Designing a model to integrate integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology

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ABSTRACT
The purpose of this research is to design a model to integrate the integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology. The current research community was formed by the experts of the mining and academic complex. In this research, using the objective judgment method, the opinions of 15 experts were used, and in the statistical part of the research, based on Cochran's formula and sampling method, the opinions of 384 experts related to the research topic were used. The process of data analysis was carried out in two stages, which includes the identification of the factors affecting the integration, agility, and financial performance of the supply chain of the mining industry through interview tools and using thematic analysis method, and then evaluating the models. The measurement and structural model of the research is by using the questionnaire tool (made by the researcher) and the partial least squares method. The research results showed that the research model is divided into four main parts including data sharing, data awareness, partnership and agility with key supply chain partners. In addition, the integration of the supply chain has a positive and direct effect on the financial performance of the supply chain, and the factors related to digital technology in the supply chain have a direct and positive effect on the integration and agility of the supply chain, and thus And indirectly, it will facilitate the improvement of the financial performance of the supply chain.

Keywords: supply chain, integration, agility, financial performance, digital technology

1. Introduction

The mining industry is known for its heavy machinery, large-scale operations, and often remote locations. This sector has traditionally been slower to adopt new technologies and approaches, but today, the concept of integration and agility to improve competition and financial performance in this industry has begun to attract attention. Business integration and agility is an organization's ability to quickly adapt to changing market conditions, customer needs, and technological advances.

In order to achieve more market value and respond to consumer demands, supply chain managers seek to reduce costs and develop more flexible and connected systems in the changing and fluctuating market. (Adu-Tankarang and Helo, 2016) When integration in the supply chain with digital technology takes place, it creates a digital supply chain (DSC) that electronically moves products from origin to destination. The destination sends (Burns et al, 2021). This supply chain model uses new digital technologies to create an open, secure and reliable supply chain management (SCM) and integrated system. (Bechtsis and others, 2018). In this context, studies mention the relationship between digital technology and the positive effect of integration characteristics on the supply chain as a key concept in supply chain operations and management. (Di Maria et al., 2022; Campbell et al., 2021).

Observations show that this work can only be achieved by using the agile features of the supply chain (Yildiz Oznak and others, 2023). Agility enables companies to remain competitive in a competitive industry. Digital transformation also uses integrated technologies for more agile manufacturing, which helps to synchronize production, reduce information corruption, and shorten delivery times (Arunachalam et al., 2018). In order to be agile, a supply chain must have three characteristics. First, it must be responsive to the market, which means that the supply chain has the ability to understand and respond to real demands in the market. Second, it must use digital technology. It refers to the use of advanced electronic tools to share information between buyers and suppliers in the supply chain. Finally, the integration of processes in such a way that cooperation between buyers and suppliers facilitates and guarantees the development of common principles, common systems and common knowledge. (Siros Keshavarz and others, 2021).

Due to the concentration of mineral reserves of strategic elements in several countries, the supply of these minerals has faced many limitations. Iran, as a country rich in various mines that can be exploited, can have a very important position in providing strategic metals and as a result, producing national wealth. In this context, some of the investigations carried out on the supply chain of mineral sectors are considered an important factor in the progress and improvement of the current situation. Therefore, the financial spheres of this sector in the country are very important considering the current political conditions that make these elements consider stricter sanctions laws. Although the academic sector of the country has contributed very little in this field, no other research has been done in the country.

Research goal

Designing an integrated model of integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology
research question:

- What is the integrated model of integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology?

Conceptual definitions

Supply chain integration: Supply chain integration means a process in which, from procurement of raw materials to production, quality control to packaging, distribution or supply to final delivery, is simple and inseparable. In fact, it is a comprehensive set of different processes that may be under the full control of one company or several partners must come together to have collective control over an integrated approach (Wong et al., 2021).

Supply chain agility: Supply chain agility can be defined as its ability to adapt quickly to changes in demand, both in volume and variety. An agile supply chain uses up-to-date information to utilize current operations and real-time data to forecast demand, thereby increasing the efficiency and productivity of the entire unit (Zhou et al., 2022).

Supply Chain Financial Performance: Financial performance is a subjective measure of how well a supply chain can utilize its assets in the initial state of its business and generate revenue. Financial performance is a complete assessment of the overall state of a supply chain in categories such as assets, liabilities, equity, costs, revenue and overall profitability (Shi and Yu, 2013).

Digital technology: Digital technology includes all electronic tools, automatic systems, technological devices and resources that generate, process or store data (Biza, 2020).

2. Research background

Foreign research background

Tan et al. (2022), conducted a study on "the link between blockchain observability, supply chain integration and supply chain performance in the era of digital transformation". For this purpose, convenience sampling was done from 71 operations and supply chain managers related to semiconductor manufacturing companies in Malaysia. A questionnaire was used to collect data. The results of the analysis showed that supply chain integration mediates the relationship between blockchain visibility (information exchange, business intelligence collection and knowledge asset status) and supply chain performance. Likewise, the results of the importance-performance matrix analysis (IPMA) showed that information technology plays a minor role. The results show that semiconductor manufacturers should pay less attention to information technology, because this technology is the least priority for improvement.

Rajasanti and Mathewswami (2022), conducted a research entitled "The impact of blockchain technology on the supply chain of production and logistics". In this study, the role of blockchain technology in the supply chain and challenges related to logistics were investigated. This study shows that blockchain technology can transform the supply chain into safe, agile, reliable and transparent operations. A conceptual application scenario was presented and investigated in this study that shows the benefits of blockchain technology in providing provenance and traceability to vital products. Based on the results, it was stated that artificial intelligence, blockchain, Internet of Things, cloud computing and big data analysis are the needs of an intelligent supply chain network; And together, these technologies can help industries create a transparent and reliable supply chain ecosystem that can reduce operational challenges and improve financial standing.

Yu and others (2021), conducted a research entitled "Impact of information technology on supply chain integration and performance". The data collection tool in this research was a questionnaire and the data were analyzed using the structural equation modeling technique. The results show that supplier and customer information technology significantly promotes supplier and customer system and process integration. Supplier system and process integration increases operational performance. Meanwhile, IT indirectly affects financial performance through operational performance. Customer system integration has positive effects on operational and financial performance, albeit with an indirect effect on financial performance through operational performance. However, customer process integration only improves financial performance.

Internal investigation background

Rahimi and others (1401) conducted a research entitled "Investigation of the effect of using blockchain technology on collaborative interactions and improving performance in the supply chain". The data collection tool was a questionnaire. Structural equation modeling and SmartPLS software were used for data analysis. The results showed that the use of blockchain technology has a positive and significant effect on the performance of the supply chain and cooperative interactions, and also the creation of cooperative interactions leads to the improvement of the supply chain performance.

Nozari and others (1400) conducted a research entitled "Quantitative analysis of the challenges of implementing the digital supply chain based on Internet of Things technology". In this study, the most important challenges of implementing a supply chain 4.0 were investigated and prioritized using a non-linear hierarchical analysis method. The results showed that the lack of technological infrastructure and security challenges are among the most important challenges of implementing supply chain 4.0 in the era of digital transformations, which should be given special attention for a successful implementation.

Mohammadi and others (2019) conducted a research titled "The effect of supply chain integration on financial performance with the mediating role of supply chain risk management". Cochran's formula was used to determine the number of samples equal to 320 people. The collected data were analyzed with SPSS and AMOS software and the method of structural equations. The research results show that supplier integrity has a significant impact on risk management. Also, internal integrity has a significant impact on supplier integrity and customer integrity. And customer integrity has a significant effect on supply chain risk management, but internal integrity does not have a significant effect on supply chain risk management. In addition, supply chain risk management has a significant impact on financial performance.

3. Theoretical foundations of research

The strategic stages of the supply chain can be experienced and analyzed through the following four profiles (Gambatti and Gionardi, 2013):

Competitive profile / planning profile / mid-term production planning profile / operational coordination profile

These profiles show a kind of top-down decision-making of the supply chain, which includes chains of steps and processes in the scope of long-term strategic decision-making affecting the design and planning of the supply chain and medium-term and short-term tactical activities related to normal supply chain issues.

. The operational stages of the supply chain are based on four main processes (Gambatti and Gionardi, 2013):

Procurement (sourcing and purchasing) / production planning and control / warehouse and inventory / distribution (goods and transportation)

The supply chain consists of two main coherent processes, which are (Shajaei and Ghajavand, 1392):

Inventory control and production planning / logistics and distribution process

There are four main actors in the supply chain, which are:

Supplier / producer / distributor / customers

Each of the above groups will play specific roles and effects in the efficiency of the company's supply chain. Therefore, knowing the relationships between the mentioned groups and trying to optimize these relationships are one of the basic issues of companies (Sharif Arizi, 2019).

Research Methodology

The present research in terms of purpose; practical, in terms of inference method; descriptive-survey and in terms of the nature of the data; It is qualitative (theme analysis) and quantitative (structural equation modeling).

Research steps

The current research will follow a three-step process, which is as follows:

First, with a library study, while examining the theoretical and empirical bases related to the research topic, the background of the aligned research was examined.

In the second stage (qualitative part), using the interview tool and the theme analysis method, it finally leads to the identification of the effective components on the integration, agility, and financial performance of the supply chain of the mining industry. And the initial research model was drawn.

In the third stage (quantitative part), in order to fit the initial model, evaluate the measurement models (external model) and structural model (internal model) of the research, using the questionnaire tool (made by the researcher) and the method of structural equations with the method of partial least squares. , used.

Therefore, the diagram of research steps is drawn as below.

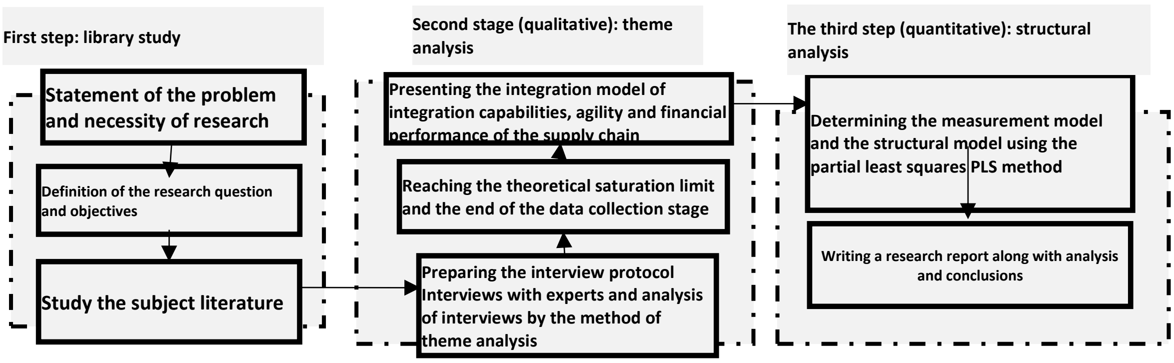

Figure 1- Research steps

Methods and tools for collecting data and information

In general, the methods of collecting information are divided into two categories: library and field, in this research, both methods were used, and the information needed for the research was obtained from the following sources according to the stages of the research. Came:

Quality stage:

In this research and in the qualitative stage, interviews will be used to identify the components of integration capabilities, agility and financial performance of the supply chain.

Quantitative step:

In this research and in the quantitative stage, a questionnaire will be used to fit the model (examination of the measurement model and the structural model of integration capabilities, agility and financial performance of the supply chain).

The research community in the qualitative stage:

The research community in the qualitative part is the experts of Angoran Zanjan lead and zinc mining complex, Mote gold complex, Central Plateau iron ore complex, Kalibar nepheline complex, Sabzevar ferrochrome complex, Kahnuj titanium complex, Jalalabad iron ore complex, Potaskhor complex, Zarand Coking Company, Zarshouran Gold Company, Phosphordi Phosphate Complex, Sefidabah Antimony Complex, Mehdi Abad Lead Complex, Sangan Iron Ore Complex, Glendroud Coal Complex and academic experts.

The research community in the quantitative stage:

The research community in the quantitative section includes all the experts related to the research topic in the mining industry companies mentioned above. Table 3-1 (appendix)

Determining the sample size in the quantitative stage:

In order to determine the random sample size in structural equations by partial least square (PLS) method, available sampling method and Cochran's formula are used as follows:

$$N = \frac{t^2 pq}{d^2}$$

In this formula, N is the population size.

The p-statistic is the percentage of distribution of traits in the society, i.e. the proportion of people who have the trait under study.

The q statistic is also the percentage of people who do not have the trait under study.

If the amount of p and q is not known, use their maximum value, i.e. 0.5.

The statistic is z=t and at the 5% error level, the value of t is equal to 1.96 and t2 is equal to 3.61.

The d value is also the difference between the real proportion of the trait in the society and the researcher's estimate for the presence of that trait in the society. The accuracy of sampling depends on this factor, and if we want to have the most accurate sampling, we should use the maximum d value of 0.05.

According to the aforementioned cases, the minimum sample size for the current research was estimated to be 384 people. Based on this, the research questionnaire (appendix) was designed and provided to the respondents.

Reliability and validity of data collection tools

First, the relevant scientific sources were studied and in order to prepare the questionnaire and the required variables for each of the factors, in order to determine the validity of its content, opinions were sought from expert professors and the questionnaire was approved by them.

In this research, by referring to the opinions of experts and conducting in-depth interviews to reach the consensus of experts, the required standards have been met in the estimation of parameters and some initial values of variables. In addition, in order to ensure the validity of the research findings and the accuracy of the analysis of the processes, after conducting 12 interviews, it was seen that the main and secondary factors were repeated in the interviews and the answers follow a repetitive process, but for more certainty, three more interviews were also conducted and The sample was confirmed with 15 people and the interview process was ended and the researcher reached theoretical saturation. Some of the codings as well as the results of the research were shared with some of the interviewees and based on the comments provided, the review process and results were revised, modified and confirmed. To confirm the validity of the research, retest methods (stability index) and reproducibility index were used based on different perspectives, especially the perspective (Khastar, 2008).

Retest reliability calculation (stability index)

To calculate the open reliability of the test, the working method is as follows: among all the interviews, some samples are randomly selected and each of them; They are coded twice, in a short and specific time interval (between five and thirty days). Then, the specified codes in two time intervals are compared with each other for each of the interviews, and the stability index for that research is calculated through the amount of agreements and non-agreements in two stages of coding. In each of the interviews, the codes that are similar in two time intervals are labeled as "agreement" and the codes that are not similar are labeled as "disagreement". The proposed method for calculating the reliability of the test between the codings of the researcher, in two time intervals, which is the stability index. It is like this:

"retest reliability percentage" = "2 x number of agreements" / "total number of codes" x "100"

Considering that agreements are determined by referring to two codes and non-agreements are determined by referring to one code, to consider this effect, the number of agreements should be multiplied by 2.

In the present study, to calculate the reliability using the test-retest reliability method, three interviews were selected as samples from among the conducted interviews and each of them was recoded in a short time interval (two weeks). Then the specified codes were compared in two time intervals for each of the interviews. In each of the interviews, codes that were similar in two time intervals were identified as "agreement" and non-similar codes as "disagreement".

As can be seen in Table 1, the total number of codes, in two 15-day time intervals, equals 51, the total number of agreements between codes, in these two times, equals 20 and the total number of non-agreements (agreements that are expected by chance be) equal to 11 in these two times. The re-test reliability of the interviews of this research, using the proposed method, is equal to 78%. Considering that this amount is more than 60%, it can be said that the reliability of the codings of this research is confirmed.

Calculation of reliability between two coders (repeatability index)

To calculate the reliability of the interview with the intra-subject agreement method of two evaluator coders, the researcher uses a research colleague (coder). The necessary and standardized training and techniques for coding the interviews are transferred to the research associate. Then, the researcher along with this research colleague will randomly select and code some interviews. The suggested method for calculating the reliability percentage between two coders (reproducibility index) which is used as the reliability index of the analysis is as follows:

"Reliability percentage between two coders" = "2 x number of agreements" / "total number of codes" x "100"

In the present study, to calculate the reliability of repeatability with the intra-subject agreement method of two coders (evaluators), one of the experts familiar with the subject was requested to be used as a research partner (coder) in the research. The necessary training and techniques for coding the interviews were transferred to them. Then, the researcher along with this research colleague randomly selected and coded the number of three interviews and the percentage of agreement between the coders was calculated.

Table 1- Calculating the reliability of the test (stability index)

Retest reliability (percentage)	*Number of disagreements*	*Number of agreements*	*Total number of codes*	*interview*
73%	5	7	19	*2*
77%	4	7	18	*10*
85%	2	6	14	*12*
78%	11	20	51	*Total*

Table 2- Calculation of reliability between two coders (repeatability index)

Retest reliability (percentage)	*Number of disagreements*	*Number of agreements*	*Total number of codes*	*interview*
82%	4	7	17	*2*
81%	4	9	22	*10*
84%	3	8	19	*12*
83%	10	24	58	*Total*

Verbal evidence 30 items	Basic coding 16 items	Sub-theme 4 items	main theme
Interviewee 1 "We should share production planning and demand forecast data with the key partners of the supply chain in the mining industry through the integration of the supply chain in the mining industry. Interviewee 4 "One of the main aspects in creating coordination is information sharing, so that in the context of supply chain coordination, the high level of interdependence depends on the high level of information sharing. Interviewee 10 "Close relationships between suppliers and parent companies have created significant integration in the digital supply chain. Currently, data sharing is the most widely used component of the mineral supply chain that helps create a connected society.	Sharing data with key supply chain partners	Supply chain integration	Combining integration capabilities, agility and financial performance of the supply chain
Interviewee 3 "Key partners in the supply chain of the mining industry must inform each other of their changing needs, which is realized through the integration of the supply chain in the mining industry.	Informing key supply chain partners of changing needs		
Interviewee 2 "The key partners of the supply chain through the process of integrating the supply chain in the mining industry in the planning activities and setting the goals should cooperate and participate.	Participation of key supply chain partners in planning activities and setting goals		
Interviewee 5 "Regarding cooperation strategies and production-business plans, the purpose of reaching a common business plan is the participation of supply chain partners in planning and setting goals.	Regular and joint resolution of existing problems with key supply chain partners		
Interviewee 8 "An agile supply chain must quickly respond to changing needs by designing new and innovative processes. Interviewee 12 "The mining industry has always been subject to paradigm changes. These changes have been transitioning from manual industry to mass production, then to lean production, and in the present era to agile production.	Agility in processes	Supply chain agility	
Interviewee 3 "Supply chain integration is a strategy that creates a single system that can bring together multiple stakeholders involved in the process for greater efficiency, agility and, consequently, cost savings. bring. Interviewee 11 "Since mining industries operate on a large scale, they are very expensive. Therefore, an agile supply chain is needed to quickly react to the increase in costs and adjust them.	Agility in cost adjustment		
Interviewee 2 "The supply chain should be agile enough to quickly respond to the needs in the area of product improvement. Interviewee 6 "We need agility in the company because unscrupulous but obvious copying of products and services always occurs. Therefore, we must always think about improving and upgrading the product.	Agility in product improvement		
Interviewee 7 "In today's competitive world, presenting or introducing new products to the mining industry market should be more agile.	Agility in presenting/introducing new products to the market		
Interviewee 8 "Agile supply chain in mining industries is important in terms of being able to effectively increase and decrease its production capacity while maintaining normal efficiency.	Agility in adjusting production capacity		
Interviewee 9 "The opportunities for growth and profitability of industrial-mining companies are different according to the selection criteria of suppliers in the	Profitable growth	Supply chain financial performance	

Verbal evidence 30 items	Basic coding 16 items	Sub-theme 4 items	main theme
supply chain. Interviewee 14 "Supply chain capabilities play a fundamental role in allowing mining companies to exploit emerging opportunities to enhance growth and improve profitability.			
Interviewee 6 "As a result of higher market share growth, mining companies can increase their sales, which may lead to greater profitability and, ultimately, better financial performance.	Market share growth		
Interviewee 4 "Investment growth in the mining supply chain is a strategic move that has the potential to create significant profitability and sustainable growth of financial performance. Interviewee 5 "With the strategic allocation of resources and the growth of investment in innovative technologies, companies active in mining industries can create significant financial performance while optimizing operational efficiency. Interviewee 15 "Advanced operational efficiency, risk reduction, customer satisfaction, data-driven decision-making, sustainability and collaborative innovation are some of the main factors that contribute to the growth of mineral supply chain investments.	Investment growth		
Interviewee 3 "By investing in green technologies, renewable energy and reuse of recycled products such as purified water, mining industry companies can reduce costs related to waste disposal, energy consumption and compliance with environmental regulations and thereby Increase the yield of their assets. Interviewee 14 "There is a negative relationship between the asset growth of mining companies listed on the Tehran Stock Exchange and the stock returns of these companies, and this negative relationship is probably greater in companies that rely on bank financing for growth.	Growth in return on assets		
Interviewee 3" IoT technology helps track and monitor products in real time and enables mining companies to make informed decisions about their supply chain. Interviewee 15 "[Digital technology] has real potential to optimize supply chain operations, especially to collect data from many data sources and measure performance in real time.	Data collection and informed decision-making	Digital technology in the supply chain	
Interviewee 9 "Digital technologies provide remote monitoring, tracking and control of supply chain processes of mining industries that are typically scattered or far from cities. Interviewee 10 "Automation of operations and systems through digital technology can simplify the work along the supply chain.	Remote monitoring, tracking and control of processes		
Interviewee 1 "Digital technologies provide a large amount of data to perform advanced data analysis for decision making. Interviewee 3 "Advanced analytics can play an important role in making digital supply chain management data usable, providing greater insight into processes, products and people in the mining industry, and in turn, supply chain leaders Enables them to make better decisions to improve operations and business. Interviewee 13 "If a mining company cannot analyze and use data quickly and intelligently, a huge amount of collected supply chain data is of little use.	Advanced analysis		

As can be seen in Table 2, the total number of codes recorded by the researcher and research associate is equal to 58, the total number of agreements between these codes is 24, and the total number of disagreements between these codes is equal to 10. The reliability between the coders for the interviews conducted in this research, using the mentioned formula, is equal to 83%. Considering that this reliability rate is more than 60%, it can be said that the reliability percentage between coders is confirmed in this research.

data analysis method

Analysis method in the qualitative section

theme analysis

In this research, in order to identify the effective components in integrating the integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology from the interview and to analyze them and draw the study model, the six-step inductive theme analysis method of Brown and Clark (2006), was used.

Analysis method in quantitative research

Structural equation modeling

In this research, structural equation modeling with partial least squares (PLS) approach was used to validate the research model.

4. Data analysis

Qualitative data analysis - identification of dimensions and components

In this research, interviews and theme analysis methods were used to identify dimensions and components. In the current research, the data has been reviewed many times and in some cases, the need to return to the previous stage was felt. Although during the research process, the researcher needed to go back to the previous stages in order to increase the accuracy and accuracy of the investigations; But in general, it can be said that after collecting the data, the research process in the qualitative part has been carried out according to the steps that will be explained.

Due to the limitation of the number of pages of the article, tables and graphs are presented in the appendix.

Getting to know the data

This stage starts when the researcher has read the interviews and got familiar with them. This stage was completed by underlining the parts of the interview text (15 interviews) that are interesting and related to the research topic.

Table 6. Summary of the results of the current research in the qualitative section (theme analysis).

According to the results of the current research in the qualitative part, a model for integrating the integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology has been presented, according to Figure 2.

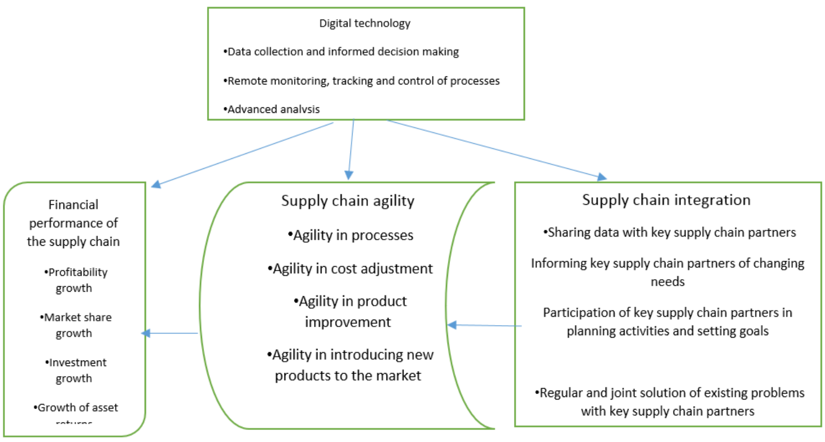

Figure 2. Initial research mode

In general and according to the model presented in the research (Figure 2), it is possible to explain the combination of integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology in such a way that due to the need to share Sharing data with key supply chain partners, informing key supply chain partners of changing needs, participation of key supply chain partners in planning activities and setting goals, as well as regular and joint resolution of existing problems with key supply chain partners as The supply chain integration set that affects the agility of the supply chain, including agility in processes, agility in cost adjustment, agility in product improvement, agility in offering/introducing new products to the market, and agility in adjusting production capacity; If there are conditions such as data collection and informed decision-making, remote monitoring, tracking and control of processes, as well as advanced analysis as a moderating role of digital technology in the supply chain; The optimal financial performance of the supply chain, which includes profitability growth, market share growth, investment growth, and asset yield growth, will be realized.

Validation of the research model

In this part of the research, the results of the qualitative part are tested using the PLS method. First, the descriptive statistics and then the inferential statistics resulting from the analysis are reported.

Descriptive findings of the quantitative part of the research

In order to provide a proper perspective on the characteristics of the studied people, in this section, the distribution of the frequency of sample people according to demographic variables is presented. Also, in order to better compare the distribution of the studied people, in addition to stating the number of people in terms of demographic variables, these figures are also expressed as a percentage. Finally, the graphs related to the distribution of people are also given below the corresponding table so that a better comparison can be drawn.

In the following, using the structural equation modeling test by the method of partial least squares, The measurement and structural model has been investigated.

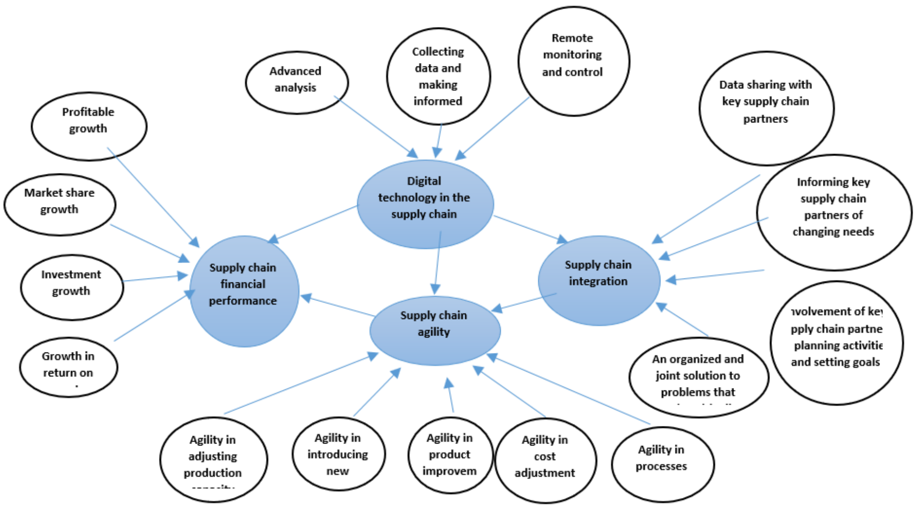

Figure 3. A view of the model drawn in PLS software

Fit of measurement models

Factor loadings of obvious variables

For this purpose, factor loading values were examined. Some suggested to remove the reflective observed variable from the measurement model that is below 0.7, if the composite reliability of the corresponding reflective measurement model is increased by removing it (Serstedt et al., 2017). In this model, all relationships were analyzed simultaneously. In the following, the research model is presented in the form of standardized coefficients.

As seen in Figure 4, the path coefficient was used to evaluate the model. Each path coefficient in PLS structural model can be considered equivalent to a standardized beta coefficient in ordinary least squares regressions. The structural paths whose sign agrees with the algebraic sign of the previous assumptions provide an empirical validation to the theoretical assumptions about the relationships between the underlying variables. The paths whose algebraic signs are opposite to expectations do not confirm the previously formed hypotheses. Based on this, the results of the significance of factor loadings (external) after removing cases less than 0.7 are shown in Table 11.

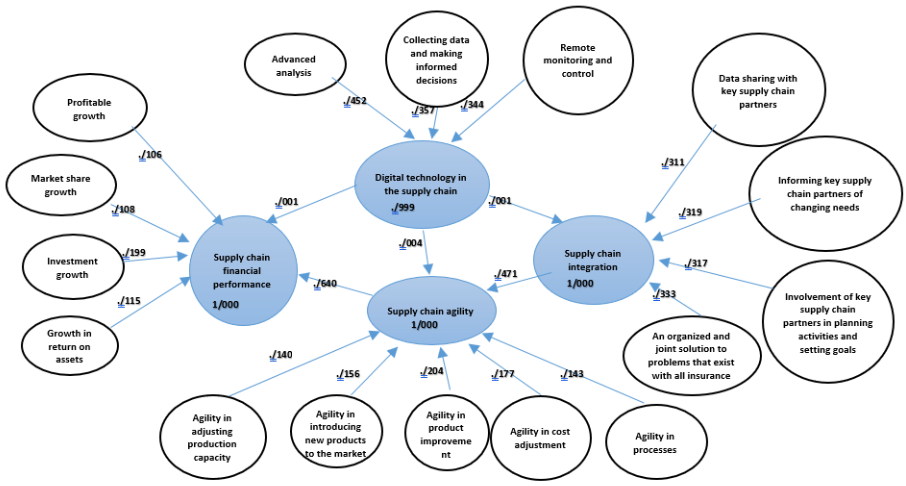

Figure 4. Test of the research model in the case of standardized coefficients

Table 11. The results of factor loading of indicators

0/852	R1 <- Data sharing with key supply chain partners
0/822	R10 <- Agility in processes
0/776	R11 <- Agility in processes
0/785	R12 <- Agility in cost adjustment
0/860	R13 <- Agility in cost adjustment
0/868	R14 <- Agility in product improvement
0/862	R15 <- Agility in product improvement
0/770	R16 <- Agility in presenting/introducing new products to the market
0/881	R17 <- Agility in presenting/introducing new products to the market
0/890	R18 <- Agility in adjusting production capacity
0/816	R19 <- Agility in adjusting production capacity
0/754	R2 <- Data sharing with key supply chain partners
0/803	R20 <- Profitable growth
0/753	R21 <- Profitable growth
0/816	R22 <- Market share growth
0/810	R23 <- Market share growth
0/877	R25 <- Investment growth
0/894	R27 <- Investment growth
0/705	R29 <- Supply chain financial performance

1/000	R29 <- Growth in return on assets
0/811	R30 <- Collecting data and making informed decisions
0/835	R31 <- Collecting data and making informed decisions
0/781	R32 <- Remote monitoring, tracking and control of processes
0/811	R33 <- Remote monitoring, tracking and control of processes
0/729	R33 <- Supply chain financial performance
0/740	R33 <- Digital technology in the supply chain
0/715	R33 <- Supply chain agility
0/720	R33 <- Supply chain integration
0/762	R34 <- Digital technology in the supply chain
0/886	R34 <- Advanced analysis
0/704	R35 <- Digital technology in the supply chain
0/866	R35 <- Advanced analysis
0/742	R4 <- Informing key supply chain partners of changing needs
0/869	R5 <- Informing key supply chain partners of changing needs
0/803	R6 <- Participation of key supply chain partners in planning activities and setting goals
0/838	R7 <- Participation of key supply chain partners in planning activities and setting goals
0/843	R8 <- Regular and joint resolution of existing problems with key supply chain partners
0/806	R9 <- Regular and joint resolution of existing problems with key supply chain partners

As the results of Table 11 show, the factor load values of the items (indices) after removing the items are less than 0.7. Therefore, the measurement model is a homogeneous model and the factor loading values are acceptable values.

Composite reliability coefficient

Convergent validity

As can be seen in Table 12, composite reliability and convergent validity of each of the dimensions are reported.

The results of the composite reliability check in Table 12 showed that the values of these indices for all hidden variables are greater than 0.7, and therefore the reliability of the measurement tools was confirmed using these two indices. Also, the results of examining the extracted variance values of the hidden variables of the research (convergent validity) showed that all variables had values greater than 0.5. Based on this, it can be said that the convergent validity of the measurement tools was confirmed using the extracted average variance index.

Table 12. Reliability values (composite reliability and convergent validity)

Convergent validity (AVA>0/5)	Composite reliability (Alpha>0/7)	
0/653	0/789	Informing key supply chain partners of changing needs
0/647	0/785	Data sharing with key supply chain partners
0/768	0/869	Advanced analysis
0/677	0/808	Collecting data and making informed decisions
0/680	0/809	Regular and joint resolution of existing problems with key supply chain partners
0/784	0/879	Investment growth
0/661	0/796	Market share growth
0/606	0/754	Profitable growth
0/٦20	0/932	Supply chain financial performance
0/504	0/859	Digital technology in the supply chain
0/674	0/805	Participation of key supply chain partners in planning activities and setting goals
0/634	0/776	Remote monitoring, tracking and control of processes
0/685	0/812	Agility in presenting/introducing new products to the market

Convergent validity (AVA>0/5)	Composite reliability (Alpha>0/7)	
0/748	0/856	Agility in product improvement
0/678	0/808	Agility in cost adjustment
0/729	0/843	Agility in adjusting production capacity
0/639	0/780	Agility in processes
0/617	0/921	Supply chain agility
0/646	0/886	Supply chain integration

Structural model fit

Path coefficients in the form of t-value statistics:

The structural model tests the hypotheses or the relationships of the existing variables. Based on this, the research model was tested using the partial least squares technique and Smart Pls software. In the following, the structural model of the research is fitted and presented in a significant state (t-statistic) (Figure 5).

According to the model fitted in Figure 5, the value of the t statistic for all paths except "digital technology in the supply chain -> financial performance of the supply chain" is greater than 1.96 and the probability of the said statistic is less than 0.05. Therefore, it is within the acceptable range. Accordingly, according to the fitted model; Path coefficients, standard deviation, T statistic and probability value (P) are as follows:

According to the results obtained from Table 13, the T statistic shows the significance of the relationships of the model variables, because the probability value of this statistic is less than 0.05. In other words, the significance test of path coefficients shows that all paths except "digital technology in the supply chain -> financial performance of the supply chain" are statistically significant and their effect is confirmed. This means that the components compiled in the research model have adequate reliability after removing the above path.

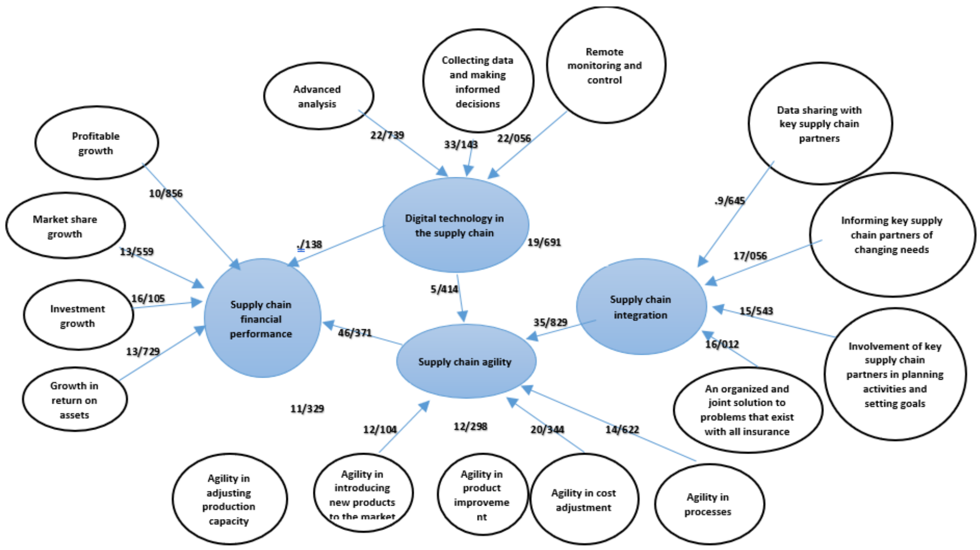

Figure 5. The test of the structural model of the research in the significance mode (t statistic)

Table 13. Structural model execution results

Probability values	T statistic	standard deviation	Path coefficients	
0/000	17/056	0/011	0/192	Informing key supply chain partners of changing needs -> supply chain integration
0/000	9/645	0/016	0/150	Data sharing with key supply chain partners -> Supply chain integration
0/000	22/739	0/018	0/416	Advanced Analytics -> Digital Technology in Supply Chain
0/000	22/056	0/017	0/373	Data collection and informed decision-making -> Digital technology in the supply chain
0/000	16/012	0/013	0/212	Regular and joint resolution of existing problems with key supply chain partners -> Supply chain integration
0/000	13/729	0/006	0/084	Growth in return on assets -> financial performance of the supply chain
0/000	16/105	0/007	0/116	Investment growth -> supply chain financial performance
0/000	13/559	0/008	0/102	Market share growth -> supply chain financial performance
0/000	10/856	0/009	0/098	Profitability growth -> supply chain financial performance
0/890	0/138	0/010	0/001	Digital technology in the supply chain -> financial performance of the supply chain
0/000	5/414	0/013	0/068	Digital technology in the supply chain -> supply chain agility
0/000	19/691	0/026	0/509	Digital technology in the supply chain -> supply chain integration
0/000	15/543	0/014	0/215	Involvement of key supply chain partners in planning activities and setting goals -> supply chain integration
0/000	33/143	0/012	0/381	Remote monitoring, tracking and control of processes -> digital technology in the supply chain
0/000	12/104	0/009	0/108	Agility in presenting/introducing new products to the market -> Agility of the supply chain
0/000	25/298	0/006	0/145	Product improvement agility -> supply chain agility
0/000	20/344	0/007	0/134	Agility in cost adjustment -> supply chain agility
0/000	11/329	0/009	0/103	Agility in adjusting production capacity -> Agility of the supply chain
0/000	14/622	0/008	0/117	Agility in processes -> supply chain agility
0/000	46/371	0/016	0/740	Supply chain agility -> supply chain financial performance
0/000	35/829	0/015	0/539	Supply chain integration -> supply chain agility

Investigating differential or discriminant validity

In this research, Fornell-Larker test was used for differential validity. According to this criterion, a hidden variable compared to other hidden variables, should have more dispersion among its observables, so that it can be said that the hidden variable in question has high diagnostic validity. Based on this, the root mean extracted of each hidden variable must be greater than the maximum correlation of that hidden variable with other hidden variables. Next, as seen in Table 14, the differential validity of each variable has been calculated.

Based on the results obtained from Table 14, the root mean extracted of each hidden variable (gray cell) is greater than the maximum correlation of that hidden variable with other hidden variables (column under the gray cell). Based on this, the divergent validity of the measurement model was confirmed using the Fornell-Larker test.

Model strength or validity (Q2)

The values obtained from this test are positive, which indicates the appropriate quality of the structural model. Regarding the predictive power of the model regarding endogenous latent variables, three values of 0.02, 0.15, and 0.35 have been introduced as weak, medium, and strong values for this index, respectively (Serstedt et al., 2017). Based on this, the results of model prediction power or redundancy validity are stated in Table 15, which are at an acceptable level.

Table 14. Divergent validity of mutual factor loadings of hidden variables

	Informing key supply chain partners of changing needs	Data sharing with key supply chain partners	Advanced analysis	Collecting data and making informed decisions	Regular and joint resolution of existing issues with key supply chain partners	Growth in return on assets	Investment growth	Market share growth	Profitable growth	Supply chain financial performance	Digital technology in the supply chain	Involvement of key supply chain partners in planning activities and setting goals	Remote monitoring, tracking and control of processes	Agility in presenting/introducing new products to the market	Agility in product improvement	Agility in cost adjustment	Agility in adjusting production capacity	Agility in processes	Supply chain agility	Supply chain integration
Informing key supply chain partners of changing needs	0.808																			
Data sharing with key supply chain partners	0.429	0.804																		
Advanced analysis	0.359	0.198	0.876																	
Collecting data and making informed decisions	0.409	0.331	0.468	0.843																
r and joint resolution of existing issues with key supply chain p	0.465	0.482	0.452	0.564	0.825															
Growth in return on assets	0.445	0.279	0.444	0.580	0.501	1.000														
Investment growth	0.351	0.130	0.572	0.424	0.505	0.400	0.885													
Market share growth	0.396	0.312	0.513	0.520	0.305	0.340	0.340	0.813												
Profitable growth	0.277	0.084	0.500	0.363	0.399	0.488	0.472	0.385	0.778											
Supply chain financial performance	0.664	0.448	0.715	0.751	0.754	0.705	0.695	0.650	0.627	0.983										
Digital technology in the supply chain	0.484	0.293	0.837	0.824	0.606	0.608	0.582	0.597	0.515	0.878	0.901									
ent of key supply chain partners in planning activities and sett	0.629	0.304	0.431	0.293	0.528	0.428	0.412	0.412	0.375	0.666	0.475	0.821								
Remote monitoring, tracking and control of processes	0.473	0.223	0.646	0.670	0.535	0.542	0.484	0.481	0.445	0.778	0.710	0.475	0.806							
Agility in presenting/introducing new products to the market	0.400	0.278	0.547	0.350	0.435	0.322	0.468	0.614	0.500	0.679	0.530	0.497	0.437	0.828						
Agility in product improvement	0.427	0.405	0.468	0.593	0.692	0.514	0.503	0.360	0.373	0.747	0.606	0.432	0.487	0.396	0.865					
Agility in cost adjustment	0.511	0.333	0.475	0.593	0.541	0.506	0.445	0.431	0.321	0.739	0.647	0.398	0.589	0.396	0.576	0.823				
Agility in adjusting production capacity	0.236	0.162	0.213	0.491	0.348	0.250	0.381	0.417	0.253	0.544	0.417	0.279	0.373	0.444	0.378	0.458	0.854			
Agility in processes	0.572	0.278	0.467	0.338	0.452	0.566	0.407	0.224	0.466	0.641	0.495	0.459	0.454	0.303	0.448	0.405	0.198	0.799		
Supply chain agility	0.694	0.498	0.706	0.742	0.779	0.664	0.626	0.597	0.530	0.983	0.873	0.678	0.784	0.653	0.773	0.767	0.546	0.647	0.969	
Supply chain integration	0.737	0.549	0.707	0.728	0.795	0.645	0.583	0.577	0.494	0.565	0.876	0.735	0.796	0.589	0.698	0.682	0.421	0.602	0.563	0.588

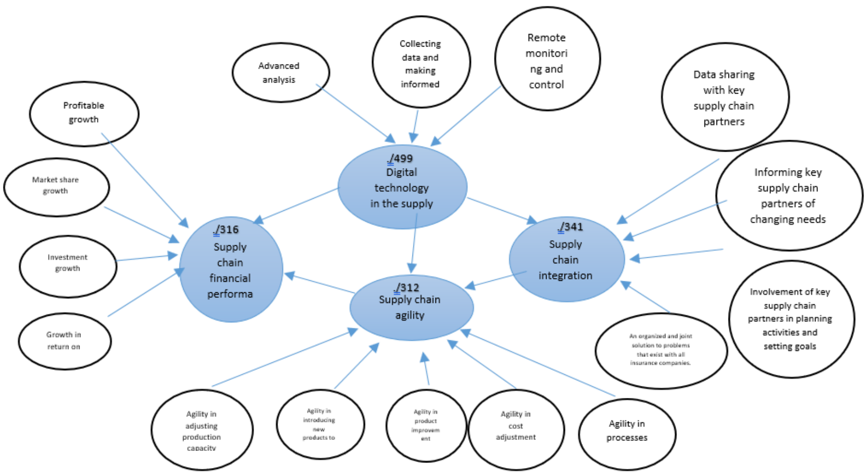

Figure 6. Model strength or validity (Q2)

According to the results reported in Table 15, the strength of the model or redundancy (Q2) are in the acceptable range (moderate to strong).
coefficient of determination (R2)
According to the results reported in Table 16, the coefficient of determination (R2) is in the acceptable (strong) range.
In general, the results showed that the integration of the supply chain has a positive and direct effect on the financial performance of the supply chain. Also, the factors related to digital technology in the supply chain directly and positively affect the integration and agility of the supply chain, and thus indirectly, it will facilitate the improvement of the financial performance of the supply chain. Therefore, according to the fitting results of the initial research model (Figure 2), the final model of Figure 7 is presented as follows:

Table 15. The results of model predictive power or redundancy

Q^2 (=1-SSE/SSO)	SSE	SSO	Hidden variables in the structural equation model
0/316	7926/140	11580/000	Supply chain financial performance
0/499	1159/344	2316/000	Digital technology in the supply chain
0/312	6901/529	10036/000	Supply chain agility
0/341	3817/183	5790/000	Supply chain integration

Table 16. Results of determination coefficient (R2)

SSE	SSO	Hidden variables in the structural equation model
0/997	0/997	Supply chain financial performance
1/000	1/000	Digital technology in the supply chain
0/999	0/999	Supply chain agility
0/996	0/996	Supply chain integration

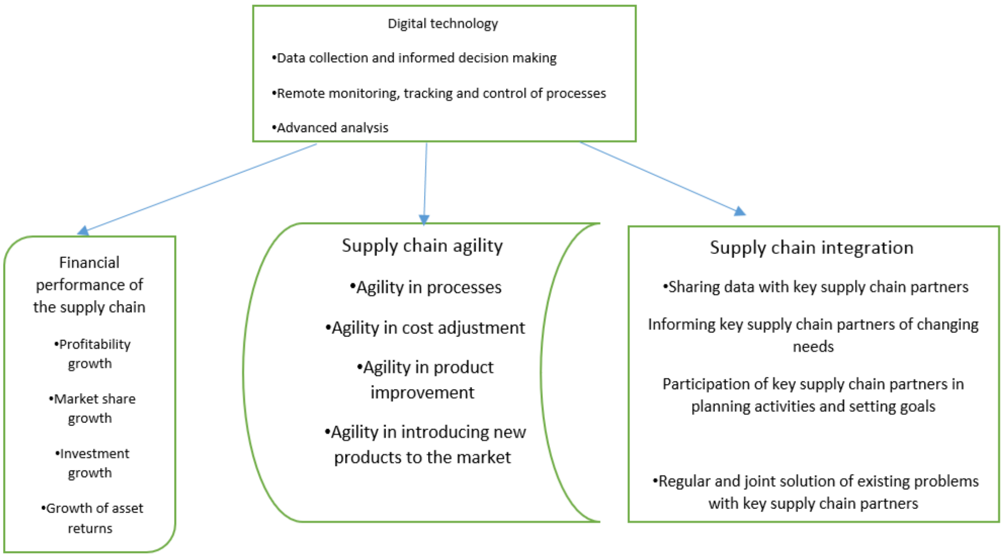

Figure 7. The integration model of integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology

5. Conclusion

According to the model presented in the research, the capabilities of supply chain integration include sharing data with key supply chain partners, informing key supply chain partners of changing needs, participation of key supply chain partners in activities Planning as well as setting goals is the systematic and joint solution of existing problems with key partners of the supply chain. In this regard and regarding the sharing of data with the key partners of the supply chain, it can be said that one of the main aspects in creating coordination is the sharing of information. So that in the context of supply chain coordination, the high level of interdependence depends on the high level of information sharing. In other words, close relationships between suppliers and parent companies have created significant integration in the digital supply chain. Currently, data sharing is the most widely used component of the mineral supply chain, helping to create a connected society. In this regard, key partners in the supply chain of the mining industry must inform each other of their changing needs, which is also realized through the integration of the supply chain in the mining industry. Because the key partners of the supply chain through this awareness through the process of integrating the supply chain in the mining industry can collaborate and participate in planning activities as well as setting goals. And finally, through this integration of the supply chain in the mining industry, solve the existing problems regularly and jointly with the key partners of the supply chain.

According to the model presented in the research, agility includes agility in processes, agility in cost adjustment, agility in product improvement, agility in presenting/introducing new products to the market, agility in adjusting production capacity. In this regard, it can be said that the mining industry has always been subject to paradigm changes. These changes have been transitioning from manual industry to mass production, then to lean production and in the present era to agile production. Therefore, the agile supply chain must quickly respond to the changing needs by designing new and innovative processes. Meanwhile, supply chain integration is a strategy that creates a single system that can bring together multiple stakeholders involved in the process for greater efficiency, agility and, consequently, cost savings. and since the mining industries operate on a large scale, they are extremely costly. Therefore, the agile supply chain is required to quickly react to the increase in costs and adjust them, and at the same time, quickly react to the needs in the field of product improvement. In fact, in today's competitive world, presenting or introducing new products to the mining industry market should be more agile. Therefore, the agile supply chain in the mining industry is important in terms of being able to effectively increase and decrease its production capacity while maintaining normal efficiency.

According to the model presented in the research, the financial performance of the supply chain includes profitability growth, market share growth, investment growth, asset return growth. In this regard, it can be stated that since the opportunities for growth and profitability of industrial-mining companies are different according to the selection criteria of suppliers in the supply chain, the capabilities of the supply chain play a fundamental role in allowing mining companies In order to take advantage of emerging opportunities to boost growth and improve profitability, and as a result of higher market share growth, mining companies can increase their sales, which may lead to greater profitability and, ultimately, better financial performance. On the other hand, growing investment in the supply chain of the mining industry is a strategic move that has the potential to generate significant profitability and sustainable growth in financial performance. By strategically allocating resources and growing investment in innovative technologies, mining companies can generate significant financial performance while optimizing operational efficiency. Among these, enhanced operational efficiency, risk mitigation, customer satisfaction, data-driven decision making, sustainability, and collaborative innovation are some of the main factors contributing to the growth of mineral supply chain investments. Therefore, with measures such as investing in green technologies, renewable energy and reuse of recycled products such as purified water, mining industry companies can reduce the costs related to waste disposal, energy consumption and compliance with environmental regulations and thereby increase efficiency. Increase their assets.

In general and according to the final model presented in the research Figure 7, the combination of integration capabilities, agility and financial performance of the supply chain with an emphasis on digital technology can be explained in such a way that due to the need to share data with the key partners of

the supply chain, informing the key partners of the supply chain of the changing needs, the participation of the key partners of the supply chain in planning activities, as well as setting goals, as well as the regular and joint solution of existing problems with the key partners of the supply chain as a set of creating factors Supply chain integration that affects the agility of the supply chain, including agility in processes, agility in cost adjustment, agility in product improvement, agility in offering/introducing new products to the market, and agility in adjusting production capacity; The optimal financial performance of the supply chain, which includes profitability growth, market share growth, investment growth, and asset yield growth, will be realized. In fact, the integration of the supply chain has a positive and direct effect on the financial performance of the supply chain. On the other hand, the provision of conditions such as data collection and informed decision-making, remote monitoring, tracking and control of processes as well as advanced analysis in the form of a set of factors related to digital technology in the supply chain, directly and It has a positive effect on the integration and agility of the supply chain and thus, indirectly, it will facilitate the improvement of the financial performance of the supply chain.
According to the research results regarding the effect of supply chain integration on the agility and financial performance of the supply chain; The use of artificial intelligence capabilities is suggested to the workers of the mining industry to integrate the supply chain.

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