

# Strategic Business-IT Alignment: A Multi-Agent Systems Approach

Aouatif Benkhayat <sup>1\*</sup>, Mohammed Salah Chiadmi <sup>2</sup>, Mohamed Tkiouat <sup>3</sup>

<sup>1</sup> Laboratory of Studies and Research in Applied Mathematics, Mohammadia School of Engineering, Mohammed V University of Rabat, Rabat, Morocco

<sup>2</sup> Laboratory of Studies and Research in Applied Mathematics, Mohammadia School of Engineering, Mohammed V University of Rabat, Rabat, Morocco

<sup>3</sup> Laboratory of Studies and Research in Applied Mathematics, Mohammadia School of Engineering, Mohammed V University of Rabat, Rabat, Morocco

\* **Corresponding Author:** [aouatif.benkhayat@gmail.com](mailto:aouatif.benkhayat@gmail.com)

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## ABSTRACT

This paper discusses one of the most critical concerns in all organizations, which is business-IT alignment, and it needs coherent organizational and technological strategies. Over time, the definition has changed to show that alignment is a strategy that can be used to be more competitive and gain value for stakeholders. Aligning to drive corporate goals is crucial for competitive strategy and business success. Achieving this across multiple firms poses a challenge due to budgetary limitations, the complexity of the IT systems, and the rapid advances of technology can be barriers to overcome. Strategic alignment relies on understanding stakeholder requirements, strategic statements, communication levels, a highly skilled workforce, and rapid feedback mechanisms. We propose a new multi-agent system to address these difficulties by emphasizing the roles of managers, external influences, clients, communication tools, employees, stakeholders, and suppliers. This framework improves existing models by enabling real-time adaptation and cooperation through advanced algorithms and communications protocols. To ensure the practicality and efficiency of our framework, we conducted an empirical study using different Moroccan organizations. This is followed by a call for more case studies to prove that the proposed model works, underscoring the importance of practical validation in business-IT alignment.

**Keywords:** Business Strategy, Information Technology Strategy, Strategic Alignment Model, System Multi-Agent System, Agent.

## INTRODUCTION

In a rapidly changing business environment, any investment in IT needs to deliver substantial benefits, ensuring IT is flexible and efficient and can best support the company's strategy. Business-IT alignment is the long-understood but short-supplied requirement.

Information technology (IT) plays a pivotal role in shaping competitive strategies and driving business success, as it empowers firms to achieve their corporate objectives effectively (Melville, Kraemer, & Gurbaxani, 2004). However, IT deployment is contingent upon organizations having a clear vision that aligns IT initiatives with the overarching goals of enhancing financial performance and competitiveness in their respective markets. This alignment is crucial for IT managers and business leaders, underscoring its status as a top priority globally in management agendas.

According to Luftman et al. (2012), strategic alignment—specifically the synchronization of business and IT strategies—consistently ranks among the foremost concerns for management worldwide. This recognition highlights its critical importance in enabling organizations to navigate dynamic market conditions and capitalize on technological advancements to maintain competitive advantage and operational efficiency.

In today's era of advanced AI and algorithms, technological advancements offer unparalleled opportunities for enhancing business-IT alignment (BIT). Despite this, existing alignment models often overlook the specific applications of these technologies in driving strategic alignment.

Companies face budget constraints for IT investments and evolving business goals and strategies (Pollard & Cater-Steel, 2009). The costs are enormous when it comes to businesses optimizing their business processes for greater efficiency. In addition, a gap between IT services and business needs may prevent client requirements from being met (Hochstein, Zarnekow & Brenner, 2005). The primary challenges include managing the interaction between people, processes, and technology issues while maintaining the budget. Regrettably, the communication and collaboration between business and IT departments is often insufficient within many organizations. Functional requirements are often poorly specified and ambiguous, leading to misalignment and suboptimal outcomes (Henderson & Venkatraman, 1999). In many cases, the alignment process is more heavily dependent on the prevailing organizational culture, social dynamics, and individual understandings rather than being grounded in quantifiable or measurable business needs.

This document addresses existing challenges by introducing a novel strategic business-IT alignment framework centered around multi-agent systems. Our approach focuses on developing a dynamic and adaptive alignment model incorporating mechanisms for ongoing feedback and coordination protocols. We emphasize various internal and external agents' roles within an organization, such as managers, clients, communication systems, personnel, stakeholders, and suppliers, to ensure a comprehensive and integrated alignment process.

We begin by reviewing established alignment models and situating our proposed framework with approaches like the Strategic Alignment Model and Luftman's Strategic Alignment Maturity Model. We identify the limitations these models exhibit in addressing evolving business environments and highlight the need for a more responsive approach adaptable to change.

Next, we present the framework of our multi-agent system, outlining its core components, functions, and roles different agents assume. This framework leverages cutting-edge algorithms facilitating strategic matching, real-time recalibration, and dynamic coordination to guarantee continuous alignment between business strategies and IT capabilities.

We conducted an empirical study across multiple Moroccan organizations to validate our proposed model. This study evaluated the Strategic Alignment Engine's effectiveness in improving strategic alignment, organizational performance, and adaptability to shifting business and IT landscapes. We provide detailed insights from pre- and post-implementation, demonstrating practical benefits and improvements achieved through our approach.

Finally, we discuss the implications of our findings and advocate for clear communication and coordination standards to enhance strategic alignment. We suggest additional real-world case analyses to validate and refine this proposed model, ensuring its applicability and impact in diverse organizational settings.

## LITERATURE REVIEW

### Definition and Theoretical Foundation

The definition of business-IT alignment has been provided in the literature over time. Benkhayat defines strategic alignment as "harmonizing information system strategies with Business strategies to serve productivity, performance, and success" (Benkhayat, 2024). According to Wong, IT alignment can be defined as the "strategic use of information technology to gain competitive advantage and in particular to deliver value to its customers or stakeholders, while enabling the company and its enterprise to carry out its strategic mission or business plan" (Wong, Ngan, Chan, & Chong, 2012). Jorfi provided a definition similar to our perspective, defining it as "the degree to which business mission, objectives, and plans support and are supported by information technology mission, objectives, and plans" (S. Jorfi & Jorfi, 2011). This emphasizes that business strategy affects IT strategy and vice versa.

While numerous studies champion the importance of business-IT alignment, the existing literature suffers from several fundamental shortcomings. Firstly, alignment definitions are often ambiguous and equivocal, lacking

a clear and consistent meaning (Maes, Rijsenbrij, Truijens, & Goedvolk, 2000). This ambiguity leads to contradictory interpretations of what alignment entails and how to achieve it in practice. Secondly, the concept is frequently discussed theoretically without sufficient guidance on its implementation and operationalization within organizations (Maes et al., 2000).

To address these issues and develop a clear understanding, several scholars have attempted to define business-IT alignment. Majstorović offers a comprehensive definition by combining various perspectives (Majstorović, 2016):

- **Strategic Alignment:** Harmony between the organization's goals and activities (business system) and supporting information systems.
- **Fit and Integration:** The degree of compatibility and interconnectedness between business strategy, IT strategy, business infrastructure, and IT infrastructure.
- **Agreement:** The level of concordance between the mission, objectives, and plans outlined in the business and IT strategies.

This combined definition provides a more robust understanding of business-IT alignment, encompassing strategic congruence, operational fit, and goal alignment.

Chan distinguishes two prevailing conceptualizations of the alignment problem. The first focuses on planning and objectives integration, viewing alignment as the degree to which the IT mission and plans support the business mission, objectives, and plans are supported by the IT mission and plans (Chan, Sabherwal, & Thatcher, 2006). This view can be found in the works of Reich and Benbasat (1996), Kearns and Lederer (2004), and Hirschheim and Sabherwal (2001).

- Henderson and Venkatraman's (1993) widely used Strategic Alignment Model (SAM) provides a more holistic conceptualization of business-IT alignment. Their framework is described later in the Existing Frameworks and their Limitations paragraph.

We are not here to prove the previous theories and definitions wrong but to fill the innovation gap. Hence, we redefine business-IT alignment as "the extent to which IT applications, infrastructure, and organizational practices facilitate and reinforce the business strategy and operational processes, as well as the capability to adjust strategic evolution in response to evolving business requirements. It involves fostering adaptability and agility within IT operations to support and align with overarching business objectives effectively".

The social dynamics in achieving strategic alignment are multifaceted and often profoundly rooted within organizational power structures and political tensions. At the heart of the challenge lies the need to navigate the complex power dynamics between business and IT leadership. Historically, these two functions have frequently operated in siloes, each vying for resources, influence, and importance within the organization. Bridging this divide requires a careful balance of asserting the value and strategic importance of IT while also ensuring that business priorities remain the driving force behind alignment efforts. This can create a very subtle power struggle scenario that forms 'turf wars' in which one department tries to direct the alignment agenda in its preferred manner. Thus, coming out of such antagonistic alignments requires a conscious effort to understand and develop trust between the business and IT.

Because strategy execution involves a firm's internal processes, communication and coordination across functional units are crucial. However, it is essential to note that the language and mental models and the conception of decision-making differ between business and IT professionals, which can present significant challenges to collaboration. IT personnel may not have a sufficient understanding of the enterprise's business challenges, so there is a lack of parity in this aspect; likewise, business executives may not fully understand the technology of IT, which may hamper effective collaboration between these two factions (Hirunyawipada, Beyerlein, & Blankson, 2010).

Another social factor that influences the accomplishment of managerially initiated strategic alignment processes is organizational culture. It is, therefore, more accessible for cultures that embrace innovation, risk-taking, and cross-functional teaming as the best practices to align since they open the door to more practice and cohesiveness. On the other hand, bureaucratic systems of control socialized in the organizational field and cultures of professional functionalism venerate functional division of labor, stifling the integration of staff and the free flow of information critical for achieving strategic consistency. Besides, even the culture between IT function subgroups can influence the overall IT department culture and its effectiveness. Having an over-emphasis on technology and entrenching a culture that revolves around it without much regard for its goals and objectives can culminate in considerable misalignment between the IT function and the organization's strategic framework.

Other factors significantly influencing business users' alignment efforts are their attitudes and perceptions

toward IT. End-users may always have some skepticism or even resistance toward IT (Adeleke, 2016), and this may lessen or even wholly counter the alignment effort that has been made.

Overcoming such user resistance requires a concerted effort to demonstrate IT investments' direct business value and engage end-users as active partners in the alignment process. Finally, the leadership culture and priorities set by executives at the top of the organization play a crucial role in shaping the social and cultural dynamics around strategic alignment. Leaders who visibly champion the importance of alignment, model collaborative behaviors, and align incentive structures accordingly can help institutionalize a culture of strategic coherence throughout the organization.

### Existing Frameworks and their Limitations

Strategic alignment, particularly business-IT alignment, has been extensively studied in the literature. Many models and frameworks have been proposed to deal with the significant challenge of aligning business and IT strategies. An example is the Strategic Alignment Model (SAM) by Henderson and Venkatraman (1999). It suggests that alignment of business strategy, IT strategy, organizational infrastructure, and IT infrastructure is essential (Henderson & Venkatraman, 1999). Although this model succinctly captures the alignment dimensions, it cannot efficiently adapt to a dynamic business environment. Alignment shouldn't be considered a final goal; business must continually evolve to the surrounding conditions. In addition, the industry should be challenged by information technology rather than led by it.

Strategic alignment has traditionally been approached from various perspectives on business-IT alignment: business strategy versus IT strategy, Organizational infrastructure versus IT infrastructure, IT governance, and Systemic alignment mechanisms. These models have been used in different contexts: IT and business executives, small business units (SBUs), manufacturing firms, and higher education establishments (Luftman, 2001).

Luftman (2024) built on the concept of business-IT alignment and developed the Strategic Alignment Maturity (SAM) Model. This is a holistic assessment framework for enterprises that want to understand how well they are aligned between Business and IT from a strategy perspective (Luftman, 2004). Although the SAM Maturity Model is applicable for anyone wanting to assess alignment, it does not address where speed has an impact offsetting the changing landscape. The model can evaluate the current state; it needs agility to maintain alignment as business and IT strategies evolve.

Reich and Benbasat (2000) have focused on the social dimension of alignment, arguing that perceptions of alignment between business and IT executives are critical to effective communication and shared understanding. While their work highlights the importance of the human aspect in achieving alignment, it needs to provide a technical mechanism to orchestrate alignment programmatically. They have the ingredients to build a human-centric approach but require a robust technological infrastructure to enable real-time adaptation and responsiveness to the changing business landscape.

S. Jorfi and Jorfi (2011) outlined a model for strategic operations management to highlight the elements that influence strategic alignment between IT and business. They also stressed the significance of employee alignment and organizational culture for achieving strategic goals. However, without the semblance of objectiveness and a deeper technical level, real-time adaptation and response would be allowed to ensure aggressive strategic alignment. This model does not have a comprehensive framework that can dynamically support the alignment process over time by changing and adapting its components as business and IT strategies change, which is necessary for overcoming strategic business-IT alignment challenges.

Benkhayat (2024) suggested a new alignment model representing strategies similar to Miles and Snow, using the Analytical Hierarchy Process to determine decision-maker preferences. This model proposes a pragmatic way of quantifying the alignment between business and IT strategies by studying their orientations. If both strategies' orientation matches prospectors, defenders, analyzers, or reactors, alignment is achieved. While this model provides a technical tool that calculates how much in alignment a business and its IT strategy are with each other, it does not consider the specific strategy components and ingredients within an organization.

Current business models and frameworks have had limitations in gaining a deep, intensive interdisciplinary perspective due to their lack of agility, sophistication, and inadequacies of their core technical bases to meet the emerging challenges in today's dynamic, constantly evolving business environment.

### The Gap

A holistic-oriented action is essential to guarantee that strategic alignment can be more easily retained even though business and IT strategies are subsequently adjusted dynamically. By studying the previous models, it is evident that the nature of businesses today demands a strategic alignment framework that goes beyond static assessments to incorporate real-time review and adjustment mechanisms. Existing models cannot seamlessly

integrate agility into their assessment criteria and implementation, displaying inadequate provision for crisis adaptation and stakeholder inclusion throughout the alignment process.

Furthermore, once businesses decide to expand, they often face the daunting task of reassessing and re-strategizing their entire alignment process, akin to initial business planning. Such an iterative cycle points to the need for a systematic and dynamic approach beyond the simple evaluation of alignment. Without such a comprehensive approach, many businesses, especially SMEs, are in danger of being left behind regarding their ability to wriggle out and innovate in the current cutting operational costs business environment.

Perhaps one of the most notable drawbacks is the absence of an analytic investigation of the underlying alignment principles. So, by first refining the key inputs, performance metrics, and organizational constraints and then subjecting these to a more organized, processes-based decision-making apparatus, it is perhaps possible to derive options that are more aligned with the organization's strategic goals and objectives while simultaneously being more feasible in terms of the IT function.

It could have involved systematically collecting inputs from all the key players—corporate execs, tech gurus, and consumers—and filtering the collected data through a predefined analytical framework. The application of this model may involve the consideration of issues such as cost, technical and social enablers, and business risks. The output of this process would be a set of aligned, data-driven recommendations that consider the stakeholder's needs and perspectives.

### **Positioning of our Proposed Framework**

The approach we propose—multi-agent systems—addresses this gap and provides a framework that combines real-time feedback mechanisms and adaptive coordination protocols. Our framework enhances Henderson and Venkatraman's SAM (1999) by enabling real-time adaptation, achieved using multiagent systems for ongoing realignment of the SAM with evolving business priorities and IT capability. We also advance the mutual adjustment advocated by Reich and Benbasat by promoting constant communication and feedback among all agents in the system, thus fostering common understanding and joint decision-making.

Additionally, when incorporating operational and strategic alignment as parts of the same multiagent system, our multiagent system can reach the alignment of strategic and operational goals at run-time, over and above the work in Jorfi et al. on a similar topic of operational management method.

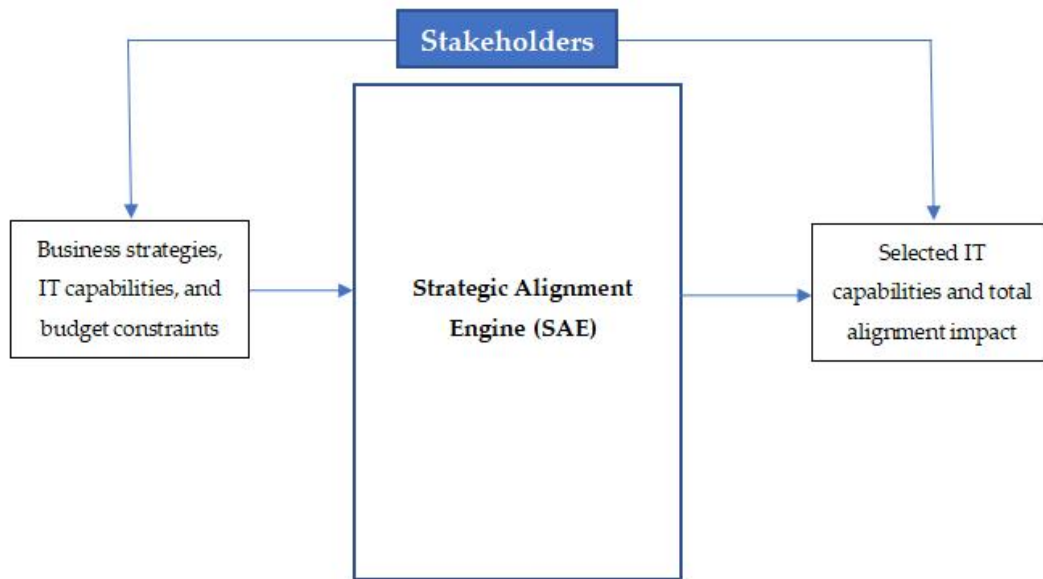
Unlike other models, our framework ensures that all organization stakeholders, including internal and external, are a part of the alignment process. These include managers, external influences, clients, communication systems, workforce, shareholders, and suppliers. Our model also incorporates communication tools that smooth the flow of information and collaboration between all levels of the organization, addressing the gaps present in many existing models that often ignore the need to incorporate the full range of stakeholders and a communication strategy to foster strategic alignment.

## **PROPOSED FRAMEWORK**

The proposed solution leverages a multi-agent approach to support more responsive and adaptive information systems and organizational structures. The central idea is to create a calculated fusion of human interactions and algorithms with defined roles and inputs that apply to all sizes and types of enterprises.

Key components include an intelligent Strategic Alignment Engine (SAE) that utilizes advanced optimization algorithms to match business strategies with available IT capabilities, adjusting in real-time as conditions change, as pictured in **Figure 1**. It comprises most key players, such as managers, influences outside the business, clients, employees, and suppliers. The carefully coordinated orchestration of roles marks it, as well as the communication cycle of feedback and the communication system.

This multiple-agent approach intends to ensure that the four elements (input data continuously collected, performance analysis, and alignment self-correction) will assist the multiple-agent system in enhancing and maintaining the strategic business-IT alignment within an organization, thus making adaptation to new market requirements and strategic managerial priorities easier.



**Figure 1.** Multi-agent System Approach

### Strategic Alignment Engine

The enabler of strategic business-IT alignment in this solution is the proposed Strategic Alignment Engine. The SAE is meant to act as a real-time communications and coordination hub at the intersection of business strategies and IT.

The SAE incorporates the latest data inputs, involving its algorithms to permanently correlate business strategies with the current IT capabilities and make self-corrections and adjustments. This is important as strategies and IT capabilities are dynamic and require real-time alignment of business and IT strategies.

#### Component and Functionality

**Real-Time Strategy Matching:** The SAE utilizes sophisticated algorithms (Appendix A) to analyze and compare business strategies with IT capabilities. This involves optimization algorithms, pattern recognition machine learning models, and multi-criteria decision-making support systems.

**Automatic Adjustment Mechanisms:** The SAE continuously monitors business strategy and IT capabilities changes. Upon detecting any progress or shifts, such as a change in business priorities or an update to IT infrastructure, the SAE recalculates the new alignment degree to ensure the organization's strategic objectives are continuously supported in near real-time. This allows the organization to remain nimble and adapt quickly to new opportunities or challenges as the business environment evolves.

### Agents Involved and Their Roles

**Table 1.** The Roles and Challenges of the Agents Involved

Factor	Description	Challenges
Managers	Play a central role in managing alignment through adaptation and reconfiguration.	Predicting future problems and sustaining alignment in the long run.
External Influences	Market pressures and regulations exert a strong force.	Companies can only react to and not control these factors (Porter, 1989).
Clients	Client involvement is crucial, but their needs can impact schedules.	Precise communication and expectation setting are critical for alignment.
Workforce	A skilled and focused workforce is essential.	Training programs are needed to prepare employees for change and plan implementation. Trust, motivation, and an adaptive culture are crucial (Leading Change, 2006).
Stakeholders	Delineating relationships and effective interaction are necessary.	Effective stakeholder management requires steady communication, information sharing, involvement, and transparent decision-making (Freeman, 2010).

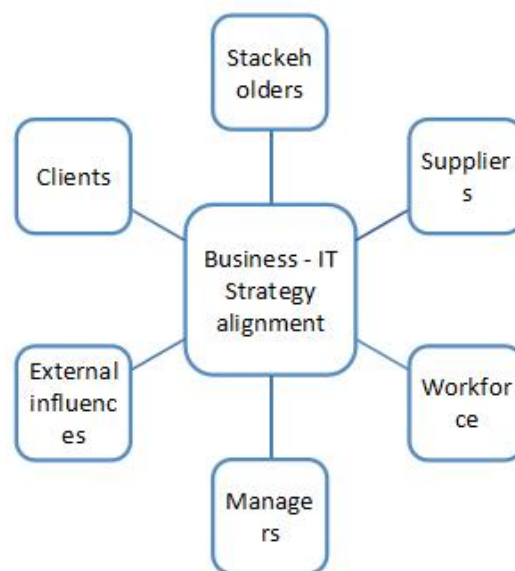
Factor	Description	Challenges
Suppliers	Relationships need to be organized for skills, understanding, and information sharing.	Finding trustworthy suppliers, setting expectations, and maintaining a dialogue are critical. Performance evaluation and feedback loops on quality and delivery times are beneficial.

Beyond the technical aspects of IT-business alignment, achieving and sustaining a well-aligned state requires careful consideration of various human factors. **Table 1** highlights these factors and the challenges associated with them. Our proposed Multi-Agent System (MAS) directly addresses these challenges by incorporating them into its simulation models.

For instance, managers play a critical role in adapting and reconfiguring IT systems as business needs evolve. The MAS can simulate the impact of different managerial decisions on alignment, helping predict potential problems and ensuring long-term alignment. Similarly, by incorporating relevant data into its simulations, the MAS considers external influences like market pressures and regulations. This allows for proactive adjustments to IT strategies in response to external changes, even if companies cannot directly control them.

### Feedback Mechanisms

In a multi-agent system, feedback mechanisms are essential for continuous performance analysis, strategy evaluation or verification, and subsequent adjustment. These mechanisms collect and process data from agents (**Figure 2**) in the organization, providing insight into alignment efficiency.



**Figure 2.** Agent Influencing Business-IT Strategy Alignment

The alignment of these strategies is evaluated in real-time for feedback within such mechanisms so that performance data is constantly passed. The input is then applied to that strategy, ensuring the alignment is effective and responsive to changing circumstances.

#### Functionality:

- **Data collection and analysis:** Gather information from managers, customers, employees, and suppliers to determine the current performance level of alignment.
- **Dynamic Synchronization:** Access data regarding the analyzed to flag opportunities and enable alterations simultaneously to perform more efficiently in alignment.

### Communication Protocols

Communication protocols are rules and procedures that govern how information is exchanged between different groups involved. They ensure clear and effective communication among managers, teams, clients, email systems, workforce, investors, and suppliers (**Table 2**).

- Managers provide strategic updates regularly through meetings, emails, and reports, covering goals,

progress, challenges, and upcoming changes. They follow a decision-making protocol for announcing and executing decisions.

- External Influences involve sharing market intelligence reports with internal stakeholders and setting up alerts for regulatory changes to ensure compliance.
- Clients' feedback is systematically collected through surveys, focus groups, and interviews, analyzed, and shared with relevant teams. A client communication plan keeps clients informed about new products or service updates.
- The workforce stays informed through regular briefings on strategic goals, company progress, and communication about training opportunities.
- Stakeholders participate in regular meetings to discuss strategic initiatives and receive ongoing updates through meetings, reports, and briefings.
- Suppliers collaborate through tools like order-tracking devices and receive feedback through periodic performance reviews to align with strategic goals and quality standards.

**Table 2.** Communication Protocol in the Multi-agent System for Strategic Alignment

Agent	Communication Protocol	Frequency
Managers	Regular strategic updates through meetings, emails, and reports	Weekly team meetings, monthly reports
External Influences	Market intelligence reports and compliance alerts	Bi-monthly market reports, as needed compliance alerts
Clients	Structured feedback collection and client communication plan	Quarterly feedback sessions, client advisory boards
Workforce	Regular briefings and communication of training opportunities	Weekly briefings, periodic training announcements
Stakeholders	Regular stakeholder meetings and supplier collaboration tools	Quarterly stakeholder meetings, monthly supplier performance reviews
Supplier	Supplier collaboration tools and Performance reviews	Monthly supplier performance reviews

### Coordination Mechanisms

Coordination mechanisms ensure that every agent organization works effectively in the multi-agent system for strategic alignment. These, in turn, make the coordination and integration of activities easier and help resolve any operational tensions or conflicts that may be obstacles to implementing major strategic initiatives. Each agent interacts with other agents, allowing for various interactions between each agent and the rest of the agents. This interaction is detailed in **Table 3**.

**Table 3.** Agent Interactions

Agent	Description	Interacts with
Managers	Provide direction and oversee the work of others to achieve strategic goals.	Workforce (Task Management Systems, Performance Reviews), External Influences (Strategic Planning Sessions, Scenario Planning), Stakeholders (Stakeholder Alignment Sessions, Regular Updates), Clients (Client Feedback Integration, Service Improvement Initiatives), Suppliers (Supplier Scorecards, Collaboration Tools)
External Influences	Factors outside the organization that can impact its strategies.	Managers (Market and Regulatory Updates, Strategic Planning Input), Clients (Market Trends Impact, Customer Needs Feedback), Stakeholders (Regulatory Compliance, Market Trends Adaptation)
Clients	The customers who purchase the organization's products or services.	Managers (Client Advisory Boards, CRM Systems), Workforce (Customer Support Coordination, Direct Feedback), Stakeholders (Customer Satisfaction Metrics, Influence on Strategic Priorities), Suppliers (Product Quality Feedback, Collaborative Improvement Programs)
Workforce	The employees who carry out the tasks and activities to achieve goals.	Managers (Task Management Systems, Performance Reviews), Clients (Customer Interaction, Support Coordination), Stakeholders (Engagement in Strategic Initiatives, Performance Metrics), Suppliers (Training on Products, Workflow Integration)



Agent	Description	Interacts with
Stakeholders	Individuals or groups with an interest in the organization's success.	Managers (Stakeholder Alignment Sessions, Regular Updates), External Influences (Regulatory Compliance, Market Trends Adaptation), Clients (Customer Satisfaction Focus, Influence on Strategy), Suppliers (Strategic Goals Alignment, Performance Reviews)
Suppliers	The organizations that provide the goods or services needed by the main organization.	Managers (Supplier Scorecards, Collaboration Tools), Workforce (Product Training, Workflow Integration), Clients (Product Quality Feedback, Collaborative Improvement), Stakeholders (Alignment on Strategic Goals, Performance Reviews)

It is evident that every agent in this multi-agent system has specific responsibilities and collaborates with other agents to achieve strategic goals. While managers drive key initiatives and help coordinate cross-department efforts, external factors like market trends and regulations set the strategic priorities. Clients provide valuable feedback for continuous evolution and collaborating systems of communication that bind the firm together easily. The workforce performs strategy on the ground; stakeholders offer strategic guidance and resources, and suppliers ensure the timely delivery of goods and services.

Our multi-agent systems framework ensures that all the agents work together, each from their own perspective, in a collaborative process to achieve an integrated approach to strategic business-IT alignment (Figure 3). All these agents, with advanced coordination mechanisms, manage to maintain strategic alignment.

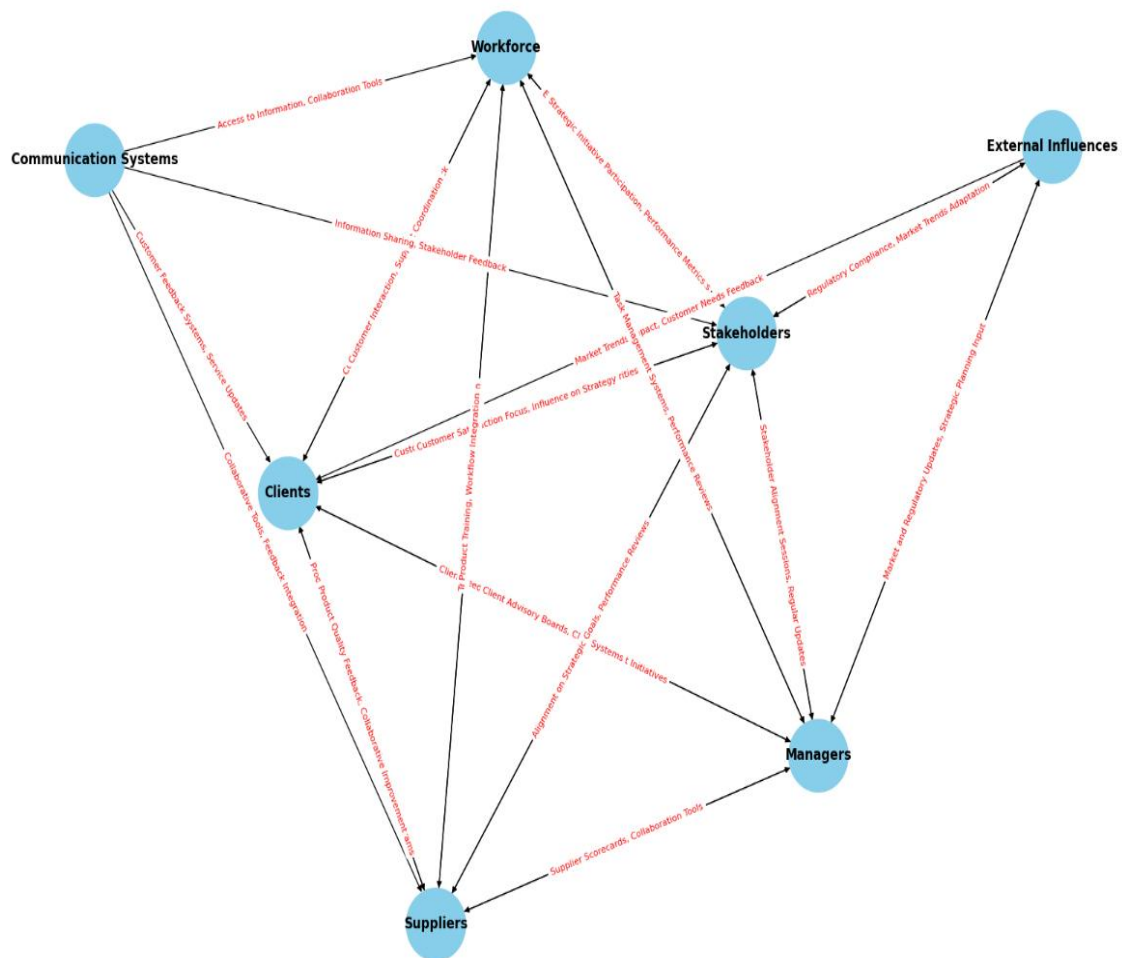


Figure 3. Enhanced Coordination Mechanisms in a Multi-agent System for Strategic Alignment

The quality of these interactions will determine the effectiveness of strategic alignment. For this reason, the communication among agents and the coordination of activities needs to be robust so that all can carry out their

roles perfectly, free of conflicts, in a coordinated way, and in alignment with the strategic objectives. Strategic alignment typically involves optimizing the interaction between the IT department and the rest of the company, constructing transparent IT infrastructure, and establishing procedures for IT project budgeting.

## IMPLEMENTATION OF THE MULTI-AGENT SYSTEM MODEL FOR STRATEGIC BUSINESS-IT ALIGNMENT

This section describes a proof-of-concept implementation of the multi-agent system model to help organizations better align their IT capabilities with business strategies using real-time data inputs and sophisticated optimization algorithms. The optimization results are presented to the user, showcasing the selected IT capabilities and their overall impact on alignment. These findings provide insights into the specific actions that leadership can undertake to achieve the highest strategic alignment between IT investments and overall business impact.

The first process is the identification and communication of the strategic goals and objectives by the manager agents. These objectives form the basis of the alignment process. Second, the model specifies how to assess business strategy IT capability fit to determine how the firm's business strategies align with the existing IT capabilities. It uses managers' and IT department input through the above-mentioned coordination mechanisms and opens up areas for possible development in case there are gaps that this assessment has revealed need attention.

According to this assessment, all the interested parties ("agents"), such as managers, employees, stakeholders, and suppliers, come up with the right measures to deal with the gaps mentioned. This way of working lends itself to having the action plans reflect the respective needs of the different players in the matter.

In this implementation process, communication and coordination indeed become a focal point. Communication agents work in a way that allows information to be quickly passed from one agent to another, which discourages the act of secrecy and enhances information sharing. In the same way, the cooperation protocols developed between the agents guarantee that the different actions and processes are compatible and occurring simultaneously, which actually enhances the effectiveness of the strategic alignment activities. It is only after these basic courses that the model uses the high-end SEA to further enhance the alignment process through real-time strategic matching, dynamic reconfiguration, and efficient novel agent mop-up.

This will allow the model to address the social and human dimensions, going beyond technical functionality.

- The pre-defined communication protocols between agents create a platform for ongoing dialogue, negotiation, and collaboration. This fosters a sense of shared purpose and understanding among stakeholders, which is crucial for social alignment.

- The model facilitates social learning by enabling agents to observe each other's actions and adapt their behaviors accordingly. For example, the "Workforce" agent reads the client feedback that will be given as input by the "Clients" agent to learn and improve customer service practices. This continuous learning loop fosters a shared understanding of strategic goals and promotes social alignment across the organization.

- The multi-agent model can be integrated with existing communication channels and social platforms within the organization. This allows for seamless information flow and collaboration, leveraging established social connections and fostering a sense of community around strategic alignment initiatives.

### System Architecture

#### Components

1. Strategic Alignment Engine (SAE): The heart of the system is the component that is responsible for real-time strategy matching and adjusting mechanisms.
2. User Interface: Interactive data input from pages and result display pages.
3. Algorithm principles: We must implement optimizing and constraint handling methods to maximize the scaled total alignment within the budget.

#### User Interface Design

This application's minimal graphical user interface combines intuitive design, easy data input, and direct data results visibility. Its interface consists of essential components that make it easier to access data and visualize (Figure 4).

1. Interface Elements. Answer Fields: Get information on business strategies and IT capabilities; fill it out as input. Entrants shall provide specific details on their goals, such as their importance for the company's business success and IT resources that can be allocated economically.

- Expand Market Share Weight: This shows the significance of expanding market share within both objectives. It is a numerical value, with 0 indicating the feature has no citizenship at all and one indicating the feature perfectly predicts citizenship.

- Expand Market Share Impact: Determine the impact of expanding market share on overall business performance. Enter a numerical value between 0 and 1, where the higher value indicates greater importance.

- Improve Customer Service Weight: The weight assigned to this goal in the context of overall strategic objectives. It is a value between 0 and 1, where the higher value indicates greater importance.

- Improve Customer Service Impact: Quantifies how much improvement in customer service you will provide that translates to overall business effect. It is a value between 0 and 1, where the higher value indicates greater importance.

- Upgrade CRM Cost: Indicates upgrading the Customer Relationship Management (CRM) system. Enter a monetary cost value.

- Upgrade CRM effectiveness: Quantify how the CRM enhancement has helped justify strategic objectives. It is a value between 0 and 1, where the higher value indicates greater importance.

- Enhance Data Analytics Cost: cost incurred by supercharging data analytics capabilities. Enter a monetary cost value.

- Increase Data Analytics Impact: Measures the impact of increasing data analytics capabilities towards strategic objectives. It's a value between 0 and 1; the higher one represents more effectiveness.

- Manager Influence: Reflects on how managers influence driving strategic alignment. Enter a number between 0 and 1 (greater values indicate a more significant impact).

- External Influences: This measure quantifies how market trends, regulations, and other changes influence strategic alignment. It's a value between 0 and 1; the higher the number, the more effective.

- Client Feedback: This value indicates the impact of client feedback on strategic alignment decisions. It ranges between 0 and 1; the higher the number, the more effective.

- Workforce efficiency: Assess the workforce's efficiency in executing strategies. The value is between 0 and 1; the higher the number, the better the efficiency.

- Stakeholder Engagement: Describes the level of stakeholder engagement and support. It's a value between 0 and 1; higher numbers mean more engaging

- Supplier Reliability: Indicates the efficiency of suppliers in delivering critical goods and services. It is a number from 0 to 1, where higher values indicate more excellent reliability.

- Total Budget: This shows the budget destined to implement the strategic alignment initiatives. Enter a numerical value for the total budget.

2. Submit Button: This button triggers the calculation. When users finish entering all pertinent information, they can submit it to run the optimization.

3. Output Display: The selected IT capabilities and aggregate alignment impact are shown. It is easy to read and gives an excellent, brief overview of the optimization results so you can access implications right on the page.

**Strategic Alignment Engine**

Expand Market Share Weight: <input type="text" value="0"/>	Manager Influence: <input type="text" value="0"/>
Expand Market Share Impact: <input type="text" value="0"/>	External Influences: <input type="text" value="0"/>
Improve Customer Service Weight: <input type="text" value="0"/>	Client Feedback: <input type="text" value="0"/>
Improve Customer Service Impact: <input type="text" value="0"/>	Workforce Efficiency: <input type="text" value="0"/>
Upgrade CRM Cost: <input type="text" value="0"/>	Stakeholder Engagement: <input type="text" value="0"/>
Upgrade CRM Effectiveness: <input type="text" value="0"/>	Supplier Reliability: <input type="text" value="0"/>
Enhance Data Analytics Cost: <input type="text" value="0"/>	Total Budget: <input type="text" value="0"/>
Enhance Data Analytics Effectiveness: <input type="text" value="0"/>	

**Figure 4.** User Interface Design for Collecting Data for SAE

### Processing Data

The first step is defining a function to process and optimize the input data, essentially finding the best alignment strategy. We use the calculate alignment function to do this (with the code provided in Appendix A).

The source code provided in Appendix A demonstrates an example of implementing the optimization algorithms used by the SAE's real-time strategy matching functionality.

#### Data Definition

- The strategies dictionary defines the business strategies, each with a weight and an impact value.
- The capabilities dictionary defines the available IT capabilities, each with a cost and effectiveness value.
- The budget\_value is defined as a constraint to limit the total cost of selected IT capabilities.

#### Objective Function

The objective function calculates the total alignment impact by summing the effectiveness of the selected IT capabilities, weighted by the strategy weights and effects. The goal is to maximize this total alignment impact.

#### Constraint Function

The constraint function ensures that the total cost of the selected IT capabilities does not exceed the defined budget.

#### Optimization Setup

- The initial guess  $x_0$  starts with no capabilities selected.
- The bounds for the decision variables ensure that each capability is selected (1) or not (0).
- The constraint is defined as an inequality.
- Optimization Execution:
  - The minimize function from the scipy.optimize library is used to optimize, employing the Sequential Least Squares Programming (SLSQP) method.

#### Result Extraction

The selected IT capabilities and the total alignment impact are extracted from the optimization solution and

printed as the output.

#### Source Code Explanation

Source Code (Appendix A) calculates the best combination of IT capabilities to achieve the most strategic alignment for businesses, considering the impact on business goals and the cost of implementing those capabilities. Here's a breakdown of how it works:

#### Setting Up the Data (Preparation)

- Imagine having two business strategies: "Expand Market Share" and "Improve Customer Service". Each strategy has a weight (importance) and an impact value (desired outcome).
- With proper communication and coordination, the user can create a list of potential IT capabilities, such as "Upgrade CRM" and "Enhance Data Analytics". Each capability has a cost and an effectiveness value (how well it supports the strategies).
- Finally, enter the total budget available for implementing IT capabilities.

#### Calculating the Best Fit (Optimization)

- The code uses a mathematical optimization technique to find the best combination of IT capabilities.
- It considers two factors:
  - Impact: How effectively each IT capability supports business strategies. This is calculated by multiplying the effectiveness of the capability by the weight and impact of the strategy it supports. The weight of the business strategies depends on the importance of each strategy in the organization.
  - Cost: The financial cost of implementing each IT capability.

#### Finding the Balance (Constraint)

The code keeps the total cost of selected capabilities within the defined budget by ensuring the sum of the costs of chosen capabilities doesn't exceed the budget.

#### Presenting the Results (Output)

Once the optimization is complete, the code presents the following results:

- Selected IT Capabilities: Based on the optimization results, it lists which IT capabilities are recommended for implementation (Yes) and which are not (No). This helps you prioritize IT investments based on their strategic alignment.
- Total Alignment Impact: This represents the overall strategic benefit you gain from implementing the selected IT capabilities. This value helps you understand the potential return on investment for IT spending.

#### Adaptability for Different Scenarios

The beauty of this code is its adaptability. For example, the user can easily adjust data by changing the weights, impacts, costs, and effectiveness values of strategies in real-time and capabilities to reflect priorities and resource constraints. The approach is also valid for multiple scenarios, and the optimization is done numerous times with different data sets to explore various scenarios and find the best approach for each.

This model must be tested in enterprise environments with substantial volume and using transaction production data to ensure this approach is performant and reliable. Such pilot programs in different organizations would offer insights and empirical evidence to evolve the model further and illustrate its applicability in enabling strategic business-IT alignment. In this way, the model will be stateful, resistant to change, not a limitation, and able to cater to the varied requirements of our larger enterprises today.

## **EMPIRICAL STUDY FOR THE STRATEGIC ALIGNMENT ENGINE (SAE) MODEL ACROSS MULTIPLE MOROCCAN ORGANIZATIONS (GAUGING SUCCESS OF MULTI-AGENT MODEL)**

This work investigates the impact of using the proposed strategic Alignment Engine Model to align business strategies to IT capabilities across Moroccan organizations. This study will use quantitative measures to measure the effects of the SAE Model on strategic alignment, dynamic adaptability, and organizational performance.

## Research Objectives

1. Assess how the SAE Model helps to align business strategies with IT capabilities
2. Evaluate the SAE Model's flexible response capability regarding a change in the business and IT environments.
3. Assess the impact of the SAE Model on the Organizational performance and strategic goals

## Data Collection

In this study, thirteen Moroccan organizations participated, which were strategically chosen for diverse hierarchical structures, different strategic goals, and areas of operations (**Table 4**), including the historical telecommunication operator, the railway company, the highway company, the post office, three manufacturers, and six organizations in finance and insurance and services (**Table 4**). The number of employees ranged from 500 employees to more than 9,000 employees. Total revenue for the five publicly traded companies ranged from 6.5 billion to 1.2 million Dirhams.

**Table 4.** List of Companies whose Stakeholders were Interviewed

Company	Area of Operation
Souriau Esterline	Connection technology producer
Maroc Telecom	Telecommunication operator
ONCF	Moroccan railway company
Sofac	Credit institution
Capgemini	IT service company
Barid Al Maghrib	Letters and parcel delivery company
Nexans	Manufacture of industrial wires and cables and fiber optic cables
Metallurgy anonym	A company in the metallurgy sector which preferred to remain anonymous
SGMB	Bank
RMA Assurance	Insurance company
GROUPE AFMA	Insurance broker
ADM	National company in charge of building, maintaining and operating the motorway network
A-SIS	Publisher and integrator of complete solutions for logistics

### Pre-implementation Baseline Data Collection

#### Internal Stakeholder Interviews and Online Questionnaire

Online surveys were sent to key stakeholders in each organization, including executives, IT managers, and business unit leaders. covering the following aspects:

- The current level of alignment between business strategies and IT capabilities
- The primary business strategies pursued by these companies
- The most critical IT capabilities to achieve these strategies
- The effectiveness of the IT department's support for business objectives
- The challenges faced in aligning IT with business strategies
- The frequency of reviewing and updating IT strategies
- The success measures of IT initiatives
- The existence of formal processes to collect stakeholder feedback
- The level of integration of IT systems with other departments
- The proposed improvements to better align IT and business strategies
- The current degree of alignment between IT and business strategies
- A description of the current IT infrastructure

Internal stakeholder interviews were also conducted to investigate the alignment between IT and business strategies (Appendix B). The main points in this questionnaire were about:

- Current State of Business-IT Alignment: Understanding the present alignment and identifying gaps.

- Business Strategies: Identifying key business strategies the organization focuses on.
- IT Support for Business Objectives: Evaluating how well IT capabilities support business goals.
- Challenges: Identifying significant challenges in aligning IT with business strategies.
- Review and Update Frequency: Understanding how often IT strategies are reviewed and updated.
- Success Measures: Defining how the success of IT initiatives is measured.
- Stakeholder Feedback: Assessing the processes to gather stakeholder feedback on IT performance.
- IT Integration: Evaluating the level of integration of IT systems with other departments.
- Improvement Suggestions: Collecting suggestions for better aligning IT with business strategies.
- Current IT Infrastructure: Describe the existing IT infrastructure and identify areas for improvement.

#### Customer Satisfaction Survey

Questions were rated on a scale of 1 to 5 to gauge customer satisfaction. Calculate the average score for each question by summing the scores and dividing by the number of respondents.

$$\text{Average Score} = \frac{\text{Total Score}}{\text{Number of Respondents}}$$

Normalize to 100-Point Scale: Multiply the average score by 20 (since each question is rated on a scale from 1 to 5, and 5 corresponds to 100%).

#### Collected Information and Findings Result

Several key findings and general trends emerged from the analyses of the questionnaire responses and interviews:

- The level of alignment between IT and business strategies varies significantly across the companies, ranging from very poor (Maroc Telecom, ONCF) to excellent (Sofac, Barid Al Maghrib).
- The primary business strategies aim to expand market share, improve service reliability, reduce default rates, or increase the customer base.
- The most critical IT capabilities identified are improving CRM systems, enhancing data analytics, and implementing ERP systems.
- The most frequently mentioned challenges are budget constraints, lack of communication between departments, and lack of skilled personnel.
- The frequency of reviewing IT strategies ranges from annual to quarterly, depending on the company.
- The main success measures of IT initiatives are revenue growth, customer satisfaction, and improved operational efficiency.
- Most companies have formal processes to collect stakeholder feedback on IT performance.
- The level of integration of IT systems with other departments also varies from low to very high, depending on the company.
- The main proposed improvements concern modernizing IT infrastructure, strengthening data analytics capabilities, and improving system integration.

The survey covered the current state of business-IT alignment, strategic goals, IT infrastructure, and key performance indicators.

The alignment level for each organization was extracted from a previous study by Benkhayat (2024), which aimed to validate a new tool for measuring the alignment degree between business and IT. Notably, the same organizations were involved in this study and the Benkhayat study. The alignment degree results are recorded in the "alignment rating" column of **Table 5**, and the data from interviews and surveys taken from stakeholders is collected in the "alignment rating" column. There was a variable variance in the alignment ratio of IT with strategy between online survey responses and interview feedback.

**Table 5.** Data Collected from Interviewed Companies

Organization	Alignment Degree	Alignment rating	Strategic Goals	IT Infrastructure	Revenue Growth	Operational Efficiency	Customer Satisfaction	
Souriau Esterline	12%	Very Low (0-20%)	Increase global market presence by 10%	Outdated moderate analytics	CRM, data	4%	60/100	70/100
Maroc Telecom	21%	Low (21-40%)	Expand market share by 5%, improve customer service	Legacy moderate analytics	systems, data	3%	65/100	75/100
ONCF	4%	Very Low (0-20%)	Modernize infrastructure, improve service reliability	Siloed limited integration	systems,	2%	55/100	65/100
Sofac	5%	Very Low (0-20%)	Expand loan portfolio, reduce default rates	Basic IT systems, limited automation		3%	60/100	68/100
Capgemini	62%	Very High (81-100%)	Increase client base by 15%, enhance service delivery	Advanced IT infrastructure, robust data analytics		6%	75/100	80/100
Barid Al Maghrib	23%	Low (21-40%)	Enhance delivery speed, expand service offerings	Mixed IT systems, moderate analytics	data	3%	60/100	70/100
Nexans	71%	Very High (81-100%)	Improve production efficiency, expand product range	Moderate IT systems, limited data integration		4%	65/100	72/100
Metallurgy anonym	59%	Moderate (41-60%)	Increase production capacity, reduce costs	Outdated systems, minimal analytics	data	2%	55/100	60/100
SGMB	13%	Low (21-40%)	Expand services, financial improve customer experience	Modern IT systems, robust data analytics		5%	70/100	75/100
RMA Assurance	76%	High (61-80%)	Expand insurance offerings, improve customer service	Moderate IT systems, limited data analytics		3%	65/100	70/100
GROUPE AFMA	22%	Moderate (41-60%)	Increase client base, enhance service delivery	Basic IT systems, limited automation		4%	60/100	68/100
ADM	77%	High (61-80%)	Expand network, motorway improve maintenance	Moderate IT systems, limited data integration		2%	65/100	70/100
A-SIS	45%	High (61-80%)	Enhance solutions, logistics increase client base	Advanced IT infrastructure, robust data analytics		5%	70/100	75/100

**Table 5** reveals discrepancies between the alignment degree calculated using the Benkhayat model and the alignment rating perceived by stakeholders through interviews and surveys. This highlights a crucial point: stakeholders might think their IT is well-aligned with strategy, but a more objective assessment reveals shortcomings.

The MAS approach helps bridge this gap by considering various factors beyond subjective perceptions. The model provides a more nuanced view of the alignment by incorporating crucial parameters, external influences, and feedback mechanisms. This allows for data-driven recommendations that address the technical aspects and the human and environmental factors affecting IT-business integration. For example, Capgemini rated the alignment as very high. However, the calculation revealed a moderate level of alignment. However, while stakeholders perceived a "High" alignment level for organizations like ADM, the Benkhayat model indicated a 77% degree. Here, the gap is smaller, suggesting a better understanding of the alignment state.

### Implementation Phase

We have chosen two companies from the studied and surveyed organizations to apply our strategic alignment model based on MAS. The criteria for selection were the degrees of alignment. We chose ONCF, which has the lowest degree of alignment, and ADM, which has the highest degree of alignment.



### Application of Strategic Alignment Based on Multi-agent System

Recommendations for ONCF and ADM are focused on strategic alignment through IT infrastructure upgrades, workforce integration, client feedback enhancement, and stakeholder integration.

#### ONCF Recommendation

- Main aim: Infrastructure modernization and improving the reliability of services
- Actions:
  - IT infrastructure enhancement:
    - Integrate siloed systems: Bring collaboratively inimical IT systems into a single system to facilitate data flow and operational efficiency.
    - Unified communication tools: Implement new-generation communications tools for better intradepartmental coordination and information sharing.
  - Workforce integration enhancements:
    - Training on new systems: Arrange continuous training programs to adapt the employees to the IT systems and tools being introduced.
    - Appropriate workflow integration: Create efficient workflows so that the new systems can be executed into the daily framework without disruptions.
  - Client feedback improvements:
    - Monthly focus group information: This can be used as feedback for the level of service. Further, Regular Passenger Surveys can be conducted to gather reliability and passenger satisfaction.
  - Stakeholder alignment improvements:
    - Monthly strategic reviews: Conduct monthly reviews of strategic goals, operational performance, and alignment with business objectives.
    - Perform supplier performance evaluation: Conduct an ongoing review of suppliers to evaluate their compliance with standards, helping to ensure reliability overall.
- Anticipated Impact: Improved service reliability and customer satisfaction.
- Specific recommendations for communication and protocol feedback:

Since ONCF already used Microsoft Teams for their internal exchanges, we suggested extending its use to dialogues with external suppliers and clients by creating dedicated channels for them. Doing this would leverage familiarity with the tool while enhancing communication and collaboration across different agents. In addition, we suggested using SurveyMonkey, a new but cost-effective tool for collecting feedback from other stakeholders.

- Managers: Use Microsoft Teams for strategic updates through weekly meetings and monthly reports to ensure clear direction and oversight.
- External Influences: Utilize Microsoft Teams for bi-monthly market intelligence reports and compliance alerts to stay updated with external factors.
- Clients: Establish structured feedback collection through quarterly feedback sessions using SurveyMonkey and create a client advisory board within Microsoft Teams for direct input.
- Workforce: Provide regular briefings and communication about training opportunities using Microsoft Teams for announcements and training programs.
- Stakeholders: Conduct quarterly stakeholder meetings and regular updates using Microsoft Teams for virtual meetings and collaboration.
- Suppliers: Use Microsoft Teams for supplier collaboration and conduct monthly performance reviews to maintain quality and timely delivery by creating dedicated supplier channels.

#### ADM Recommendations

- Main aim: Enhance the highway system and its maintenance.
- Actions:
  - IT Infrastructure enchantments:
    - Improve IT systems: Modernize IT systems for expanding operations and implement data analytics software, allowing for strategic decisions.

- Workforce integration enhancements:
  - Continue training on new maintenance techniques and technical improvements: Bird staff in the latest developments for improved efficiency.
- Client feedback improvements:
  - Collect feedback through frequent user surveys, Surveying the conditions of highways, and Surveying service delivery regarding highway maintenance.
- Stakeholder alignment enhancements:
  - Bi-Annual Business Alignment Meetings: Conduct bi-annual meetings to evaluate business strategy compared with operational plans and shareholders' expectations.
  - Performance Evaluation: Regular performance evaluation regarding maintenance improvements and network expansion.
- Anticipated impact: The road system will be widened, and maintenance coverage will improve.
- Specific recommendations for communication and protocol feedback:

ADM also uses Microsoft Teams for their internal exchanges. So we made the same recommendation to extend its use to external communications, too. And the use of SurveyMonkey for collecting feedback.

#### Recommendations for ADM

- Managers: Continue effective strategic updates and decision-making protocols using Microsoft Teams for project tracking and documentation.
- External influences: Maintain the current market intelligence sharing and compliance monitoring practice using Microsoft Teams for data visualization and management.
- Clients: Enhance client communication plans and ensure feedback is systematically analyzed and shared using SurveyMonkey and Microsoft Teams for CRM and customer support.
- Workforce: Keep up with regular briefings and training announcements using Microsoft Teams for internal communications and continuous learning.
- Stakeholders: Hold regular meetings and use Microsoft Teams for real-time communication and collaboration to discuss strategic initiatives.
- Suppliers: Keep up with performance reviews and feedback loops using Microsoft Teams for supply chain management and tracking supplier performance by creating dedicated supplier channels.

Three months after recommending the adaptation of our new strategic alignment cadre, we conducted new workshops to review this organization's new alignment degree. In this workshop, we evaluated the importance of the different agents in making a decision, and then we used our SAE engine to assess the impact of the new alignment.

For ONCF, the extension of Microsoft Teams to suppliers and clients and the structured feedback collection through SurveyMonkey improved communication and coordination, leading to a more efficient and cohesive strategy alignment process. Similarly, ADM benefited from the enhanced use of Microsoft Teams and SurveyMonkey, ensuring continuous feedback and dynamic adjustments to their strategies.

#### Application of SAE to ONCF and ADM

The SAE's real-time strategy matching and automatic adjustment mechanisms helped assess and enhance the alignment. We collected the necessary input Data for the SEA as follows, and the updated results of these assessments are shown in **Tables 6, 7, 8 and 9**.

**Table 6.** Input Data of ONCF

Parameter	Value
Expand Market Share Weight	0.4
Expand Market Share Impact	0.3
Improve Customer Service Weight	0.6
Improve Customer Service Impact	0.7
Upgrade CRM Cost	500000
Upgrade CRM Effectiveness	0.5
Enhance Data Analytics Cost	400000

Parameter	Value
Enhance Data Analytics Effectiveness	0.6
Manager Influence	0.7
External Influences	0.4
Client Feedback	0.6
Workforce Efficiency	0.5
Stakeholder Engagement	0.6
Supplier Reliability	0.5
Total Budget	1000000

**Table 7.** Result for ONCF

Metric	Pre-implementation	Post-implementation	Change
Alignment Degree	4%	30%	26%
Selected IT Capabilities			Upgrade CRM, Improve Integration
Revenue Growth	2%	4%	2%
Operational Efficiency	55/100	65/100	+10 points
Customer Satisfaction	65/100	70/100	+5 points

**Table 8.** Input Data of ADM

Parameter	Value
Expand Market Share Weight	0.3
Expand Market Share Impact	0.4
Improve Customer Service Weight	0.7
Improve Customer Service Impact	0.6
Upgrade CRM Cost	600000
Upgrade CRM Effectiveness	0.6
Enhance Data Analytics Cost	500000
Enhance Data Analytics Effectiveness	0.7
Manager Influence	0.8
External Influences	0.5
Client Feedback	0.7
Workforce Efficiency	0.6
Stakeholder Engagement	0.7
Supplier Reliability	0.6
Total Budget	1200000

**Table 9.** Result for ADM

Metric	Pre-implementation	Post-implementation	Change
Alignment Degree	77%	85%	8%
Selected IT Capabilities			Enhance Data Integration, Upgrade CRM
Revenue Growth	2%	4%	2%
Operational Efficiency	65/100	75/100	+10 points
Customer Satisfaction	70/100	78/100	+8 points

### Interpretation

The application of the multi-agent system for strategic alignment to ONCF and ADM shows its effectiveness in improving even a company's most critical performance parameters. Although the SAE used the same input data to optimize alignment, it produced results that were several times better than they were.

ONCF's alignment degree has increased from 4% to 30%, demonstrating the model's ability to assist in identifying and prioritizing critical IT investments that drove the achievement of organizational strategy. Upgrading CRM and Better Integration are two areas of focus. In turn, it is hoped that these changes will simplify the clutter and improve how data moves through the organization. This results in better revenue growth,

operational efficiency, and customer satisfaction, showing the real impact of aligning IT capabilities with business strategies. Improved CRM and integration ultimately provided ONCF with better customer service, increasing revenue growth. Increased operational efficiency means the organization operates its processes more efficiently, so there are probably fewer redundancies and better-aligned departments. Improved customer satisfaction shows a better customer experience, and the improved CRM supports more responsive and tailored services.

The degree of alignment at ADM was initially 77% but rose to 85%, revealing that even if an organization is in a state of high performance, it can still be refined and optimized, whether it's to obtain a complete view of all its products or services or quickly increase CRM Without investing too much time and money on a single task. The fundamental objective is to make data integration easier. And that makes it simpler for the second and third derivative processes that derive from this to generate more profit for you. The paper reported improvements in revenue growth, operational efficiency, and customer satisfaction for ADM, which is evidence that the company's integration of IT capabilities has been effective. Benefits to ADM included:

- Revenue growth: Deeper data integration and a refreshed CRM have better-enabled ADMs to interpret and service customer demand, driving higher sales volumes and customer loyalty.
- Operational efficiency: Multiple parts of the organization are running in alignment and doing so more efficiently, likely through increased data usage or smoother processes
- Customer satisfaction: Improved quality of service and customer interactions with the aid of the CRM system.

The multi-agent system model has provided exemplary assistance in aligning key performance indicators in ONCF and ADM. The results show that organizations gain significant advantages through a strategic alignment of their business and IT functions; this includes higher revenue growth, better operational efficiency, and enhanced customer satisfaction. This lens for optimizing IT investments using agent influences aligned to strategic goals is how the model empowers organizations to make efficient and sustainable choices to achieve their objectives.

#### Improved Alignment and Performance

The core finding is the substantial increase in alignment degree observed in both ONCF (4% to 30%) and ADM (77% to 85%). This aligns with research highlighting the positive correlation between business-IT alignment and organizational performance metrics (Melville et al., 2004; Luftman et al., 2012). The study extends these findings by showcasing a method (Multi-Agent System) for achieving this alignment and demonstrating its effectiveness in real-world scenarios.

#### MAS Advantages over Traditional Approaches

Traditional methods for business-IT alignment often rely on static assessments and cannot consider dynamic factors like stakeholder influences and external pressures. The MAS approach appears to address these shortcomings. The model likely creates a more nuanced understanding of the alignment landscape by incorporating parameters like manager influence, client feedback, and workforce efficiency. Also, its algorithm can easily adapt to changing numbers and inputs. This allows for data-driven recommendations considering the technical aspects and the human and environmental factors affecting IT-business integration. MAS's role is to identify and prioritize critical IT investments. In ONCF, the model recommended upgrading the CRM and improving data integration. This aligns with existing literature that suggests focusing on core IT capabilities that directly support strategic objectives (Pollard & Cater-Steel, 2009). Also, as discussed in the Market gap above, there is no real-time integration and adaptation; however, the proposed MAS algorithm can take real-time inputs and provide adjusted alignment strategies. The improved customer satisfaction and operational efficiency observed in ONCF are likely attributed to these targeted CRM and data flow improvements.

## CONCLUSION

Clear communication and coordination protocols within a multi-agent system are often critical for organizational achievement. Representing strategic alignment as a multi-agent system facilitates comprehension of how various actors—such as executives, external forces, patrons, communication systems, workforce, stakeholders, and partners—interact and contribute to the overarching purpose of accomplishing strategic aims. There is no gap between IT strategy and business strategy, as well as between individuals and organizations, and all act in a coordinated manner.

It also helps organizations to minimize the overall complexity and interactivity of agents in the context of the multi-agent system representation in the sense that, instead of having several complex/several agents, there can

be many a simple one integrated into the system with a role or with impact described and exemplified. This allows agents to evolve with the environment through the immediacy of information flow and continuous feedback formed ad infinitum between agents. It helps to make the decision-making process even more productive and fixes likely misses on the spot, which could create a better-performing organization (Wooldridge, 2009).

In addition, the multi-agent system architecture increases adaptability by incorporating external insight (e.g., updates on market trends and regulatory changes) into the strategic alignment. It allows organizations to respond better to outside forces and remain agile, enabling them to keep their strategies aligned with the evolving business (Jennings, 2000).

This also encourages a climate of collaboration and learning. Better networking among agents allows for better relationships and room for teamwork, which improves employee engagement and satisfaction. Engaged employees are more motivated and committed to the organization's strategic goals, which leads to higher productivity and lower turnover (Grant & Parker, 2009).

In conclusion, modeling strategic alignment as a multi-agent system provides an organization with a robust and agile organizational scheme by corresponding IT strategy to its business counterpart. This structured approach to commencements, reinforced by the understanding of communication protocols and coordination, ensures that every agent plays a part in making the business successful and staying competitive when accomplishing the organization's strategic goals.

However, this strategic alignment model has not been proven to be the best and needs to be tested and validated with actual case studies from real enterprises. This empirically validates the effectiveness of what is proposed and serves as the seed for enhancing them in deployments across real-world business settings.

## LIMITATIONS AND FURTHER RESEARCH

While the study provides promising results, some limitations need to be considered. The small sample size makes it difficult to generalize the findings. Additionally, the specifications of the MAS algorithm and its inner workings are not mature. The study will continue to find more sample data and robust algorithms to reveal further findings. Further research with a larger sample size and automation of the MAS's functionalities would strengthen the overall analysis in the future.

## RECOMMENDATIONS

The process starts by identifying key stakeholders across departments and clearly defining the organization's strategic goals. Data collection on IT capabilities, operational efficiency, customer satisfaction, and stakeholder influences is crucial. Businesses can then select an MAS tool based on their technical expertise and budget. The core step involves parameterizing the model by assigning weights to factors like manager influence and IT capability effectiveness. Running simulations allows businesses to prioritize IT investments with the highest impact on achieving strategic goals.

However, implementing the MAS framework comes with challenges. The accuracy and completeness of data collection depend on storage methods and data-cleaning processes. People management and engagement with the relevant stakeholders are crucial to respond to their concerns during the process. A simple model should be initially used that includes basic parameters to be refined as an application specialist improves. Companies that do not possess adequate technical capital can involve external consultants or IT specialists. One of the most essential communication issues is providing the list of benefits of MAS and addressing the issues related to change in this area.

To get the maximum advantage of the MAS approach, starting with a particular department and using it to expand to the entire organization gradually may be helpful. The ability to change priorities to fit the current operational model and review the model's efficiency makes it possible to establish continuous improvement of the parameters. Another prospect for applying the MAS is to connect it to other business intelligence or strategic planning platforms for a more comprehensive solution. By following the above steps and managing any of these challenges, the companies can apply the MAS framework to align the firm's IT with the business to enhance its performance and attain its strategic goals.

## **CONFLICT OF INTEREST**

The authors declare no conflicts of interest.

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## APPENDIX A

# This Python function calculates the optimal selection of IT capabilities to achieve strategic alignment between business goals and IT investments.

```
def calculate_alignment(b):
```

```
    """
```

```
    #This function calculates the best combination of IT capabilities to maximize
    strategic alignment impact within a defined budget.
```

```
    Args:
```

```
    b (not used): This argument is currently unused.
```

```
    Returns:
```

```
    None: The function directly prints the results to the console.
```

```
    """
```

```
    With output:
```

```
    output.clear_output()
```

```
    # Fetch form data (assuming data comes from form elements)
```

```
    strategies = {
```

```
        "ExpandMarketShare": {
```

```
            "weight": ems_weight.value,
```

```
            "impact": ems_impact.value
```

```
        },
```

```
        "ImproveCustomerService": {
```

```
            "weight": ics_weight.value,
```

```
            "impact": ics_impact.value
```

```
        }
```

```
    }
```

```
    capabilities = {
```

```
        "UpgradeCRM": {
```

```
            "cost": crm_cost.value,
```

```
            "effectiveness": crm_effectiveness.value
```

```
        },
```

```
        "EnhanceDataAnalytics": {
```

```
            "cost": eda_cost.value,
```

```
            "effectiveness": eda_effectiveness.value
```

```
        }
```

```
    }
```

```
    budget_value = budget.value
```

```
    def objective(x):
```

```
        """
```

```
        This function calculates the total alignment impact by considering the effectiveness of selected IT capabilities
```

weighted by strategy weights and impacts. The goal is to maximize this value.

Args:

x (list): A list of binary values (0 or 1) representing the selection status of each IT capability.

Returns: float: The negative total alignment impact (to be minimized).

"""

```
total_impact = 0
```

```
for strategy, strategy_values in strategies.items():
```

```
    strategy_impact = 0
```

```
    for capability, capability_values in capabilities.items():
```

```
        strategy_impact += x[list(capabilities.keys()).index(capability)] * capability_values["effectiveness"]
```

```
    total_impact += strategy_values["weight"] * strategy_impact * strategy_values["impact"]
```

```
return -total_impact # Minimize this function
```

```
def constraint(x):
```

"""

This function ensures the total cost of selected IT capabilities doesn't exceed the defined budget.

Args:

x (list): A list of binary values (0 or 1) representing the selection status of each IT capability.

Returns:

float: The difference between budget and total cost. This should be non-negative to satisfy the constraint.

"""

```
total_cost = 0 for i, capability in enumerate(capabilities.keys()):
```

```
    total_cost += x[i] * capabilities[capability]["cost"]
```

```
return budget_value - total_cost
```

```
x0 = np.zeros(len(capabilities))
```

```
bounds = [(0, 1) for _ in capabilities] # 0: not selected, 1: selected
```

```
con = {'type': 'ineq', 'fun': constraint}
```

```
solution = minimize(objective, x0, method='SLSQP', bounds=bounds, constraints=[con])
```

```
selected_capabilities = {list(capabilities.keys())[i]: round(solution.x[i]) for i in range(len(solution.x))}
```

```
total_impact = -solution.fun
```

```
result_message = "Selected IT Capabilities for Alignment:\n" for capability, selected in selected_capabilities.items(): result_message += f"- {capability}: {'Yes' if selected else 'No'}\n"
```

```
result_message += f"\nTotal Alignment Impact: {total_impact}"
```

```
print(result_message)
```

```
# Assuming this function is called when a button is clicked
```

```
button.on_click(calculate_alignment)
```

## APPENDIX B

### Survey Questions

1. The current level of alignment between business strategies and IT capabilities
2. The primary business strategies pursued by these companies
3. The most critical IT capabilities to achieve these strategies
4. The effectiveness of the IT department's support for business objectives
5. The challenges faced in aligning IT with business strategies
6. The frequency of reviewing and updating IT strategies
7. The success measures of IT initiatives
8. The existence of formal processes to collect stakeholder feedback
9. The level of integration of IT systems with other departments
10. The proposed improvements to better align IT and business strategies
11. The current degree of alignment between IT and business strategies
12. A description of the current IT infrastructure

### Online Survey Questions for Internal Stakeholders

1. How would you rate the current alignment between your business strategies and IT capabilities?

Response Options:

- Very Poor
- Poor
- Fair
- Good
- Excellent

2. What are the primary business strategies your organization is focusing on? (Select all that apply)

Response Options:

- Expanding market share
- Improving customer service
- Reducing operational costs
- Innovating new products/services
- Enhancing data analytics capabilities

3. What IT capabilities are most critical to achieving your business strategies? (Select all that apply)

Response Options:

- Upgrading CRM systems
- Enhancing data analytics
- Implementing ERP systems
- Improving cybersecurity measures
- Adopting cloud computing

4. How effectively does your IT department support your business objectives?

Response Options:

- Not at all
- Slightly
- Moderately
- Very well

- Extremely well

5. What challenges do you face in aligning IT with business strategies? (Select all that apply)

Response Options:

- Budget constraints
- Lack of skilled personnel
- Poor communication between departments
- Rapid technological changes
- Resistance to change

6. How often do you review and update your IT strategies to align with business goals?

Response Options:

- Never
- Annually
- Bi-annually
- Quarterly
- Monthly

7. How do you measure the success of IT initiatives in supporting business strategies? (Select all that apply)

Response Options:

- Revenue growth
- Customer satisfaction
- Operational efficiency
- Market share increase
- Employee productivity

8. Do you have formal processes for gathering feedback from stakeholders on IT performance?

Response Options:

- Yes
- No

9. How well do your IT systems integrate with other departmental systems (e.g., finance, HR, marketing)?

Response Options:

- Not at all
- Slightly
- Moderately
- Very well
- Completely

10. What improvements would you suggest to align IT with your business strategies better?

Open-ended Response

11. What is the current degree of alignment of your organization's IT and business strategies?

Response Options:

- Very Low (0-20%)
- Low (21-40%)
- Moderate (41-60%)
- High (61-80)
- Very High (81-100%)

12. How would you describe your current IT infrastructure? (Select all that apply)

Response Options:

- Outdated CRM
- Legacy systems
- Siloed systems
- Basic IT systems
- Advanced IT infrastructure
- Moderate data analytics
- Robust data analytics
- Limited integration
- Limited automation
- Minimal data analytics
- Mixed IT systems

13. What was your organization's revenue growth percentage last year?

Open-ended Response

### **Interview Questions**

1. Can you describe the current state of business-IT alignment in your organization?
2. What specific business strategies are you currently prioritizing, and how do you see IT supporting these strategies?
3. What are your main challenges when aligning IT with business strategies?
4. How do you ensure continuous alignment between IT and business strategies in a rapidly changing environment?
5. Can you provide an example of a recent IT initiative that significantly impacted your business strategy?
6. What role do external influences, such as market trends and regulatory changes, play in your IT alignment strategy?
7. How do you gather and utilize feedback from stakeholders regarding IT performance?
8. What metrics do you use to evaluate the success of IT initiatives in supporting business goals?
9. How do you prioritize IT investments to align with business strategies?
10. What plans do you have for improving the alignment of IT with your business strategies?

### **Customer Satisfaction Survey Questions**

Each question should be rated on a scale of 1 to 5, where 1 indicates strong dissatisfaction and 5 indicates intense satisfaction.

1. How satisfied are you with the overall quality of our products/services?
  - Very Unsatisfied
  - Unsatisfied
  - Neutral
  - Satisfied
  - Very Satisfied
2. How would you rate our customer service?
  - Very Poor
  - Poor
  - Fair
  - Good
  - Excellent
3. How likely will you recommend our products/services to others?

- Very Unlikely
- Unlikely
- Neutral
- Likely
- Very Likely

4. How satisfied are you with the timeliness of our service delivery?

- Very Unsatisfied
- Unsatisfied
- Neutral
- Satisfied
- Very Satisfied

5. How well do our products/services meet your needs?

- Not at all
- Slightly
- Moderately
- Very well
- Extremely well

6. How satisfied are you with the value for money of our products/services?

- Very Unsatisfied
- Unsatisfied
- Neutral
- Satisfied
- Very Satisfied

7. How would you rate your overall experience with our company?

- Very Poor
- Poor
- Fair
- Good
- Excellent

8. What improvements would you suggest to enhance your experience with our products/services?