kind of distributive, crowd intelligence-based and ICT-assisted intelligence, is a potential way to overcome this problem. By identifying and engaging expert knowledge and perceptions, employing potent Web-focused analytics to draw strategic meaning from social-media data, and channelling this information to people within the organisation who need and want it, the social intelligence is forward looking and capable of playing out in real time. Social intelligence radically alters the process of gathering information before analysing it. The social computing technologies (SCT) are the enabling force for effectively addressing the above mentioned changes in manufacturing as well as other industry. From both theoretical and technological perspectives, SCT will move beyond social information processing toward emphasising social intelligence (Carretero and Garcia, 2014).

Prosumers have faced competitive challenges that the manufacturing information is moving quickly from central-controlled databases to the open social platforms, since various outsourcing and crowdsourcing is the new philosophy of manufacturing. Navigating this new environment effectively will require new skills to engage in social collaborative environment rather than merely assemble information. It is believed that social intelligence will sharpen decisions. Under this circumstance, this paper presented a novel concept of social intelligence way toward service-oriented manufacturing termed Social Manufacturing. The concept, architecture, and core enabling technologies are studied in Sections 3 and 4. A social manufacturing prototype platform is developed as a primary demonstrative application in Section 5. Finally, the conclusions are presented in Section 6.

2 Related work

Various advanced manufacturing models have been considered by scholars to fulfil these transitions, such as Agile manufacturing, application service provider, manufacturing grid, and cloud manufacturing (Xu, 2012; Wu et al., 2013a).

Social manufacturing is a new idea viewed as a ‘third industry revolution’ (Economist, 2012), and there are few follow-up academic studies in this field. In the first stage, scholars attempt to embody the meaning and connotation of social manufacturing from the computing and service perspective (Cao and Jiang, 2012; Wang, 2012), which can be enhanced from a more comprehensive scope. In the second stage, scholars studied on the framework and architecture of social manufacturing (Ding et al., 2013; Wu et al., 2013b; Jiang and Ding, 2012; Shang et al., 2013), and tried to figure out how to use social networks in the 3D printing (Wang, 2012) and apparel industry (Mohajeri, 2015; Shang et al., 2013; Mohajeri et al., 2014). These works are limited in a relatively small industry area rather than in an industrial-chain or eco-system level. That is because that the apparel industry has always been highly individualised, while the 3D printing was the most promising technology to meet the customer’s customised needs.

Although the idea of social manufacturing is still in its early stages, the academic world has recently shown more interest in studying the key enabling techniques of social manufacturing (third stage), such as outsourcing coordination mechanism and service
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3 Concept and framework of social manufacturing

3.1 Concept of social manufacturing

Social manufacturing can be defined as a specialised production outsourcing and crowdsourcing driven, mass socialised manufacturing services (MSs) self-organisation-based, and service-oriented way toward mass individualisation paradigm. By employing the SCT for identifying and channelling the complex interaction among prosumers and initiative matchmaking between demands and socialised resources, it aims to realise the proactively integration of resources throughout the product life-cycle. As shown in Figure 1, it enables the prosumers or even the individual person to produce full personalised products on the basis of an online, self-organising and social-enable outsourcing or crowdsourcing mechanism. It emphasises much more on what and how to establish and maintain dynamic and temporary outsourcing or crowdsourcing relationships in distributed collaborative and interactive mode. To some extent, social manufacturing is computing-based facilitation of social interaction, behaviour operation, and system dynamics as well as the design and use of SCT in social interaction context.

In a social manufacturing system, a manufacturing community (MC) is comprised of large number of prosumers that have shared interests and tasks. Different users can outsource or insource a certain task from a related manufacturing community according to their needs or capabilities, and consequently form a virtual manufacturing environment or solution to complete their manufacturing task involved in the whole life cycle of manufacturing processes under the support of social computing, service-oriented technologies, and advanced computing technologies. Various manufacturing resources and abilities are virtualised and collected that can be proactively push to demanders based on knowledge by using social computing and service-oriented technologies. The prosumers are self-organised as different kinds of manufacturing communities according to the outsourcing or crowdsourcing relationship.
3.2 Framework of social manufacturing

Basically, the framework of social manufacturing shown in Figure 2 deals with four layers including interaction layer, formulation layer, organisation layer, and operation layer.

The interaction layer is to realise networked-driven social interactions among prosumers. Social manufacturing emphasises the proactive and intelligent service matchmaking through the perception of prosumer behaviour (Vosniakos et al., 2015). It relies on SCT to support interaction analysis and evaluation, so as to enable the decision-making support in the other three layers. SCT plays a central role in how information is sourced, collected, analysed, and distributed. From an information-processing perspective, the technological infrastructure encompasses web, ontology, database, multimedia, wireless, agent, and software engineering technologies. There are primarily three category roles in a social manufacturing system, which can be collectively called prosumers, described briefly as follows.

a) Outsourcer: the outsourcer is the demander of the manufacturing service. They purchase the service from the operator of communities according to their needs.

b) Subcontractor: the subcontractor coordinates and utilises its network relationship resources to satisfy its service consumer (outsourcer) by decomposing and subcontracting MSs to other enterprises.

c) Provider: the provider owns and provides the manufacturing resources and abilities involved in the whole life cycle of manufacturing process.

In the formulation layer, users release their manufacturing capabilities and outsourcing demands, corresponding to step A1 and A2 in Figure 2. Various socialised manufacturing resources (MRs) and abilities (Lu et al., 2014) are virtualised and collected into a set that can be proactively push to demanders based on knowledge by using social computing and
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service-oriented technologies. In return, the manufacturing demands (MDs) can be intelligently sensed and connected into the wider range of potential MRs.

**Figure 2** A four-layer framework for social manufacturing (see online version for colours)

The organisation layer is to create a bridge between MDs and MRs. This layer emphasises the proactive and intelligent service matching (Eriksson, 2012) through with the support of knowledge drawn from the perception of prosumers’ interaction, corresponding to step B1 and B2 in Figure 2. In other words, not only service demanders can find the most suitable manufacturing capabilities for their demands, but service providers can also find the capable tasks to give full play to their manufacturing capabilities. By this way, the distributed MRs can be integrated automatically and then provide on-demand services.

Social manufacturing have several distinctive hallmarks:

1. it creates and delivers its value over the prosumer network indirectly by decentralised production
2. it intelligently form effective strategies to take advantage of the new balance of abundance and scarcity, along with greatly reduced dependencies on the old balance
3. social power structures are what drives forward manufacturing internally and externally, which then become perpetuating communities of self-interested, like-minded prosumers.

### 3.3 Value drivers of social manufacturing

While the evolution of social manufacturing will take long time to unfold fully, the driven force of social manufacturing that enable it rapidly taking shape can be concluded as follows:
Peer production as the most efficient source of value creation. Centralised production has greatly limited when you can tap into the vast capabilities of the global network for mutual benefit.

‘Do it anywhere’ as the ability to dynamically adapt and rapidly respond to the current needs of the manufacture customers.

Social power structures as the means of self-organising and governing. Social manufacturing paradigm is about using community-based relationships to drive forward production activities and objectives.

Cloud and ecosystem-based sustainable supply chains as the basis of growth and agility. Social manufacturing will form best-of-class and trustworthy prosumers, building an intensive meshed supply chain while pervasively channelling and analysing their manufacturing data.

4 Core aspects to achieve social manufacturing

4.1 Analysis of prosumers’ social-interaction

Social manufacturing is an asynchronous platform for the prosumers to share service experiences collectively and influence their outsourcing and crowdsourcing behaviour. It provides a vehicle for using interaction data to predict future collaboration. Social manufacturing emphasises the proactive and intelligent service matchmaking through the perception of prosumer interaction behaviour. As shown in Figure 3, a semi-supervised efficient learning approach is developed to automatically extract knowledge from the prosumers’ social-interaction to construct the network for supporting the decision making in the decision progress.

Figure 3  Analysis of prosumers’ social-interaction (see online version for colours)

The proposed approach is a sustainable reinforcement technique that learns extraction patterns from the tuples and then exploits the learned extraction patterns to identify more tuples that belong to the relation. Eliza-like pattern is used to make use of limited
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syntactic and semantic information and represents the context around the related entities in the patterns in a flexible way that produces patterns that are selective and effective. For instance, one of the patterns used here is defined as a seven-tuple

\[ T_i = \langle \text{prefix}, \text{entity tag}_1, \text{infix}_1, \text{entity tag}_2, \text{infix}_2, \text{relation tag}, \text{suffix} \rangle , \]

where \( \text{prefix}, \text{infix}_1, \text{infix}_2, \) and \( \text{suffix} \) are vectors associated with weights with the terms. For example, an expression of \( \text{JUNYE provide BEIREN with deep-hole drilling service to construct a seven-tuple pattern} \)


After generating a number of patterns from the initial seed examples, the system scans the available social context sentences in search of a segment of text that matches the patterns to generate new tuples and use them as the new seed and starts the process all over again by searching for these new tuples in the documents to identify new promising patterns. The \( \text{Match}(T_i, T_j) \) is defined as

\[ \text{Match}(T_i, T_j) = W_{\text{prefix}} \cdot \text{Sim}_{\text{prefix}}(i, j) + W_{\text{infix}} \cdot \text{Sim}_{\text{infix}}(i, j) + W_{\text{suffix}} \cdot \text{Sim}_{\text{suffix}}(i, j) \]

After generating patterns, the context collection is scanned to discover new tuples. A candidate tuple \( E_1, E_2 \) is generated if there is a pattern \( T_p \) such that \( \text{Match}(T, T_p) \) is greater than the pre-specified threshold. To eliminate unreliable tuples and patterns from further computation, a metric proposed by Riloff (1996) to evaluate extraction reliable pattern \( P_i \) is defined as

\[ \text{Scor}(P_i) = \frac{F_i}{N_i} \cdot \log(F_i) , \]

where \( F_i \) is the number of unique tuples among the extractions produced by \( P_i \) and \( N_i \) is the total number of unique tuples that \( P_i \) extracted. Consider a candidate tuple \( T_j \) and the set of matching patterns \( P = \{P_j\} \) that were used to generate \( T_j \). The confidence of an extracted tuple \( T_j \) is evaluated as

\[ \text{Conf}(T_j) = 1 - \prod_{k=1}^{m} \left( 1 - \text{Score}(P_i) \cdot \text{Match}(T_k, T_j) \right) , \]

where \( m \) is the number of patterns to generate \( T_j \). \( \text{Conf}(T_j) \) is of great significance for the precision of re-computation and growth of the procedure. After determining the confidence of the candidate tuples using the definition above, our approach discards all tuples with low confidence. By repeating the same procedure, the relationship table is dynamically constructed. The extracted relationship network can be defined as a directed graph \( G = (V, E, W) \), where vertical \( V \) represents prosumers, edge \( E \) represents interaction, \( W \) represents relationship properties between pairs of prosumers.

4.2 Self-organising of manufacturing communities

To create dynamic maps that pinpoint where resource and capability reside and to track new data in real time, the most effective way is to engage a carefully mapped network of manufacturing enterprise on specific attribute. The overlay MC of network \( G = (V, E, W) \) is dynamically formed using a self-organised clustering strategy, which exploits the
semantic information exhibited by the MSs offered by heterogeneous enterprises. Each enterprise peer is therefore characterised by the semantic MSs it offers. Enterprises offering semantically similar MSs will then be automatically clustered into a similarity-oriented MC denoted $G^k$. Let $MSS_a$ and $MSS_b$ be the manufacturing services sets of two enterprises, which comprise $m$ and $n$ MSs, respectively. These relationships can be formulated as

$$G = (V,E,W) = G^1 \cup G^2 \cup \ldots \cup G^i,$$

$$G^k = (V^k,E^k,W^k) = MS_{w1} \cup MS_{w2} \cup \ldots \cup MS_{wk},$$

$$MSS_a = (MS_{a1}, MS_{a2}, \ldots, MS_{am}).$$

Assuming $m < n$, the similarity calculation between $MSS_a$ and $MSS_b$ can be transformed by finding a subset $MSS'_a$ of $MSS_b$ such that $MSS_a$ and $MSS'_a$ have an equal number of MSs. The similarity $Sim(MSS_a, MSS_b)$ between two enterprise peers can be expressed in

$$Sim(MSS_a, MSS_b) = \max (MSS_a, MSS'_b),$$

$$Sim(MSS_a, MSS'_b) = \prod_{k=1}^{m} (MS_{ak}, MS_{bk}).$$

Ontology-based similarity calculation method of MSs in our previous work (Leng et al., 2014) is used to calculate the similarities $Sim(MS_{ak}, MS_{bk})$ for the matchmaking between service demands and capabilities. By introducing this similarity-based clustering and matchmaking, the initial organising structure of MCs is formed. MCs are increasingly driving innovation from the bottom up, and the ownership of resource, capability and value is starting to shift from individuals to communities. All of these communities are focused on some kind of common objective, attracting like-minded prosumer highly interested and engaged in what they do, to forming core competence. The MCs management is to mature fairly quickly as a discipline and begin to branch out into specific areas of knowledge. Based on that, prosumers in the MCs could self-configure their own resources, which would cause the micro-adjustment of community structure to move towards a more reasonable one with a stable collaboration relationship within the MC.

### 4.3 Life cycle self-coordination of service relationships

For a manufacturing service provider, there is a significant phenomenon that some machining process of the insourcing task would be outsourced or subcontracted to other providers if the machining workshop cannot handle it or considering to decreasing the special cost of running it as soon as insourcing a manufacturing task. By the sum of multiple subcontracts, this will form an outsourcing-driven social manufacturing network. Classical hierarchical management structures often don’t work effectively when directing the activities of this kind of loosely-coupled Social Manufacturing network, which is a highly complex, dynamic, and autonomy rather than stable structure due to the conflicts of local and overall interest.
Thus, to realise the just-in-time (JIT) manufacturing in social manufacturing network, the key issue is that collects and channels vital, accurate capability and information to eliminate the need for extensive searches of traditional databases inside the workshop of a prosumer. This real-time information helps preempt key actions of competitors or lead to adjustments of manufacturing, product, and strategy. When prosumers can easily disseminate outsourcing information across an entire community or across the Social manufacturing network, prosumers can be aware of problematic situations before they occur and also want to ensure they can detect violations and defects as quickly as possible before they become an actual problem. This has great implications for JIT manufacturing, as it frees up prosumers to work on more value-added activities rather than waiting for the completion of another phase of the production.

4.4 Self-adaptive peer production

To achieve quick response to the dynamic individualisation requirements, the production process state alongside the social manufacturing should be dynamic scheduled. As depicted in Figure 4, the initial manufacturing outsourcer allocates its machining tasks to the optimal manufacturing service providers through a social intelligence based self-organised multiple outsourcing and subcontracting, which generates a production-centred MC. The MS outsourcing and providers in the community interact with each other through social network media in social manufacturing platform.

**Figure 4**  Self-adaptive adjusting production (see online version for colours)
For a certain manufacturing service order, the real-time state of production and logistics, such as the manufacturing quality, production scheduling and logistic progress, etc. are tracked and fed back to the manufacturing outsourcer. Extending one initial service to all the sub-services around the certain product, a comprehensive MS monitoring network is shaped to realise the closed-loop management and control of the whole production process states. At its core, social manufacturing connects to a data warehouse then collects information from a company’s ERP, MES, and other operations software. A unified information exchange interface for MS in community $G^v$ is denoted as

$$MS^v := \{\{\text{Basic}^v\}, \{\text{Struct}^v\}, \{\text{Schedule}^v\}, \{\text{Progress}^v\}\},$$

$$\text{Progress}^v = \bigcup^t \bigcup^j \bigcup^i \text{Progress}_{i,j,...,t},$$

$$\text{Schedule}^v = \bigcup^t \bigcup^j \bigcup^i \text{Schedule}_{i,j,...,t}.$$  

Though this dashboard-like interface, social manufacturing displays the data (i.e., service basic info., structure, schedule, progress) collected and organised across all the outsourcing and subcontracting of a MS and allows it to be drilled into for greater insights into production activities and trends. Social manufacturing aims to realise the intelligent perception and connection into the Internet of various physical manufacturing resources and abilities. Based on the unified interface $MS^v$, any prosumer within the MS can therefore create a personalised information dashboard, which ‘democratises’ intelligence and embeds relevant data deep within the organisation. Such information maps highlight particularly strong knowledge relationships within community and may provide clues for new designs that optimise intelligence. It’s a process from curating and embedding tracking data to self-adaptive adjusting production.

### 4.5 Sustainable-improvement of communities and social manufacturing network

Improvement rather than control is supposed to be the way to achieve social manufacturing, since the player of social manufacturing is a prosumer or a business entity that absolutely bargain for their own benefit. A way of proactively addressing the requirements of and improving online communities is now being seen as needed.

However, social manufacturing system is a complex dynamic system (Aslam et al., 2014). The community could be structured around a dynamic reputation-based trust model that incorporates core competencies required to successfully socialise an organisation. The enterprises join and leave dynamically and their attributes change frequently and unpredictably over time. There are needs not only to dynamically select the most reputed peers as the leaders, but also to dynamically maintain a table of the reputed leaders. The important enhancement helps to identify and provide incentives for an enterprise that is not a service provider but acts as intermediary to locate and coordinate the sub-service providers in fewer subcontracts. The reputation of enterprise $v$ toward the other enterprises, denoted by $R_{\text{total}}(v)$ means the total reputation, and comprises below two metrics.
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\[ R_{\text{total}}(v) = \alpha \cdot R_p(v) + \beta \cdot R_s(v), \]

where \( \alpha \) and \( \beta \) denote the weight factors for three metrics to indicate their respective importance.

(a) Reputation as a service provider \( R_p(v) \) evaluates how well an enterprise fulfils its service agreement upon service execution by providing appropriate MSs to the service consumers (demanders). It is the accumulation of ratings of feedback peer \( v \) receives from the service demanders for its historical service executions, which are weighted on the credits of service consumers. Let \( J \) is the total number of executed services; \( E(v,j) \) is the rating of feedback the enterprise \( v \) receives from enterprises for its \( j^{\text{th}} \) service execution; \( C(u,j) \) is the credit got from the service consumer \( u \) on service execution; and \( C_{\text{max}} \) is the maximum value among all credits of the involved peers. \( R_p(v) \) is defined as

\[ R_p(v) = \sum_{j=1}^{J} E(v,j) \cdot \frac{C(u,j)}{C_{\text{max}}}. \]

(b) Reputation as a service subcontractor \( R_s(v) \) evaluates how well an enterprise utilises its network relationship resources to satisfy its service consumer by decomposing and subcontracting MSs to other enterprises. Let \( K \) denotes the total number of services subcontracted by enterprise \( v \); \( F(v,k) \) denotes the relevance of service recommended by peer \( v \) in its \( k^{\text{th}} \) recommendation; \( N(v,k) \) denotes the amount of nodes enterprise \( v \) traverses to fulfil the requested service; and \( N_{\text{max}} \) denotes the maximum amount of enterprise nodes for service subcontracting. \( R_s(v) \) is defined as

\[ R_s(v) = \sum_{k=1}^{K} F(v,k) \cdot \left(1 - \frac{N(v,k)}{N_{\text{max}}} \right). \]

5 A demonstrative application

The social manufacturing model is a massive project. Considering that the mobile internet is the most promising technologies in the social manufacturing environment, a web-based mobile social manufacturing prototype platform is proposed. The essence of prototype is to provide a primary social intelligence to build a bridge between different requirements and different capabilities, thus forming a closed loop of online to offline (O2O) service in the product life cycle. We developed a representational state transfer (REST) (Battle and Benson, 2008) architecture based social manufacturing prototype with some machine tools, sensor nodes, middleware using related networking protocols (e.g., Zigbee, RFID, Modbus, and TCP/IP), routers, and web-applications for Android operating systems in smartphone for smart entities (i.e., integration of manufacturing infrastructures, sensors, and controller) to illustrate how social manufacturing works. The implementation architectures of the prototype platform are shown in Figure 5.
Figure 5  The implementation architectures of the prototype platform (see online version for colours)

The corresponding screenshots of a running example in the prototype platform are shown in Figure 6. Firstly, the service provider should release its manufacturing equipment as a MR in the established ontology model of the platform. This information describes what kind of manufacturing capability the service provider can offer. Meanwhile, the outsourcing task is also virtualised through a descriptive ontology model. Secondly, the prototype intelligently pushes candidate suppliers who have the potential to meet the demand. The result may turn out to be that there are several communities which can fulfil this task. When chosen a single community, social manufacturing will match and assign the corresponding MSs to finish this order automatically through evaluate all kinds of MSs in the community. The service demander can choose suitable one or several providers. And then, by an arbitration game-simulation algorithm as presented in our former study (Leng et al., 2014), they can bargain off-line until they reach a deal and generate an outsourcing service order. Then, this prototype provides the real-time information about the outsourcing order including the current progress, quality information, etc. essentially, RFID and sensors are deployed in workshop to capture the on-site real-time data. Auto-ID computing technology is applied to process the collected data into the production information, such as the needed progress information and quality information. Finally, when all the manufacturing parts are finished, the service provider can transport them to the service demander by itself, or searching for a professional third part logistical company to do that. The logistics procedure can also be tracked by IoT. Because of its convenience, fast response to the change of events, the prosumers can track order state whenever and wherever possible only if there exists mobile network. It is expected that this prototype supports the prosumers to make the product manufacturing interoperable in the social manufacturing paradigm.
6 Conclusions

Social manufacturing is a new service-oriented manufacturing way realising mass individualisation paradigm. It extends the crowdsourcing idea that ‘realising socialised intelligent production through network of prosumers’ into manufacturing area. Self-organising peer production is the motive force and network effects are the new global market share. As the traditional computing is fundamentally unable to adapt to new production conditions, the novel social intelligent computing technologies are proposed as embedding knowledge in the outsourcing and crowdsourcing-oriented life cycle of mass individualisation production process including designing, process planning, manufacturing, assembling, selling, and maintenance. However, this is not to suggest that social manufacturing will entirely displace current methods of intelligence manufacturing. But it should emerge as a strong complement.

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