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Data, Information, Knowledge, wisdom and meta-synthesis of wisdom-comment on wisdom global and wisdom cities

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Abstract

We introduce the relationships between data, information, knowledge, wisdom and the new theory on meta-synthesis of wisdom proposed by Qian Xuesen in 1992. Then we point out that with the appearance of many wisdom cities in China the theory on meta-synthesis of wisdom will be shown more imperatively.

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1. Introduction

In the 20th century we have heard a lot of terminologies-digital city, digital earth, knowledge creation and knowledge economy, which are related too much with data, information and knowledge. Coming to the 21th century we enjoyed the advantages from data, information and knowledge from one hand, but from the other hand we are also perplexed by the information overload, information explosion, false information and misuse of knowledge. People also unsatisfied with some knowledge discovered from data base, so the scholars of data mining start propose so-called intelligent data mining, domain driven data mining etc.. It means we care not only the amount of the knowledge we mined, but the quality of knowledge, such as interesting knowledge, useful and operable knowledge. Especially we found that terminology-wisdom appears more and more. As matter of fact Chinese famous scholar Qian Xuesen had paid attention on wisdom even in the 1990, and furthermore he proposed the meta-synthesis of wisdom in the 1992. All his theory, method and tool related to

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meta-synthesis of wisdom are valuable to the fashionable terminologies, such as wisdom earth (smarter planet), wisdom city (smarter city) and big data nowadays.

2. Data, Information, Knowledge, wisdom and meta-synthesis of wisdom

2.1. Data, Information, Knowledge

Data, Information, Knowledge hierarchy is often used from eighties to nineties in the 20th century in the cycle of IT (see Fig. 1). In order to obtain the knowledge we often use data mining and text mining. With the appearance of internet we also use web mining to obtain knowledge from web. As to deal with the knowledge itself the knowledge management and knowledge science also had been appeared.

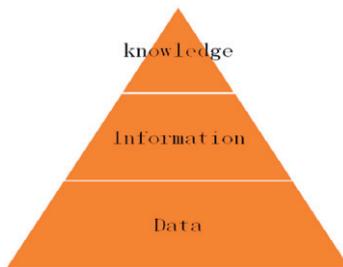


Fig. 1 D-I-K hierarchy

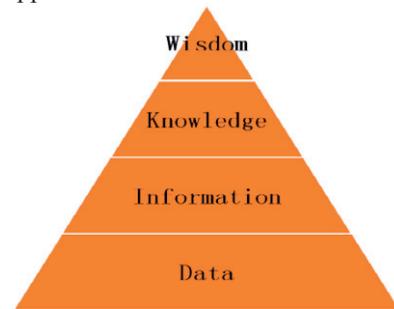


Fig. 2 D-I-K-W hierarchy

2.2. Making difference between knowledge mined in data mining

Recently some scholars in Data mining find some general knowledge found by usual data mining methods is not so good for users, so they wish make distinguishes between the knowledge found:

- Knowledge I (general knowledge), mined by usual data mining methods;
- Knowledge II (interesting Knowledge), interested by users or miners;
- Knowledge III (actionable Knowledge), which may be operated by users;
- Knowledge IV (available and useful Knowledge).

We do hope that the knowledge found which might be operated and used in practice by users, only user and practitioner may provide such kind of judgment. From data mining now there developed domain driven data mining, which may dig mentioned knowledge much more deep from knowledge I to knowledge IV (Cao L.B., Zhang C. Q. 2006; Cao L.B., et al, 2005; Zhu Z.X., et al, 2009; Zhu Z.X., et al.,2010). The another direction for developing the knowledge is intelligent knowledge management conducted by Shi Yong and Zhang Lingling , This study not only promotes more significant research beyond data mining, but also enhances the quantitative analysis of knowledge management on hidden patterns from data mining. a new proposition from original data, rough knowledge to intelligent knowledge, and actionable knowledge. (Zhang L. L., et al., 2009)

2.3. D-I-K-W (Data, Information, Knowledge and wisdom)

DIKW is data, information, knowledge, wisdom: a four layer hierarchy, where each layer adds certain attributes over and above the previous one (see Fig. 2). Data is the most basic level; Information adds context; Knowledge adds how to use it; Wisdom adds when and why to use it.

DIKW is a hierarchy useful to understanding analysis and the importance and limits of conceptual works. DIKW is used primarily in the fields of Information Science and Knowledge Management. In knowledge

science we have to furthermore make difference between explicit knowledge and tacit knowledge. As usual computer and IT technology easily deal with the explicit knowledge, but with the tacit knowledge hardly.

Milan Zeleny, which details out the DIKW hierarchy in 1987. Zeleny builds the DIKW hierarchy by equating Data, Information, Knowledge and Wisdom to “know-nothing”, “know-what”, “know-how” and “know-why” respectively. Zeleny’s 1987 mention of the hierarchy is earlier than Ackoff’s 1989 address, but it seems more people knew Ackoff’s idea on DIKW hierarchy (Ackoff R.L.,1989), especially he added the “understanding” between knowledge and wisdom. Bellinger G et al had depicted Ackoff’s idea in a Figure (see Figure 3), in which they pay more attention on the “understanding” (Bellinger G et al, 2004).

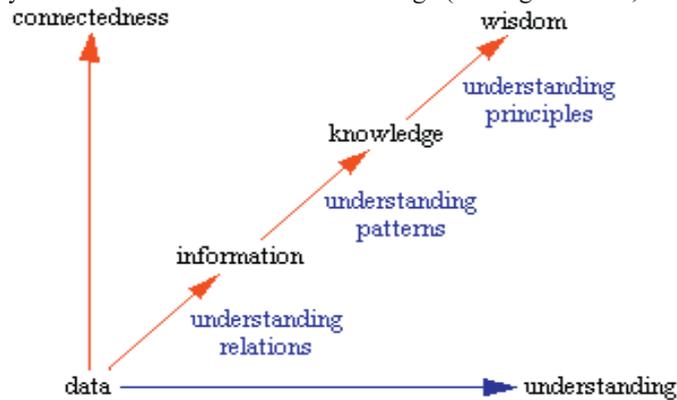


Fig. 3 D-I-K-W hierarchy in Ackoff’s explanation (Bellinger G et al, 2004)

2.3.1. Definition of Wisdom

In order to explain the wisdom more detail. Here we will depict the wisdom more. According to the Western classification wisdom may be divided into two kinds: sophia (theoretical wisdom) and phronesis (practical wisdom), the previous emphasizes on how to explore, explain, and understand the knowledge, the later on how to use the knowledge into practice. According to the Eastern classification wisdom may be divided into nature wisdom and magnitude wisdom, the previous comes from art, culture emphasizing on intuition thinking and imagery thinking, the later from natural science emphasizing on logical thinking, certainly both require creative thinking.

By wisdom also means based on the neural organism the advanced biology has some higher capability for synthesizing and comprehending, it covers such as perception, knowledge, memory, understanding, association, emotion, logic, identification, computation, analysis, judgment, culture, golden mean, tolerance and decision making etc. Wisdom forces people to understand deep people, things and events, society, cosmos, present, past and future. Wisdom differs with intelligence. If we say the wisdom is metaphysical, then the intelligence is physical. (Wiki, Wisdom, 2013)

Wisdom includes: understanding knowledge related to self; enlighten knowledge to others; apply knowledge concerning with when, where to use; create and invent knowledge means obtain new knowledge. In ancient Chinese Tao Te Ching the wisdom covers following: knowing others is intelligence; knowing yourself is true wisdom; mastering others is strength; mastering yourself is true power. (Tao Te Ching, 33, tr. S. Mitchell)

2.3.2. The source of wisdom

The source of wisdom comes from individual wisdom, collective wisdom (wisdom of crowd) and machine wisdom (artificial intelligence).

2.3.3. *Wisdom and noetic science (cognitive science)*

Qian assumed wisdom connected with noetic science. Noetic science (in Western called cognitive science) includes intuition thinking, logical thinking, creative thinking, collective thinking and finally the meta-synthesis thinking

2.4. *D-I-K-W-M*

Zeleny proposes to add “enlightenment” on top of the familiar DIKW framework. According to Zeleny (personal communication, October 29, 2004) “Enlightenment is not only answering or understanding why (wisdom), but attaining the sense of truth, the sense of right and wrong, and having it socially accepted, respected and sanctioned.”

Besides of wisdom we also may find that Zeleny and Ackoff asked people that you must keep the moral to judge affairs between right and wrong. Nonaka recently often mention the phronesis (practical wisdom), also requires people must do good things. So we should add the fifth word: “Moral” on the top over the DIKW hierarchy.

2.5. *Meta-synthesis of wisdom by Qian Xuesen*

For solving the problems related to open giant complex systems Qian Xuesen et al and proposed a new system methodology- from qualitative to quantitative meta-synthesis system approach in 1990, then in 1992 he proposed the Hall for workshop of Meta-synthetic Engineering as an important tool for realizing the meta-synthesis system approach. Summarizing the wisdom understood in Western and Eastern and meta-synthesis system approach he suggested the “Theory of meta-synthetic wisdom” in the beginning of 1990’s. This theory guided by scientific philosophy, integrated natural science, social science, engineering science and art, culture, or in short integrates and synthesizes all useful theories together to obtain wisdom. Based on the dialectical materialism this theory tries to use the human-machine combination emphasizing on human, collect all available information, experiences, knowledge and wisdom from both historical and modern times, especially now the web wisdom. This theory combines the qualitative wisdom (nature wisdom) and quantitative wisdom (magnitude wisdom), the science and art, logical thinking and imagery thinking. This theory also pays attention to the collective wisdom or community, society wisdom (Qian X.M. 2000, 2001) This theory stands on following principles:

- Integrate various disciplinary of science-*interdisciplinary*;
- Integrate various cultures-*cross-cultural*;
- Integrate knowledge, experiences and wisdom from group of experts-*coordinative and corporative*;
- Integrate the human wisdom and computer wisdom by using human-computer interaction emphasizing on the human wisdom-*interactive*;
- Integrate the wisdom in the past and future carrying forward and forging ahead- *inheriting and creative*.

3. **Wisdom earth (smarter planet), Wisdom nation (Intelligent nation) and Wisdom city**

In recent years in order to develop some regions and cities sustainable and efficient there appear a lot of wisdom cities, wisdom earth and wisdom nation instead of digital cities or digital earth etc (Zhong H.Y.,2012). According to the level of development we may divide them into several stages

3.1. stage mainly by using IT technology

In June of 2006 Singapore put out a ten year planning “Intelligent Nation 2015” for constructing intelligent nation and global city driven by the using and popularizing advanced information and communication technology.

3.2. stage by using IT technology and innovation

In November of 2006 EU Started operate Living Lab. The original idea of Living Lab came from William Mitchell at MIT in 1995, he argued that a living lab represents a user-centric research methodology for sensing, prototyping, validating and refining complex solutions in multiple and evolving real life contexts. Living Lab not only paid attention to the advanced IT Technology, but to the innovation especially by the collective innovation. So in short expression they use:

Living lab =innovation 2.0 +Innovation service architecture.

Innovation 2.0 aimed to solve complex problems by centering the users, innovating based on human, facing to the practice, standing for collective innovation, open innovation and user participation. Some main ideas are similar with one proposed by Qian in 1992. Then Living Lab launched so call ENoLL (European Network of Living Labs) asked more countries and members join with them. In the October of 2007 ENoLL enlarged his memberships till 65 countries and regions, and launched the network for wisdom cities in Europe (Living Lab, Wikipedia, 2012).

3.3. Trend by IT and Intelligence

In November 2008, IBM’s Chairman, CEO and President Sam Palmisano, during a speech at the Council on Foreign Relations, outlined a new agenda for building a "Smarter Planet". The speech emphasized how the world's systems and industries are becoming more instrumented, interconnected and intelligent, and leaders and citizens can take advantage of this state of affairs to improve these systems and industries.

In January 2010 Palmisano gave a follow-up speech called the "Decade of Smart". He highlighted dozens of initiatives in which leaders created smarter systems to solve the planet's most pressing problems. The speech aimed to inspire others to follow the leads of these innovators by helping to create a smarter planet.

IBM has found that many of the challenges the planet faces are concentrated in cities. Cities struggle with traffic congestion, water management, communication technology, smart grids, healthcare solutions, and rail transportation etc. As a practice IBM from 2009 has worked on smarter city jointly with Dubuque in USA (IBM, 2013-1-20).

IBM use the smarter not wisdom, we think that this is main idea for IBM to develop the IT technology, to sell their advanced techniques. They suggest so-called instrumented, interconnected and intelligent. The first one is about the sensing technology, second one is related to wireless communication, the third one tries to obtain the intelligent knowledge from data and information. IBM doesn’t too much concern the innovation and wisdom themselves. IBM in China may sell their techniques and ideas to some Chinese cities very well, but they have met the trouble with how to realizing the wisdom cities in China.

4. Some situations about the constructing wisdom cities in China

In China nearly 60% cities have proposed the strategy for developing the wisdom cities, they need the help from technological supports provided by some large IT companies, but they also wish connect closely with the other political, economical and environmental objectives. They also concern with innovation and creation both for the industries and the social management.

4.1. *The strategy for developing the wisdom cities needs the guidance by system methodologies*

- 1) We have to follow the system methodology like meta-synthesis approach
- 2) We must pay attention to the theory of Meta-synthetic Engineering
- 3) We need to differ on the intelligent with wisdom cities, later must pay attention not only to develop a lot of advanced IT technology, but also the economy, sustainability, social stability and progress, health, environment and ecology and finally improve the social management.
- 4) We will use the wisdom from experts and also from the common people, pay attention to teach the common people be more wise and keep higher morality.

4.2. *Coordination needed*

There are several top government organizations who care the development of wisdom cities in China, such as State Development and Reform Committee, who starts map out the guide suggestion for developing wisdom cities, and wish initiate pilot work for wisdom cities. According estimation the total scale of investment in wisdom cities expect to be 500 billion RMB during the period of “12th Five-Year Plan” (2011-2015). National Administration of surveying, mapping and Geo-information will run the pilot work for constructing the space-time information cloud platform for wisdom cities. Ministry of Housing and Urban-Rural Development announced “Announcement on developing the pilot work for wisdom cities” and published the administrating method for the pilot wisdom cities.

4.3. *A good system of indexes for evaluating the wisdom cities in China is needed*

China Wisdom Engineering Association launched “the evaluation system of indices for constructing wisdom cities in China (2011) in August of 2011. This system of indices includes well-being, management and social responsibility three first level indices; job and income, health, social security etc, 23 second level indices; 86 Information and network etc. third level indices and 362 detail fourth level indices (China Wisdom Engineering Association, 2012).

Shanghai Pudong Wisdom cities development Academy also designed “an evaluation system of indices for wisdom cities 1.0” in 2012, which includes five dimensions: fundamental network infrastructure, public management and service, information service for economy, human science literacy, democratic perception; coverage level of wide network, investment for infrastructure etc. 19 second level indices, 64 third level indices (Wenku, baidu, 2013).

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References

- [1] Ackoff R.L., From data to wisdom, Journal of Applied Systems Analysis, 16, 1989:3-9
- [2] Baike, baidu, Theory of meta-synthetic wisdom, <http://baike.baidu.com/view/3126138.htm>, 2010-2-12
- [3] Bellinger G., Castro D., Mills A., Data, Information, Knowledge and Wisdom, <http://www.Systems-thinking.org/dikw/dikw.htm>, 2004
- [4] Cao L.B., et al., Domain-driven in-depth pattern discovery: a practical methodology, Proceeding of AusDM, 101-114, 2005.

- [5] Cao L.B., Zhang C.Q., Domain-Driven Actionable Knowledge Discovery in the Real World, PAKDD 2006, LNAI 3918, pp. 821 – 830,2006
- [6] Cao, L., Zhang, C. Domain-driven data mining, *Advances in Data Warehousing and Mining*, IGI Publisher, 2007.
- [7] China Wisdom Engineering Association, the evaluation system of indices for constructing wisdom cities in China (2011), 2012-04-16 <http://www.wicity.org/html/79/>
- [8] Gu J.F., From D-I-K to wisdom and meta-synthesis of wisdom, KDD2012, Beijing
- [9] IBM, Smarter planet, <http://www.ibm.com/smarterplanet/cn/zh/index.html>, 2013-1-20
- [10] Nonaka I., Toyama R., Hirata T., et al., *Managing Flow: A Process Theory of the Knowledge-Based Firm*, Palgrave Macmillan, New York, 2008.
- [11] Qian X.M., Theory of meta-synthetic wisdom, *Xinhua Bulletin*, 2002, N.4, <http://www.xinhuaawz.com>
- [12] Qian X.M., Qian Xuesun and Theory of meta-synthetic wisdom, *People Dairy abroad edition*, 2001-2-24
- [13] Sharma N., The Origin of the Data Information Knowledge Wisdom Hierarchy http://go.webassistant.com/wa/upload/users/u1000057/webpage_10248.html [Updated: 11/01/2004]
- [14] Sternberg R.J., *Wisdom: Its Nature, Origins, and Development*, Cambridge University Press, 1990, 339 <http://books.google.com.hk/books/about/Wisdom.html?id=YuBKWJDmiEC>
- [15] Wenku, baidu, A system of indices for wisdom cities 1.0, http://wenku.baidu.com/view/244d7d0103d8ce2f006623_c2.html, 2013-1-20
- [16] Wikipedia en., DIKW, <http://en.wikipedia.org/wiki/DIKW> 15 December 2011
- [17] Wikipedia en., Living Lab, http://en.wikipedia.org/wiki/Living_lab
- [18] Wikipedia en., Phronesis, <http://en.wikipedia.org/wiki/Phronesis>, 2012-2-2
- [19] Wikipedia en., Smarter planet, http://en.wikipedia.org/wiki/Smarter_Planet,2013-1-20
- [20] Wikipedia en., Wisdom, <http://en.wikipedia.org/wiki/Wisdom>, 29 April 2012
- [21] Wikipedia zh., Wisdom, <http://zh.wikipedia.org/wiki/2013-1-20>
- [22] Zhang L.L., Li J., Shi Y., Liu X.H., Foundation of intelligent knowledge ,*Human Systems Management*, 28(4), 2009:145-161
- [23] Zhong H.Y., Examining the recent progress on “Wisdom cities” in world, *Shanghai informatization*, 10, 2012:78-83
- [24] Zhu Z.X., Gu J.F., Zhang L.L., Song W.Q., Gao R. Research on Domain-Driven Actionable Knowledge Discovery, In [25] Shi Y., et al. (Eds.): MCDM 2009, CCIS 35, 2009:176-183.
- [26] Zhu Z.X., Gu J.F., Gao R., Research on Domain-Driven Data Mining Based on SPIRPRO Principles, 《*Journal of the China Society for Scientific and Technical Information*》 2010-06.