Proceedings of the International Conference on Industrial Engineering and Operations Management

Publisher: IEOM Society International, USA DOI: 10.46254/AP06.20250247
Published: August 5, 2025

Identifying and Prioritizing CSFs in Data Science and AI: The Case of tiket.com Using DEMATEL and ANP

Feliks Prasepta Sejahtera Surbakti
Department of Industrial Engineering
Atma Jaya Catholic University of Indonesia
Jakarta, Indonesia
feliks.prasepta@atmajaya.ac.id

Raynaldi Cahyadi
Department of Industrial Engineering
Atma Jaya Catholic University of Indonesia
Jakarta, Indonesia
raynald.202104030003@student.atmajaya.ac.id

Arif Perdana
Director of the Action Lab Indonesia
Monash University
Tangerang, Indonesia
arif.perdana@monash.edu

Irvan B. Arief-Ang
PT. Global Tiket Network[1]
Universitas Bunda Mulia[2]
Jakarta, Indonesia
irvan.arief@tiket.com[1], iarief@bundamulia.ac.id[2]

Jonathan Liono
PT. Global Tiket Network
Singapore
jonathan.liono@tiket.com

Abstract

One significant advancement in Online Travel Agency (OTA) technology is the implementation of Artificial Intelligence (AI) for data processing in OTA systems. However, previous research indicates that the adoption of AI in OTAs faces challenges, such as algorithmic bias and data privacy risks. To address these issues, this study aims to analyze eight Critical Success Factors (CSFs) identified in prior research that have been proven to significantly influence the performance of AI project teams in overcoming the challenges associated with AI implementation. Through analysis using DEMATEL and Analytic Network Process (ANP) methods, this study provides an output in the form of an impact digraph that illustrates the interrelationships among CSF indicators and the priority weights of

each CSF. The findings reveal that all eight CSFs are interrelated in terms of influence and dependence, with the exception of Knowledge & Skill. The CSFs categorized as causal factors include problem-driven approach, data understanding, and knowledge and skill, while communication, collaboration, top management support, operational agility, and cost-benefit analysis are categorized as effect factors. The top three most critical factors are problem-driven approach with a weight of 0.105, followed by Data Understanding (0.088) and communication (0.074).

Keywords
Critical Success Factors, Artificial Intelligence, Online Travel Agency, DEMATEL, ANP

1. Introduction
Technological developments in Indonesia have significantly transformed operational processes from manual to automated systems across various industries. One significant result of this development is the emergence of data science, a multidisciplinary field combining computer science, statistics, and business, to create insights from massive datasets and support informed decision-making (Martinez et al., 2021). However, the number of data scientists in Indonesia remains limited compared to growing demand, creating a gap that needs to be addressed (Surbakti et al., 2023). Artificial Intelligence is directly connected with data science, which also handles large-scale data analysis to identify patterns, detect anomalies, and support strategic decisions. While artificial intelligence (AI) was first introduced in Indonesia in the 1980s within limited sectors, such as oil and gas, it is now widely applied through Internet-based platforms (Yusriadi et al., 2023). These technologies hold great promise for industries that rely on large volumes of data, including tourism.

One application of technological advancements in AI and data science is in the tourism industry. Indonesia's tourism sector continues to grow rapidly, supported by numerous attractive destinations. In the first half of 2023, there were 433.57 million domestic tourist trips or a 12.57% increase compared to the previous year. Additionally, international arrivals reached 6.31 million trips, marking a 196.85% increase from 2022 (Dávid et al., 2024). This growth calls for more advanced travel services that can handle increasing demand efficiently.

Online Travel Agencies (OTAs) have emerged as digital innovations in this space, offering online platforms for booking flights, accommodation, holiday packages, and other travel services (Oktavia & Abner, 2023). A study by Jolene (2023) indicates that promotions through Online Travel Agencies (OTAs) have an R^2 value of 0.767, suggesting that approximately 76.7% of the increase in room occupancy can be attributed to OTA-based promotional strategies—highlighting the effectiveness of such promotions in the hospitality sector. Furthermore, Start.io (2024) reports that 53.5% of OTA users in Indonesia belong to the 18–24 age group and commonly use OTAs for flights, hotels, and rentals. This supports high OTA usage among younger Indonesians. This strong preference underlines the growing importance of OTAs in national tourism ecosystems. To maintain user satisfaction and operational efficiency, many OTAs have begun integrating AI technologies, such as chatbots, preference-based recommendation engines, and automated service processes. These systems rely heavily on big data collected from user interactions (Sousa et al., 2024). For instance, AI can suggest personalized travel options based on user history, simplify the booking process, and improve the overall experience (Yang et al., 2024).

Despite these advantages, several challenges have arisen in the application of AI to OTA systems. As demand increases, managing large-scale data becomes more complex, raising concerns regarding algorithmic bias and data privacy (Surbakti et al., 2024). Pagano et al. (2023) emphasize that bias and unfairness in machine learning often stem from imbalanced datasets, inadequate fairness metrics, and insufficient mitigation strategies, posing significant challenges to ethical AI deployment. To address these challenges, it is essential to effectively implement AI projects in OTAs. Critical Success Factors (CSFs) play a vital role in determining the success of projects. According to Surbakti et al. (2024), key CSFs include problem-driven approaches, cost-benefit analysis, data understanding, top management support, collaboration, communication, knowledge and skills, and operational agility. Although these factors have been studied in other contexts, research specific to OTAs remains limited.

1.1 Objectives
This study focuses on identifying and analyzing the interrelationships and prioritization of these CSFs within the OTA environment, particularly on tiket.com, one of the top two most preferred OTAs in Indonesia. Focusing on tiket.com, the results are expected to be broadly applicable across the OTA industry. To achieve this, this study applies the

DEMATEL method to map causal relationships among CSFs and uses Analytics Network Process (ANP) to prioritize them. DEMATEL is well-suited for analyzing interdependencies, whereas ANP supports a network-based decision structure that offers greater flexibility and realism than traditional hierarchical methods such as Analytical Hierarchial Process (AHP). tiket.com can develop more targeted strategies for AI project implementation by identifying the most influential CSFs and understanding their relationships. This will not only enhance project success, but also boost competitiveness, customer satisfaction, and sustainable digital transformation in the OTA landscape.

2. Literature Review

Critical Success Factors (CSFs) are analytical methods that consider essential aspects within a company's environment to determine the factors that influence a company's goals. This method helps companies identify key aspects of operational activities that affect their performance in achieving their vision and mission. The purpose of CSFs is to enhance organizational objectives by determining necessary actions and relevant information. CSFs are required to achieve a company's mission and are usually established after strategic analysis (Kim, 2022). In this study, there are eight CSFs that will be analyzed: problem-driven approach, cost-benefit analysis, data understanding, top management support, collaboration, communication, knowledge and skills, and operational agility (Surbakti et al., 2024).

2.1 Competence and Teamwork Category

The CSFs identified in the study by Surbakti et al. (2024) can be categorized into competency aspects and teamwork aspects. Competence can be understood as a combination of abilities, skills, experience, and success in performing job responsibilities. Competence consists of three main indicators: knowledge relevant to the job and desire for continuous self-development, technical expertise aligned with the field of responsibility, and ability to recognize and solve problems. It also includes attitudes such as showing initiative in assisting colleagues and demonstrating friendliness and politeness while performing tasks (Calhau et al., 2024).

Teamwork refers to the ability of individuals to effectively collaborate in a group to achieve common goals. This includes good communication among team members, collaboration, and mutual support to synergistically complete tasks. Moreover, teamwork also involves regular coordination and mutual trust among members to ensure a smooth workflow and optimal results (Paredes-Saavedra et al., 2024). The following are the explanations of each CSF.

2.2 Problem-Driven Approach

The problem-driven approach is a decision-making method that focuses on identifying specific problems before collecting relevant data to guide problem-solving. This approach is highly beneficial for supporting strategic decisions by observing the environment and identifying potential issues. The most crucial first step in this approach is identifying the problem that needs to be resolved using relevant data and then seeking appropriate solutions (Wu et al., 2023).

2.3 Cost-Benefit Analysis

Cost-benefit analysis (CBA) is a method used to evaluate the effectiveness of an activity by comparing the benefits obtained with the costs incurred, while also considering potential risks. Previous studies have shown that CBA play a critical role in assessing whether big data projects achieve their goals. Moreover, analyzing cost-benefit factors is essential to ensure the feasibility of big data initiatives (Chatterjee et al., 2023).

2.4 Data Understanding

Data understanding is used to identify the relevant data used in solving problems, particularly in the context of a problem-driven approach. Data from various sources cannot be used directly because of differences in origin and reliability. Therefore, several processes are required, including finding links between data and business processes, identifying primary data sources, assessing data value, selecting and integrating data, analyzing data trends, and finding additional sources for improvement. The goal is to understand the strengths and weaknesses of the data and ensure their suitability for solving the identified problem (Holstein et al., 2024).

2.5 Top Management Support

Top management support refers to the active involvement and support of top-level leaders such as CEOs and other executives. This includes providing sufficient resources such as time, funding, skills, and team motivation. Top

management support plays a crucial role in creating a supportive environment to ensure project success through influences that can shape team behavior (Fareed & Su, 2022).

2.6 Collaboration

Collaboration involves active interaction and cooperation between two or more individuals within an organization. It aims to combine all the relevant resources to produce outcomes that are more effective and efficient than working individually (Meyers et al., 2023).

2.7 Communication

Communication in organizations refers to the process of sharing information required by all team members for decision-making. It is essential to organize and execute tasks. Focused and efficient communication initiatives are necessary to ensure smooth operation within an organization (Subiyanto et al., 2024).

2.8 Knowledge and Skills

In the corporate context, knowledge refers to the information and understanding possessed by employees regarding the procedures needed to perform tasks and responsibilities in a particular field. This knowledge enhances the operational effectiveness and efficiency. Skilled employees tend to complete tasks more accurately and productively, positively impacting overall company performance (Arévalo et al., 2022). Skills refer to the level of expertise employees possess in executing their assigned tasks. This includes choosing effective methods, adapting to different situations, and utilizing prior experience to deliver better outcomes. Knowledge and skills are critical factors for any company (Sony & Mekoth, 2022).

2.9 Operational Agility

Operational agility is a key factor that reflects how quickly a company can adapt to changes in market and customer needs. This involves internal adjustments and the rapid adoption of new technologies. Operational agility enables organizations to respond to challenges and uncertainty by redesigning internal processes, adopting technology, and adjusting production or service operations to remain competitive. These reasons make operational agility a vital factor in achieving business success (Asghar et al., 2025).

2.10 CSF's Indicators

CSF indicators are measurable signs or criteria that indicate whether a Critical Success Factor is successfully achieved. Each CSF typically has one or more indicators that provide concrete evidence of its performance or effectiveness. These indicators are essential for monitoring success, guiding decision-making, and identifying areas that need improvement. The indicators for each CSF are listed in Table 1.

Table 1. CSF's Indicators

Aspect	Critical Success Factor	Indicators	Source
Competence	Problem Driven Approach	Problem Identification Ability Root Cause Identification Ability Solution-Finding Ability	(Marmaras & Pavard, 1999)
	Cost Benefit Analysis	Cost Understanding Benefit Potential Understanding Risk Analysis Ability	(Ananyi & Somieari-Pepple, 2023)
	Data Understanding	Basic Data Understanding Selection & Integration Ability Trend Analysis Ability	(Holstein et al., 2024)
	Knowledge and Skill	Work Experience Educational Background Fit SOP Understanding Level	(Sony & Mekoth, 2022)
Teamwork	Collaboration	Teamwork Ability Trust Level Employee Empowerment	(Meyers et al., 2023)

Aspect	Critical Success Factor	Indicators	Source
	Communication	Focused Communication Ability Knowledge Sharing Ability Initiative in Communication	(Subiyanto et al., 2024)
	Operational Agility	Internal Adaptability New Technology Adoption Ability Productivity Level Management	(Asghar et al., 2025)
	Top Management Support	Leader Involvement in Monitoring Leader Involvement in Decision-Making Leader Involvement in Analysis	(Fareed & Su, 2022)

3. Methods

3.1 Data Collection and Participants

The primary data collection was conducted using a questionnaire. A questionnaire is a data-collection method that involves a series of structured questions. Respondents were asked to provide answers that could be evaluated either by choosing from predefined options or completing available open-ended sections. This technique is commonly used in quantitative research to collect data from broader samples (Kuphanga, 2024). In this study, the data were collected twice using questionnaires.

Two types of questionnaires were designed for this study due to the need for two rounds of data collection. The first questionnaire was designed to gather information on the interrelationships among CSFs using the DEMATEL method. The second was a pairwise comparison questionnaire used in the ANP method to determine the weight of each CSF with the aim of identifying the CSF that most significantly influences the desired goal. Both questionnaires were distributed to the entire AI project team as they were directly involved with the issues being studied.

Both questionnaires were designed using Excel to improve the efficiency of the completion process and ease the response burden. The DEMATEL questionnaire was filled out by entering scale values in designated Excel cells, following the instructions described in the previous chapters. For the ANP questionnaire, respondents highlighted the cells using colors based on the selected scale. The format of the questionnaire is provided in the Appendix.

To ensure that data were sourced from valid respondents, data collection was conducted among all employees on tiket.com from Data Science and Machine Learning Engineer who were related to the topic and were available during the data collection period, totaling 26 individuals. The results of this questionnaire served as the basis for data processing using the DEMATEL method to identify the interrelationships among CSFs and the ANP method to determine the factors that most influence goal achievement.

3.2 DEMATEL Method for Data Processing

Based on the results of the collected data, the first set of data obtained from the DEMATEL questionnaire was processed using the following steps: determining the questionnaire scale, creating a direct relation matrix, normalizing the matrix, constructing the total relation matrix, calculating vectors, and creating an impact digraph (Nyimbili et al., 2023).

3.2.1 Creating the Direct Relation Matrix

The measurement was carried out using a previously established scale derived from the questionnaire responses. These results were compiled into a direct-relation matrix. The matrix is structured as a pairwise matrix labeled A with dimensions of $n \times n$, where the value of A_{ij} represents the extent to which factor i influences factor j.

3.2.2 Normalizing the Direct Relation Matrix

The constructed matrix represents the direct relationships between the respective factors, which can be normalized using the following formula:

$D = k \times A$ .....(1)

$k = \frac{1}{max \sum_{j=1}^{n} a ij}, i, j = 1,2, \dots, n$ .....(2)

Where D represents the normalized direct relation matrix.

3. 2.3 Constructing the Total Relation Matrix

After normalizing the direct relation matrix, the next step is to create the total relation matrix using the following formula:

$T = D(I - D)^{-1}$ .....(3)

Where T is the total relation matrix.

3. 2.4 Calculating Vectors Ri (Received Influence) and Ci (Centralized Influence)

The row and column sums are denoted by the vectors Ri and Ci, respectively. The horizontal axis (Ri + Ci), known as prominence, was calculated by summing Ri and Ci to reflect the importance level of each criterion. The vertical axis (Ri − Ci), referred to as relation, is used to categorize the cause and effect groups, where a positive value is categorized as a cause and a negative value as an effect. The formulas used are as follows:

$T = [tij]_{nxn'} \quad i, j \ 1,2,3, \dots, n$ .....(4)

$D = \left[\sum_{j=1}^{n} t ij\right]_{nx1}$ .....(5)

$R = \left[\sum_{j=1}^{n} t ij\right]_{1xm}$ .....(6)

3. 2.5 Impact Digraph

Based on the total relation matrix, each value within the matrix indicates the degree of interconnection between factors i and j. These values were used to create an impact digraph that visualizes the relationships among the factors. However, if all relationships are shown in the digraph, the structure becomes too complex for effective decision making. Therefore, it is necessary to determine a threshold value to filter out only the most influential relationships. Only relationships with values exceeding this threshold will be considered in the construction of the impact digraph, which will serve as the foundation for the ANP structure. This diagram provides crucial insights for supporting decision making by clearly illustrating factor interrelationships. The DEMATEL method complements ANP by identifying the interdependencies among groups of factors. The combination of ANP and DEMATEL is highly effective in managing interdependent and feedback relationships more accurately and realistically.

3.3 ANP Method for Data Processing

Following the distribution of the second questionnaire, the responses were processed using the ANP questionnaire data in several steps: creating a pairwise comparison matrix, weighting, conducting a consistency check, and designing a supermatrix (Taherdoost & Madanchian, 2023). At the first step, the output from the questionnaire responses was in the form of pairwise comparisons with highlighted weights to indicate the relationship strength. At the second step, Based on the questionnaires distributed to the AI team at tiket.com, the responses yield priority weights for each CSF involved in the study. The weighting process was conducted using Super Decisions software, which processes the questionnaire data to determine the priority level of each criterion.

The third step, a consistency check was performed using the consistency ratio to ensure the reliability and coherence of respondents' pairwise comparisons. A comparison matrix is considered consistent if its consistency ratio (CR) does not exceed 10%. The formula for CR is:

CR = CI / IR .....(7)

Where:
CR = Consistency Ratio
CI = Consistency Index
IR = Random Index
A consistency ratio close to zero indicates a high consistency. If any weights were found to be inconsistent, they were excluded, and the weighting process was repeated. This consistency check can also be performed using the Super Decisions software.

Next step is designing the supermatrix. In the ANP method, a supermatrix is a large table used to display the relationships among the elements in a system, including CSFs, criteria, and objectives. The process consists of three main steps, create unweighted, weighted, and limit supermatrix. Unweighted Supermatrix is the initial table containing raw relationship weights between system elements. The next step is creating weighted Supermatrix. This matrix is adjusted by multiplying the initial weights with the results of the pairwise comparisons, producing more accurate final weights. The weighted supermatrix is raised to powers until it converges, producing a final matrix called the limit supermatrix, which serves as the final result.

4. Results and Discussion

Based on the ANP structure shown in Figure 1, there are interrelated influences among the CSFs owing to the connection between indicators across different CSFs and even within the same CSF. However, all CSFs influence and are influenced by others, except for the "Knowledge and Skill" factor. This CSF is influenced only by two indicators from the "Problem-Driven Approach" (problem identification ability and solution-finding ability) and one of its own indicators (SOP understanding ability). This indicates that " knowledge and skills are relatively independent and unaffected by changes in the other CSFs.

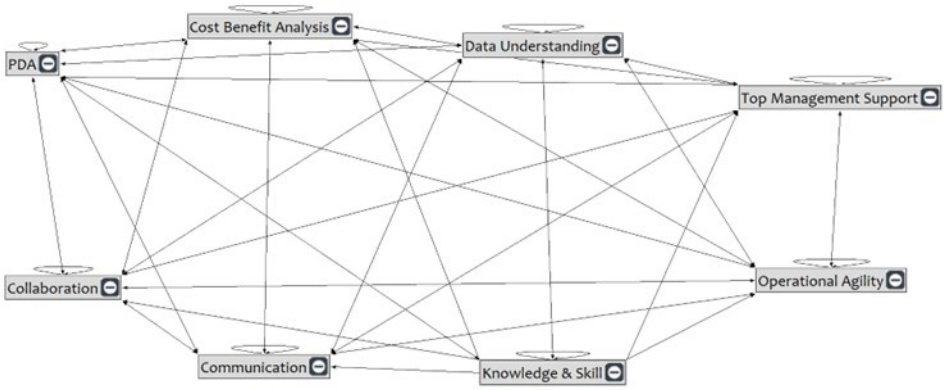

Figure 1. Intercorrelation CSF Cluster Structure

In Figure 2, the yellow-highlighted cells indicate values above the defined threshold, representing significant relationships considered in the ANP structure. In this matrix, rows represent the influencing factors (causes), while columns represent the affected factors (effects). Figure 3 summarizes the number of relationships between the indicators and the CSFs. According to Haghighat (2017), influencing factors tend to drive change more than the affected ones. The "Problem-Driven Approach" is identified as the most influential factor, followed by "Operational Agility." Agility is essential for adapting to change, which positively impacts organizational performance (Nguyen et al., 2024).

Furthermore is "Data Understanding" with 38 influences, followed by "Communication" (36 influences) and "Top Management Support." Employees' ability to understand data is crucial for decision making, reducing inefficiencies, and improving communication. Understanding data also supports strategic planning and risk reduction (Society, 2025). The less influential group includes "Collaboration," "Knowledge & Skill," and "Cost-Benefit Analysis." These

are more often affected than influencing; therefore, these CSFs should not be prioritized as key drivers. Improving other key factors will indirectly enhance collaboration, cost-benefit analysis, and knowledge and skills.

DEMATEL Questionnaire	Problem Identification Ability	Root Cause Identification Ability	Solution-Finding Ability	Cost Understanding	Benefit Potential Understanding	Risk Analysis Ability	Basic Data Understanding	Selection & Integration Ability	Trend Analysis Ability	Leader Involvement in Monitoring	Leader Involvement in Decision-Mak	Leader Involvement in Analysis	Teamwork Ability	Trust Level	Employee Empowerment	Focused Communication Ability	Knowledge Sharing Ability	Initiative in Communication	Work Experience	Educational Background Fit	SOP Understanding Level	Internal Adaptability	New Technology Adoption Ability	Productivity Level Management
Problem Identification Ability	0.38516	0.463683563	0.46814	0.39811	0.43274	0.44923	0.41811	0.4226	0.4215	0.41447	0.43476	0.412	0.45367	0.46151	0.45206	0.4523	0.44159	0.45194	0.40623	0.34611	0.38408	0.4318	0.42949	0.45074
Root Cause Identification Ability	0.42117	0.387021896	0.4563	0.38196	0.41969	0.44239	0.40263	0.4151	0.4038	0.39449	0.41818	0.39517	0.43836	0.44556	0.42618	0.43372	0.42431	0.42982	0.38521	0.32616	0.37067	0.41036	0.40715	0.43096
Solution-Finding Ability	0.43262	0.460214778	0.42303	0.41053	0.44877	0.45712	0.41706	0.4367	0.4265	0.42046	0.44789	0.41733	0.46609	0.47963	0.46127	0.45907	0.44487	0.46098	0.41286	0.34934	0.39118	0.44342	0.44261	0.46816
Cost Understanding	0.34094	0.357447542	0.37372	0.28978	0.36148	0.37549	0.32347	0.3456	0.341	0.33649	0.3548	0.33018	0.35581	0.36609	0.35436	0.36152	0.34602	0.35673	0.33108	0.26686	0.3116	0.34837	0.34875	0.37142
Benefit Potential Understanding	0.36947	0.386970561	0.39522	0.35241	0.33909	0.39083	0.35325	0.3702	0.3707	0.36405	0.37942	0.36341	0.39349	0.4019	0.38527	0.38574	0.37923	0.3907	0.35705	0.29282	0.32567	0.38243	0.37724	0.39837
Risk Analysis Ability	0.3859	0.411822862	0.42713	0.37695	0.40477	0.37015	0.37833	0.3987	0.3918	0.38369	0.40149	0.38422	0.41094	0.4201	0.41193	0.41945	0.40408	0.4124	0.37821	0.31316	0.35123	0.39939	0.39375	0.41691
Basic Data Understanding	0.41693	0.435348841	0.44027	0.38505	0.41503	0.42409	0.34962	0.4043	0.4093	0.39635	0.41091	0.38753	0.42864	0.44337	0.4243	0.42888	0.41636	0.42611	0.38582	0.31937	0.36083	0.40497	0.40121	0.42597
Selection & Integration Ability	0.37304	0.398814484	0.41676	0.36397	0.39601	0.38923	0.36997	0.3473	0.3739	0.37036	0.39033	0.36615	0.42212	0.42334	0.40978	0.41035	0.40472	0.40846	0.36612	0.30188	0.34514	0.39246	0.38986	0.4061
Trend Analysis Ability	0.373	0.384876801	0.39918	0.34275	0.37683	0.38592	0.36573	0.3685	0.3269	0.36231	0.37131	0.34982	0.38801	0.40083	0.38925	0.39591	0.37646	0.38784	0.34975	0.28975	0.32784	0.37237	0.3703	0.39122
Leader Involvement in Monitoring	0.35552	0.37320509	0.37939	0.3412	0.37106	0.38063	0.3475	0.3606	0.3516	0.31737	0.38266	0.36831	0.39613	0.40247	0.39164	0.38905	0.37119	0.38384	0.34419	0.28784	0.31728	0.37001	0.36997	0.39431
Leader Involvement in Decision-Making	0.37899	0.394317626	0.40663	0.35697	0.38899	0.39411	0.36362	0.3777	0.3706	0.37954	0.38518	0.37913	0.41474	0.42779	0.40886	0.41066	0.39524	0.40662	0.36806	0.30569	0.34203	0.39453	0.38361	0.4203
Leader Involvement in Analysis	0.40746	0.42702764	0.43816	0.37496	0.40798	0.42177	0.38304	0.4019	0.3985	0.39623	0.42409	0.38317	0.4305	0.44238	0.4289	0.43147	0.41374	0.42614	0.37676	0.31849	0.35604	0.41257	0.40341	0.43866
Teamwork Ability	0.3844	0.403823636	0.41901	0.35433	0.38428	0.39884	0.37098	0.3935	0.3773	0.3714	0.39751	0.37497	0.38066	0.43889	0.42143	0.42987	0.41104	0.42248	0.37404	0.31018	0.34796	0.40596	0.39106	0.41713
Trust Level	0.35047	0.366641672	0.37533	0.32973	0.36487	0.36935	0.33684	0.3557	0.3414	0.35168	0.36818	0.36344	0.39886	0.35771	0.392	0.3943	0.37604	0.3911	0.34509	0.28821	0.31678	0.37463	0.36064	0.38276
Employee Empowerment	0.38345	0.397828193	0.41391	0.35216	0.38351	0.393	0.36118	0.3832	0.3669	0.37145	0.39041	0.36379	0.42486	0.42975	0.36817	0.42002	0.39962	0.41427	0.36598	0.30315	0.34648	0.39056	0.37756	0.40894
Focused Communication Ability	0.38862	0.409352741	0.42081	0.35957	0.39226	0.402	0.37124	0.3881	0.3821	0.37629	0.40435	0.38541	0.42991	0.44182	0.42434	0.37998	0.41442	0.42474	0.37111	0.30939	0.34981	0.40353	0.38947	0.42149
Knowledge Sharing Ability	0.38146	0.393775841	0.40821	0.3544	0.38068	0.39463	0.3603	0.3843	0.3752	0.36494	0.39695	0.37147	0.42327	0.42881	0.4148	0.4154	0.35829	0.41272	0.3695	0.30666	0.34628	0.39285	0.38807	0.40626
Initiative in Communication	0.37569	0.395975896	0.40769	0.34996	0.38374	0.38628	0.3565	0.3778	0.37	0.37016	0.39578	0.37242	0.41947	0.42653	0.4121	0.41891	0.40066	0.36564	0.36188	0.29745	0.34435	0.39017	0.37214	0.39998
Work Experience	0.43008	0.448124566	0.45996	0.40013	0.43153	0.44714	0.41746	0.4334	0.4177	0.40883	0.43743	0.40846	0.45978	0.46886	0.45196	0.45782	0.43709	0.44996	0.36926	0.34316	0.39068	0.4374	0.42802	0.4586
Educational Background Fit	0.35902	0.369415017	0.38467	0.32995	0.36219	0.36734	0.34911	0.3611	0.3533	0.33709	0.36043	0.33899	0.37196	0.38776	0.37292	0.37256	0.3611	0.37025	0.33621	0.25429	0.32603	0.35979	0.35998	0.37677
SOP Understanding Level	0.36054	0.37447977	0.38446	0.34239	0.36974	0.37754	0.35021	0.3638	0.3528	0.35323	0.37294	0.36099	0.39474	0.40179	0.38714	0.38696	0.37811	0.38757	0.35491	0.29536	0.29513	0.37303	0.36316	0.38712
Internal Adaptability	0.3806	0.39344437	0.40721	0.35362	0.38626	0.38946	0.36113	0.3885	0.3775	0.37613	0.39305	0.3738	0.41497	0.43045	0.40844	0.4076	0.40176	0.4162	0.37498	0.30619	0.34963	0.39586	0.39995	0.41766
New Technology Adoption Ability	0.38836	0.40218496	0.4212	0.36696	0.39312	0.40662	0.36394	0.396	0.3863	0.37864	0.39823	0.37428	0.41632	0.42826	0.41595	0.41211	0.40493	0.41448	0.37489	0.31861	0.35069	0.40403	0.38401	0.42241
Productivity Level Management	0.39389	0.409323437	0.41769	0.36613	0.39554	0.40283	0.36704	0.3874	0.3784	0.37361	0.40154	0.37822	0.42218	0.42728	0.41985	0.42418	0.40203	0.41408	0.37861	0.31283	0.35254	0.40289	0.39638	0.42758

Figure 2. Impact Diagraph Map

No	Indicator	CSF	Total Influence Given (Indicator)	Total Influence Received (Indicator)	Total Influence Given (CSF)	Total Influence Received (CSF)
1	Problem Identification Ability	Problem Driven Approach	21	8	62	42
2	Root Cause Identification Ability		19	16		
3	Solution-Finding Ability		22	18		
4	Cost Understanding	Cost Benefit Analysis	0	3	21	31
5	Benefit Potential Understanding		6	12		
6	Risk Analysis Ability		15	16		
7	Basic Data Understanding	Data Understanding	17	4	38	23
8	Selection & Integration Ability		14	11		
9	Trend Analysis Ability		7	8		
10	Leader Involvement in Monitoring	Top Management Support	4	5	34	23
11	Leader Involvement in Decision-Making		12	14		
12	Leader Involvement in Analysis		18	4		
13	Teamwork Ability	Collaboration	13	21	27	61
14	Collaboration Trust Level		4	21		
15	Employee Empowerment		10	19		
16	Focused Communication Ability	Communication	15	19	36	54
17	Knowledge Sharing Ability		11	16		
18	Initiative in Communication		10	19		
19	Work Experience	Knowledge and Skill	22	2	24	4
20	Educational Background Fit		0	0		
21	ISOP Understanding Level		2	2		
22	Internal Adaptability	Operational Agility	13	16	43	48
23	New Technology Adoption Ability		15	13		
24	Productivity Level Management		15	19		

Figure 3. Recapitulation of the Number of Relationships Between Indicators & CSFs

Collaboration is the most affected CSF, followed by "Communication." Collaboration includes teamwork, trust, and workforce empowerment, and its quality improves when the driver factors are strengthened. Most competency-related factors serve as causes, whereas teamwork-related factors are mostly effects. Competency includes skills, experience, and achievements at the individual level (Ramírez-Zavala et al., 2024), whereas teamwork involves collective effort, communication, and shared goals (Meneses-La-Riva et al., 2025). For example, "Problem-Driven Approach," "Data Understanding," and "Knowledge & Skill" Knowledge and Skill are the dominant causes. Meanwhile, "Collaboration," "Communication," and "Operational Agility" are the effects.

This shows that teamwork in this case was largely driven by individual competencies. According to Kusbandono et al. (2024), to improve collaboration, companies should enhance their individual skills through interpersonal communication training. Although "Knowledge & Skill" has a low total influence score, the "Work Experience"

indicator has a high influence score (22), indicating that experience significantly affects operational performance. In contrast, educational background and SOP understanding had little impact. Similarly, "Cost Understanding" is not relevant to data scientists or MLE roles, as it is more aligned with financial functions.

The priority of each factor was calculated based on the weighting results. The problem-driven approach has the highest limiting weight (0.105) among all CSFs. This indicates that it is the most critical factor compared with the other seven factors. This is supported by Jackson Nickerson's symposium, which concludes that an organization's ability to identify problems, define problem-based solutions, and prioritize issues is essential for success (Nickerson et al., 2012). The Data Understanding factor ranked second with a limiting weight of 0.088. The shift toward data-centric AI highlights the importance of data quality over algorithmic complexity. Machine learning is increasingly viewed as data-driven software supported by big data and modern computing infrastructure (Whang et al., 2023). Therefore, a strong understanding of the data is crucial to ensure unbiased and accurate datasets.

Communication ranked third with a limiting weight of 0.074. According to Fan et al. (2025), effective communication is central to Shared Mental Models (SMMs), which are key to smooth team collaboration and operational success. Interestingly, most factors in the competence aspect received higher rankings than those in teamwork. Pairwise comparison results showed that respondents considered competence twice as important as teamwork. The results showed that competence had a limiting weight of 0.282, while teamwork had a limiting weight of 0.218. This suggests that, within the Data Scientist and MLE divisions at tiket.com, individual understanding, skills, and experience are prioritized over team collaboration.

Using the Balanced Scorecard (BSC) perspective, the top three prioritized CSFs can be further explored as solutions for improving team performance. From the BSC perspective, these CSFs fall under the learning and growth dimension as they relate to human resources and work culture at tiket.com (Nafari & Rezaei, 2022). The BSC distinguishes between leading and lagging indicators. Leading indicators drive performance, whereas lagging indicators measure outcomes (Fabac, 2022). Based on the DEMATEL analysis, the problem-driven approach and data understanding act as leading indicators because they influence other CSFs. In contrast, communication serves as a lagging indicator because it is more often affected by other factors.

This analysis provides insights into improving an AI team's performance on tiket.com. As leading indicators, the quality of problem-driven approaches (PDA) and data understanding must be enhanced. To strengthen PDA, companies can conduct training in problem framing, prioritization, and analysis tools, such as the five reasons, fishbone diagram, and root cause analysis (Ito et al., 2022). Integrating PDA-based SOPs into projects can improve analytical skills, decision-making, and solution effectiveness. To improve Data Understanding, training in statistics, data visualization, and certification exams can be provided. Research by Sahni and Chilton (2025) shows that most employees prefer informal learning because of time constraints and learning preferences. One possible solution is to form mentoring groups to regularly share insights into data understanding (Sahni & Chilton, 2025). Once the leading indicators are strengthened, communication, as a lagging indicator, can be measured using tools such as the Communication Satisfaction Questionnaire (Jaafari et al., 2023), as shown in Figure 3. Regular evaluations using this tool can help track improvements in communication and reflect progress in leading indicators.

6. Conclusion

The analysis revealed several key insights into Critical Success Factors (CSFs). Among the eight CSFs identified,the majority reflect bidirectional relationships, where they affect and are affected in return by one another, except for Knowledge & Skill, which appears to be affected only by the problem-driven approach and by itself. This suggests that Knowledge & Skill function as independent factors that are relatively unaffected by external factors. Furthermore, the analysis categorizes problem-driven approach, data understanding, and knowledge and skill as causal factors, meaning that they tend to drive change to other CSFs. In contrast, communication, collaboration, top management support, operational agility, and cost-benefit analysis emerged more as effect factors, often shaped by the influence of others. Of all the CSFs, the problem-driven approach stands out as the most critical, with the highest weight of 0.105, followed by Data Understanding at 0.088 and communication at 0.074.

Based on the results of this study, several recommendations are suggested for future research and practical improvements within the company. To gain a more comprehensive and globally relevant understanding, future studies

could explore similar analyses within international Online Travel Agencies (OTAs). Meanwhile, for the Data Scientist and Machine Learning Engineer (MLE) divisions at tiket.com, it is important to focus on strengthening the quality of the most influential CSFs, that is, the problem-driven approach and data understanding. In parallel, the ongoing evaluation of communication, which serves as an outcome indicator, can help assess the impact of improvements made to the leading factors, ensuring a balanced and sustainable enhancement of team performance.

Acknowledgements

This research was funded by the Institute for Research and Community Service, Atma Jaya Catholic University of Indonesia under the Decentralized Research Scheme. The authors gratefully acknowledge the financial support provided, dated February 4, 2025.

References

Ananyi, S. O., & Somieari-Pepple, E. Cost-benefit analysis of artificial intelligence integration in education management: Leadership perspectives. *International Journal of Economics Environmental Development and Society*, 4(3), 353-370, 2023.

Arévalo, F., MP, C. A., Ibrahim, M. T., & Schwung, A. Production assessment using a knowledge transfer framework and evidence theory. *Ieee Access*, 10(3), 134-152, 2022.

Asghar, J., Kanbach, D. K., & Kraus, S. Toward a multidimensional concept of organizational agility: A systematic literature review. *Management Review Quarterly*, 1-27, 2025.

Calhau, R. F., Almeida, J. P. A., Kokkula, S., & Guizzardi, G. Modeling competences in enterprise architecture: From knowledge, skills, and attitudes to organizational capabilities. *Software and Systems Modeling*, 23(3), 559-598, 2024.

Chatterjee, S., Chaudhuri, R., Gupta, S., Sivarajah, U., & Bag, S. Assessing the impact of big data analytics on decision-making processes, forecasting, and performance of a firm. *Technological Forecasting and Social Change*, 19(6), 122-134, 2023.

Dávid, L. D. D., Rahmat, A. F., & Priatmoko, S. Main trends in the tourism industry in Indonesia between 2020–2023. *Journal of Infrastructure, Policy and Development*, 11(8), 81-102, 2024.

Fabac, R. Digital balanced scorecard system as a supporting strategy for digital transformation. *Sustainability*, 14(15), 90-112, 2022.

Fan, S., Wang, S., Mbanyele, W., & Zhang, Y. Dual-Path Model of Team Communication and Shared Mental Models in Entrepreneurial Education: Enhancing Team Efficacy in Higher Education Using PLS-SEM. *Systems*, 13(7), 53-66, 2025.

Fareed, M. Z., & Su, Q. Project governance and project performance: The moderating role of top management support. *Sustainability*, 14(5), 25-36, 2022.

Haghighat, N. Evaluating airline service quality using fuzzy DEMATEL and ANP. *Strategic Public Management Journal*, 3(6), 57-77, 2017.

Holstein, J., Spitzer, P., Hoell, M., Vössing, M., & Kühl, N. Understanding data understanding: a framework to navigate the intricacies of data analytics. *Proceedings of the 32nd European Conference on Information Systems (ECIS 2024)*, 2024.

Ito, A., Hagström, M., Bokrantz, J., Skoogh, A., Nawcki, M., Gandhi, K., Bergsjö, D., & Bärring, M. Improved root cause analysis supporting resilient production systems. *Journal of Manufacturing Systems*, 64, 468-478, 2022.

Jaafari, M. I., Amin, R., Latif, M. A., & Bin Ajjaj, H. A. Calibrating internal communication satisfaction within organizations as an auditing index. *Sustainability*, 15(16), 12-25, 2023.

Jolene, K. The influence of online travel agencies (otas) on Hotel Revenue and Distribution Strategies. *Journal of Modern Hospitality*, 2(1), 14-25, 2023.

Kim, S. Critical success factors evaluation by multi-criteria decision-making: a strategic information system planning and strategy-as-practice perspective. *Information*, 13(6), 270-283, 2022.

Kuphanga, D. Questionnaires in research: Their role, advantages, and main aspects. *ActionAid International*, 12(2), 1-8, 2024.

Kusbandono, D., Zaakiyyah, H. K. A., & Junaidi, A. The Role of International Communication in Building Leadership That Positively Impacts Business Performance in The Entrepreneural Context. *Technopreneurship and Educational Development Review (TENDER)*, 1(2), 68-75, 2024.

Marmaras, N., & Pavard, B. Problem-driven approach to the design of information technology systems supporting complex cognitive tasks. *Cognition, Technology & Work*, 1(4), 222-236, 1999.

Martinez, I., Viles, E., & Olaizola, I. G. A survey study of success factors in data science projects. *2021 IEEE international conference on big data (big data)*, 2021.
Meneses-La-Riva, M. E., Fernández-Bedoya, V. H., Suyo-Vega, J. A., Ocupa-Cabrera, H. G., Grijalva-Salazar, R. V., & Ocupa-Meneses, G. d. D. Enhancing Healthcare Efficiency: The Relationship Between Effective Communication and Teamwork Among Nurses in Peru. *Nursing Reports*, 15(2), 59, 2025.
Meyers, M. C., van Woerkom, M., & Bauwens, R. Stronger together: A multilevel study of collective strengths use and team performance. *Journal of Business Research*, 159, 113-128, 2023.
Nafari, E., & Rezaei, B. Relationship between human resources strategies and organizational performance based on the balanced scorecard in a public hospital in Iran: a cross-sectional study. *BMC health services research*, 22(1), 36-48, 2022.
Nguyen, T., Le, C. V., Nguyen, M., Nguyen, G., Lien, T. T. H., & Nguyen, O. The organisational impact of agility: a systematic literature review. *Management Review Quarterly*, 16(3), 1-49, 2024.
Nickerson, J., Yen, C. J., & Mahoney, J. T. Exploring the problem-finding and problem-solving approach for designing organizations. *Academy of Management Perspectives*, 26(1), 52-72, 2012.
Nyimbili, P. H., Erden, T., & Mwanaumo, E. M. u. A DEMATEL-based approach of multi-criteria evaluation for urban fire and emergency facilities. *Frontiers in Environmental Economics*, 12(2), 119-131, 2023.
Oktavia, T., & Abner, E. Resistance to the Adoption of Online Travel Agencies in Indonesia after Covid-19. *Journal of System and Management Sciences*, 13(6), 199-213, 2023.
Pagano, T. P., Loureiro, R. B., Lisboa, F. V., Peixoto, R. M., Guimarães, G. A., Cruz, G. O., Araujo, M. M., Santos, L. L., Cruz, M. A., & Oliveira, E. L. Bias and unfairness in machine learning models: a systematic review on datasets, tools, fairness metrics, and identification and mitigation methods. *Big data and cognitive computing*, 7(1), 15-27, 2023.
Paredes-Saavedra, M., Vallejos, M., Huancahuire-Vega, S., Morales-García, W. C., & Geraldo-Campos, L. A. Work team effectiveness: Importance of organizational culture, work climate, leadership, creative synergy, and emotional intelligence in university employees. *Administrative Sciences*, 14(11), 280-292, 2024.
Ramírez-Zavala, M. R., López-Guerrero, A., Olivares-Fong, L. d. C., Velázquez-Victorica, K. I., & Montoya-Alcaraz, M. Factors that impact the dynamics and effectiveness of work teams during the implementation of continuous improvement tools in the manufacturing industry: A systematic literature review. *Applied Sciences*, 14(3), 10-17, 2024.
Sahni, R., & Chilton, L. B. Beyond Training: Social Dynamics of AI Adoption in Industry. *arXiv preprint arXiv:2502.13281*, 2025.
Sony, M., & Mekoth, N. Employee adaptability skills for Industry 4.0 success: a road map. *Production & Manufacturing Research*, 10(1), 24-41, 2022.
Sousa, A., Pais, S., & Sofia Viana, A. Applications of artificial intelligence in tourism and hospitality: A systematic literature review. *International conference on management, tourism and technologies*, 2024.
Start.io. Users Booking Travel Through OTAs in Indonesia, 2024. https://www.start.io/audience/users-booking-travel-through-otas-in-indonesia?.
Subiyanto, D., Wahidah, U., Septyarini, E., & Arjuna, A. B. Digital Leadership: Predicting Team Dynamics, Communication Effectiveness, and Team Performance. *Journal The Winners*, 25(1), 35-47, 2024.
Surbakti, F., Suprata, F., Natalia, C., & Kezia, N. Exploration of data science expertise in Indonesia: Study case of industry in Jakarta metropolitan area. *AIP Conference Proceedings*, 2023.
Surbakti, F. P. S., Perdana, A., Indulska, M., Liono, J., & Arief, I. B. From data to decisions: Leveraging AI to enhance online travel agency operations. *Journal of Information Technology Teaching Cases*, 20438869241279130, 2024.
Taherdoost, H., & Madanchian, M. Analytic Network Process (ANP) method: A comprehensive review of applications, advantages, and limitations. *Journal of Data Science and Intelligent Systems*, 1(1), 12-18, 2023.
Whang, S. E., Roh, Y., Song, H., & Lee, J.-G. Data collection and quality challenges in deep learning: A data-centric ai perspective. *The VLDB Journal*, 32(4), 791-813, 2023.
Wu, C., Zhang, R., Kotagiri, R., & Bouvry, P. Strategic decisions: survey, taxonomy, and future directions from artificial intelligence perspective. *ACM Computing Surveys*, 55(12), 1-30, 2023.
Yang, X., Zhang, L., & Feng, Z. Personalized tourism recommendations and the E-tourism user experience. *Journal of Travel Research*, 63(5), 1183-1200, 2024.
Yusriadi, Y., Rusnaedi, R., Siregar, N. A., Megawati, S., & Sakkir, G. Implementation of artificial intelligence in Indonesia. *International Journal of Data and Network Science*, 7(2), 11-23, 2023.

Biographies

Feliks Prasepta Sejahtera Surbakti is an Associate Professor of Industrial Engineering and Management and Head of Industrial Engineering Department at Faculty of Bioscience, Technology, and Innovation, Atma Jaya Catholic University of Indonesia. He earned his Doctorate in Computer Science from The University of Queensland in 2020. His main interest includes innovation, emerging technologies, business process reengineering, and quality management. He has published his works in reputable journals and conferences, including Information and Management, Journal of Information Technology Teaching Cases, TEM Journal, and The Pacific Asia Conference on Information Systems (PACIS). His work is characterised by a strong interdisciplinary approach, integrating insights from technology, business, and social sciences. Feliks also works as a consultant for several organisations and serves as an assessor for the National Professional Certification Board (BNSP).

Raynaldi Cahyadi is a final year Industrial Engineering student at Atma Jaya Catholic University of Indonesia with strong interests in data science, procurement, ergonomic system design, and business process optimization. Through multiple internships, he has built practical experience in IT purchasing analysis, drafting procurement contracts for HSE and office goods, system layout design, risk management, and ergonomic workload assessments. He gained experience as a Procurement Category Analyst Internship at PT Sinarmas Sentra Cipta, supporting IT procurement and contract development for companies under PT SMART across several Indonesian regions. At PT Innoventure Synergy Indonesia, he deigned new factory layout and make a risk assessment report for a construction project. He also proposed workload improvements at PT Viura Indotirta, resulting in a significant reduction in overload issues. Raynaldi has received several awards, including 2nd place in the Product Innovation Poster Competition at the Atma Jaya Student Award 2023 and Best Presenter in the Business Plan Competition at Atma Jaya Business Incubator 2024. He was selected to represent his department in the IISMA program for PILMAPRES selection. A recipient of the Adaro Foundation Scholarship 2024/2025, Raynaldi combines technical proficiency with strong communication and leadership. He is skilled in Microsoft Office, AutoCAD, Minitab, Canva, and SAP, and is fluent in both Indonesian and English (EPT score 497, TOEFL equivalent).

Arif Perdana specialises in digital strategy and data science, with over a decade of experience from institutions like The University of Queensland, Singapore Institute of Technology, and Aarhus University. Since December 2022, he has been the Director of the Action Lab Indonesia, focusing on responsible AI, blockchain, machine learning, and digital strategy across finance, education, and healthcare. Arif has secured significant funding from Bank Indonesia, Monash Data Future Institute, the Whyte Fund, and Singapore Government, highlighting his role in advancing digital strategy research. He is also an educator, leading workshops supported by SkillsFuture and the Institute of Chartered Accountants Singapore, training professionals in data science and analytics. As a speaker, Arif has delivered insightful talks at prestigious venues across the globe, including the QS Higher Ed Summit and the T20/ G20 International Conference. His presentations cater to audiences from professional associations and financial institutions across Australia, Indonesia, and beyond. This includes engagements with the Ministry of Finance of the Republic of Indonesia, Financial Service Authority (OJK) Indonesia, Indonesia Re, Association of Certified Fraud Examiners Indonesia, CPA Australia Indonesia, University of Sussex, Anglia Ruskin University, Swinburne University of Technology, and RMIT Vietnam. His research contributions are published in leading journals such as Information & Management, Production, Planning, and Control, Electronic Markets, Journal of Information Systems, and International Journal of Accounting Information Systems. He has written numerous business and teaching cases in Journal of Information Technology Teaching Cases.

Irvan Bastian Arief is an award-winning, PhD-qualified digital executive, leader and strategist with over 19 years of commercial experience in technology, digital and datarelated domains. He has worked with and for some of Australia and Asia's most progressive multinational global companies. He is the recipient of The World CIO 200 Summit 2024 (Category: Master), recognised as the CIO100 Awards: Next CIO (2023), the winner of the 2022 Outstanding Taiwan Alumni of the Year and the 2020 Australia Alumni of the Year (Innovation and Entrepreneurship Award) from Australia Global Alumni and the Australian Embassy for Indonesia. He is currently the Vice President of Data Science, Machine Learning Engineering, Tech Infrastructure, and Information Security at PT. Global Tiket Network (tiket.com) and the senior lecturer and advisor at Universitas Bunda Mulia. His research interests include Artificial Intelligence, Machine Learning, Large Language Model (LLM) and Retrieval Augmented Generation (RAG) applications, information retrieval, and recommender systems.

Jonathan Liono received his Ph.D. degree from the School of Science (Computer Science & IT), RMIT University, Melbourne, VIC, Australia. He is currently a Senior Data Scientist Lead at PT. Global Tiket Network (tiket.com),

Singapore. He has served as Publication Co-Chair of MobiCase (2015). He has recently served as Publicity Chair of the 2020 IEEE PerCom and Web Chair of MDM 2023. His research interests include Large Language Model (LLM) and Retrieval Augmented Generation (RAG) applications, information retrieval, recommender systems, ubiquitous data mining, mobile context and activity recognition, spatio-temporal pattern mining and dynamic mobility pattern.