INFORMATION SOCIETY DEVELOPMENT TRENDS, FROM DATA THROUGH KNOWLEDGE TO WISDOM

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Abstract: The paper investigates both the causes and effects of the rapid increase in the data volume (Big Data) and their impact on human cognition. The role of the Internet in distributing and exchanging of such data, and their impact on the growth of the Information Society are emphasized. As a result, Wisdom Science – a new kind of research – emerges which has the potential to facilitate more advanced solutions in the digital world. In consequence, new kinds of info-driven devices, services and systems called "smart" are developed and applied in almost every aspect of human activities around the world. However, this is not enough for humans to use all those well-informed smart devices and systems because, first of all, their decisions should be wise. Therefore, the paper, coming from a cognitive informatics approach defines wisdom and its applications, illustrated by some practical cases. Based on this, relations between knowledge and wisdom are shown, and human abilities corresponding to them are defined. They can decide about a transformation of a knowledge society to a wisdom society.

Keywords: data, information, knowledge, wisdom, information, society development, human abilities

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1. Introduction

The rapid development of information technologies decisively affects the transformation of the information society nowadays. The transition of paper driven information and analog devices into digital ones gives new possibilities of data transmission and processing. People can e-communicate in an easy way, and faster, in different places and in different times. Since the distance is dead and time is now [1]. Hence, plenty of different e-applications arise which try to support real and virtual human activities. The concept of "going paperless" is implemented stepwise, which affects models of businesses, and whole segments of the society such as e-government, e-medicine and e-science, and even e-democracy. A society where the creation, distribution and use of different kinds of digital data is called the "Digital Society". This new modus operandi creates new capabilities of the Internet, based on digital recording and disseminating of data, information, concepts and knowledge [2]. Leading to new information processing services, offering much higher and complex functionalities and benefits of IT applications. As a result, one can see new forms of production and distribution of organization and management to satisfy the emerging super-consumerism of goods consumption [3]. The new business knowledge stimulates creative activities, increases competitive advantages and creates smart devices and services, smart organizations, smart buildings, or even smart cities and so forth. This kind of society used to be called "technological society" (predicted already in the 1960s) today is being transformed into a "knowledge society", where the majority of its sphere of life is penetrated by scientific and technological knowledge.

The major criticism of digital and knowledge societies refers to the rapid and radical changes, which do not allow people to adapt accordingly to new realities of virtuality and online living. In consequence, instead of universal effects, some part of society can be excluded from the offered possibilities. Leading to Digital Divide, which together with Money Divide even *worsen* that part of the society. Moreover, many existing problems and those new ones occurring simultaneously even deepened the scope of unsolved societal problems. Therefore, such traditional human properties as deep observation, critical thinking, creativity and search for rightness are still important to solve many present and future challenges and enhancements. Here, the questions arise; how to understand human ultimate cognition which is wisdom, and how to create and develop a "wisdom society" in the digital and knowledge-driven new world, or rather, how to transform from a "knowledge society" to a "wisdom society", since a "knowledge society" is not yet a "wise society." because wisdom is not better knowledge as many authors would like to perceive these units of cognition.

It is a well-known fact that some researchers have refused the "wisdom" term as unclear, as an undefined and irrelevant one [4]. Others show the power of wisdom for creating effective teams, organizations including countries, and emphasize that a "wisdom society" is most important for the future fate of the world [5]. Hence, in this paper we concentrate on the main properties of wisdom, and try to show a new kind of thinking in order to collect some knowledge about wisdom and a wisdom society. We also show challenging issues of our civilization which are waiting for wisdom solutions to eventually become a wise civilization.

2. Simple example – Big Data problem

Let us consider the problem of product choice by customers in internet shops. We assume that a customer is interested in the lowest price of the selected product. In such a case he/she should check the product price in all available shops. The procedure to choose such a product is very simple and consists of the following two steps:

- Find the known internet shops and remember the prices of the selected product;
- Choose the product with the lowest price.

It is assumed that customers are able to express their needs in a similar way to how products are described by Internet pages. However, in many cases customers have only a general idea about the required products (see Figure 1a). Only some functions and expected processes or other loosely determined properties of products are assumed. Contrary to these general characteristics, store sellers describe their products much more precisely (see Figure 1b).

In case of the product functionality, some quality characteristic such as weight, size, reliability, quality, power consumption, etc. are taken into account. Sometimes it is essential that the product is chosen from stores located in the local area (city, region) or in the global context because the product price can be increased by transportation costs. Besides, some stores can offer many alternative products having similar functionality and quality parameters, even in the same store. In consequence, the number of all products which can be taken into account by a customer can be big enough. We can imagine that all requirements and products available in all such stores can be represented by points in n-dimensional spaces, as is shown in Figure 1. The spaces can be dynamic because some wishes or products have disappeared, and new ones have appeared in such space. Furthermore, we should distinguish subspaces representing collections of products belonging to one store, or to a chain of stores. Moreover, each of the dimensions of such space can be represented by several metrics, *e.g.* functionality by different functions, quality or/and reliability, usability and power-consumption. Then, one point in a 3-dimensional space can be transitioned to another set of points in a multidimensional space.

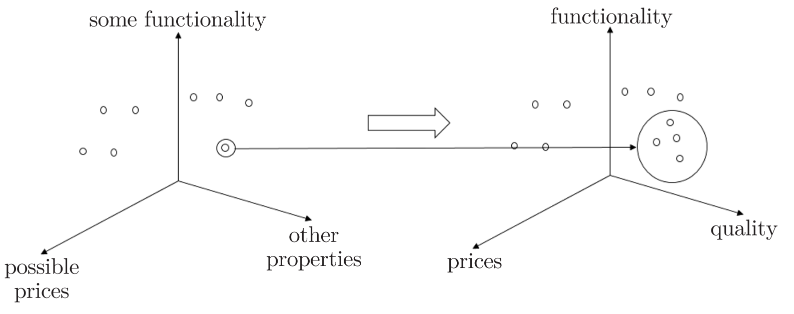

Figure 1. Concept of mapping user requirements (a) into product characteristics (b)

In order to select suitable products satisfying user needs we should determine a mapping procedure in which a specific point from the user requirements space transforms into a set of points in the product characteristics space. In general, the problem of choosing suitable products, satisfying some customer criteria is very complex, and requires some intelligent algorithms. Additionally, the customer requirements, as well as some available product properties can be changed in time. Therefore, it is not easy to define such mapping algorithms.

We can distinguish three categories of solutions which are as follows:

1. Complete approaches – it means that we should consider all existing possibilities in different ways and make a product ranking list (top products);
2. Heuristic approaches – where we try to find one approach which is close to the best approach satisfying a customer's requirements, defined by certain simulation and optimizations techniques;
3. Common sense approaches – where basing on the so called collective practice we decide to choose the most popular products selected already by other customers with similar needs.

The cases given above require different kinds of data related to customers and products. When the customer information about the product is low, then marketing policies play an important role in the customer's decisions. In general, if the mapping procedures are more clever, then the user satisfaction is higher. Therefore, there is high competition among store owners (providers) to find an effective mapping procedure. Based on large sets of different data describing users and products, special knowledge can be discovered and utilized in mapping algorithms. Examples of such approaches are observed in recommendation systems [6] which try to recognize very well the needs of users, and then define wide acceptable proposals of product candidates. Another example is a solution called crowd-sourcing [7], where individuals or organizations contribute via the Internet to solve some problems, *i.e.*, to find the best product recommendations. It is assumed that collective opinions or suggestions are characterized by more power of wisdom. In such approaches the knowledge can be discovered in a much simpler way and the found solution can be more acceptable for customers. It is one of the reasonable approaches, especially when customer requirements are not strictly determined. Then, marketing also can have a strongly impact on customer decisions, and therefore it very often is largely used by stores.

We have considered one simple example of human activities – shopping, in spite of different data and knowledge available to customers, they can select a product using some simple knowledge rules, because otherwise it is much more impractical, owing to the complexity and high costs. For other problems related to *e.g.* finding cooperation bridges between scientists and businessmen, we should create two different spaces representing research possibilities and business needs. There is no direct correspondence between coordinates of those spaces. Then, the mapping problem is much more difficult to solve similarly in case of product developing or enterprise planning [8] to find the best strategy is much more complicated and difficult to achieve using some mathematical (formal) approaches. In such cases, at the beginning, we have only a requirement and to achieve a product, we should create not only the space, if its characteristic but also transforming processes. In other words, there are some barriers for systematic-oriented solutions and rather some heuristic approaches based on Big Data should be taken into account. It shows that the role of human creativity and wisdom always plays the most important role. As is shown below, the role of wisdom is more significant, first of all in such situations where data and knowledge are incomplete.

3. Main aspects of wisdom

Due to the collection of Big Data and formulation of some knowledge, we can define general rules describing some cases of life. For instance, more modern education takes place in universities having scientists with a better position in the world Academia. Another rule shows that we need more higher quality information about the managed organization to realize more efficient management. Such rules follow directly from long experience of analyzing paper data, and can be formulated either by analysis of large sets of data, which is time consuming or directly follows from human expert observations and does not require higher costs for gathering large sets of data. These examples show that useful utilization of data may eventually trigger more informed or even wiser behavior and decision-making. Moreover, wisdom is a very useful human resource, which in the case of the lack of sufficient information, concept and knowledge, allows taking intuitive but promising decisions the correct effects of which will be perhaps visible over some time perspective.

Let us consider a simple model of a human project realized over some period of time, the results of which can be really obtained and evaluated in some future time (see Figure 2).

Let us assume that we can distinguish four main steps of implementation of that project:

1. Project problem definition following from specific human needs or their development goal and strategy;
2. Expectations of a specification requirement following from inter and intra current and future conditions, and possibilities of the environment where the project can be designed and implemented;
3. Choice of the required tasks to be able to implement the project;
4. Execution of planned tasks to obtain the predicted project goals.

We can describe the above activities on different levels of detail, and use some available methods and tasks to define, design and execute the project. Owing to these details we need responsive sets of data to describe useful information, and on such basis, formulate some general rules which represent fruitful concepts, knowledge and wisdom to support project implementation. In consequence, we can apply the best available algorithms to make progress in a given project implementation (see Figure 3). In some situations, where the required knowledge is not available, we can handle the project through our own wisdom based on common sense.

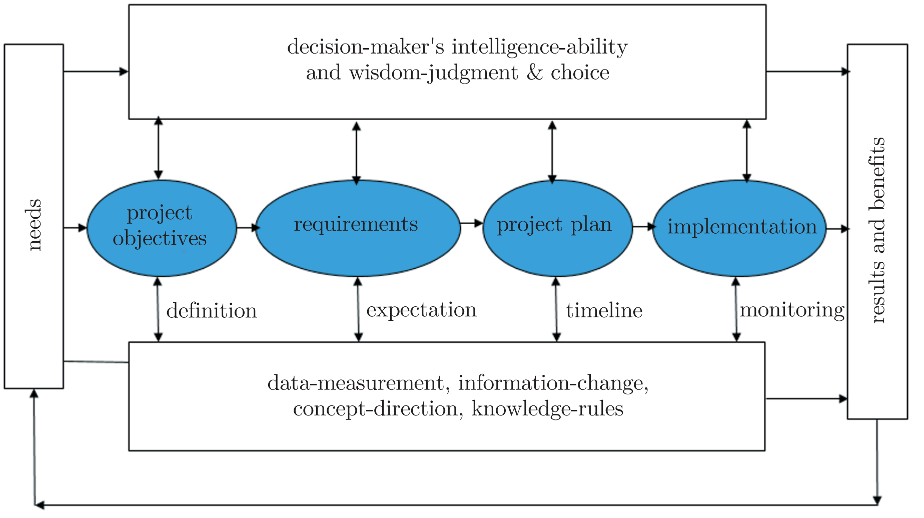

Figure 2. Main project cycle steps and their support by cognition units: data, information, concept, knowledge, wisdom

When discussing main differences between knowledge and wisdom societies we try to describe the relation existing between knowledge and wisdom. Referring to Figure 2 we show two kinds of items supporting each project implementation. In the bottom rectangle we point out such cognitive units as data, information, concept, knowledge that are well defined and largely used in different areas. In the upper rectangle, human intelligence, creativity, and first of all, wisdom are taken into account. As was shown in Section 2, knowledge is the most valid unit, which plays an essential rule in evaluation and decision making processes. In Figure 3 three units: knowledge, decision making and project effects are shown to stress their important role in a project cycle. Based on observation and analysis in various project implementations we can also comprehend the sense of wisdom and its impact on final project effects.

Let us assume that each of all these cognition units can be classified on three levels of complexity. In the case of knowledge, we can consider its quality and then we have: small (S), medium (M) or high (H) levels. In the case of a decision, we can evaluate the level of risk for project implementation activities, and we also distinguish three levels: S, M, H.However, the possible project effects can be referred to the achieved results, and their impact on the society. Then, we can distinguish: positive progress (H), no change for society (M) and regress (L). Using the above values of aspects, we can point out where wisdom plays the most important role to achieve progress of society to whom the considered project was devoted.

Let us consider the cases, when an implemented project has achieved only positive results. Wisdom is also necessary to reduce negative results, but these cases are omitted, nonetheless, they can be analyzed in a similar way.

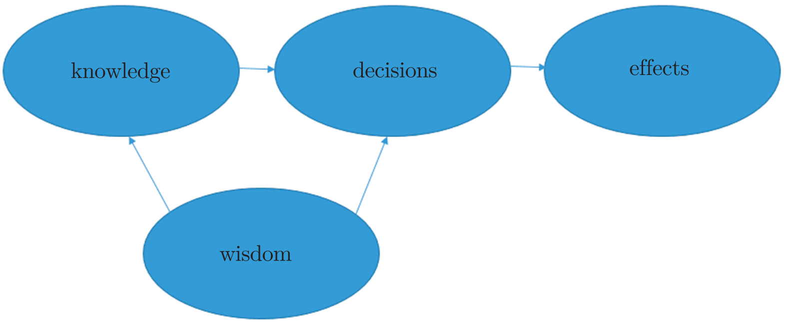

Figure 3. Three main considered cognition units

Table 1. The role of wisdom in project implementation for different knowledge quality and different decision risk

Knowledge quality	Decision risk	Obtained effects	Role of wisdom / Case 1	Role of wisdom / Case 2
S	S	H	H	M
S	M	H	H	M
S	H	H	H	H
M	S	H	H	S
M	M	H	H	M
M	H	H	H	H
H	S	H	H	S
H	M	H	H	M
H	H	H	H	H

In Table 1 (Case 1) it is shown that project effects are always high in spite of what the level of knowledge and what the level of the decision risk are. It means that in such situations the role of wisdom is dominant for all these cases. A significant progress of knowledge and improvement of the decision making progress causes that the role of wisdom is less visible (Case 2). In such cases we distinguish three levels of the role of wisdom: small (S), medium (M) and high (H). As has been shown in Table 1 in case of low level knowledge and high level decision risks, the role of wisdom is more important than in the case of high level knowledge and low level decision risk, it is the reason why wisdom recognition is not easy in our life.

Therefore, we very often take into account the following rules: if knowledge increases, the decision risk decreases (assuming a good art of living of the decision maker which assumes for example his/her good control of emotions and so forth), positive effects (of project implementation) increase, what can be described in following way:

$$\text{knowledge} \nearrow \ \text{decision risk} \searrow \ \text{positive effects} \nearrow \tag{1}$$

It means that wisdom becomes less important in our life, when knowledge is still improving. Moreover, as has been shown in Table 1, in many cases wisdom is necessary to collect proper knowledge to make decisions in a rational way in order to minimize risk and control our activities to achieve promising effects. There are many practical examples corresponding to such cases confirming the essential role of wisdom.

In case of product selection discussed in Section 2 we can consider several selection strategies, as follows:

1. Select randomly a product, when we have only the list of available products without any data describing then (*e.g.* space without values of coordinates);
2. Trial and error, we have some data about products and criteria of our choice, then, this is a sequence of random choice, until the criteria are satisfied;
3. Complete approaches where we have limited the product space and try to find the optimal solution by using mathematical approaches (*e.g.* linear programming, multicriteria optimizations);
4. Intelligence-based behavior oriented approaches, based on natural behavior of different customers/users and their experiences, to solve the problem using some tested choice-oriented rules (neuronal networks, simulated annealing);
5. Human oriented approach where first-of-all cognitive thinking (*e.g.* human skills in thinking-reasoning, learning and decision-making) is used or some representative user cases verified in practice are recommended.

In many cases it is difficult to decide which of the above given strategies is the most suitable in given circumstances determined by different conditions. Taking into account extra constrains occurring with time and the cost or quality requirements we enlarge the complexity of solutions. In such cases, as is shown in Table 1, a new wisdom decision should be taken, which allows finding a better solution. In such an unusual way we obtain a pattern to solve more complex problems which can become the new representative user case. In consequence, the rule (1) can be modified in the following way:

$$\text{wisdom} \nearrow \text{ new knowledge} \nearrow \text{ decision risk} \searrow \text{ positive effects} \nearrow \qquad (2)$$

It means that with the addition of evolved past wisdom, the former rule (1) becomes more evident. In general, wisdom should be the final application of cognition for any human activities, including the development of knowledge, taking right decisions, minimizing risks, and giving a big chance for fruitful effects of human undertakings.

4. Knowledge collection about wisdom-oriented decisions

Our society which is perhaps already *digital* gives a chance to think possibly about a *wise society* due to the rising almost unlimited capabilities of the digital technology in processing the human cognition. In many cases they are coordinated by governments which are formulating development goals and strategies and support them by funding many projects. Figure 4 illustrates a step-wise developing processes of a digital society. To evaluate the directions of their changes we should compare the past and current states and discover new problems which must be solved in order to achieve the assumed or modified effects. In the implementation of such transformation we should remember about the rules presented in the previous section. If only the rule (1) is generally used, we rather create a *knowledge society*, if the rule (2) is largely utilized, we are closer to a wisdom society.

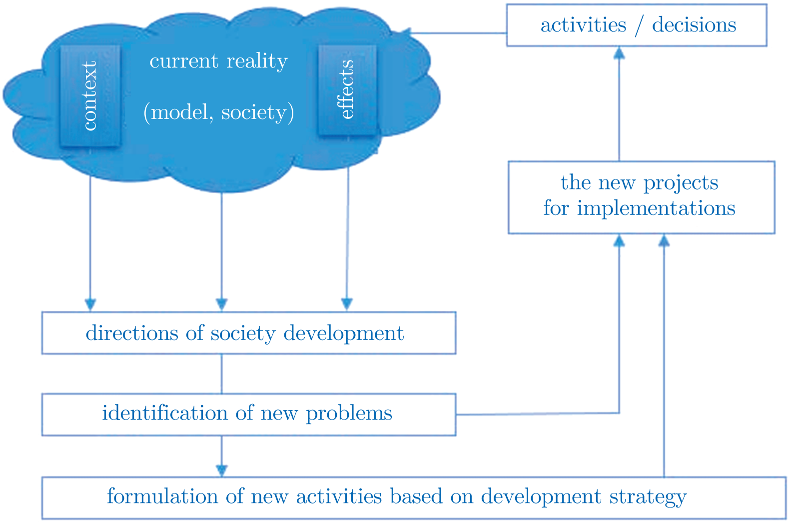

Figure 4. A step-driven development processes of information society

In practice, we should take into account different real cases of human decisions which take place during the performance of various human activities. The most interesting of them correspond to these shown in Table 1. In such a way we can collect data and, in further consequence, create knowledge about the role of wisdom in our society. Some of such cases have been well described in the literature [9]. However, to initiate a new direction of *wisdom science* we need more information about the decisions of humans and the society in different existing life contexts and we should analyze their possible positive and negative consequences. To collect such information, we should monitor and analyze data on different levels of human activities; the whole or a part of the human society. By making observations on such different levels we can evaluate also the different human attitudes, and classify categories of people following their possibilities related to both their knowledge and wisdom abilities, as is shown in Figure 5.

We may distinguish four broad categories of decision making people. Authorities/experts combining high knowledge with high wisdom are in the most advantageous position (Rules 1 and 2). At the other end of the spectrum there are the most disadvantaged people with low knowledge and low wisdom, trapped

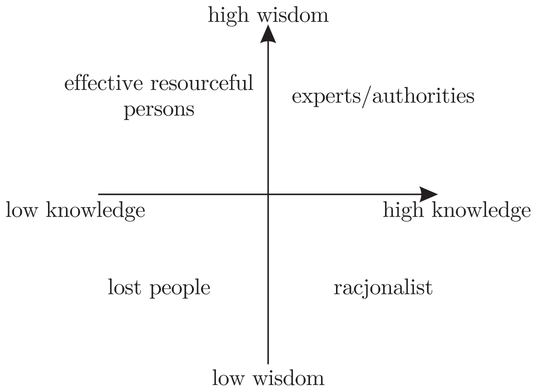

Figure 5. The diamond of four basic human abilities

between Scylla and Charybdis[1]. The decision making of rationalists is based on knowledge, but at the same time it is limited by imagination, they can make "relevant" or "irrelevant" decisions. Resourceful people make the most of what they have, but they are equally limited by low knowledge, according to the maximum of intuition (Rule 2). Coming back again to our example considered in Section 2 we can assume that experts will choose one of the mapping strategies according to the available knowledge about the user requirements and product characteristics and making some simplification of them according to a current context. Lost people will decide using random or trial and error strategies. Rationalists can try to find the best formal and complete strategy using either well-known discrete optimization or well-defined heuristics approaches. At the end, decisions of resourceful people can be based on either their past experiences or opinions of some experts. It seems that in real life pure categories of people cannot be easy distinguished. In real life those categories may be found partially but in a combination applied by each of them. This is one of the practiced wisdoms which should be verified. If verified, then the idea of that wisdom becomes some new knowledge in that category. Hence, the discovered wisdom-driven decisions lead to significant knowledge improvement. In consequence the wisdom society is much better in knowledge discovery in comparison to the possibilities of the knowledge society. The latter looks like an unfinished bridge?

5. Final remarks

In this paper some theoretical aspects of the concept of wisdom are investigated. Their important role in transition of the digital society and the knowledge society into the wisdom society is shown. Hence, the needs arise for the development of a new kind of science called the wisdom science. The initial step of such a science can be cognitive informatics. Cognitive informatics investigates the human – *e.g.* the methods that the mind uses to process different kinds

1. "Between the sword and the wall". Scylla lived on the cliffs and Charybdis was a dangerous whirlwind. None of the destinations were more attractive as both were difficult to beat.

of cognition units such as data, information, concept, knowledge and wisdom. Presently it is a multidisciplinary approach including such scientific disciplines as intelligent technologies, natural intelligence, bio-and neuroinformatics, brain modeling, knowledge engineering, neuronal networks, etc. They try to explain what and where the source of human intelligence and cognition is in general, and why they work successfully. In our approach we have focused on the effects of human wisdom in project-oriented undertakings, and we have tried to explain which human decisions are wise and who has such abilities in our society. In our next investigations we plan to show in what way we can combine wisdom science with service science. In other words, we want to define some set of services which can support wisdom-driven decisions. This paper should provoke a new discussion about the more complete trends in the development of the Digital Society, the Knowledge Society and the Wisdom Society which will be not only broadly informed but also wise. Which means that it should be able to solve, in a timely manner, the challenging issues of our civilization which today is at risk of being overpopulated, ecologically declining, with depleting strategic resources like *inter alia*, fresh water, fresh air, oil and gas.

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