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# Factors Affecting Green Business Process Management Readiness in the Iranian Banking Industry

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## Abstract

This study aimed to identify factors affecting the green management process readiness of banks and determining the interactions and priority of these factors. To this end, factors affecting the green management process readiness in the banking industry were extracted by using an in-depth study of the extant research and qualitative content analysis. Also, fuzzy DEMATEL method was used to explain and assess the interrelationships between the identified factors. The research sample included 14 experts in the process management field in the industry and academicians with knowledge of the concepts of emerging technologies and more than 10 years of experience at the level of managerial activities in the banking industry. Application of DEMATEL revealed that "green awareness", "green attitude", "green governance", and "green technology" are the influential factors, while "green operation", "green infrastructure", "green lifecycle", "green strategy", and "green policies" are permeable factors. It was also found that "green awareness" has the greatest impact on other factors and "green operations "is the most permeable factor. The obtained results might help to raise the awareness of individuals including managers, policymakers of the organizations toward establishing and fostering a green attitude to adopting green operations.

**Keywords:** Green business process management, Environmental sustainability, Green readiness, Banking industry, DEMATEL technique, Content analysis.

## 1 | Introduction

Environmental sustainability challenges represent an important issue for global economic stability in the United Nations Sustainable Development Goals in 2030. Businesses are under pressure from lawmakers, competitors, customers, and various groups of the community to implement sustainable business practices [1]. Creating a balance between economic and environmental performances in order to have a green business is one of the key and strategic issues in organizations. Business processes are one of the factors that can be changed to reduce an organization's harmful environmental outcomes [2]. In the face of global warming and rising energy costs in government agencies and private companies, investment in the search for ways to protect the environment has increased, leading to the emergence of a growing global movement to use ICTs in a way that is compatible with the environment has become.



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The name chosen for this movement is "Green Information and Communication Technology" and represents the use of information and communication technology to reduce energy consumption and environmental waste. It deals with energy and a set of methods to support the important mission of "saving the earth" [3]. Economic growth is no longer sustainable if pollution, waste, and the risks imposed by economic activities, production techniques, and consumption patents on the environment and ultimately on humans themselves are not taken into consideration. That is why in recent years the concept of sustainable development has received serious attention. Greenness is an advantage that all stakeholder will benefit from it.

The growing population of the world, the demand for living within the standard limits, the need for paying attention to sustainability practices, and the permanent exploitation of natural resources are on the agenda of organizations more frequently than in the past. Financial and banking institutions, with their mediating role in economic and investment exchanges, can play an effective role in fulfilling these goals. Banks, as part of society, are directly bound to observe environmental issues. As organizations providing services to help other sectors of the community, they also face sustainability challenges. Green banking means the combination of technological, operational, and customer behaviour changes in the banking business, decreasing the carbon footprint from banking activities, and promoting environmentally friendly measures. Considering all environmental aspects, the role of green banking is expected to be observed at all business process levels. The main emphasis on analyzing the concepts and needs of green banking in business processes aims at having an adaptable environment and enriching economic efficiency.

A look at Iran's position in terms of the Environmental Performance Index (EPI) over the past 15 years shows that country does not have a favorable position in terms of environmental indicators (both in the world and in the region), to the extent that Iran's ranking fell from 83 in 2014 to 105 in 2015 among 180 countries, representing the country's worst position in the last 15 years.

Traditionally, organizations have focused on economic requirements such as time, price, productivity, and quality in their attempt to manage their operations. This has turned organizations into the main destructor of the environment. Hence, organizations are progressively encouraged to advance their strategies from an environmental perspective [4]. To respond to the environmental and sustainability challenges, organizations monitor their processes and identify defective processes, evaluate and measure different scenarios based on environmental indicators, and design and implement a green process for the organization and the community. Green business processes refer to as all management actions done to monitor and decrease the environmental impacts of business processes in designing, implementing, and improving, contributing to making cultural changes in the product and service lifecycle [5]. Green business process management is to understand, document, model, analyze, simulate, and implement business processes regarding the environmental outcomes of such processes. The financial sector, and especially banks, has a key role to play in promoting environmental sustainability [6]. Banks face, directly and indirectly, environmental sustainability challenges. Green banking is a set of operations and codified instructions that make the bank economically, environmentally, and socially sustainable. In this system, banking processes are efficient and effective tools. Different channels such as ATMs, self-service payment machines, mobile banking, and internet banking contribute to environmental protection in the banking sector. This approach will reduce costs in the long term [7]. The green organization manages its inputs, recreates product and service processes based on sustainability indicators, and delivers green products to customers who demand these products, and thus creating a superior position compared to its competitors and making more profits. Therefore, green banking requires not only an insight-based philosophy that considers the organization to be responsible before the community but also need effective strategies to fulfill its goals. Such strategies are developed under the influence of by and in response to environmental changes. Green bank measures are generally divided into two categories: actions required to be taken by a bank as part of the community and actions to be taken by the bank as a service provider to help other community sectors that have targeted such an approach. In this study, readiness means the level of preparedness of individuals, systems, or organizations to assess the current

situation and carry out a series of planned actions. Readiness is developed based on planning, adequacy, and staff training, and the provision and maintenance of services, and the support for services or systems (business dictionary).

Despite the knowledge of banks about serious environmental issues and the expansion of areas such as green information technology as discussed in their academic and organizational literature, an issue of interest is to know how they can increase their readiness to eliminate the effects of their activities by using green business process management. Accordingly, the main aim of the present study was to identify factors affecting the green business process management readiness in the Iranian banking industry and the possible interrelationship between these factors.

In the second section of the research, the literature and previous studies will be reviewed. In the third section, the research methodology will be stated. In the fourth section, the data will be analyzed and the results will be given. In the fifth section, conclusions and research suggestions will be provided

## 2 | Literature Review

The UN's World Commission for Environment and Development in its report on "Our Common Future" defines sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". Stating that "the sustainable development strategy, in its broadest sense, intends to promote the coordination between human beings, humanity, and nature", the report emphasizes that sustainability requires an environmental and social perspective, along with an economic perspective, affecting the organization's development and performance. The sustainability nature is such that all three dimensions should be considered simultaneously without one dimension being preferred over others. This generally accepted definition establishes a balance between long-term goals and short-term decision-making concerning the unpredictable and uncertain future. Stability has been added to the classic management of business processes as an important dimension and takes into account considerations such as renewable energy consumption, carbon emissions, waste generation, and environmental performance in improving the management of an organization's operations [4].

Over the recent decades, utilizing information technology has expanded in various fields leading the development of life and business, and has provided many facilities to the public. While everyone wants extensive information technology advances, they should be aware of the environmental impacts and problems created by this technology [8]. The impact of information technology and its role in environmental and ecological sustainability, called green information technology, is a key issue in IT management. Information technology is known as a factor supporting business processes. Another role of IT is empowering the business with technology. The green information system means the use of information systems to achieve environmental goals [9] and [10]. With the growth of research on sustainability, the role of green information technology and green information systems has expanded in developing the design of green business processes [11]. Information systems play a key role in collecting, processing, and releasing information related to environmental sustainability in business processes [4]. Only through process modification and the use of process-oriented techniques, including process performance measurement, process analysis, and process improvement, information systems can create sustainable environmental organizations, and therefore an environmentally sustainable society [6]. In the interface empowered IT systems and process change, the greatest potential is created for creating sustainability innovations [4].

The financial sector, especially banks, plays an important role in promoting environmental sustainability. The banks that have employed the green banking model for their services have gone through two stages:

- *Identifying and explaining green strategies, services, products, and processes. By applying the appropriate measures and conditions; strategies, products, and services have transformed the banking processes into environmentally sustainable processes.*
- *Establishing a green organization. It includes creating green technology-based organizations, physically green organizations (including green buildings), and using innovations that guide the bank in providing services and designing internal strategies to protect the environment more effectively [12].*

This section provides a brief discussion of factors extracted from the literature contributing to the preparation of green business process management in banks:

**Green awareness.** Promoting environmental awareness is an easy way to become an environmental observer. There are many resources available to promote environmental awareness including group learning (inside or outside the organization), information and inspirational seminars, environmental books, brochures, and social networks [13].

**Green attitude.** Attitude is defined based on the assessment of emotions according to specific goals, and desirable or undesirable abstract actions or concepts. It is also referred to as the experience of individual life. Consequently, attitudes can be observed in individuals' behaviours, feelings, and beliefs. Green attitude is a set of beliefs and desires associated with environmental and sustainable actions [14].

**Green governance.** Case study showed that green technology needs "management infrastructure to understand the impacts, actions, prioritization, and management of organizational responses". Governance includes budget allocation, the definition of roles, responsibilities, and control, supervision on green innovations, and setting benchmarks for evaluating impacts in a transparent manner [15] and [16].

**Green strategies.** By using green strategy, the organization can make decisions that have positive impacts on the environment. The alignment of green strategies with the organization's strategies will enable the development of operational programs consistent with sustainability goals [17].

**Green policies.** Green policies are developed with the goal of creating a society with a sustainable environment and relies on adaption to the environment, lack of violence, social justice, public democracy, as well as local and indigenous issues. Green policies must be comprehensive, coordinated, and available throughout the organization and monitored continuously [18].

**Green measures.** Green banking measures are meant to promote environmentally friendly practices and reduce carbon footprint in daily banking activities. Green banks or environmentally accountable banks improve their standards and also affect the responsible behaviour of other businesses [19]. Teleworking and collective cooperation, carbon emission management, business applications, paperless communication cycle, green printing services, cloud computing, virtualization, smart management systems solutions, e-waste management, computer shut down management, green information technology, electricity consumption management, and cooling systems are among these measures [20].

**Green lifecycle management.** Redesigning banking processes is the first step in implementing green banking. Some important issues to be noted here are supply chain management, investment resource management, customer relationship management, service management, and green products. Other measures include reducing the energy consumed by computers and other information systems and utilizing them in an environmentally friendly manner. The equipment purchased by an organization must comply with environmental standards including energy star or electronic environmental assessment criteria. Green production is known as clean produce. Computers, electronic components, and other subsystems must be manufactured with the least effect on the environment. Replacing the IT equipment at a specific time interval so that any piece that complies with the hardware standards of the organization

can execute the software that it requires, can provide the possibility of reusing it. Eco-friendly disposal techniques are recommended to reduce environmental damages from electronic waste [21]-[23].

**Green technologies.** They are technologies that use the available energy in the best way and provide special equipment for activities. Such technologies also consider consumption on disposal of unused equipment. In the following section, business process management trends affecting two dimensions of strategy and technology are discussed [24] and [25]:

**Internet of Things (IoT).** This technology automatically responds for a specified period of time to the information received through the sensor from objects without human supervision. Managing business processes can manage, track, and store all the processes needed to work with sensors in real-time. This technology will disrupt the current payment culture and will create a future in which digital commerce and micropayment will potentially begin from a variety of locations. Customers need a realistic view of their money transfers and how they obtain their receipt [26].

**Blockchain.** According to Sanat Rao, the Chief Business Officer and Global Head of Finacle, "Blockchain technology has a great potential to help bank processes. This technology automatically helps to carry out intra-organizational processes and greatly improves transparency and available requirements". One of the most important and controversial uses of this technology is its application in the banking sector to the extent that can replace banks in the future [27], with this technology, cross-border transfers will be faster and cheaper. The invention and emergence of Bitcoin as an electronic currency in 2008 led to a major shift in traditional payment methods, resulting in more people paying attention to the problems of the traditional banking system and seeking solutions to these problems. With the use of smart contracts, the efficiency of transactions and payments in the stock market increases. Also, by speeding up and cheapening financial services, it is possible to coordinate this system with the changing order of the world, and this reduces transferred payment fees and transaction fees for credit cards [28]. Automatic recording of data and the possibility of reviewing them makes clearer the transaction and destination processes, making it easier to fight financial crimes such as money laundering. Digitization of this process not only reduces the extra costs and saves paper consumption, but also greatly simplifies tracking the customer affairs for banks and lawmakers.

**Cloud computing.** Is a model for generic, simple, and demand-based access through a network connected to a stock of adjustable computing resources that can be released and received with minimal management effort and with the least amount of communication, and high speed? Service models in cloud computing include software as a service, a cloud platform as a service, a platform as a service [29].

**Smartphones and devices.** By improving Internet access through smartphones, mobile phones have marked their place as a prominent banking channel. In their mission to provide value-added services to their customers and increase their revenues, banks are required to facilitate the performance of services such as cashing the copy of a check sent by a mobile phone, transferring funds, making payments, issuing statements, tracking costs, using mobile phones as a wallet, NFC, and mobile payments [30].

**Virtual assistant.** It enhances the performance of business processes. The user needs a natural language-based smart interface to use smartphones. A virtual personal assistant will progressively become more valuable as a mediator among people, objects, and business process management systems [31].

**Near real-time event processing support.** Providing better operational efficiencies is essential for business process management personnel. Understanding triggers and events can determine behaviour patterns that are utilized to identify opportunities or problems for a change. The core capabilities of business process management improve event processing, operational decision making, and real-time forecasting analysis [32].

**Adaptive Case Management (ACM).** Adaptive management is essential for unpredictable and nonstructural procedures where the precise sequence of activities and tasks is not determined. Business process management does not focus solely on structured processes. But many employees spend a lot of time responding to nonstructural and unpredictable work patterns. It is difficult to carry out these processes automatically because every event that is occurring must be responded ad-hoc and periodically until it is fully resolved. In unstructured procedures, the endpoint is known, but the way of achieving the final result is determined in each management phase, each stage, or the main step. Each case follows a specific sequence of activities and predefined results; therefore, to solve these unpredictable and indirect processes, adaptive management systems are applied. This feature is provided by the major manufacturers of green business process management systems, and it is commonly known in business process management systems as intelligent business process management systems [33].

**Process mining.** Organizations spend a lot of time on modeling because they are not able to understand all the information they need about the status quo. Process mining techniques allow the use of transaction logs to detect the existing conditions of the processes. This will help reduce the time required to detect the processes and model the existing situation. The mining process has many possible applications. Its three scenarios include process discovery using event information, process compliance review, and process enhancement [34].

**Increasing demand for the low-code business process management platform.** Companies now have fully automatic process software that can be customized in a few days and fully adapted to the company's procedures. The evolution of BPM into coding-free software has been playing a major role for many years. In 2018, many business process management software suppliers will try to develop low-code process-focused platforms [35].

**Immersive user experience requires augmented/virtual/mixed reality.** Business process management innovation involves the virtual reality of the three-dimensional environment, augmented reality (real-time use of data integrated with real objects), and emerging realities (extending the physical world - touch and sound) to improve employees' productivity to enable using them to increase design, visualization, and training, and provide free information when performing any business activity and process [36]. Banks are testing augmented reality to improve customer experience [37]. This technology enables them to provide integrated solutions to customers. In the future, banks will replace their traditional physical branches with virtual branches, and this will save time and money.

**Robotic Process Automation (RPA).** It is utilized to automate legitimate and repetitive business procedures that do not need Natural Language Processing (NLP). In business processes, some tasks are performed using bots (software robots) that perform different activities from desktop functions to complex operations with the same efficiency and error expected of a person and thus set aside more time for other activities to be done by employees [38]. The three main RPA applications include automation: automating repetitive tasks in order to speed them up by reducing risk and error, which reduces the number of employees required. Data recording: when performing automated processes, RPA can record data faster than humans. Digitizing: manipulating manual processes, such as data entry, to enable this functionality for employees to focus on knowledge-based tasks [39].

**Social media.** Banking interactions with the new generation to create loyal customers are followed by factors such as cost-cutting, building trust in the new generation, revenue growth, and the importance of brand in social media. Social media facilitate online interactions between groups of people and have greatly reduced the cost of content production, distribution, and content discovery techniques [40].

**Omni channel.** The shift from single channeled banking (inside-out), which referred to the client referring in person to a credit and banking unit to integrated banking, enabling the client to access banking services and products using multiple, integrated, and consistent channels. Omni-channel banking is a combination of digital and branch banking. In omni-channel banking, customers can access

the bank's services and products at any time and any place. Data transfer across all channels of the bank is done in a coordinated way so that customers' transactions and experiences through business processes can be monitored [41].

**Virtualization.** Virtualization in banks results in more hardware efficiency and cost reduction, optimal use of physical space in data centers, reduced energy consumption in the data center, and reduced cost of maintaining and managing server and services, the possibility of creating development and testing environments in a very affordable way, backing up and restoring servers, reducing network equipment costs, reducing server maintenance and installation costs by 70%, and reducing costs for electricity, ventilation systems, and human resource. This technology allows banks to provide more computational resources at a lower cost [29].

**Data and information.** A business with a 360-degree perspective of customers (records of sales of services to customers, resources and expenditures, customer behaviour, etc.) can identify their needs, offer customized service and product packages at customized rates, and improve the customer value, profitability and risk management.

**Big data.** Big data are a combination of structured and non-structured data (such as downloadable data from the Internet and social networks) and internal data (such as call centers data). Big data enable banks to collect data from any source and then analyze relevant data to answer the questions that lead to cost reductions, time reductions, product development, and new proposals and more intelligent business decision-making. Applications of analytical tools include fraud detection, compliance with regulatory requirements, customer classification, personal marketing, risk management, etc. [42].

**Artificial intelligence.** This technology enables emotional analysis and the conversion of unstructured data to structured data. Deep learning and machine learning are the products of continuous learning of the system from workflow information and is used to improve efficiency and effectiveness when processes are running. Process automation uses cognitive systems to make the right decisions based on past and offline analysis [25].

**Cognitive technologies.** Such technologies are important because they focus on unstructured data. The application of cognitive technologies falls into 3 major categories of products, processes, or attitudes. Cognitive banking uses cognitive computational power to develop and enhance human expertise, use complex data for new attitudes, and make more accurate and timely decisions. Cognitive capabilities help banks extract meaningful patterns from the market, customers, stakeholders, and employees' data, and utilize these data for better predicting changes or even shape them in the future. Cognitive computing enables banks to reach their strategic priorities in ways that were not previously conceivable [43].

**Financial Technology (Fintech).** The fourth industrial revolution has created a kind of convergence in the physical and cybernetic worlds. In this line, digital technologies have created innovative paths Fintech refers to new business models, products, processes, and applications in the financial service industry [44]. Fintech is developing new services and introducing innovative products in almost every field of the banking and finance industry such as traditional banking, credit cards, payment arrangements, personal loans, business, insurance, brokerage and asset management, and even real estate purchase facilities [45]. Fintech accesses to a huge customer base and an enormous financial network of traditional banks. Accordingly, banks will be able to integrate their services and provide new services that are in a better position in terms of convenience, cost, speed, and performance [46].

**Open API (Application Programming Interface).** Open application programming interfaces enable banks to integrate their services and products with third-party applications and provide customers with various services and products through the bank's ecosystem [47].

**Banking as a Platform (BaaP).** With banks serving as platforms for many Fintech companies, a major and new change has been created in banking and business models [36]. BaaP is linked to Fintech firms and enables them to provide single-step centers for its customers. Fintech firms with the least degree of infrastructure development allow banks to achieve a completely new revenue stream.

**GIS technologies.** Adding a component called "location" with geographical modeling creates tangible benefits for banks. GIS helps banks to provide support in strategic decision-making and strategic planning [48].

Shariatmadari Serkani [49] uses the DEMATEL-ANP hybrid algorithm approach to select the most effective CRM dimensions on innovation capabilities. The proposal of this study was to select the most effective CRM dimensions using the combined method of laboratory decision making and decision evaluation (DEMATEL) and Analytical Network Process (ANP). Therefore, based on the experiences of Sanat Company, using the DEMATEL mathematical model, the causal relationships between innovation capabilities have been drawn and their effects on each other have been determined. Then, based on these causal relationships, the most effective CRM dimensions have been selected using the ANP model. As a result, "long-term collaboration" has the highest score, and this is the most effective dimension, followed by customer relationship management technology, customer engagement, information sharing, and problem advising, respectively.

Niazi and Nikbakht [50] identifying and prioritizing barriers to implementing green supply chain management in industry: a case study in South Pars Petrochemical Company. The purpose of this paper is to identify and prioritize barriers to GSCM implementation in the petrochemical industry. GSCM barriers have been identified by extracting resources and interviewing experts. The statistical population includes the personnel of a South Pars petrochemical company in the Persian Gulf. This paper uses the Shapiro-Wilk test to examine the normality of research variables and the structural equation modeling technique to examine the relationships between the variables. Analytic Hierarchy Process (AHP) is used to prioritize barriers to GSCM implementation. Obstacles identified have a significant impact on GSCM implementation. Regulations, a competitive market, technological infrastructure, and a lack of commitment from top management are ultimately the most important obstacles to implementing supply chain management.

## 3 | The Conceptual Model and Theoretical Framework of the Study

The theoretical framework of the present study is on the basis of the review of valid documents and library studies. In the end, different books, journals, articles were used to review the theoretical concepts about the problem under study. This study is applied research in terms of its objectives because it seeks to identify the factors influencing the green business processes management readiness in the banking industry, and the findings and insights from this study can help banks to manage green processes to reduce negative environmental impacts and also reduce their costs. The research Statistical population included academic experts, managers, and consultants who had Master's degree and above in one of the fields of management, engineering, and information technology and were active in the banking industry for at least 10 years. For the purpose of sampling, a combination of purposeful, nonprobability, judgmental, and snowball techniques was used. To collect the data, a questionnaire was distributed among 14 academic and industry experts in May 2019 in Tehran. The collected data were analyzed using the fuzzy DEMATEL method, which is used for decision making based on paired comparisons. Using expert opinions, factors affecting a system are extracted. Besides, the principles of graph theory are employed to obtain a hierarchical structure of the factors in the system coupled with their interrelationships [51]. Using fuzzy language variables, the fuzzy DEMATEL method facilitates decision making under uncertain conditions. In order to compare the criteria, five verbal statements were used, as shown in *Table 1*.

**Table 1. Verbal statements used in this study and their equivalent fuzzy values.**

| Verbal Statements | Fuzzy Values |
|---|---|
| No impact | (0.00,0.00,0.25) |
| Very low impact | (0.00,0.25,0.50) |
| Low impact | (0.25,0.50,0.75) |
| High impact | (0.50,0.75,1.00) |
| Very high impact | (0.75,1.00,1.00) |

## 4 | Results

*Table 2* shows the participants' demographic data.

**Table 2. The participants' demographic data.**

| Variable | Description | | Frequency |
|---|---|---|---|
| Banking service records | Faculty members | 10-15 years | 4 |
| | | Over 15 years | 1 |
| | Industry directors * | 10-15 years | 6 |
| | | > 15 years | 3 |
| Field of study | MA | | 6 |
| | Ph.D. student | | 2 |
| | Ph.D. | | 6 |
| | Information Technology | | 7 |
| | Management | | 3 |
| | Industrial engineering | | 4 |

* Four faculty respondents are also industry directors.

*Table 3* shows the nine factors extracted from the literature along with related references.

**Table 3. Factors affecting green business process management readiness (extracted from the literature).**

| Indicator | Reference |
|---|---|
| Green awareness | [1], [13] and [22] |
| Green attitude | [14], [22], [52], [53], [54], [55], [56], [57], [58], [59] and [60] |
| Green technology | [22], [58], [61], [62],[63] |
| Green policies and laws | [18], [22], [58] and [64] |
| Green strategy | [28], [55], [56], [57], [58], [59], [60] and [65] |
| Green governance | [16], [22], [55], [58], [59], [60] and [62] |
| Green operations | [8], [19], [20] and [66] |
| Green lifecycle | [8], [22] and [23] |
| Green infrastructure | [67], [68] and [69] |

The calculations and steps related to the fuzzy DEMATEL method are described as follows: upon collecting the paired comparison questionnaire from the experts, the arithmetic mean of the expert opinion was estimated through *Eq. (1)*:

$$z = \frac{x^{1} + x^{2} + x^{3} + \ldots + x^{p}}{p}. \quad (1)$$

Where p is the number of experts, $\tilde{x}^1$, $\tilde{x}^2$, and $\tilde{x}^p$ are the paired comparison matrixes of expert 1, 2, and p, respectively, and $\tilde{z}$ is the triangular fuzzy number calculated as $z_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$.

Table 4. The total mean of the expert opinions.

| Mean of Expert Opinions | $C_9$ | $C_8$ | $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ |
|---|---|---|---|---|---|---|---|---|---|
| $C_1$ | (0.46,0.71,0.89) | (0.55,0.80,0.93) | (0.55,0.80,0.96) | (0.46,0.71,0.89) | (0.55,0.80,0.96) | (0.54,0.79,0.96) | (0.54,0.79,0.96) | (0.66,0.91,1.00) | (0.00,0.00,0.00) |
| $C_2$ | (0.48,0.73,0.96) | (0.55,0.80,0.96) | (0.52,0.77,0.96) | (0.45,0.70,0.93) | (0.52,0.77,0.96) | (0.52,0.77,0.96) | (0.52,0.77,1.00) | (0.00,0.00,0.00) | (0.20,0.45,0.70) |
| $C_3$ | (0.64,0.89,1.00) | (0.45,0.64,0.80) | (0.52,0.77,0.96) | (0.43,0.68,0.93) | (0.46,0.71,0.93) | (0.50,0.75,1.00) | (0.00,0.00,0.00) | (0.41,0.66,0.86) | (0.25,0.50,0.73) |
| $C_4$ | (0.59,0.84,0.98) | (0.55,0.80,0.95) | (0.50,0.75,0.96) | (0.59,0.84,1.00) | (0.57,0.82,1.00) | (0.00,0.00,0.00) | (0.43,0.61,0.79) | (0.41,0.66,0.89) | (0.29,0.54,0.77) |
| $C_5$ | (0.43,0.68,0.89) | (0.50,0.75,0.96) | (0.54,0.79,1.00) | (0.57,0.82,1.00) | (0.00,0.00,0.00) | (0.50,0.75,0.96) | (0.36,0.61,0.86) | (0.41,0.66,0.86) | (0.29,0.54,0.73) |
| $C_6$ | (0.50,0.75,0.93) | (0.48,0.73,0.96) | (0.52,0.77,0.96) | (0.00,0.00,0.00) | (0.61,0.86,1.00) | (0.57,0.82,1.00) | (0.43,0.68,0.89) | (0.30,0.55,0.79) | (0.18,0.43,0.66) |
| $C_7$ | (0.25,0.50,0.75) | (0.21,0.46,0.71) | (0.00,0.00,0.00) | (0.32,0.57,0.82) | (0.39,0.64,0.82) | (0.32,0.57,0.82) | (0.41,0.66,0.91) | (0.32,0.57,0.77) | (0.39,0.64,0.84) |
| $C_8$ | (0.54,0.79,1.00) | (0.00,0.00,0.00) | (0.46,0.71,0.86) | (0.36,0.61,0.82) | (0.39,0.64,0.86) | (0.39,0.64,0.89) | (0.36,0.61,0.86) | (0.32,0.57,0.79) | (0.25,0.50,0.73) |
| $C_9$ | (0.00,0.00,0.00) | (0.32,0.50,0.75) | (0.46,0.71,0.93) | (0.29,0.54,0.79) | (0.36,0.61,0.86) | (0.36,0.61,0.86) | (0.50,0.75,0.96) | (0.39,0.57,0.71) | (0.25,0.43,0.62) |

Table 5. The normalized matrix.

| The Normalized Matrix | $C_9$ | $C_8$ | $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ |
|---|---|---|---|---|---|---|---|---|---|
| $C_1$ | (0.06,0.09,0.12) | (0.07,0.11,0.12) | (0.07,0.11,0.13) | (0.06,0.09,0.12) | (0.07,0.11,0.13) | (0.07,0.10,0.13) | (0.07,0.10,0.13) | (0.09,0.12,0.13) | (0.00,0.00,0.00) |
| $C_2$ | (0.06,0.10,0.13) | (0.07,0.11,0.13) | (0.07,0.10,0.13) | (0.06,0.09,0.12) | (0.07,0.10,0.13) | (0.07,0.10,0.13) | (0.07,0.10,0.13) | (0.00,0.00,0.00) | (0.03,0.06,0.09) |
| $C_3$ | (0.08,0.12,0.13) | (0.06,0.08,0.11) | (0.07,0.10,0.13) | (0.06,0.09,0.12) | (0.06,0.09,0.12) | (0.07,0.10,0.13) | (0.00,0.00,0.00) | (0.05,0.09,0.11) | (0.03,0.07,0.10) |
| $C_4$ | (0.08,0.11,0.13) | (0.07,0.11,0.12) | (0.07,0.10,0.13) | (0.08,0.11,0.13) | (0.08,0.11,0.13) | (0.00,0.00,0.00) | (0.06,0.08,0.10) | (0.05,0.09,0.12) | (0.04,0.07,0.10) |
| $C_5$ | (0.06,0.09,0.12) | (0.07,0.10,0.13) | (0.07,0.10,0.13) | (0.08,0.11,0.13) | (0.00,0.00,0.00) | (0.07,0.10,0.13) | (0.05,0.08,0.11) | (0.05,0.09,0.11) | (0.04,0.07,0.10) |
| $C_6$ | (0.07,0.10,0.12) | (0.06,0.10,0.13) | (0.07,0.10,0.13) | (0.00,0.00,0.00) | (0.08,0.11,0.13) | (0.08,0.11,0.13) | (0.06,0.09,0.12) | (0.04,0.07,0.10) | (0.02,0.06,0.09) |
| $C_7$ | (0.03,0.07,0.10) | (0.03,0.06,0.09) | (0.00,0.00,0.00) | (0.04,0.08,0.11) | (0.05,0.08,0.11) | (0.04,0.08,0.11) | (0.05,0.09,0.12) | (0.04,0.08,0.10) | (0.05,0.08,0.11) |
| $C_8$ | (0.07,0.10,0.13) | (0.00,0.00,0.00) | (0.06,0.09,0.11) | (0.05,0.08,0.11) | (0.05,0.08,0.11) | (0.05,0.08,0.12) | (0.05,0.08,0.11) | (0.04,0.08,0.10) | (0.03,0.07,0.10) |
| $C_9$ | (0.00,0.00,0.00) | (0.04,0.07,0.10) | (0.06,0.09,0.12) | (0.04,0.07,0.10) | (0.05,0.08,0.11) | (0.05,0.08,0.11) | (0.07,0.10,0.13) | (0.05,0.08,0.09) | (0.03,0.06,0.08) |

Table 6. The total relation matrix.

| The Total Relation Matrix | $C_9$ | $C_8$ | $C_7$ | $C_6$ | $C_5$ | $C_4$ | $C_3$ | $C_2$ | $C_1$ |
|---|---|---|---|---|---|---|---|---|---|
| $C_1$ | (0.12,0.34,1.74) | (0.13,0.34,1.67) | (0.13,0.36,1.79) | (0.11,0.33,1.70) | (0.13,0.35,1.74) | (0.13,0.34,1.76) | (0.12,0.33,1.71) | (0.13,0.33,1.60) | (0.03,0.18,1.31) |
| $C_2$ | (0.11,0.32,1.72) | (0.12,0.32,1.64) | (0.12,0.33,1.76) | (0.10,0.30,1.67) | (0.12,0.33,1.71) | (0.12,0.32,1.73) | (0.11,0.31,1.69) | (0.04,0.21,1.45) | (0.06,0.22,1.37) |
| $C_3$ | (0.13,0.34,1.68) | (0.10,0.29,1.58) | (0.12,0.33,1.71) | (0.10,0.30,1.63) | (0.11,0.31,1.67) | (0.11,0.31,1.69) | (0.05,0.21,1.53) | (0.09,0.28,1.52) | (0.06,0.22,1.34) |
| $C_4$ | (0.13,0.34,1.70) | (0.12,0.32,1.62) | (0.12,0.34,1.74) | (0.12,0.32,1.66) | (0.13,0.34,1.70) | (0.05,0.23,1.59) | (0.10,0.30,1.64) | (0.10,0.29,1.54) | (0.07,0.23,1.36) |
| $C_5$ | (0.11,0.31,1.68) | (0.11,0.30,1.61) | (0.12,0.33,1.73) | (0.12,0.31,1.65) | (0.05,0.23,1.57) | (0.11,0.31,1.69) | (0.09,0.29,1.64) | (0.09,0.28,1.52) | (0.07,0.23,1.35) |
| $C_6$ | (0.11,0.32,1.67) | (0.11,0.30,1.60) | (0.12,0.33,1.71) | (0.05,0.21,1.51) | (0.13,0.33,1.67) | (0.12,0.32,1.68) | (0.10,0.29,1.63) | (0.08,0.27,1.50) | (0.05,0.22,1.33) |
| $C_7$ | (0.07,0.26,1.51) | (0.06,0.24,1.44) | (0.04,0.20,1.45) | (0.08,0.25,1.48) | (0.09,0.27,1.51) | (0.08,0.26,1.52) | (0.09,0.26,1.49) | (0.07,0.24,1.38) | (0.07,0.22,1.23) |
| $C_8$ | (0.11,0.30,1.60) | (0.04,0.19,1.41) | (0.10,0.30,1.62) | (0.08,0.27,1.54) | (0.09,0.29,1.58) | (0.09,0.28,1.59) | (0.09,0.27,1.55) | (0.08,0.25,1.44) | (0.06,0.21,1.27) |
| $C_9$ | (0.04,0.20,1.42) | (0.08,0.24,1.44) | (0.10,0.29,1.56) | (0.07,0.25,1.47) | (0.09,0.27,1.52) | (0.09,0.26,1.53) | (0.10,0.27,1.50) | (0.08,0.24,1.37) | (0.06,0.19,1.21) |

The obtained matrix can be normalized using *Eq. (2)*:

$$H_{ij} = \frac{z_{ij}}{r} = (\frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r}) = (l''_{ij}, m''_{ij}, u''_{ij}). \quad (2)$$

Where r is calculated as through the following equation:

$$r = \max_{1\le i\le n}(\sum_{j=1}^{n} u_{ij}). \quad (3)$$

After calculating the above matrixes, the matrix for the total fuzzy relations is obtained through *Eqs. (4)-(7)*:

$$T = \lim_{K\to+\infty}(H^{1} + H^{2} + \ldots + H^{K}). \quad (4)$$

$$\left[l_{ij}^{t}\right] = H_{l} \times (I - H_{l})^{-1}. \quad (5)$$

$$\left[m_{ij}^{t}\right] = H_{m} \times (I - H_{m})^{-1}. \quad (6)$$

$$\left[u_{ij}^{t}\right] = H_{u} \times (I - H_{u})^{-1}. \quad (7)$$

In the above equations, I is the identity matrix, and $H_l$, $H_m$, and $H_u$ are n×n matrixes whose entries are the lower, mid, and upper numbers of the triangular fuzzy numbers of matrix H. The total relation matrix t is shown in *Table 6*.

The next step is calculating the sum of the rows and columns of the matrix $\tilde{T}$ through *Eq. (8)* and *Eq. (9)*:

$$D = (D_i)_{n\times 1} = \left[\sum_{j=1}^{n} T_{IJ}\right]_{n\times 1}. \quad (8)$$

$$R = (R_i)_{1\times n} = \left[\sum_{i=1}^{n} T_{IJ}\right]_{1\times n}. \quad (9)$$

Where $\widetilde{D}$ and $\tilde{R}$ are n×1 and 1×n matrices, respectively.

The next step is to determine the weight of indicators $(D_i + R_i)$ and the relationship between the criteria $(\tilde{D}_i - \tilde{R}_i)$. If $\tilde{D}_i - \tilde{R}_i > 0$, then the relevant criterion is effective, and if $\tilde{D}_i - \tilde{R}_i < 0$, then the relevant criterion is affected. *Table 7* shows $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$.

In the next step, the fuzzy numbers $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ obtained from the previous step are defuzzified using *Eq. (10)*:

$$B = \frac{(a_1 + a_2 + a_3)}{3}. \quad (10)$$

Where B is the defuzzified value of $\tilde{A} = (a_1, a_2, a_3)$.

*Table 8* shows the defuzzified numbers in *Table 7*.

Table 7. The weight &impact of criteria.

| Criteria | Abbreviation | D | R | $(\widetilde{D}_i + \widetilde{R}_i)^{def}$ | $(\widetilde{D}_i - \widetilde{R}_i)^{def}$ |
|---|---|---|---|---|---|
| Green awareness | $C_1$ | 1.577 | 11.051 | 4.737 | 6.314 |
| Green attitude | $C_2$ | 0.61 | 11.584 | 5.487 | 6.097 |
| Green technology | $C_3$ | 0.016 | 11.85 | 5.917 | 5.933 |
| Green policies and laws | $C_4$ | 0.036 | 12.164 | 6.1 | 6.064 |
| Green strategy | $C_5$ | 0.143 | 12.071 | 6.107 | 5.964 |
| Green governance | $C_6$ | 0.027 | 11.809 | 5.891 | 5.918 |
| Green actions | $C_7$ | 0.997 | 11.565 | 6.281 | 5.284 |
| Green lifecycle | $C_8$ | 0.239 | 11.367 | 5.803 | 5.564 |
| Green infrastructure | $C_9$ | 0.815 | 11.433 | 6.124 | 5.309 |

In *Table 7*, the sum of the elements in each row (D) indicates the extent of the impact of a given factor on other system factors. Accordingly, "green awareness" has the highest impact. It also has the highest interaction (6.314) with other criteria. "green attitudes", "green policy", "green strategy", "green technology", "green governance", "green lifecycle", "green infrastructure", and "green operation" occupy the other positions, respectively. The sum of the elements in column (R) for each factor shows the extent to which it is affected by other factors of the system. So, "green operations" most affected by other factors. "green infrastructure", "green strategy", "green policy", "green technology", "green governance", "green lifecycle", "green attitude", and "green awareness" are ranked in other positions. *Fig. 1* shows the weight/importance and impact of the criteria. The horizontal axis shows the weights of criteria and the vertical axis shows the criteria that affect or are affected by other criteria. The horizontal vector (D + R) indicates the extent to which the criteria affect or being affected by other criteria in the system. The higher the D+R value of a factor, the higher will be its interaction with other factors in the system. Accordingly, "green policy" with a value of 12.164 has the highest interaction with other factors. "Green strategy", "green technology", "green attitude", "green operations", "green infrastructure", "green lifecycle", and "green awareness" are placed in other positions. The vertical vector (D-R) indicates the power of each factor. In general, if the D-R is positive, the variable is considered to be effective and, if negative, is considered to be affected by other factors. In this model, "green awareness", "green attitude", "green governance", "green technology", "green operations", "green infrastructure", "green lifecycle", "green strategy", and "green policy" are affected by other factors.

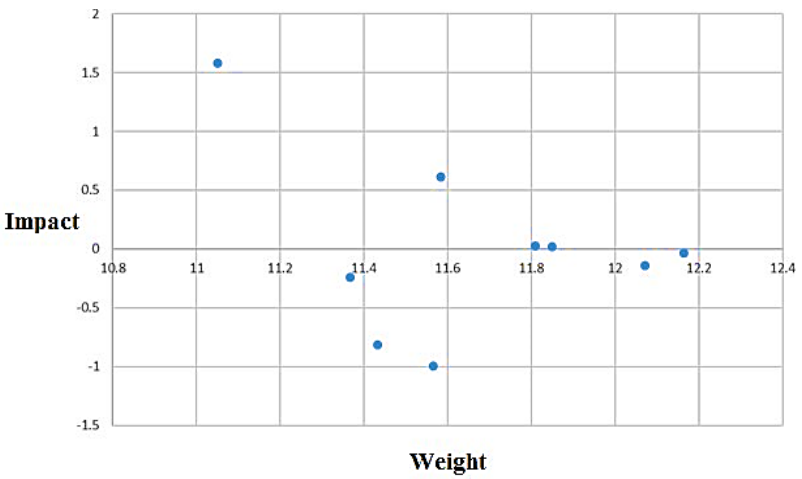


Fig. 1. The weight and interrelationship between criteria.

In order to draw the interrelations in the NRM map, the threshold value must be calculated. The threshold value that represents the value of the matrix T is 0.647. All values of the matrix T, smaller than 0.647, are zeroed, that is, the causal relationship is not considered. Therefore, the model of significant relationships is shown as follows:

Table 8. The interrelationships between the factors.

| The Total Relation Matrix | $C_1$ | $C_2$ | $C_3$ | $C_4$ | $C_5$ | $C_6$ | $C_7$ | $C_8$ | $C_9$ |
|---|---|---|---|---|---|---|---|---|---|
| $C_1$ | 0 | 0.686 | 0.72 | 0.743 | 0.74 | 0.713 | 0.76 | 0.713 | 0.733 |
| $C_2$ | 0 | 0 | 0.703 | 0.723 | 0.72 | 0.69 | 0.736 | 0.693 | 0.716 |
| $C_3$ | 0 | 0 | 0 | 0.703 | 0.696 | 0.676 | 0.72 | 0.656 | 0.716 |
| $C_4$ | 0 | 0 | 0.68 | 0 | 0.723 | 0.7 | 0.733 | 0.686 | 0.723 |
| $C_5$ | 0 | 0 | 0.673 | 0.703 | 0 | 0.693 | 0.726 | 0.673 | 0.7 |
| $C_6$ | 0 | 0 | 0.673 | 0.706 | 0.71 | 0 | 0.72 | 0.67 | 0.7 |
| $C_7$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $C_8$ | 0 | 0 | 0 | 0.653 | 0.653 | 0 | 0.673 | 0 | 0.67 |
| $C_9$ | 0 | 0 | 0 | 0 | 0 | 0 | 0.65 | 0 | 0 |

According to the results presented in *Table 8* and as shown in *Fig. 2*, the mutually interrelated factors are as follows: green technology vs. green policy, green technology vs. green strategy, green technology vs. green governance, green technology vs. green lifecycle, green policy and vs. green strategy, green policy. green governance, green policy and laws vs. green lifecycle, and green policy and laws vs. green governance. in addition, green awareness affects all factors, but green operation does not affect any factor and is affected by other factors.

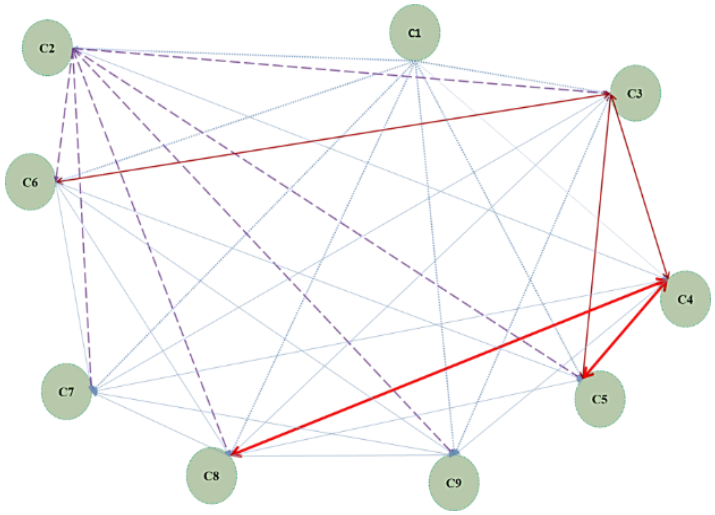


Fig. 2. The interrelationships between the factors.

## 5 | Conclusion and Suggestions

According to the findings of this study, "green awareness" has the highest interaction and also has the strongest impact. Raising the awareness of individuals including managers, customers, and employees of the organization is of high priority. Environmental knowledge and awareness affect green behaviour, indicating that by increasing environmental knowledge and awareness in the organization, green behaviour also increases. The results are consistent with the results of previous research in the literature [70]-[73].

When an organization changes its approaches to becoming green, a great deal of pressure is put on employees if they are not properly trained in terms of green practices and concepts [74]. Employees are more likely to be exposed to green behaviours if they understand the organization's adequate support [75]. Employees' regular training on environmental awareness and knowledge helps them understand how their duties and decisions can affect the environment.

Leaders and managers with environmental awareness have an important role in the commitment of employees to environmental programs. So, their training is essential [76], In fact, with increasing environmental awareness of managers, their commitment to green behaviour also increases, and employees

are also more obliged to obey environmental laws and regulations. Employees' and managers' attitudes also affect their environmental behaviours because they are those who carry out environmentally friendly tasks. Studies show that people do environmentally friendly behaviours when they turn green behaviours into a habit. Policies and activities are the foundations of the organizational culture [77], and employees' awareness of these factors leads to green behaviour [78]. Cultural values and collective beliefs shape and identify behaviours and attitudes related to business process management. Individual factors including motivation or attitude play an important role in the implementation of sustainable business procedures. Therefore, organizations must inform managers and staff about the importance and impact of their behaviours on the environment and submit their annual reports on reducing environmental impacts. In addition to training programs, organizations can encourage their employees to engage in green behaviours by establishing motivated strategies [79]. This can be achieved through new technologies such as media and social networks.

Employee's awareness and attitude towards using and performing processes in an environmentally friendly way play a significant role. For example, electronic banking services, internet banking, mobile banking, and receiving paper receipts from ATMs and POS are some instances of these processes. Managers choose green strategies and enact green policies and laws for the organization accordingly. Increasing awareness of sustainable banking practices can lead to the use of technology to become green.

The rules of the organization, aimed at helping employees and managers with green behaviour, must be improved because the rules are incentive for EGB [80]. Since organizational norms reflect the employees' understanding of the processes, policies, and activities of the organization, organizations are recommended to consider the systems and processes of environmental protection in their policymaking. In addition, policymakers need to pay attention to the environment in their planning. According to studies of organizational behaviour, leadership is the main source of employee motivation for organizational change.

Strategic alignment is a firm, permanent link to the management of organizational business processes that make it possible to achieve business goals. Green operations were found to be affected most significantly by other factors. On this basis, it can be said that for banks to be able to implement green operations, they must first develop a green strategy, green policy, and apply green technology in banks. In this regard, the following cases should be considered:

Process strategies should be designed to adequately reflect environmental goals while supporting economic benefits.

- *Important and strategic indicators should be considered for green business processes.*
- *A process improvement plan should be designed based on environmental criteria.*
- *The relationship between organizational processes and capabilities should be identified.*
- *In the architecture of the organization's process, environmental factors should be considered.*

Green reference process models or models for implementing green processes can play a significant role in sustainable business activities in addition to suitable tools and techniques for understanding the potential of green business process management in inter-organizational scenarios during the business lifecycle.

Banks need to make changes to their daily activities, such as less physical banking, mobile banking, and online documentation. To achieve environmental sustainability, Iranian banks should adopt their own policies in line with international activities that lead them to a path of sustainability and reduce carbon footprint and create necessary changes in business models to achieve the desired sustainability. It is imperative for the Central Bank to give special instructions to Iranian banks that will help them to facilitate new activities and have a clearer understanding of green concepts, which ultimately lead to sustainable development. Banks need to set up policy guidelines for Environmental Risk Management

(ERM), and they must also create new targets within the organization that help reduce carbon footprint. Banks need to be more focused on protecting the environment from specific sources by providing banking facilities and loans, and examining the impact of environmental borrowers, green products, and green loans. Banks must have a separate division or unit to measure or assess "green banking measures".

Governance, as an influential factor, includes the passing rules, guidelines, and setting roles for environmental purposes that can be used as leverage for banks. After the rules have been established, they should be monitored and controlled. Rules and regulations are not enforced correctly without proper supervision. Decision-making process governance is created with clear and appropriate accountability to align results and guide action in business process management. It is necessary to define the roles needed to implement the processes of an organization from a sustainable environmental point of view. The support of top and middle managers of the organization is necessary. In order to realize social and environmental goals, banks need a new orientation.

Awareness of new technologies and their benefits in order to become green is an effective factor. It is necessary to use green technologies in the organization's strategy, policies and rules, and the green lifecycle in the organization (green design, green use, green procurement and purchase, green production, green recycling and reuse, green waste, electronic waste, green consumption, and green standards and criteria). Without proper governance, the strategy and the right rules for the realization of green goals in the organization are not feasible.

### 5.1 | Future Research

In the end, for future research, the following are suggested to the researchers:

- *Using identified factors to prepare for the management of green business processes, banks will first identify their readiness in each case, then, with regard to the rating and its importance for improving the organization's processes for the emergence of programs and operational actions set up.*
- *The results obtained from this study are evaluated in other industries.*
- *Identify the barriers and challenges facing the management of green business processes.*
- *Examining the economic aspects of banks in managing green business processes.*
- *Research on the threefold relationship between data management and energy informatics to understand and generalize the informatics of energy to transcend a relatively data-driven viewpoint (such as sensor networks) so that it can manage the process of achieving and balancing the traditional columns of information systems.*
- *Identification of intervening or mediating factors.*

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