



Research on Modern Integrated Manufacturing Organization Overall Measurement Method based on Knowledge Innovation

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Abstract: Facing fierce market competition, knowledge innovation is the key factors of modern integrated manufacturing organization. Pay attention to the application and integration of the results become the knowledge innovation key of modern integrated manufacturing organization. In order to better evaluate the knowledge innovation within the modern integrated manufacturing organizations based on the manufacture industry characteristics of knowledge integration for innovation, this article intensive study on knowledge innovation in modern integrated manufacturing organization. On the basis of analysis the knowledge innovation perspective, the connotation of the modern integrated manufacturing organization feature information and performance parameters, modern integrated manufacturing organization overall measurement method have been proposed. According to the research, such as the work data collection, subject to identify and measure analysis, this paper selects a typical case object implementation on state detection and measurement to a modern integrated manufacturing organization knowledge innovation. It validates the method effectiveness and operability. This topic research will provide more reference on feature research for knowledge innovation and application of methods and theories provide a new tool and technology selection for modern integrated manufacturing field, which has the role in promoting and application value for its further development.

Keywords: Contemporary integrated manufacturing, Knowledge innovation, Knowledge integration, Overall measurement

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1 Introduction

1.1 Knowledge innovation

Knowledge innovation is by creating and application activities, such as new ideas into products and services, to achieve economic and social development [1-5]. Knowledge innovation, follow products, cost, quality, date of delivery, service and clean environment etc., shaping unique competitiveness of enterprises, is another key core elements in fierce competition between manufacturers.

Knowledge innovation is complex. This is manifested in: (1) The complexity of innovation tasks: Knowledge innovation is aimed at difficult real-world problems, such as ecological and energy problems, people and the environment, diseases and health problems, etc. therefore, research and development tasks possess the dynamic and uncertainty influenced by the social background. (2) The diversity of innovation organization: Various aspects such as member knowledge level, team size, organizational structure and geographical distribution. (3) Innovative impetus variety: A plenty of member of the knowledge innovation activities in order to develop scientific discoveries, a plenty of in order to receive training, a plenty of in order to achieve the achievements, a plenty of in order to obtain social recognition, a plenty of in order to change some of the government policy, etc^[6-9]. (4) The heterogeneity of innovative personnel: Due to the personality, knowledge domain and cognitive abilities different make innovation personnel have heterogeneity.

The knowledge innovation process has comprehensive creative. On the one hand, tend to break through the different knowledge gap in diversity field on different types of knowledge, information, resources and technology, knowledge innovation process build a bridge of communication and shorten the distance between each domain knowledge and accelerate the pace of innovation and development. On the other hand, knowledge

innovation is not only simple together different personnel intellectual. But with innovation research oriented, convergence the cognitive thinking of participants, emotion, intuition and insight, continuous catalytic original results, make a multidisciplinary knowledge can merge with each other into an organic whole. Therefore, knowledge innovation process integrating the concept of multidisciplinary, principle and technology, makes scientific knowledge more and more as an organic whole, which presents knowledge innovation process has the characteristics of integrated creativity.

Knowledge innovation target has environmental orientation^[10]. Throughout the organization practice, organizational culture and shared vision, knowledge innovation goals have the characteristics of innovation orientation. The way of organization development is innovation. The pursuit of knowledge innovation is a research and development organization's external demand and shared vision of organization members. Therefore, members of knowledge innovation organization in pursuit of scientific truth or common innovation visions constantly exchange and share their tacit knowledge and generated explicit knowledge to create original knowledge. Individual characteristics and behavior habit of the members of the research and development eventually condensed into organizational routines and organizational culture preserved with the target characteristics. Innovation research and development system is formed within the organization and be favorable for the creation conditions of new knowledge.

1.2 The connotation of knowledge innovation of modern integrated manufacturing organization

With the manufacturing enterprise make full use of all relevant information resources, modern integrated manufacturing organization knowledge innovation is an interdisciplinary knowledge innovation process, which not only includes automation technology, but also integrates R&D personnel thinking and knowledge of relevant departments. It is the main production mode in today's industrial integrated automation.

To meet the manufacturing system agility, fast response and rapid restructuring, manufacturing system is a complex large system. In the 21st century, modern integrated manufacturing system become a knowledge integration of three elements in enterprises, people/organization, operating management and technology, which makes organic combination of the traditional manufacturing technology, modern information technology, management, automation technology, systems engineering technology, making the whole life cycle of enterprise products in different stages of the activities organic integration and optimization operation on information flow, logistics and value stream. For product innovation, manufacturing enterprises process knowledge integration on person, organization, content, technology, information resources, etc. it is not only the technical dimension integration, but also

integrate management dimension. In order to better evaluate the knowledge innovation within the modern integrated manufacturing organizations, based on the manufacture industry characteristics of knowledge integration for innovation, this paper build a manufacturing organization overall situation measurement method, which can measure knowledge integration and level of thinking fusion between the group members by investigating the manufacturing organization published academic articles. The method can examine manufacturing organization relative rather than absolute, for the related discipline rather than all the science, integrated innovation ability.

It is able to investigate the universal manufacturing organization with the equal academic level and quality of published articles. It is worth that knowledge innovation overall situation measurement method using the SCI scholarly articles as measurement data has a strong applicability measurement but not the only measure method to measure the modern integrated manufacturing organizational knowledge integration and fusion of thinking.

2 The overall situation measurement method

2.1 Principle

Advanced modern integrated manufacturing organizations usually choose higher-end technology or theory and advertise at a higher level of academic platform. Therefore, for the selection of measurement data knowledge integration, we will choose modern integrated manufacturing organization output high level academic papers (only consider the SCI paper quality is equal, do not consider the invention and patent and other forms of knowledge innovation). On the one hand, SCI academic articles are the practice of knowledge integration and also knowledge system integration with important innovation feature. On the other hand, the generation of new knowledge is usually derived from the existing system of subject knowledge. It is difficult to directly investigate productive thinking and knowledge linkage between the members of organization for modern integrated manufacturing organization. But through citation flows between the articles of modern integrated manufacturing organization, the degree of knowledge exchange and integration can estimated by overall situation knowledge innovation level. Therefore, academic articles on behalf of the manufacturing organization research as the measurement data is practical significance.

Based on the analysis methods, analysis of gather characteristics of relevant data expressed in the scholarly articles citation, such as author, articles, magazines and subject category, is more operable. From the perspective of literature metrology, citation is the closest source of knowledge creation. Citation flows between disciplines induce the flow of information input and output manifests information transfer between disciplines^[11-16]. Reference published in the academic literature of modern

integrated manufacturing organization embodies the degree of specific integration on knowledge and thinking in the knowledge space within the team. So cited references providing different type's knowledge constitutes knowledge integration platform. Integration can be captured as the attribute of literature [17-20].

2.2 Methods

In JST (2015), the Japan Science and Technology Agency (JST) was interested in knowing, for a given sector of patents, which scientific fields have been the primary sources of published information. It is to calculate how journal articles cited in a specific sector of patents are distributed across all scientific fields [21]. Of course, any study of Modern Integrated Manufacturing Organization scientific performance cannot neglect the role played by the availability of academic papers [22]. Another approach used to visualize a discipline structure is co-word analysis, which has several advantages (direct, objective, and others) and disadvantages (polysemy, synonyms, and others) [23]. Ravikumar, Agrahari, and Singh (2015) explored the intellectual structure of scientometrics for the period of 2005–2010 using text mining and co-word analysis; those words were extracted from the keywords, titles, and abstracts of the articles manually [24]. This paper taking example by Ronald Rousseau knowledge integration measurement model puts forward modern integrated manufacturing organization overall situation measurement method. It makes integrated component more clarity and is a kind of knowledge integration measurement on the academic level based on the connotation of the essence. Therefore, the following two indicators form measurement model.

(1) Scope of the integration. Index I reflects the scope of integrated elements and the size in the process of knowledge integration, which embodies the degree of diversity knowledge integration in manufacturing organization, Eq.1.

$$I = \sum_{i \neq j} (d_{ij})^{\alpha} (p_i p_j)^{\beta} \quad (1)$$

d_{ij} denotes differentiation between factor i and factor j. p_i denotes the factor i percentage of the total factors. p_j denotes the factor j of the total factors percentage. They are embodiment of the equilibrium degree. α 、 β act as adjustment parameter usually value 1 [25-29].

(2) Degree of integration. Index A pay close attention to the degree of knowledge elements relevance, convergence, same and close in system shows the refining and upgrade on degree of polymerization of thinking and vertical integration ability. It indicates knowledge relatedness between organizational elements, Eq.2.

$$A = \sum_{ij} p_{ij} d_{ij} \quad (2)$$

p_{ij} is proportion has a connection relationship between factor i and factor j. Because the conditional probability $P_{ij} = P_i P_j / i$, assumption independence relationship between factor i and factor j, $P_{j|i} = P_j$, then $P_{ij} = P_i P_j$, it should be pointed out that index I and A have the same value although from the numerical point of view. But the scope of integration reflects the scope of subject knowledge related in knowledge integration activities. Degree of integration expression related degree between thinking. The scope of integration and degree of integration were originally twofold in modern integrated manufacturing knowledge integration innovation process. They respectively focus on analysis of integrated breadth and the depth of integration, which common embodies the different levels and three-dimensional cross space in knowledge innovation activities [30-32].

3 The empirical overall situation measurement method

This paper takes 10 typical SCI scholarly articles of team in manufacturing organization for example verification the validity and operability of the measurement method, which representative knowledge integration of manufacturing organization A. Demonstration see Fig.1.

3.1 Data collection

Firstly, according to the database for the platform Science Citation Index and Journal Citation Reports, this study seeks out academic articles of manufacturing organization A. Secondly, acquisition primary reference and the secondary references on that academic articles are called citations.

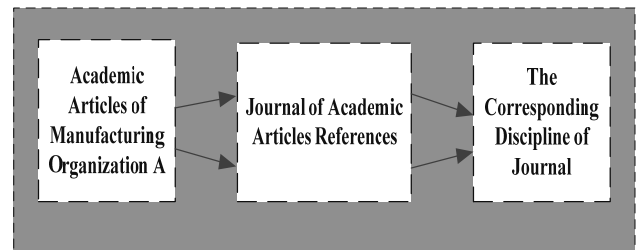
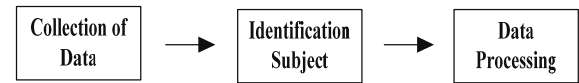


Fig. 1 The empirical route

Tab. 1 Scope of the integration and degree of integration of manufacturing team A

Article	Year	Related Disciplines	I/A
1	2006	Science & Technology, Communication, Automation, Crystallography, Theology, Metallurgy, Religion and Philosophy, Interdisciplinary, Culture, Geology, Humanities, Legislation, Biological Chemistry, Psychology	7.423848916
2	2007	Science & Technology, Communication, Theology, Metallurgy, Humanities, English language, Biological Chemistry	1.001254129
3	2008	Science & Technology, Communication, Metallurgy, Military Technologies, Agriculture, Humanities, English language, Biological Chemistry, Psychology	1.989204495
4	2009	Science & Technology, Communication, Literary, Metallurgy, Religion and Philosophy	4.28462472
5	2010	Science & Technology, Communication, Metallurgy, Dentistry, Military Technologies, Architecture, Biomedical Sciences, Statistics, Humanities	5.85549344
6	2011	Science & Technology, Communication, Literary, Crystallography, Theology, Metallurgy, Religion and Philosophy, Interdisciplinary, Culture, Geology, Humanities, Legislation, Biological Chemistry, Psychology	7.428438916
7	2012	Science & Technology, Communication, Theology, Metallurgy, Humanities, English language, Biological Chemistry	7.501204123
8	2013	Science & Technology, Metallurgy, Military Technologies, Agriculture, Humanities, English language, Biological Chemistry, Psychology	6.089904443
9	2014	Science & Technology, Communication, Metallurgy, Military Technologies, Agriculture, Humanities, English language, Biological Chemistry, Psychology	7.989200096
10	2015	Science & Technology, Communication, Literary, Metallurgy, Religion and Philosophy	8.274669866

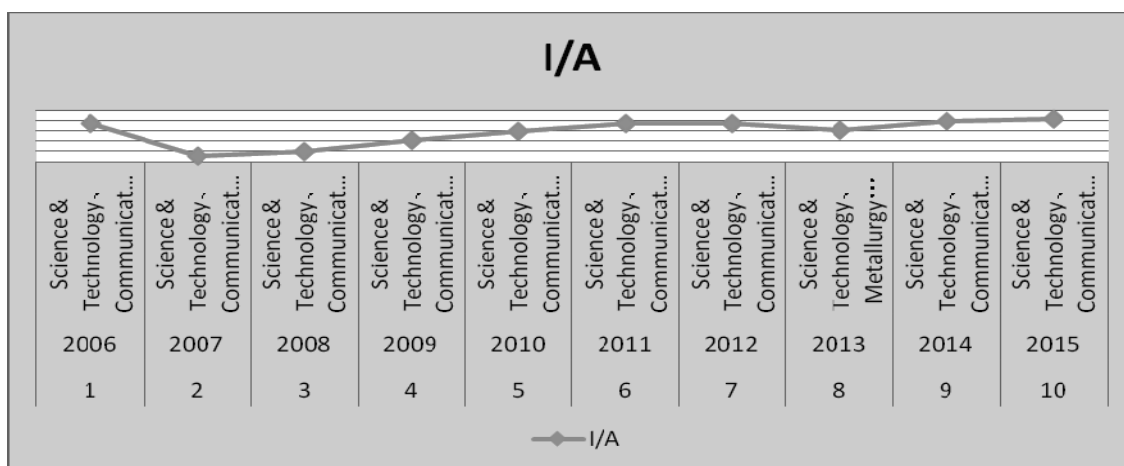


Fig. 2 Knowledge integration trend

3.2 Identification subject

The main task of this stage is journals of published citations corresponding to the subject categories. It is make use of subject categories in Journal Citation Reports to partite journals to discipline. This paper records each subject categories corresponding to published journal, so as to study the characteristics of knowledge integration from the aspect of subject. It's worth noting that this study following the principle of first contribution, direction journal into the first disciplines in Journal Citation Reports with important influence, with regard to the situation journal belongs to multiple disciplines field at the same time.

3.3 Data processing

This paper utilization excels and matlab classifies data and calculates each article published by members of the organization percentage value p_i . d_{ij} reflects different degree between factor i and factor j , which is distance and dissimilarity measurement. In order to find the differences distance between the disciplines, we learn from Classification of Instructional Programs of American establishment a unified, credible value environment. Academic article in Science Citation Index manufacturing organization A published, according to the above value in Eq.1 and Eq.2, calculated separately obtain values of scope of the integration I and degree of integration A , Tab. 1.

The higher the value of scope of the integration I , the more broad referred integrated disciplines category field. The higher the value of degree of integration A , the higher correlation degree related domain knowledge related area. Knowledge integration trend see Fig.2.

3.4 Analysis of result

The empirical result shows that the knowledge integration innovation level of manufacturing organization A has risen up year by year. Knowledge integration is more ideal between the group members and enterprises in the organization, with presentation knowledge innovation quotient increase year by year. After years of development and construction, it is observed that the organization come into being a stable research direction.

Article 1 published has appeared a special case of the value is higher on I/A , in 2006. It is consistent with the actual situation of manufacturing organization A give rise to the intra-industry attention by innovative synthesis of a new type of manufacturing materials. But in 2012 top management of manufacturing organization A run away induce slight fluctuations on the integration level in the same year. The figure can be seen that application of overall situation measurement method can clear and intuitive shows the manufacturing organization knowledge integration level and discipline/field/industry factors distribution proportion. According to this method, the knowledge integration of modern integrated

manufacturing organization can be effectively measure and knowledge innovation and knowledge integration between the manufacturing organizations can be compared.

It demonstrates the overall situation measurement method of modern integrated manufacturing organization facing the knowledge innovation is operable and effective.

4 Conclusion

Modern integrated manufacturing organization is a comprehensive technology manufacturing organization in the development, based on the traditional manufacturing technology, Information technology, management, automation technology and system engineering. It makes full use of all information related to manufacturing resources with integration of person, organization, content, technology, information resources. Knowledge integration is both technology dimension integration and integrated management dimension [33-35].

In order to better evaluate the knowledge resources integration situation in modern integrated manufacturing organization, based on the knowledge integration for the innovation characteristics of the manufacturing industry, this article builds a manufacturing organization knowledge innovation overall measurement method. By investigating the manufacturing organization published academic articles, the method measures knowledge integration level within the organization to reflect the degree of integration on the related subject/industry/field. It is effectively visual measurement method taking SCI academic articles as the knowledge integration measurement data.

Finally, this paper uses the empirical validation the validity and operability of the measurement method, which proved it is an effective way to measure discipline/field/industry of modern integrated manufacturing organization on integration.

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