Identification the components of futures research to remove barriers to production infrastructure in the steel industry

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Abstract

The emergence of new technologies in the form of the fourth industrial revolution has created close competition between different sectors of industry and mining to use these technologies in order to increase productivity and reduce production costs. Leading countries in the steel industry have also developed specific strategies to take advantage of technological advances and have implemented programs to this end. The purpose of this study is to map the future of the steel industry in terms of identifying the components of futures research of production infrastructure and the use of new technologies in the country's steel industry. The present study is a type of qualitative study. The approach of this qualitative research and the research method used in it is the data theory (Strauss-Corbin systematic method). The statistical population of this research consists of academic experts, managers and experts of the steel industry who have at least 5 years of experience in the field of futures research and the steel industry. The sampling method in this research is based on purposeful method and theoretical saturation and the data collection tools are library studies and in-depth semi-structured interviews. Also, the data analysis method is based on the systematic method in three stages of open, axial and selective coding. Based on this, a total of 45 initial codes were identified, which were classified into 16 concepts and 5 categories of underlying factors, causal factors, intervening conditions, strategies and consequences.

Keywords: steel industry, production infrastructure, technology, futures research.

1. Introduction and statement of the problem

Today, many countries in the world are on the path of reforming their industrial structures and changing from the older method of production to new and technology-oriented methods in industry, especially in the steel sector. Action of various countries, especially China, in fundamental reforms of steel production method and replacement of modern EAF method in green steel production, decarbonization of production process and reduction of

environmental impacts and consequently increase market competitiveness, other countries including India, EU, Has led the United States and the United States to take this path (Mitchell, 2019).

The steel industry should be considered one of the key and influential industries in the economies of countries. The study of indicators affecting the GDP of countries indicates the direct impact of this industry on economic growth and development. Whereas the dynamism of this industry depends on the growth and development of infrastructure; In a two-way relationship, both the development process and the process are affected. Manufacturers' efforts to develop infrastructure and move towards new and intelligent technology can change the future of steel production (roy, 2018). As one of the top ten steel producing countries in the world, Iran needs to develop its industrial infrastructure, especially in the field of steel, and neglecting this can make the country's steel production process difficult in the future and reduce its competitiveness with other producers. The problem for us is not only the development of hardware infrastructure, but also in the field of software we need realism and scientific assessment. Software refers to discussions of planning, goal setting, futures research, and human resources. According to the vision document on the horizon of 1404, Iran should reach a production of 55 million tons, which can be increased to 57 million tons. However, the current situation and the weakness in the infrastructure have made it difficult to achieve the amount of production (Simini, 2019).

However, ignoring the fourth industrial revolution in the country's steel master plan leads to issues such as severe technological dependence, loss of future markets, misalignment of capabilities, reduced productivity and increased production costs, inability to provide new models. Businesses will become vulnerable to technological threats and lose the opportunity to trade technology (Schab, 2016). Insufficient imbalance and inconsistency between the drawing goals of the industry and the existing facilities, constantly move forward and create a kind of imbalance in various industrial-scientific-economic sectors.

To reform such a trend, there is no choice but to move from reactive and passive management to intelligent and floating management, so that the model of industrial development program can be more objective and in accordance with future research, existing facts and detailed analysis in the field of software infrastructure. Executed. Accordingly, the selection of optimal production methods in industries, including the steel industry, has always been a serious concern of those involved in this field. To the process used. The importance of this research is that the results can increase the scientific richness of other research in this field while developing futures studies knowledge in the field of steel industry. Therefore, the present study seeks to answer the main question: what is the pattern of removing the infrastructure barriers of the steel industry with the future approach of the research? What factors influence the formation of this pattern?

2. Future research in the steel industry and its production infrastructure

Experts in the field of futures studies believe that past experience is not necessarily a sure way to the future, and managers should use modern planning techniques to map the future of their organization in a way that is appropriate to the future situation (Rattaningish, 2010). However, some managers are still so immersed in everyday issues and problems that in a short and specific period of time for a given job, they make several different plans and

decisions and even oppositions that lead to the loss of material and human resources (Rafi, 2014). A noteworthy point about production technologies in the steel industry is that in conventional technologies with reverse engineering and spending exorbitant costs and low productivity, it is possible to achieve production and meet the need, but in the field of new technologies, deep knowledge is needed and The rapid growth and development of these technologies has deprived the possibility and time required for reverse engineering. If the Iranian steel industry moves along the policy line of the comprehensive steel plan, there will be irreparable dependence on foreign technology companies, which due to the nature of these technologies, the opportunity for synergy will be lost (Peron, 2005). It should be noted, however, that the new technologies of the Fourth Industrial Revolution will lead to greater productivity and lower production costs for steel products (Afori, 2000). These technologies will create new business models for the steel industry and open wider markets for these industries. If maximum attention is not paid to these technologies to attract them to the Iranian steel industry, the product will reach the consumer in a non-competitive manner and at a high cost (Ahmadi, 2020).

2-1. Futurology of steel industry challenges in Iran

Technological attention to the country's steel master plan and some upstream documents such as the country's development plans, as well as the actions of government agencies, policymakers, governments and large steel companies, indicate that in the last decade, the issue of technology development and innovation, more than ever. Attention is shown (Cononik, 2015). Meanwhile, the downstream industries of the steel industry are also experiencing several technological changes, and in proportion to these developments, needs such as steel and their effects on the manufacture of parts, structures and products are relatively high, or in the automotive industry, changes There is a paradigm shift towards electric and smart cars, and these cars need a lighter body (Mohammad Ebadi, 2018). These developments in the downstream industries reflect the special needs of the steel industry, and if the steel industry fails to respond, it will lose a large market. For example, if stronger and lighter steel had not been developed, the competition in electric vehicles would have been entirely devoted to aluminum or carbon fiber (Molavi, 2015).

Therefore, given that the promotion of knowledge and technology to meet the needs of downstream industries is underway. From this perspective, the comprehensive steel plan and its monitoring are merely reporting on some innovative and technological developments, not creating a flow for innovation and technological development in the Iranian steel industry. Therefore, with the trajectory and planning of the comprehensive steel plan, even if it is produced in quantities of much more than 55 million tons, in the future the production of Iran's steel industry will be doomed to low-value markets with very low profit margins (Keramati, 2019).

Of course, it should be noted that due to recent actions of government institutions in the country on the one hand and the emergence of innovative and creative companies and teams on the other hand, on the other hand, there is organized and formal capacity for technology development in the steel industry. has it. Also considering that Iran's startup ecosystem is

growing and role-playing institutions such as research and technology funds, parks and specialized accelerators are entering the steel industry (Kosa, 2011).
Another point is that despite the fact that in many areas of the industry, there is no capacity to create joint ventures, but the steel industry has this capacity and the country has several benefits from these joint ventures. Another challenge of the steel industry is the supply of iron ore and the stagnation of the domestic market. Futurism in the field of steel and alternative products is one of the most important topics in futurology in this industry.

3. Research methodology

The present study is a type of qualitative research with a fundamental orientation and an exploratory approach. The design used in this research is based on the systematic design of Strauss and Corbin (1990), which uses three steps of open, axial and selective coding to transform the data from information sources into a set of codes. Transforms and then classifies common codes into categories, presenting them in the context of a theory. The statistical population of the present study consists of eleven academic experts in the field of futures studies of managers and experts in the steel industry who have at least 5 years of experience in this field. It is worth mentioning that the data collection tools in this research are library studies and in-depth semi-structured interviews.
In this research, there are two methods of purposeful sampling (in which the researcher defines the research situation and informational target groups according to the subject under study) and theoretical (by which the analyst so far Which achieves theoretical saturation, simultaneously collects, encodes, and analyzes the data it needs.
Also, data analysis is based on the systematic design of Strauss-Corbin (1990) and based on three stages of open, axial and selective coding. In order to validate the validity of the categories and the relationships between them, in the data collection process, a frequent reciprocal method has been used. In addition, in order to increase the validity of the research and ensure the accuracy of the coding, two experts in the field of futures studies outside the research were discussed and consulted about the research findings. Finally, with the aim of measuring the reliability of the research, during a meeting with key interviewees, the resulting model was presented to them, and after obtaining their opinions and applying the proposed corrections, the final model was presented.

4. Research findings

As mentioned, the present study is based on the data theorizing method and based on the systematic design of Strauss-Corbin in the following three main stages:

1-4. Open coding:

At this stage, interviews based on research questions and using the mechanism of data theory of the foundation with experts and activists in the field of futures studies and steel industry; After each interview, the data were extracted after hearing several times in writing and the basis of the initial line-by-line review, from each interview, statements that were directly or indirectly related to the future research of production infrastructure in the steel industry. Highlighting and selecting and extracting their concepts, the first open coding cycle was performed. This process continued until the stage of theoretical saturation and adequacy of the obtained data. Based on this, 11 interviews were conducted.

The questions asked in these interviews were based on the theory of data theory and were raised in order to discover the various dimensions affecting futures research in the production infrastructure of the steel industry. For example, what is the effect of futures studies in the steel industry on removing production barriers to production? What are the underlying factors affecting the removal of barriers to futures research in the steel industry infrastructure? What is the effect of futures research on the production infrastructure of the steel industry to remove obstacles in the production infrastructure of this industry? What are the underlying factors affecting the strategies of infrastructure barriers in the production of the steel industry with a futuristic approach? What are the factors influencing the strategies of infrastructure barriers in the production of steel industry with a futuristic approach? What are the strategies of futures research in removing infrastructural barriers in the production of steel industry? What are the consequences of implementing futures research strategies in the production infrastructure of the steel industry? Accordingly, by comparing the similarities and differences between the studied concepts, the researcher has placed similar concepts in a category or classification. The formation of categories in open coding became a guide for focusing on questions and subsequent interviews, and this cyclical movement eventually led to questions about the relationships between the categories created, and the coding gradually became more structured and rich. The category entered the axial coding stage. At this stage, the points and concepts enumerated in open coding provided questions and ideas about the relationship between the categories, and the orientation of the questions and the analysis of the interviews led to the study of the relationships between these categories. . Thus, with the emergence of relationships between several categories, a theorem arose. In the present study, the researcher collected the data through 11 semi-open interviews with academic experts and futurists in the production infrastructure of the steel industry, and based on this, a total of 45 initial codes in terms of repetitions from the text of the interviews. Were identified (open coding). In the next step, related concepts were identified and classified into 16 categories in 5 categories (axial coding).

Axial coding: In this step, the concepts obtained from the open coding step are placed in a category based on commonalities or synonyms. The result of this classification and microscopic comparison of concepts with each other, we create categories in the following 5 categories:

- Causal conditions: Includes those categories that affect the main phenomenon of futures research in the production infrastructure of the steel industry.
- Underlying conditions: includes special cases that affect the main actions and strategies of futures research in the production infrastructure of the steel industry.
- Interventional conditions: consists of mediating and intermediate variables that affect futures research actions and strategies in the production infrastructure of the steel industry.
- Strategies: Strategies are actions or interactions that arise from the central phenomenon of futures research in the manufacturing infrastructure of the steel industry;
- Consequences: Express the results and consequences that result from the adoption of futures research strategies in the production infrastructure of the steel industry.

Table 1. Open and pivotal coding of futures research components to remove barriers to production infrastructure in the steel industry

Dimensions	Categories	Concepts (open source)
Causal conditions	• Severe dependence of vulnerability to technological threats • Weak transportation system • Reducing the production capacity and efficiency of industries • Weaknesses in reliable and new marketing to sell products	Dynamics of industry - Moving towards new and intelligent technology - Manufacturers' efforts to develop infrastructure - Location and construction of intermediate factories in adverse climates - Water shortage - Water shortage crisis and high water consumption in agriculture - Use of direct arc furnace reduction technology in Production of sponge iron - Older technologies and depreciation of parts - Severe technological dependence - Insufficient imbalance and inconsistency between the drawing goals of the industry and existing facilities - Geographical distance between the mine and the upstream industries
Underlying conditions	• The potential of steel companies in the construction of dedicated power plants • Accumulated technical knowledge • Educational, research and laboratory infrastructure • Laws and institutions supporting and facilitating water shortage crisis	Change from the old method of production to new methods - Decarbonization of the production process - Technology at the core of the industry - More waste of capital and time - Geographical distance between the mine and the upstream industries with the middle industries - Weakness of infrastructure in the field of transportation and energy In power supply system - pressure drop of transmission lines - knowledge-based companies
Interfering conditions	• The potential of steel companies in the construction of dedicated power plants • Accumulated technical • knowledge Educational, research and laboratory infrastructure • Laws and institutions supporting and facilitating water shortage crisis	Cost of transmission and maintenance of lines - Production requirements such as water - Construction of factories in areas without water challenges - Water stress in the coming years

Strategies	• Modification of industrial structures for the production of green steel • Strengthening hardware and removing barriers to steel production • Strengthen software, technical knowledge and intelligent management • Upgrading operation infrastructure •	Redesign of power consumption mechanism - Growth and development of infrastructure - Manufacturers' efforts to develop infrastructure Reform of industrial structures - Replacement of modern EAF method for green steel production - Construction of intermediate plants in suitable climate - Use of continuous cycle water mechanism in cooling operations - Dry granulation or Waterless coke cooling - Return water to the production cycle through industrial wastewater recovery system - Increase the standard of input materials to smelting furnaces Using dry technology - Power supply of factories - Construction of factories in areas without water challenge - Energy swap projects
consequences	• Reduce environmental impact • Growth and development of infrastructure • Increasing market competitiveness	Economic growth and development - Reduce costs including financial, environmental, social - Hardware and software infrastructure development

Selective coding (emergence of research model)

Selective coding is the main stage of theorizing, because it systematically relates the central category to other categories and presents those relationships within the framework of a narrative, and modifies the categories that need further improvement and development. (Strauss and Corbin, 36: 2012).

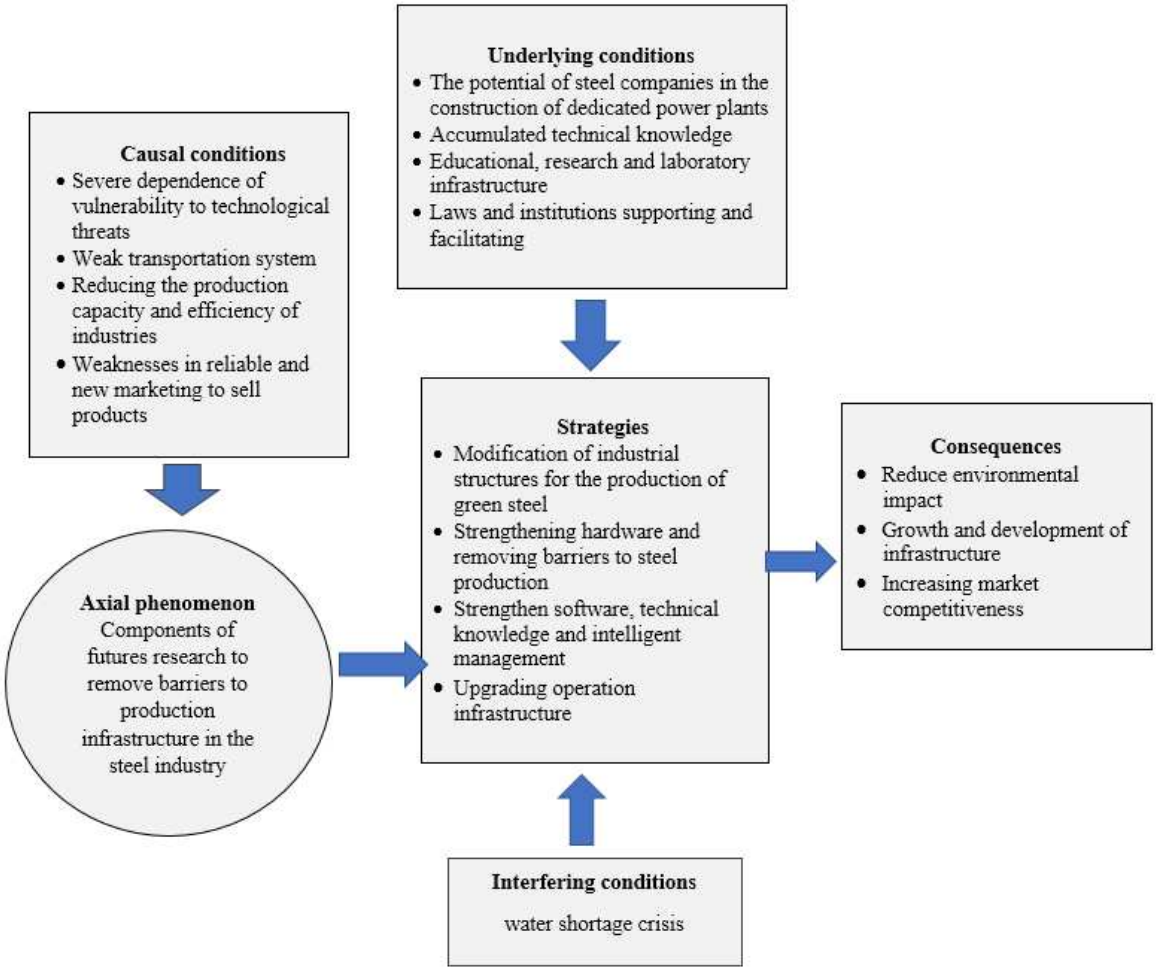

figure 1. Explain the components of futures research to remove barriers to production infrastructure in the steel industry based on data foundation theory

5. Discussion and conclusion

The globalization of the production system and the need to gain a proper position in it, has caused the global value chain to move rapidly to become more specialized. In this global system, where intense competition is the first and last word, it is necessary for the country's policymakers to seek policies based on which firms and the domestic industry sector can gain a worthy share and position in the global production system. Another point that should be considered in this new order is the need to pay attention to the acquisition and deepening of technical knowledge in the steel industry, because developing countries will have significant investments in the acquisition and deepening of modern technologies and knowledge. This issue is so serious that it has challenged the industrialized and developed countries and endangered their position. In the present study, which aims to explain the components of futures research to remove barriers to production infrastructure in the steel

industry based on data theory, the factors affecting the removal of barriers in the steel industry with a forward-looking approach were identified as follows:

- Causal conditions affecting futures studies in the steel industry's production infrastructure include the strong dependence of vulnerabilities to technological threats; Weak transportation system; Decreased production capacity and industrial efficiency and weakness in reliable and new marketing to sell products.
- Background: Factors that affect the main actions and strategies of futures research in the production infrastructure of the steel industry are the potential of steel companies in the construction of dedicated power plants; Accumulated technical knowledge; Educational, research and laboratory infrastructure; Laws and institutions supporting and facilitating.
- Intervening conditions: Mediating factors that affect the actions and strategies adopted in the future research of steel industry production infrastructure are the water shortage crisis.
- Strategies: Strategies to be adopted for future research in the production infrastructure of the steel industry include the modification of industrial structures for the production of green steel; Strengthening hardware and removing barriers to steel production; Strengthening software, technical knowledge and intelligent management, upgrading operation infrastructure
- Consequences: The consequences of implementing futures research strategies in the production infrastructure of the steel industry are the reduction of environmental impacts; Growth and development of infrastructure and increasing competitiveness in the market.

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