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An Overview on the Integration of Informatization and Industrialization (IOII)

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Abstract

The integration of informatization and industrialization (IOII) is a policy guidelines proposed by the Chinese Government to promote the production upgrade and the transformation of economic development mode, which is given increasingly attention by academic circles. In this paper, a brief introduction to IOII is presented. The research collections of IOII required to study the concept, development and process are surveyed as well as the application evaluation. By summarizing the development, relationship and the existing concept of IOII, a new concept of IOII is put forward. Then by studying comparatively the process and the application evaluation of IOII, suggestions for future empirical investigation is offered.

Keywords: *Overview, Integration, Informatization, Industrialization*

1. Introduction

As the application of information technology in the worldwide and the promotion of China's reform and opening up, research in new industrialization path draws growing attention, which has been a major issue related to the development of the national economy in China. Because of its strongest driving power for industrial technological innovation during the third industrial revolution, informatization is viewed as a focal resource for development, replacing the centrality of labor and capital during the industrial age.Under this background, the Chinese government formulated the policy that promoting the integration of informatization and industrialization (IOII).

IOII is the intrinsic requirement for enterprise reformation and development and also an important way of enhancing enterprise creativity and market competitiveness.

Improving industrialization level by applying informatization was firstly put forward by Europe and America in 1960s, but that application could not be seen as IOII. Differences in environment and foundation make IOII is a unique concept which only exists in China.

There are several advantages in promoting IOII in China compared to the developed countries. Firstly, the indstrialization level in China is relatively weak, which leads to a lower cost when popularizing informatization. In developed countries, industrialization almost have been finished, which makes the higher converge cost when information technology is infiltrating. Secondly, the sustainable development of information technology decreases the risk and enhances the reliability. When the developed countries began to apply information technology, it was not improved enough, so the risk is much higher. Thirdly, the purpose of promoting IOII in China is to expand the market and standardize the management. It is the demand of globalization and information technology.

This paper provides an overview of the definition, development, stages, and the application evaluation. In Section 2, We begin the review by illustrating the development of IOII by summarizing the policy in China. In section3, the relationship between

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informatization and industrialization is summarized. Then we sum up the concept of IOII in Section 4. In Section 5 of this paper, we discuss the process of IOII in two aspects, which include qualitative analysis and quantitative analysis. In section 6, application evaluation for the level of IOII is introduced. In the last section, we summarize the application evaluation of IOII.

2. The Development of IOII

IOII is a policy guidelines proposed by the Chinese Government to promote the production upgrade and the transformation of economic development mode. Be different from the development mode of the developed countries', the informatization cannot be developed after the time when the industrialization has been finished. Therefore, there is not enough research which studied on IOII in other countries.

The relationship between the industrialization and the informatization was proposed in the Report of Fifth Plenary Session of the 15th Central Committee of the Communist Party of China which was published in October, 2001. Participants at the plenum stressed adherence to the policy of stimulating the industrialization by promoting the informatization [1]. In 2002, the Report of the 15th Central Committee of the Communist Party of China pointed out that the informatization should be taken as an important support to the industrialization. The informatization should be the impetus of the industrialization, and the industrialization should be the fuel of the informatization [2].

The first time when IOII was proposed is in the Report of the 17th Central Committee of the Communist Party of China which was published in October, 2007. The plenum stressed that "synchronization of industrialization, informatization, urbanization, marketization and internationalization" has been the main emphasis of economic work of China at present. The plenum called for pushing forward the integration of informatization and industrialization to develop the modern industrial system [3]. In 2010, promoting "deep integration of informatization and industrialization" to raise the level of informatization in every realm was published [4]. In 2012, the 18th Central Committee of the Communist Party of China pointed out that efforts should be made to consistently promote the industrialization, informatization, urbanization and rural-modernization with Chinese characteristics [5].

In 2013, ministry of industry and industry technology of China adopted the "the Special Action Plan for the Deep Integration of informatization and Industrialization". The report stressed that economic strategic restructuring and optimizing the operational scales, industry division, and the regional structure are of great significance to promote the integration of informatization and industrialization [6].

It can be asserted that studying the integration of informatization and industrialization is very crucial for China to seek sound and fast economic and social development.

3. The Relationship between Industrialization and Informatization

In order to deeply understand the basic concepts of IOII, it is necessary to make an overview of the concepts and the relationship of industrialization and informatization.

The first time industrialization was put forward is in 1760s, which promoted the development of mechanize manufacture. Industrialization is perhaps the most pervasive and fundamental trend which affecting national societies. Davis defined industrialization as "the use of mechanical contrivances and inanimate energy to replace or augment human power in the extraction, processing, and distribution of natural resources or products derived therefrom" in 1955 [7]. This definition refers to technological change, but it is clear that such change is ordinarily accompanied by radical transformations of the social structure, principally as a result of changes in the distribution of the labor force. This has led some authors to measure the level of industrialization by the proportion of the labor force not engaged in agriculture (see, for example. Golden, 1957; and Soares,

1966) [8, 9]. In China, industrialization is defined as "the process of the increasing proportion of industry (especially the manufacturing industry) or secondary industry in the Gross National Product, and the process of the increasing proportion of the industrial quantity of employment in total employment" [10].

Informatization has many far-reaching consequences in society. Informatization is viewed as a focal resource for development, which can replace the centrality of labor and capital. So the advent of information and communication technology (ICT) can be regarded as the advanced form of the industrial process. Tadao Umesao (1963) defined informatization as a general designation which means the communication and computerization of modernization, and the rationalization of behavior [11]. Kim (2004) observed that these include repercussions in economics, politics and other aspects of modern living [12]. Alexander Flor (2008) wrote that informatization gives rise to information-based economies and societies wherein information naturally becomes a dominant commodity or resource [13]. The accumulation and efficient use of knowledge has played a central role in the transformation of the economy (Linden 2004) [14]. In China, informatization is defined as "the process of culturing and developing productivity by using ICT". The base of informatization is information industry. Information industry is the industrial cluster which works on IT research, technical innovations and technical equipment production. Lin Yifu (2000) defined informationization as a process that transforms the traditional economic and social structure by Information Technology [15]. So we know that informatization is a process which promotes the expanding of application of mordern information technology, products and resource in production procedure.

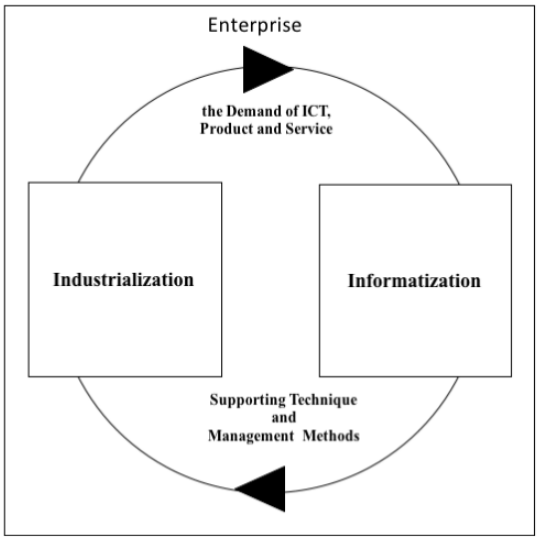

Figure 1. The Relationship between Industrialization and Informatization

The intrinsic link between industrialization and informatization is that they are mutual promoting. Yu Liping, Pan Yunhun and Wu Yishan (2009) proved that the level of informationization can promote the development of industrialization and their relationship is dynamic relation that affecting each other over a long period of time based on empirical research [16]. Some research regarded that it would increase the risk which leads to out-of-balance of the industrial structure if just stressing informationization. Although informatization originates from industrialization, it is not the appendage of industrialization. Informatization can be regarded as the evolution of industrialization and will drive the development of industrialization.

4. The Concept of IOII

In terms of production, Jiang QiPing(2008) wrote that IOII can be regarded as the process of the production mode which occurs, evolves and transforms. The process makes ICT help the development of traditional industries [17]. Zhou Zhenhua regarded innovation is the key factor of IOII [18], he also studied that the informatization of industrial structure is the incidence of the derivation of industry integration [19]. Zhou Peng studied that IOII starts from the integration of technology, the integration of products, and the integration of business is the process, then the derivation of industry which is the target will be met [20]. Zhou Shulian (2008) wrote that the key factor of IOII is the application of ICT in all industry rather than only in industrial sector, which will improve the development of national economy [21]. Yang Xueshan regarded that the most important part of IOII is a marked improvement in economic efficiency [22]. Cheng Hao regarded that applying the industry engineering is the key point of IOII [23]. Guo Lijun regarded that drive the development and strengthen the investment of basic industries are the most important task to promote IOII. It is important to pay more attention to integrate information technology with traditional industries, especially the automobile manufactory, Petrochemical Industry, financial industry [24]. Zhou Hongren wrote that the management problems in the process of integration should be draw attention. It is important to focus on the management revolution caused by informatization as well as the information equipment production and IT industries. Applying the industry engineering is the key point of IOII [25].

IOII is a scientific innovation pattern of development which will promote the integration of informatization and industrialization. Integration can be defined as the coming together of previously separate technologies in new products or services. Sometimes this union has massive consequences for industrial structure and market performance. In this paper, integration has its origin in an older debate about the existence of technological “synergies”, which means that the whole is greater than the sum of its parts. The integration should be applied into all links rather than be an independent process so that it can be effective means for the enterprises.

IOII can be defined in four aspects. Firstly, IOII should confirm the integration of strategy, which means that the strategies of informatization and the strategy of industrialization should cooperate so that their modes and development plans can cooperate. Secondly, IOII should confirm the integration of resources, which will lead to resource-saving. Thirdly, IOII is the integration of fictitious economy and real economy, which will promote the formation and development of information economy and knowledge economy. At last, IOII is the integration of information technology and industrial technology, the integration of information devices and industrial plants.

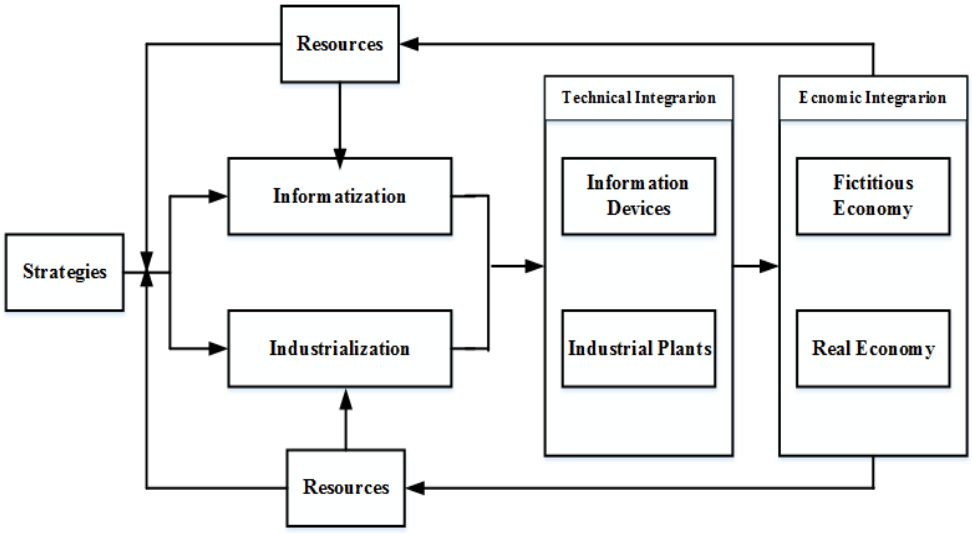

Figure 2. The Four Aspects of IOII

5. The Process of IOII

The process of IOII may be split into different stages according to different research. In this chapter, we will overview the different researches based on different classification standards.

The ministry of industry and industry technology of China states that the process of IOII can be defined as four stages, as shown in Figure 3, which are fundamental construction, independent application, comprehensive application, integration and synergy. We can see that the upgrade and advancement of the stage will boost the competitiveness of enterprises, then it will improve the economic and social effect.

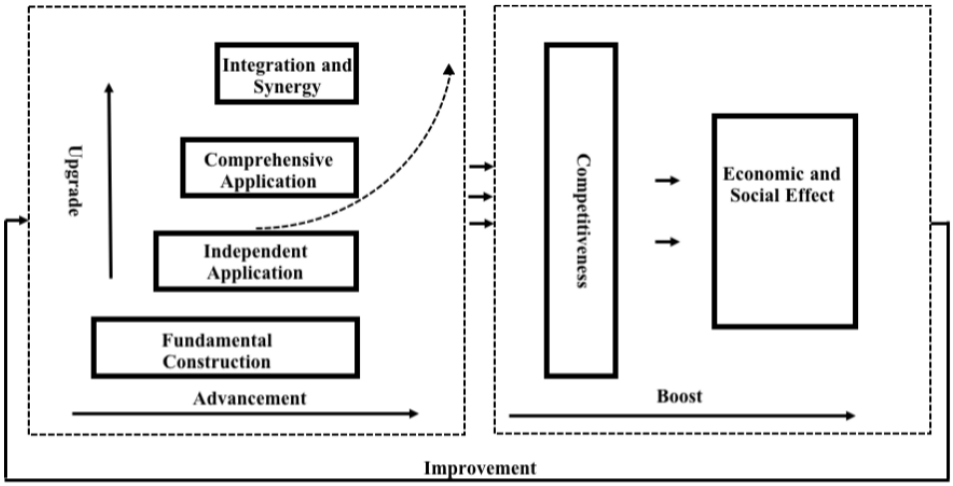

Figure 3. The Four Stages of IOII Defined by the Ministry of Industry and Industry Technology

Some Studies suggested that the process of IOII is the application of ICT and the derivation of industry. The application of ICT is that to improve the technological process and products by applying ICT in traditional industries. The derivation of industry is that make new industrial revolution by combining with ICT. To avoid the inhibiting effect on the further research of the concepts, Zhou deals with the problem in the micro level. He

split the process into four stages, which are the integration of technology, the integration of products, the integration of business and the derivation of industry [20]. Jin also raised that the integration of technology, the integration of products, the integration of business and the derivation of industry are the four stages of IOII [26]. Based on the four-stage theory, Xiao Jinghua studied the stage of integration of business by investigating 185 enterprises. She found that the integration in business level started from foundation layer to strategic layer [27]. Bally regarded that the integration of technology can change the original boundary of industries which will give an impetus to the creation of competition. The competition will promote the integration of technology and industries at the same time [28].

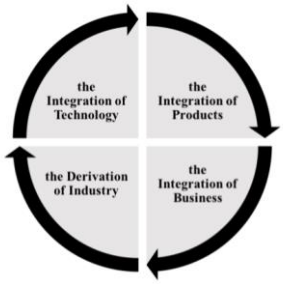

Figure 4. The Four Stages of IOII in the Micro Level

This four-stage theory makes it easy to understand the process of IOII, but there are also some problems. Firstly, in aspect of process, the four stages may not take place in an established order in different enterprises, industries or regions. Secondly, in aspect of enterprise, the not all the stages will take place in some enterprises. Even though all process of the four stages taken place in order in an enterprise, the enterprise would not become a new industry.

Wan studied that the process of IOII can be split into enterprises' level, industries' level and regions' and societies' level [29]. I think the three-stages theory is more comprehensive. Based on this theory, Xie Kang studied that friction cost exists in the process of IOII. To decrease the friction cost, coordination cost is needed. In China, the following costs make up the coordination cost. Under these different effects of adjustment costs, there will be two kinds of adjustment in the process of IOII, which are smoother adjustment and non-smoother adjustment. They will produce certain positive role to macro economy data which contains GDP growth, structural adjusting and carbon emission [30].

Zhou Hongren pointed out that researches about IOII should be focused on the following four aspects: updating and upgrading of traditional information industry, establishing of new industries, popularizing the concepts of informatization in industrial enterprises and innovating of management model [31]. Jin Jiangjun regarded that guide of government, drive by demand and promote by technology are the most important power of IOII [26]. Huang Yongxing studied that there was a positive correlation between the informatization level, industrialization level and economic increase [32]. Jin Jiangjun and Lin Zhaomu regarded that the most important step to promote IOII is to apply information technology in industrial enterprises. Then the derivation of industry should be considered [26] [33]. Yang Bingzhi put forward that the development of industrialization and informatization could not be taken up in order of priority, IOII could be the key approach to the leaping developments in China [34]. He Wei regarded that informatization affected the increasing rate of the industries in China, especially those industrial enterprise [35].

Xie Kang studied the process of IOII by making an analogy. He regarded that the relationship of couple is similar to the relationship of informatization and industrialization. He divided the process of IOII into three stages which are the primary

integration stage, the integration stage and the deep integration stage based on the couple's relationship. The primary integration stage is that industrialization promotes informatization. The integration stage is that informatization drives industrialization. The deep integration stage is the mutual effect of informatization and industrialization. Both informatization and industrialization are process of developing. Xie regarded that IOII is an evolutionary process that informatization and industrialization affect each other. Its real essence is the convergence which is a process to reveal the technology efficiency. Technology efficiency is the cost of informatization is least with the same industrialization level, or the cost of industrialization is least with the same informatization level [36]. Xiao Jinghua constructed a model to study the process of IOII based on Xie's research. According to the model, the stage that informatization and industrialization affect each other is unstable and brief compared with the other two stages, but it is necessary. The path selection will be influenced the coming stages [37].

6. Application Evaluation for the Level of IOII

To evaluate and measure the level of IOII, a standardized index system which can make quantitative processing is needed. In this chapter, method of measurement for informatization level are firstly overviewed. Then the representative researches of measurement for IOII are overviewed.

Informatization level is a quantitative description about the development level of information in a district. It can reflect the information development environment of a district, the current informatization degree, and the information development potential. Then we will overview the conventional method of measurement for informatization.

The method of measurement for informatization was firstly established by scholars from Japan in the 1960s. It was Informatization Index. As is shown in Figure 5, the model contains four second index signs and eleven third index signs. To compare these index signs which are in different qualities, a benchmark should be chose so that they can be converted into index. Then the Informatization Index which reflects the informamatization level can be figured out. But this method also has some defects. Firstly, because of the development of the informatization concept, the four second index signs of this model are oversimple. Secondly, the index system lacks of long-term stability because the index signs are real object [38].

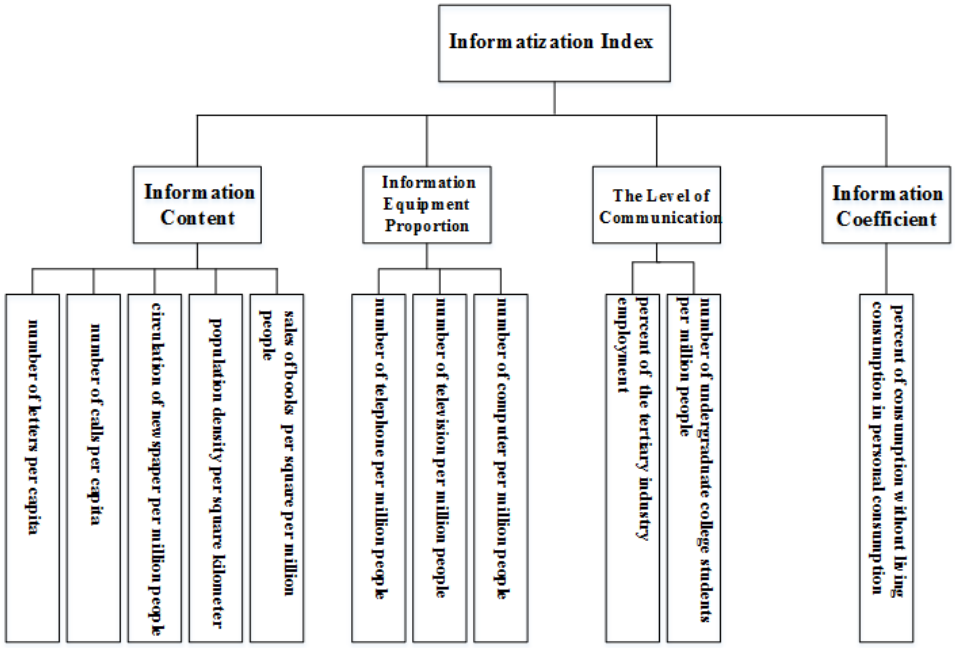

Figure 5. The Informatization Index Established by Scholars from Japan

Another method of measurement for informatization was established by M. Porat in 1977 by using the input-output analysis [39]. The core of this method is to divide the information sectors into primary information sector and the secondary information sector. The calculating methods to figure out the output value of primary information sector are based on final demand method and value added method. Formula is shown as follows:

$$\mathrm{GNP}_1 = \mathrm{C} + \mathrm{I} + \mathrm{G} + (\mathrm{X} - \mathrm{M})$$

Where GNP_1 represents the gross national product risk of primary information sector, C represents customers' demands and consumption of products and service, I represents enterprises' demands and consumption of products and service, G represents government's demands and consumption of products and service, $(X - M)$ is the net exports.

To figure out the gross national product risk of secondary information sector, namely GNP_2 , Porat regarded that the output value of information products and service which do not enter the market has two parts, which are the income of information workers who are not engaged in information industry and the the depreciation of information equipment which do not belong to the information industry. So, the gross national product risk of information industry is the sum of GNP_1 and GNP_2 .

$$\mathrm{GNP} = \mathrm{GNP}_1 + \mathrm{GNP}_2$$

But there are still some points should be improved in this measurement method. Firstly, not all the influence factors, such as the construction of information infrastructure, are reflected in the process of informatization. Secondly, with the development of economic integration, the export sales of information products cover a comparatively great proportion. So GNP cannot accurately reflect the developmental level in a specified period.

In 2001, ministry of information industry of China issued the scheme of formation of informatization indices for China. The index system which can figure out the quantitative analyses of the informatization in China contains 20 indexes in 6 classifications. Bandwidth per capita ownership, amount of satellite site, internet users per 100

populations, personal computers per 1000 population are defined as indexes to measure informatization level in China.

Compared with the research on the methods of measurement for informatization, the research on the methods of measurement for IOII is relatively less. Gong Bingzheng took the depth of IOII, the width of IOII and the benefits of IOII as index signs to measure the level IOII [40]. Yi Ruizhi took the construction situation of IOII, the application of informatization and the benefits of IOII as the index signs [41].

In 2010, to measure the development level and key features of steel industry, fertilizer industry, heavy machinery industry, car industry, paper industry, cotton textile industry and meat product processing industry, ministry of industry and industry technology of China published the index system and evaluation system. In this index system, three first index signs and nine second index signs are included. As is shown in the following table, the first index signs are the foundation of IOII, the application of IOII and the performance of IOII.

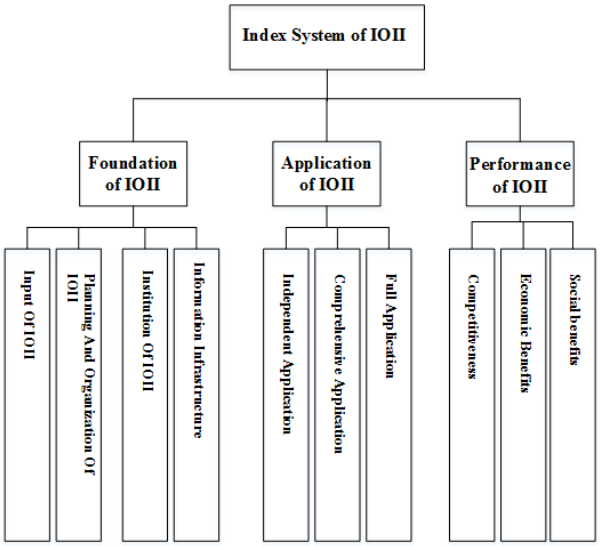

Figure 6. Index System of IOII Established by Ministry of Industry and Industry Technology of China

In 2012, Tong Haiwei built an index system of IOII for the equipment manufacturing industry. This index system is based on "evaluation standard of IOII in industrial enterprises" which was published by ministry of industry and industry technology of China in 2011. The construction and application of infrastructure and the performance of IOII are defined as the two dimensions to reflect the process of IOII in enterprises [42]. Although these methods of measurement for application evaluation have been practically used now, they are still not perfect. The major problem is that the index signs just evaluate the results of IOII and cannot reflect the process of IOII.

7. Conclusion

IOII is an important aspect of research in the development of the national economy in China. Much research has been done on the topic, and more continues to appear every year. The issue of relationship between industrialization and informatization remains important. Interest in application evaluation has recently increased. In this paper, we overview the interrelations between informatization and industrialization, reviewing what is known to date and offering suggestions for future empirical investigation. By reviewing the definition, development, process,

and the application evaluation of IOII, we hope it will be meaningful to the further research on IOII.

Acknowledgments

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