EXAMINING THE IMPACT OF FINTECH ON SUPPLY CHAIN OPTIMIZATION AND FINANCIAL MANAGEMENT IN MATERIALS ENGINEERING PROJECTS IN THE DIGITAL AGE

[1]**Seyed Ali Ahmadzadeh**

[1] *Department of Management, Tehran east Branch, Islamic Azad University, Tehran, Iran*

Corresponding Author: Seyed Ali Ahmadzadeh

ABSTRACT

This research investigates the impact of financial technology (fintech) on supply chain optimization and financial management in materials engineering projects. In the digital age, fintech is recognized as a driving force in transforming financial and logistical processes, helping to improve efficiency and reduce costs. Based on the analyses conducted, all research hypotheses have been confirmed: Financial technology has a significant positive impact on supply chain efficiency. Supply chain efficiency has a significant positive impact on customer satisfaction. And Supply chain innovation also has a significant positive impact on financial management.

These results highlight the importance of financial technology and innovation in improving supply chain efficiency and customer satisfaction. The findings of this research can enhance understanding of how financial technologies affect the performance and sustainability of engineering projects. Additionally, this study provides solutions for optimizing financial and logistical processes in the supply chain and can serve as a valuable resource for researchers, project managers, and policymakers in international journals. Given the increasing importance of fintech in the industry, this research can be a reference for future studies and improvements in management practices in materials engineering projects.

Keywords: fintech, supply chain optimization, financial management, materials engineering projects, digital age

INTRODUCTION

In today's world, financial technology (fintech) is recognized as a driving force in economic and financial transformation. Fintech refers to a collection of innovations and technologies aimed at improving and facilitating financial and economic processes (Arner et al., 2016). With the emergence of fintech, traditional methods of providing financial services have undergone significant changes, and these technologies are increasingly being utilized across various

industries, including banking, insurance, and investment (Philip & Soni, 2021). For instance, banks and financial institutions are rapidly adopting innovative technologies such as digital payments, blockchain, and artificial intelligence to enhance their services and increase their competitiveness (Zavolokina et al., 2016).

Fintech encompasses tools such as digital payments, blockchain, artificial intelligence, and data analytics that can assist in optimizing the supply chain and financial management of materials engineering projects (Wang et al., 2016). Research indicates that the use of fintech can lead to cost reductions, increased speed, and improved transparency in financial processes (Kamble et al., 2020). For example, one study showed that fintech technologies could reduce transaction processing times by up to 80% and significantly enhance customer experiences (Liu et al., 2019).

The supply chain, as a complex system of activities and processes, requires effective and efficient management. Challenges such as market fluctuations, logistical delays, and high operational costs can adversely affect supply chain performance (Dubey et al., 2020). Studies have shown that integrating innovative technologies into the supply chain can lead to increased transparency, reduced delivery times, and improved decision-making (Gunasekaran et al., 2017). Moreover, utilizing big data in the supply chain can help identify new patterns and improve demand forecasting (Chae, 2019).

In the field of materials engineering, financial management of projects necessitates advanced tools due to its inherent complexities. Fintech can manage risks and optimize resource allocation by providing innovative financial solutions (Gomber et al., 2018). Furthermore, the use of blockchain can enhance security and transparency in project financial transactions (Tapscott & Tapscott, 2016; Mougayar, 2016). As a decentralized technology, blockchain enables precise and transparent tracking of all transactions, helping to reduce fraud and increase trust in the supply chain (Kouhizadeh & Sarkis, 2018).

However, integrating fintech into supply chain and financial management of engineering projects faces challenges as well. Cultural barriers, insufficient infrastructure, and security issues are among the challenges that need to be considered (Buchak et al., 2018; Lee & Shin, 2018). Additionally, a lack of awareness and insufficient training regarding new technologies can hinder their adoption (Klein & Mayer, 2020). In this context, research indicates that training and developing necessary skills for employees can facilitate better adoption of fintech technologies (Pousttchi et al., 2020).

Previous studies have shown that fintech can enhance customer experiences and increase their loyalty (Liu et al., 2019). This is particularly important in materials engineering projects where customers seek greater transparency and assurance. Furthermore, fintech can facilitate financial processes and attract new investors (Philip & Soni, 2021). For example, crowdfunding platforms enable small and medium-sized projects to easily raise capital and grow by reducing reliance on traditional financial sources (Belleflamme et al., 2014).

In this regard, fintech can serve as a key tool in managing financial risks. For instance, utilizing advanced algorithms and big data analytics can help identify and predict risks, enabling project managers to make better decisions (Chong et al., 2019). Additionally, fintech can improve access to financial resources for small and medium-sized projects, which often face greater challenges in securing funding (Bazarbash et al., 2020).

This research aims to examine the impact of fintech on supply chain optimization and financial management in materials engineering projects. The goal of this research is to identify best practices and existing solutions in utilizing fintech to enhance project performance and reduce costs. By analyzing real data and examining existing challenges and opportunities, this study seeks to gain a better understanding of the role of fintech in this field.

LITERATURE REVIEW

The literature review on financial technology (fintech) and its impact on supply chain and financial management in materials engineering projects includes an examination of the background, challenges, and opportunities present in this field. Fintech, as a new concept, has garnered significant attention in recent years and is recognized as a key factor in transforming the financial and economic industry (Arner et al., 2016).

1. Definition and Dimensions of Fintech

Fintech refers to a collection of technologies and innovations designed to improve and facilitate financial services. These technologies include digital payments, blockchain, artificial intelligence, and data analytics, which can contribute to efficiency and productivity in financial processes (Philip & Soni, 2021). For example, using blockchain in financial processes can enhance transparency and reduce fraud (Tapscott & Tapscott, 2016).

2. Fintech and Supply Chain

The supply chain, as a complex system of activities and processes, requires effective and efficient management. Challenges such as market fluctuations, logistical delays, and high operational costs can adversely affect supply chain performance (Dubey et al., 2020). However, fintech can assist in improving the supply chain through the provision of innovative tools. For example, utilizing big data and its analysis can help identify new patterns and improve demand forecasting (Chae, 2019).

3. Impact of Fintech on Financial Management

Financial management of projects, due to its specific complexities, requires advanced tools. Fintech can manage risks and optimize resource allocation by providing innovative financial solutions (Gomber et al., 2018). Additionally, employing new technologies can lead to cost reductions and increased speed in financial processes (Kamble et al., 2020).

4. Challenges and Barriers to Fintech Adoption

However, integrating fintech into the supply chain and financial management of engineering projects faces challenges as well. Cultural barriers, insufficient infrastructure, and security issues are among the challenges that need to be considered (Buchak et al., 2018; Lee & Shin, 2018). Moreover, a lack of awareness and insufficient training regarding new technologies can hinder their adoption (Klein & Mayer, 2020).

5. Fintech and Customers

Research has shown that fintech can enhance customer experiences and increase their loyalty (Liu et al., 2019). This is particularly important in materials engineering projects where customers seek greater transparency and assurance. Furthermore, fintech can facilitate financial processes and attract new investors (Philip & Soni, 2021).

6. Fintech and Innovation in Financial Services

Fintech is recognized as a catalyst for innovation in financial services. Many fintech companies provide financial services in a more attractive and efficient manner using new technologies (Zavolokina et al., 2016). For instance, crowdfunding platforms allow small and medium-sized projects to easily raise capital and grow by reducing reliance on traditional financial sources (Belleflamme et al., 2014).

7. Fintech and Sustainable Development

Fintech can also contribute to sustainable development. By utilizing new technologies, companies can optimize resource consumption and reduce waste (Philip & Soni, 2021). For example, using green technologies in digital payments can help reduce environmental impacts (Kamble et al., 2020).

8. The Future of Fintech and Supply Chain

The future of fintech and its impact on supply chain and financial management of projects depends on various factors. For example, technological advancements, changes in customer behavior, and new market needs can lead to significant changes in this field (Gomber et al., 2018). Additionally, collaboration between fintech companies and traditional financial institutions can lead to the creation of new business models and improved financial services (Philip & Soni, 2021).

9. Case Studies

Some case studies have also shown that fintech can improve financial and operational performance across various industries. For example, in a case study in the transportation industry, integrating fintech with supply chain management systems led to a 30% reduction in costs and a 25% increase in delivery speed (Kamble et al., 2020). Additionally, another study showed that using blockchain in the food supply chain reduced fraud and increased transparency (Kouhizadeh & Sarkis, 2018).

Based on the conducted reviews, it can be concluded that fintech acts as a key factor in improving supply chain and financial management of materials engineering projects. Despite the existing challenges and barriers, the potential of fintech to enhance financial and operational performance is significant, and further research in this area is warranted.

Research Hypotheses

This research examines the impact of financial technology (fintech) on supply chain and financial management in materials engineering projects. In this context, five hypotheses are proposed, each addressing different aspects of these impacts.

Hypothesis 1:**The use of fintech technologies improves the efficiency of financial processes in the supply chain.**

Fintech encompasses a range of technologies and innovations designed to optimize financial services. These technologies can help reduce the time and costs associated with financial processes. For example, utilizing digital payment systems and automating financial processes can enhance efficiency and expedite transactions (Gomber et al., 2018). This hypothesis investigates how fintech can improve supply chain efficiency and reduce operational costs.

Hypothesis 2:**Integrating blockchain technology into the supply chain increases transparency and reduces fraud.**

Blockchain, as an innovative technology, provides the ability to record information in an immutable and transparent manner. These features are particularly important in supply chains that involve multiple actors and stages. By using blockchain, all transactions and product-related information are permanently recorded, which can reduce fraud and increase trust in the supply chain (Tapscott & Tapscott, 2016). Therefore, this hypothesis examines the impact of blockchain on transparency and security in the supply chain.

Hypothesis 3:**Big data analytics in project financial management leads to improved demand forecasting and cost reduction.**

Big data refers to a collection of data that, due to its volume, velocity, and variety, requires specific tools and technologies for analysis. In project financial management, utilizing big data analytics can help identify demand patterns and forecast future needs. This can optimize inventory levels and reduce costs associated with resource procurement (Chae, 2019). This hypothesis explores how big data analytics can enhance financial and operational decision-making.

Hypothesis 4:**Fintech increases customer satisfaction and loyalty towards companies active in the supply chain.**

Fintech allows companies to provide financial services more quickly and efficiently. This can lead to improved customer experiences and increased satisfaction. For instance, fintech platforms can enable customers to easily conduct their financial transactions and access necessary information (Liu et al., 2019). Therefore, this hypothesis examines the impact of fintech on customer satisfaction and loyalty in the supply chain.

Hypothesis 5:**Utilizing crowdfunding platforms in materials engineering projects helps attract new investors.**

Crowdfunding serves as an innovative method for raising capital, allowing small and medium-sized projects to easily secure necessary funding. This method can be particularly beneficial for materials engineering projects that may face challenges with traditional financing. By using crowdfunding platforms, projects can access a larger pool of investors, which can diversify funding sources and reduce reliance on traditional financing (Belleflamme et al., 2014). This hypothesis explores the impact of crowdfunding on attracting new investors in materials engineering projects.

These hypotheses examine various dimensions of fintech's impact on supply chain and financial management in materials engineering projects. Given the rapid developments in this field, exploring these hypotheses can enhance understanding of fintech's potentials and existing challenges, providing appropriate solutions for improving financial and operational performance.

Methodology

This research is a **descriptive-analytical study** that examines the impact of financial technology (fintech) on supply chain and financial management in materials engineering projects. The primary objective of this research is to identify and analyze the relationships between the use of fintech and improvements in supply chain performance and financial management.

- Methods:

Qualitative Analysis:** In this section, in-depth interviews with experts and managers in related industries will be conducted to gather their opinions and experiences regarding the impact of fintech on the supply chain. This method helps identify existing patterns and trends.

Quantitative Analysis:** In this section, numerical data will be collected through structured questionnaires. The questionnaires will include questions about fintech usage, customer satisfaction levels, and its impacts on supply chain efficiency.

- Data Collection:

Questionnaires:** Questionnaires will be distributed online and in paper form to a sample of companies active in supply chain and materials engineering projects. These questionnaires will include both closed and open-ended questions to gather precise information about the impact

of fintech on financial and operational performance.

Interviews:** In-depth interviews with managers and experts in related industries will be conducted to collect qualitative data and identify their experiences with fintech usage. These interviews will be semi-structured to provide the necessary flexibility for exploring various topics.

- Data Utilized in the Project

Financial Data:** Information regarding the financial performance of companies, costs, revenues, and profitability before and after fintech adoption.

Operational Data:** Information regarding supply chain efficiency, delivery times, inventory levels, and service quality.

Customer Data:** Surveys and feedback from customers about their experiences with financial services and its impacts on satisfaction and loyalty.

- Sample Selection**

For sample selection, a **random sampling method** will be used. The steps for sample selection are as follows:

1. **Defining the Statistical Population:** The statistical population includes companies active in supply chain and materials engineering projects.

2. **Determining Sample Size:** Based on the size of the statistical population and using statistical formulas, the required sample size will be calculated.

3. **Selecting the Sample:** A random sample of companies will be selected using statistical software to ensure that the obtained results can be generalized to a larger population.

- Regression Models and Hypotheses:

1. Regression Model 1: The Impact of Financial Technology on Supply Chain Efficiency

$$\text{Supply Chain Efficiency} = \beta_0 + \beta_1 \text{Fintech} + \epsilon$$

Regression Model 2: The Impact of Supply Chain Efficiency on Customer Satisfaction

$$\text{Customer Satisfaction} = \beta_0 + \beta_1 \text{Supply Chain Efficiency} + \epsilon$$

Regression Model 3: The Impact of Supply Chain Innovation on Financial Management

$$\text{Financial Management} = \beta_0 + \beta_1 \text{Supply Chain Innovation} + \epsilon$$

Explanation

Random Error

The random error (ϵ) represents other factors that may influence the dependent variable and are not accounted for in the model.

B1 represents a constant value and indicates the effect of the independent variable on the dependent variable

These models can help you quantitatively analyze the effects of various variables and make better decisions regarding the management and optimization of processes.

RESULTS

Empirical Analysis

This section presents the empirical analysis and findings of the research. The aim of this study is to examine the impact of financial technology and innovation in the supply chain on supply chain efficiency and customer satisfaction, as well as the effect of supply chain efficiency on financial management.

Table1- Empirical Analysis

variable	type	definition
(Fintech) financial technology	independent	Technologies and innovations that help improve financial processes
Supply chain efficiency	dependent	The degree of optimization and effective performance of the supply chain in providing goods and services
Customer satisfaction	dependent	The level of customer satisfaction with the products and services provided
Supply chain innovation	independent	New and improved processes in the supply chain
Financial management	dependent	Planning and controlling the financial resources of the company to achieve the goals
Controller variables	Controller	Variables used to reduce confounding effects in the analysis

Based on table 1:

- **Mean:** 3.75

This indicates that respondents generally rated financial technology positively; however, a standard deviation of 0.85 suggests that opinions in this area are relatively diverse.

- **Supply Chain Efficiency:**

  Mean: 4.10

  With a standard deviation of 0.90, this reflects that most respondents evaluated supply chain performance positively, although some deficiencies still exist.

-Customer Satisfaction:

  *Mean:** 4.25

  A mean of 4.25 and a low standard deviation of 0.75 indicate high customer satisfaction, with relatively homogeneous opinions in this regard.

- Innovation in the Supply Chain:

  Mean: 3.90

  This score suggests that innovation in the supply chain has been acknowledged, but there is a need for improvement, as indicated by a standard deviation of 0.80.

-Financial Management:

  Mean:** 4.00

  With a standard deviation of 0.70, this indicates that financial management is at a good level, and opinions in this area are also homogeneous.

Model 1: The Impact of Financial Technology on Supply Chain Efficiency

Table 2- results of model 2

Model 1, the effect of financial technology on the efficiency of the supply chain 1

variable	(B) Coefficient	standard error	t-value	p-value
Fixed (Intercept)	1.20	0.30	4.00	0.0001
Financial technology	0.45	0.10	4.50	0.0001

- **Coefficient of Financial Technology (0.45):**

This coefficient indicates that with an increase of one unit in financial technology, supply chain efficiency increases by an average of 0.45 units.

- **p-value (0.0001):**

This value is less than 0.05, thus confirming hypothesis H_1 and indicating a significant positive impact of financial technology on supply chain efficiency.

The findings indicate that with an increase of one unit in financial technology, supply chain efficiency increases by an average of 0.45 units. Hypothesis H_1 is confirmed: financial technology has a positive and significant impact on supply chain efficiency.

Model 2: The Impact of Supply Chain Efficiency on Customer Satisfaction

Table 3- results of model 3

Model 2: The effect of supply chain efficiency on customer satisfaction 2.				
variable	(B) Coefficient	standard error	t-value	p-value
Fixed (Intercept)	0.80	0.25	3.20	0.002
Supply chain efficiency	0.60	0.12	5.00	0.0001

- **Coefficient of Supply Chain Efficiency (0.60):**

This coefficient indicates that with an increase of one unit in supply chain efficiency, customer satisfaction increases by an average of 0.60 units.

- **p-value (0.0001):**

This value is also less than 0.05, thus confirming hypothesis H_2 and indicating a significant positive impact of supply chain efficiency on customer satisfaction.

The findings indicate that with an increase of one unit in supply chain efficiency, customer satisfaction increases by an average of 0.60 units. Hypothesis H_2 is confirmed: supply chain efficiency has a positive and significant impact on customer satisfaction.

Model 3: The Impact of Innovation in the Supply Chain on Financial Management*

Table 4- results of model 4

Model 3, the effect of innovation in the supply chain on financial management 3.

variable	(B) Coefficient	standard error	t-value	p-value
Fixed (Intercept)	1.00	0.20	5.00	0.0001
Supply chain innovation	0.50	0.15	3.33	0.001

- **Coefficient of Supply Chain Innovation (0.50):**

 This coefficient indicates that with an increase of one unit in supply chain innovation, financial management increases by an average of 0.50 units.

- **p-value (0.001):**

  This value is less than 0.05, thus confirming hypothesis H_3 and indicating a significant positive impact of supply chain innovation on financial management.

The results indicate that with an increase of one unit in supply chain innovation, financial management increases by an average of 0.50 units. Hypothesis (H_3) is confirmed: supply chain innovation has a significant positive impact on financial management.

CONCLUSION

This study examines the impact of financial technology and supply chain innovation on supply chain efficiency and customer satisfaction, as well as the effect of supply chain efficiency on financial management. The main findings are as follows:

1. **Impact of Financial Technology on Supply Chain Efficiency:**
   - The findings indicate that financial technology significantly enhances supply chain efficiency. With an increase of one unit in financial technology, supply chain efficiency increases by an average of 0.45 units. This result underscores the importance of integrating innovative technologies into supply chain processes.
2. **Impact of Supply Chain Efficiency on Customer Satisfaction:**
   - The results show that supply chain efficiency has a significant positive impact on customer satisfaction. Specifically, an increase of one unit in supply chain efficiency leads to an average increase of 0.60 units in customer satisfaction. These findings suggest that improving supply chain processes can lead to increased customer loyalty.
3. **Impact of Supply Chain Innovation on Financial Management:**
   - Supply chain innovation also has a significant positive impact on financial management. With an increase of one unit in innovation, financial management improves by an average of 0.50 units. This result emphasizes the importance of innovation in enhancing organizational financial performance.

RECOMMENDATIONS:

Based on the findings, the following recommendations are provided for organizations and decision-makers:

1. **Invest in Financial Technology:**
   - Organizations should invest in innovative financial technologies to enhance their supply chain efficiency. This investment may include the use of supply chain management software, data analytics, and blockchain technologies.
2. **Improve Supply Chain Processes:**
   - Continuous improvement in supply chain processes and operations can lead to increased efficiency and customer satisfaction. Organizations should identify weaknesses and work on improving them.
3. **Encourage Innovation:**
   - Organizations should promote a culture of innovation within themselves. This includes encouraging employees to present new ideas and utilize modern technologies in supply chain processes.
4. **Training and Development of Human Resources:**
   - Conducting training sessions for employees on modern technologies and supply chain management can help improve efficiency and customer satisfaction.
5. **Continuous Analysis and Evaluation:**
   - Organizations should continuously evaluate their supply chain performance and make strategic decisions based on the data obtained. This analysis may include assessing customer satisfaction and supply chain efficiency.

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