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1. Questionnaire Used in Pilot Study

ORAT Activities are presented in section 1.1-1.5.

1.1) Logistic activities which are performed during “**Operational Readiness, Activation and Transition (ORAT)**” are given in Table S1. Please verify the given activities and you are expected to indicate missing activities, if any.

Table S1. Logistics Activities

| | Activity | Detail |
|-----|---|--|
| LG1 | Development and Implementation of Transfer and Transition Management Plan | <ul style="list-style-type: none"> • Transfer of employees and passengers, Transfer of material, equipment, and vehicle, Development of logistic plan for the management of relocation and demotion area. • Development of schedule for flight carriers. • Establishing shared and crisis management center for ORAT operations. • Taking and maintaining health and safety measures for passengers and employees during the operations. • Determination and implementation of additional staff, measures etc. to ensure the efficiency of basic operational processes during the opening period. |
| LG2 | Development and Implementation of logistic risk management plan | <ul style="list-style-type: none"> • The development of risk management plan • Identification and classification of risks • Qualitative and quantitative risk analysis • The planning of risk responses (avoiding, transfer, mitigation or accept) • Control and evaluation of risks |
| LG3 | Determination and organization of logistic process assets | <ul style="list-style-type: none"> • Contracts • Competence/Competence certificate • Legal certificates • Provision of processes and documentation |
| LG4 | Development and Implementation of support and transfer strategy for both opening and post opening day | <ul style="list-style-type: none"> • The implementation of <ul style="list-style-type: none"> – Transfer plans of employees and passengers, – Transfer plans of material, equipment, and vehicle, – Logistic plan for the management of moving and demotion area • The implementation of schedule for flight carriers • Reducing vehicle traffic volume between two transferred airports. • Reducing traffic which is caused by non-passengers • The implementation of plans which include additional staff, measures etc. to ensure the efficiency of basic operational processes during the opening period. |

1.2) Leadership activities which are performed during “**Operational Readiness, Activation and Transition (ORAT)**” are given in Table S2. Please verify the given activities and you are expected to indicate missing activities, if any.

Table S2. Leadership Activities

| | Activity | Detail |
|-----|---|--|
| LD1 | Determination and control of ORAT success indicators | <ul style="list-style-type: none"> • Determination of ORAT requirements and ORAT scope, and creation of work breakdown structure • Transfer of airport within the scheduled time on opening day • Performing transfer of airport within the planned cost • Meeting user (airlines, passengers, and airport operators) satisfaction • Inspection of success indicators and identification of control mechanism |
| LD2 | Generating the organizational structure and governance to manage ORAT | <ul style="list-style-type: none"> • Establishing shared and crisis management center for ORAT operations (LG1) • Identification of responsibilities and tasks for assets and systems and sharing them with stakeholders • Updating organizational structure which embraces new asset operations during the increase in capacity / after the transfer of airport |
| LD3 | Leadership in ORAT stakeholder management | <ul style="list-style-type: none"> • Guidance in stakeholder teamwork and stakeholder participation |
| LD4 | Leading trial scenarios in operational readiness process | <ul style="list-style-type: none"> • Identification of trials <ul style="list-style-type: none"> – Identification of trial schedule and budget. – Creation of trial scenarios for each trial day. – Identification of resource requirements for each trial day – Execution of trials – Execution of required trainings for trails • Sharing information obtained from each trial scenarios with stakeholders • Performing monitoring meetings for issues which emerge during trials • Complete the procedure documents and certificates required for the trials. |
| LD5 | Leadership in risk management | <ul style="list-style-type: none"> • Development of risk management plan • Identification and classification of risks • The quantitative and qualitative risk analysis • The planning of risk responses (avoiding, transfer, mitigation or accept) • To lead the control and evaluation of risks |
| LD6 | Leadership in stakeholder management | <ul style="list-style-type: none"> • Planning of communication management (analysis of communication requirements, and identification of communication technology, methods, and models) • Communication management (Information management systems) • Control of communication |

1.3) Stakeholder activities which are performed during “**Operational Readiness, Activation and Transition (ORAT)**” are given in Table S3. Please verify the given activities and you are expected to indicate missing activities, if any.

Table S3. Stakeholder Activities

| | Activity | Detail |
|----|--|---|
| S1 | Management of airport and ORAT stakeholder engagement | <ul style="list-style-type: none"> • Identification of internal and external stakeholders (public enterprises such as customs, security chief office etc., internal stakeholders such as airlines, logistic, ground services companies etc.) • Planning of stakeholder management (development of stakeholder risk management, management of participation of stakeholders (i.e. airlines, passengers etc.) into processes, motivating stakeholders to participate operational readiness activities) • Control and management of stakeholder participation and communication |
| S2 | Management of ORAT human resources | <ul style="list-style-type: none"> • Planning of human resources management (organizational charts, human resources management plan, tasks, and responsibilities) • Creation of ORAT team (assignment of personnel, resource schedule) |
| S3 | Development of stakeholder (staff etc.) training, orientation and familiarization programs related to the airport operation | <ul style="list-style-type: none"> • Determination of training, orientation and familiarization schedule expectation of stakeholders, and facility requirements • Preparation of training, orientation, and familiarization program budget • Identification of method of e training, orientation, and familiarization program (classroom, field, e-learning, 3D simulations etc.) • Preparation of training materials • Preparation of pocket guide and employee handbook which include training, services, features of facility and related maps (operational concepts handbook, safety management handbook, emergency plan, terminal operational plan etc.) • Preparation of 3D facility simulation • The development of ORAT operational training program |
| S4 | Implementation of stakeholder (staff etc.) training, orientation and familiarization programs related to the airport operation | <ul style="list-style-type: none"> • Periodic harmonization training of systems and procedures for all staff • Periodic private on-the-job training for airport key staff • Periodic field and/or classroom training for all staffs • Execution of operational training for ORAT team • Execution of trainings for integrated trial scenarios |
| S5 | Implementation of operational trial scenarios with relevant stakeholders | <ul style="list-style-type: none"> • Identification of stakeholders who participate in trial scenarios • Meeting pre-qualifications for participants who participate in trial scenarios (passport, fake passengers, baggage, ground service personnel, conveyor, push-pull etc. vehicle trials, airline representatives, public institutions etc.) • Execution of integrated trial scenarios (before and after the opening) |

1.4) Facility activities which are performed during “**Operational Readiness, Activation and Transition (ORAT)**” are given in Table S4. Please verify the given activities and you are expected to indicate missing activities, if any.

Table S4. Facility Activities

| | Activity | Detail |
|----|---|--|
| F1 | Completing the construction processes of the facility before the operation | <ul style="list-style-type: none"> • Harmonization of delivery of facility (the main terminal building of the airport, apron, hangar etc.) with ORAT planned schedule • Acceptance of the facility by the employer |
| F2 | Providing process and documentation requirements for operational transition of the facility | <ul style="list-style-type: none"> • Preparation and execution of necessary contracts with all relevant stakeholders for operational services • Identification, updating, and execution of required financial policy, processes, and systems • Meeting legal certification/standards/regulations (fire and safety certifications, health and environment certifications, quality certifications etc.) • Meeting legal warranty coverage for new assets and operations • Preparation of operation and maintenance process and procedures • Preparation of facility handbooks for operational procedures |
| F3 | Integrated facility management | <ul style="list-style-type: none"> • Planning of facility management • Facility risk management • Planning of facility energy and waste management • Planning of facility emergency management • Development of asset management plan • Establishing integrated test center • Procurement of equipment and vehicles for facility management • Integration of new facility to existing facilities • Management of warranty contracts of assets |

1.5) Technology, system and information activities which are performed during “**Operational Readiness, Activation and Transition (ORAT)**” are given in Table S5. Please verify the given activities and you are expected to indicate missing activities, if any.

Table S5. Technology, System, and Information Activities

| | Activity | Detail |
|------|---|---|
| TSI1 | Management of airport systems | <ul style="list-style-type: none"> • Identification of system and infrastructure • Setting up required system infrastructure for airport <ul style="list-style-type: none"> – Facility management system – Flight information system – Wireless network – Security system – Check-in and Boarding system – Baggage management system – ERP – Signaling etc. • Execution of test and trials and feedback <ul style="list-style-type: none"> – Operational integrated verification tests – Testing interfaces between systems – Testing integration of systems and creation of interfaces which covers existing systems – Testing the interoperability and compatibility of business partners' Information, Communication and Technologies with new software and systems • Providing systematic third-party certificates, documents etc. • Starting-up new facility systems • Development of operational risk management of systems • Integration of airport systems with each other and facility • Maintenance of airport system <ul style="list-style-type: none"> – Procurement and existence of maintenance equipment and tools – Maintenance contracts for maintenance of systems |
| TSI2 | Preparation of ORAT management and tracking systems | <ul style="list-style-type: none"> • Setting up infrastructure of systems by identifying requirements of ORAT system and infrastructure <ul style="list-style-type: none"> – Information management system before, during and after ORAT relocation |

2. Questionnaire Used in Case Study

Please, evaluate ORAT processes of Istanbul Grand Airport (IGA) based on the activities presented below. (You are expected to eliminate or add new activities, if it is required).

Table S6. ORAT Activities

| | Activity | İstanbul Grand Airport |
|------|--|-------------------------------|
| LG1 | Development and Implementation of Transfer and Transition Management Plan | |
| LG2 | Development and Implementation of logistic risk management plan | |
| LG3 | Determination and organization of logistic process assets | |
| LG4 | Development and Implementation of support and transfer strategy for both opening and post opening day | |
| LD1 | Determination and control of ORAT success indicators | |
| LD2 | Generating the organizational structure and governance to manage ORAT | |
| LD3 | Leadership in ORAT stakeholder management | |
| LD4 | Leading trial scenarios in operational readiness process | |
| LD5 | Leadership in risk management | |
| LD6 | Leadership in communication management | |
| S1 | Management of airport and ORAT stakeholder engagement | |
| S2 | Management of ORAT human resources | |
| S3 | Development of stakeholder (staff etc.) training, orientation and familiarization programs related to the airport operation | |
| S4 | Implementation of stakeholder (staff etc.) training, orientation and familiarization programs related to the airport operation | |
| S5 | Implementation of operational trial scenarios with relevant stakeholders | |
| F1 | Completing the construction processes of the facility before the operation | |
| F2 | Providing process and documentation requirements for operational transition of the facility | |
| F3 | Integrated facility management | |
| TSI1 | Management of airport systems | |
| TSI2 | Preparation of ORAT management and tracking systems | |

3. Questionnaire Used in Pythagorean Fuzzy Analytic Hierarchy Process (PFAHP)

| Please fill in the blanks in below questions. | |
|---|--|
| Name - Surname | |
| Contact Information | |
| Affiliation / Duty | |
| Level of experience (please indicate as year basis) | |

- 1) Please indicate the importance level of each factor listed below by rating each factor over other factor. Please use the given scale below.

Table S7. Comparison scale

| | | |
|-----|----------------------------|---|
| CLI | Certainly, low importance | 1 |
| VLI | Very low importance | 2 |
| LI | Low importance | 3 |
| BAI | Below average importance | 4 |
| AI | Average importance | 5 |
| AAI | Above average importance | 6 |
| HI | High importance | 7 |
| VHI | Very high importance | 8 |
| CHI | Certainly, high importance | 9 |
| EE | Exactly equal | 0 |

| | Logistic | Leadership | Stakeholder | Facility | Technology, system, and information |
|-------------------------------------|----------|------------|-------------|----------|-------------------------------------|
| Logistic | | | | | |
| Leadership | | | | | |
| Stakeholder | | | | | |
| Facility | | | | | |
| Technology, system, and information | | | | | |

| | Development and Implementation of Transfer and Transition Management Plan | Development and Implementation of logistic risk management plan | Determination and organization of logistic process assets | Development and Implementation of support and transfer strategy for both opening and post opening day |
|---|---|---|---|---|
| Development and Implementation of Transfer and Transition Management Plan | | | | |
| Development and Implementation of logistic risk management plan | | | | |
| Determination and organization of logistic process assets | | | | |
| Development and Implementation of support and transfer strategy for both opening and post opening day | | | | |

| | | |
|---|-------------------------------|---|
| | Management of airport systems | Preparation of ORAT management and tracking systems |
| Management of airport systems | | |
| Preparation of ORAT management and tracking systems | | |

| | Determination and control of ORAT success indicators | Generating the organizational structure and governance to manage ORAT | Leadership in ORAT stakeholder management | Leading trial scenarios in operational readiness process | Leadership in risk management | Leadership in communication management |
|---|--|---|---|--|-------------------------------|--|
| Determination and control of ORAT success indicators | | | | | | |
| Generating the organizational structure and governance to manage ORAT | | | | | | |
| Leadership in ORAT stakeholder management | | | | | | |
| Leading trial scenarios in operational readiness process | | | | | | |
| Leadership in risk management | | | | | | |
| Leadership in communication management | | | | | | |

| | Management of airport and ORAT stakeholder engagement | Management of ORAT human resources | Development of stakeholder, training, orientation, and familiarization programs related to the airport operation | Implementation of operational trial scenarios with relevant stakeholders |
|---|---|------------------------------------|--|--|
| Management of airport and ORAT stakeholder engagement | | | | |
| Management of ORAT human resources | | | | |
| Development of stakeholder (staff etc.) training, orientation and familiarization programs related to the airport operation | | | | |
| Implementation of operational trial scenarios with relevant stakeholders | | | | |

| | Completing the construction processes of the facility before the operation | Providing process and documentation requirements for operational transition of the facility | Integrated facility management |
|---|--|---|--------------------------------|
| Completing the construction processes of the facility before the operation | | | |
| Providing process and documentation requirements for operational transition of the facility | | | |
| Integrated facility management | | | |

4. Pythagorean Fuzzy Analytic Hierarchy Process (PFAHP)

4.1 The mathematical operations that are used in Pythagorean fuzzy sets

Pythagorean fuzzy AHP method is one of the methods that consider vagueness and impreciseness of subjective evaluations in Multi Criteria Decision Making Methods (MCDM). Pythagorean fuzzy set gives an opportunity to experts to express their thoughts by considering their thoughts' vagueness and impreciseness. In intuitionistic fuzzy sets, there are lots of fuzzy sets. Pythagorean fuzzy set is an extension of intuitionistic fuzzy sets. Moreover, sum of membership and non-membership degrees that are used in AHP should be at most 1. In Pythagorean fuzzy set's the sum of squares of degrees should be at most 1 [45]. Figure S1 illustrates the differences between membership and non-membership degrees.

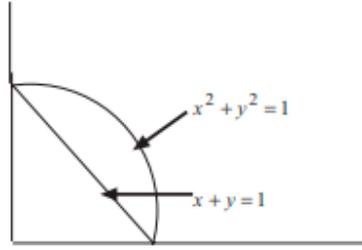


Figure S1. Comparison of membership and non-membership degrees for Pythagorean and intuitionistic [50].

In the literature, Pythagorean fuzzy AHP method was implemented in risk assessment for occupational health and safety [45], risk evaluation and prevention in hydroplant operations [47], landfill site selection [46], service quality evaluation [48], identification of enablers of sustainable supply chain innovation [41] etc. The mathematical operations that are used in Pythagorean fuzzy sets are explained with definitions below [51].

Definition 1: X is assumed as a fixed set. A Pythagorean fuzzy set \tilde{P} is an object. The fuzzy set was explained in Eq. 1:

$$\tilde{P} = \{(x, \mu_{\tilde{P}}(x), \nu_{\tilde{P}}(x)); x \in X\} \quad (1)$$

Where the function $\mu_{\tilde{P}}(x): X \rightarrow [0,1]$ and $\nu_{\tilde{P}}(x): X \rightarrow [0,1]$ define degree of membership and non-membership respectively. These functions are in the gap as given in Eq. 2:

$$0 \leq \mu_{\tilde{P}}(x)^2 + \nu_{\tilde{P}}(x)^2 \leq 1 \quad (2)$$

Additionally, the degree of hesitancy condition is calculated as given in Eq. 3:

$$\pi_{\tilde{P}}(x) = \sqrt[2]{1 - \mu_{\tilde{P}}(x)^2 - \nu_{\tilde{P}}(x)^2} \quad (3)$$

Definition 2: Let's assume $\tilde{L} = (\mu_1, \nu_1)$, $\tilde{M} = (\mu_2, \nu_2)$ two Pythagorean fuzzy numbers, and if λ is bigger than 0, the mathematical operations between \tilde{L} and \tilde{M} fuzzy numbers are calculated with the use of Eq. 4-7:

$$\tilde{L} + \tilde{M} = (\sqrt[2]{\mu_1 + \mu_2 - \mu_1\mu_2}, \sqrt[2]{\nu_1\nu_2}) \quad (4)$$

$$\tilde{L} \otimes \tilde{M} = (\mu_1\mu_2, \sqrt[2]{\nu_1 + \nu_2 - \nu_1\nu_2}) \quad (5)$$

$$\lambda\tilde{L} = (\sqrt[2]{1 - (1 - \mu^2)^\lambda}, \nu^\lambda) \quad (6)$$

$$\lambda\tilde{M} = (\mu^\lambda, \sqrt[2]{1 - (1 - \nu^2)^\lambda}) \quad (7)$$

4.2 Steps of Pythagorean fuzzy AHP

Pythagorean fuzzy AHP method has 6 main steps which are namely: 1) Data collection from experts by using linguistic terms and development of Pairwise comparison matrices, 2) Creation of the differences matrix (D) by using the lower and upper values of membership and non-membership degrees, 3) Creation of the interval multiplicative matrixes (S); 4) Calculation of the determinacy value (τ); 5) Calculation of the matrix of weights and 6) The normalization is performed.

Step 1. The data is collected from experts by using linguistic terms. Pairwise comparison matrix are developed. The used linguistic terms are given in Table S8.

Table S8. The linguistic terms for Pythagorean fuzzy AHP [41].

| Linguistic terms | Pythagorean fuzzy numbers | | | |
|---------------------------------|--|--|--|--|
| | Lower value of membership degree (μ_L) | Upper value of membership degree (μ_U) | Lower value of non-membership degree (ν_L) | Upper value of non-membership degree (ν_U) |
| Certainly low importance – CLI | 0.00 | 0.00 | 0.90 | 1.00 |
| Very low importance – VLI | 0.10 | 0.20 | 0.80 | 0.90 |
| Low importance – LI | 0.20 | 0.35 | 0.65 | 0.80 |
| Below average importance - BAI | 0.35 | 0.45 | 0.55 | 0.65 |
| Average importance - AI | 0.45 | 0.55 | 0.45 | 0.55 |
| Above average importance – AAI | 0.55 | 0.65 | 0.35 | 0.45 |
| High importance - HI | 0.65 | 0.80 | 0.20 | 0.35 |
| Very high importance – VHI | 0.80 | 0.90 | 0.10 | 0.20 |
| Certainly high importance – CHI | 0.90 | 1.00 | 0.00 | 0.00 |
| Exactly equal - EE | 0.1965 | 0.1965 | 0.1965 | 0.1965 |

Step 2. The differences matrix ($D = (d_{ik})_{m \times n}$) are created by using the lower and upper values of membership and non-membership degrees. Eq. 8 and 9 are used to create these matrixes.

$$d_{ikL} = \mu_{ikL}^2 - \nu_{ikU}^2 \quad (8)$$

$$d_{ikU} = \mu_{ikU}^2 - \nu_{ikL}^2 \quad (9)$$

Step 3. The interval multiplicative matrixes $S = (S_{ik})_{m \times n}$ are created by using Eq. 10 and 11.

$$S_{ikL} = \sqrt{1000^{d_{ikL}}} \quad (10)$$

$$S_{ikU} = \sqrt{1000^{d_{ikU}}} \quad (11)$$

Step 4. The determinacy value $\tau = (\tau_{ik})_{m \times n}$ is calculated by using Eq. 12.

$$\tau_{ik} = 1 - (\mu_{ikU}^2 - \mu_{ikL}^2) - \nu_{ikU}^2 - \nu_{ikL}^2 \quad (12)$$

Step 5. The matrix of weights is calculated. To calculate the matrix, the arithmetic value of Eq. 10 and 11 is multiplied with Eq. 12.

$$t_{ik} = \left(\frac{S_{ikL} + S_{ikU}}{2} \right) * \tau_{ik} \quad (13)$$

Step 6. The normalization is performed (Eq. 14).

$$W_i = \left(\frac{\sum_{k=1}^m t_{ik}}{\sum_{i=1}^m \sum_{k=1}^m t_{ik}} \right) \quad (14)$$

4.3 Identification of Weights of ORAT Activities with the Application of the Pythagorean Fuzzy AHP

Before applying the Pythagorean Fuzzy AHP method, the consistency ratio (CR) needs to be calculated to find out consistency issues that arise from expert judgements. To calculate CR, the classical AHP that was proposed by Saaty (1977) is followed. CR value should be between 0 and 0.1. As a result of CR analysis, all pair-wise comparison matrices were found in acceptable limits. Analysis results were summarized in Table S9.

Table S9. CR analysis for pair-wise comparison matrices

| | DM1 | DM2 | DM3 | DM4 | DM5 |
|---|----------|----------|----------|----------|----------|
| Main Criteria | 0.077768 | 0.099574 | 0.083832 | 0.092728 | 0.061977 |
| Logistic | 0.057136 | 0 | 0 | 0.016252 | 0.078591 |
| Leadership | 0.04463 | 0.09479 | 0.09105 | 0.04337 | 0.09483 |
| Stakeholder | 0.099607 | 0.005264 | 0 | 0.05716 | 0 |
| Facility | 0.025172 | 0 | 0 | 0 | 0.070333 |
| Technology, system and Information | 0 | 0 | 0 | 0 | 0 |

After control of CR value, pair-wise comparison matrices that were evaluated according to the linguistic terms for Pythagorean fuzzy AHP were aggregated according to the geometric mean operation [49]. Thus, ranks of all ORAT activities and main criteria were calculated. Aggregated matrices and weights are given in Table S10-S15.

Table S10. Aggregated pairwise comparison matrix of main criteria

| | LG | | | | LD | | | | ST | | | | F | | | | TSI | | | | R |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | |
| LG | 0.20 | 0.20 | 0.20 | 0.20 | 0.30 | 0.36 | 0.31 | 0.36 | 0.30 | 0.35 | 0.33 | 0.37 | 0.27 | 0.33 | 0.35 | 0.39 | 0.25 | 0.31 | 0.34 | 0.39 | 4 |
| LD | 0.31 | 0.36 | 0.30 | 0.36 | 0.20 | 0.20 | 0.20 | 0.20 | 0.43 | 0.57 | 0.24 | 0.38 | 0.33 | 0.43 | 0.00 | 0.00 | 0.52 | 0.55 | 0.31 | 0.43 | 1 |
| ST | 0.33 | 0.37 | 0.30 | 0.35 | 0.24 | 0.38 | 0.43 | 0.57 | 0.20 | 0.20 | 0.20 | 0.20 | 0.32 | 0.41 | 0.41 | 0.48 | 0.00 | 0.00 | 0.35 | 0.44 | 5 |
| F | 0.35 | 0.39 | 0.27 | 0.33 | 0.00 | 0.00 | 0.33 | 0.43 | 0.41 | 0.48 | 0.32 | 0.41 | 0.20 | 0.20 | 0.20 | 0.20 | 0.00 | 0.00 | 0.26 | 0.36 | 3 |
| TSI | 0.34 | 0.39 | 0.25 | 0.31 | 0.31 | 0.43 | 0.52 | 0.55 | 0.35 | 0.44 | 0.00 | 0.00 | 0.26 | 0.36 | 0.00 | 0.00 | 0.20 | 0.20 | 0.20 | 0.20 | 2 |

Table S11. Aggregated pairwise comparison matrix of logistic activities

| | LG1 | | | | LG2 | | | | LG3 | | | | LG4 | | | | R |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | |
| LG1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.46 | 0.53 | 0.24 | 0.33 | 0.49 | 0.56 | 0.18 | 0.28 | 0.48 | 0.54 | 0.21 | 0.30 | 1 |
| LG2 | 0.24 | 0.33 | 0.46 | 0.53 | 0.20 | 0.20 | 0.20 | 0.20 | 0.36 | 0.41 | 0.24 | 0.31 | 0.34 | 0.39 | 0.27 | 0.33 | 2 |
| LG3 | 0.18 | 0.28 | 0.49 | 0.56 | 0.24 | 0.31 | 0.36 | 0.41 | 0.20 | 0.20 | 0.20 | 0.20 | 0.29 | 0.34 | 0.35 | 0.39 | 4 |
| LG4 | 0.21 | 0.30 | 0.48 | 0.54 | 0.27 | 0.33 | 0.34 | 0.39 | 0.35 | 0.39 | 0.29 | 0.34 | 0.20 | 0.20 | 0.20 | 0.20 | 3 |

Table S12. Aggregated pairwise comparison matrix of leadership activities

| | LD1 | | | | LD2 | | | | LD3 | | | | LD4 | | | | LD5 | | | | LD6 | | | | R |
|-----|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | |
| LD1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.33 | 0.37 | 0.30 | 0.35 | 0.33 | 0.37 | 0.30 | 0.35 | 0.39 | 0.46 | 0.36 | 0.43 | 0.32 | 0.36 | 0.32 | 0.36 | 0.45 | 0.51 | 0.27 | 0.35 | 2 |
| LD2 | 0.30 | 0.35 | 0.33 | 0.37 | 0.20 | 0.20 | 0.20 | 0.20 | 0.35 | 0.39 | 0.29 | 0.34 | 0.43 | 0.49 | 0.33 | 0.40 | 0.34 | 0.38 | 0.31 | 0.35 | 0.45 | 0.51 | 0.31 | 0.38 | 1 |
| LD3 | 0.30 | 0.35 | 0.33 | 0.37 | 0.29 | 0.34 | 0.35 | 0.39 | 0.20 | 0.20 | 0.20 | 0.20 | 0.38 | 0.44 | 0.38 | 0.44 | 0.38 | 0.44 | 0.38 | 0.44 | 0.40 | 0.46 | 0.36 | 0.43 | 4 |
| LD4 | 0.36 | 0.43 | 0.39 | 0.46 | 0.33 | 0.40 | 0.43 | 0.49 | 0.38 | 0.44 | 0.38 | 0.44 | 0.20 | 0.20 | 0.20 | 0.20 | 0.38 | 0.44 | 0.38 | 0.44 | 0.41 | 0.48 | 0.34 | 0.41 | 5 |
| LD5 | 0.32 | 0.36 | 0.32 | 0.36 | 0.31 | 0.35 | 0.34 | 0.38 | 0.38 | 0.44 | 0.38 | 0.44 | 0.38 | 0.44 | 0.38 | 0.44 | 0.20 | 0.20 | 0.20 | 0.20 | 0.36 | 0.41 | 0.26 | 0.32 | 3 |
| LD6 | 0.27 | 0.35 | 0.45 | 0.51 | 0.31 | 0.38 | 0.45 | 0.51 | 0.36 | 0.43 | 0.40 | 0.46 | 0.34 | 0.41 | 0.41 | 0.48 | 0.26 | 0.32 | 0.36 | 0.41 | 0.20 | 0.20 | 0.20 | 0.20 | 6 |

Table S13. Aggregated pairwise comparison matrix of stakeholder activities

| | ST1 | | | | ST2 | | | | ST3 | | | | ST4 | | | | R |
|------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | |
| ST1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.42 | 0.49 | 0.28 | 0.36 | 0.26 | 0.32 | 0.36 | 0.41 | 0.31 | 0.35 | 0.34 | 0.38 | 3 |
| ST2 | 0.28 | 0.36 | 0.42 | 0.49 | 0.20 | 0.20 | 0.20 | 0.20 | 0.31 | 0.39 | 0.43 | 0.50 | 0.26 | 0.34 | 0.46 | 0.53 | 4 |
| ST3 | 0.36 | 0.41 | 0.26 | 0.32 | 0.43 | 0.50 | 0.31 | 0.39 | 0.20 | 0.20 | 0.20 | 0.20 | 0.31 | 0.35 | 0.34 | 0.38 | 2 |
| ST4 | 0.34 | 0.38 | 0.31 | 0.35 | 0.46 | 0.53 | 0.26 | 0.34 | 0.34 | 0.38 | 0.31 | 0.35 | 0.20 | 0.20 | 0.20 | 0.20 | 1 |

Table S14. Aggregated pairwise comparison matrix of facility activities

| | F1 | | | | F2 | | | | F3 | | | | R |
|-----------|------|------|------|------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | ml | mu | vl | vu | ml | mu | vl | vu | |
| F1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.29 | 0.34 | 0.35 | 0.39 | 0.41 | 0.48 | 0.32 | 0.41 | 2 |
| F2 | 0.35 | 0.39 | 0.29 | 0.34 | 0.20 | 0.20 | 0.20 | 0.20 | 0.50 | 0.57 | 0.20 | 0.31 | 1 |
| F3 | 0.32 | 0.41 | 0.41 | 0.48 | 0.20 | 0.31 | 0.50 | 0.57 | 0.20 | 0.20 | 0.20 | 0.20 | 3 |

Table S15. Aggregated pairwise comparison matrix of technology, system, and information activities

| | TSB1 | | | | TSB2 | | | | R |
|-------------|------|------|------|------|------|------|------|------|---|
| | ml | mu | vl | vu | ml | mu | vl | vu | |
| TSI1 | 0.20 | 0.20 | 0.20 | 0.20 | 0.46 | 0.57 | 0.39 | 0.52 | 1 |
| TSI2 | 0.39 | 0.52 | 0.46 | 0.57 | 0.20 | 0.20 | 0.20 | 0.20 | 2 |

As a result of calculation of weights of all ORAT activities in each category, global weights of all ORAT activities were calculated. The results are given in Table S16.

Table S16. Global ranks of all ORAT activities

| Criteria | Weight | Ranks | Sub-criteria | Weight | Ranks | Global Weight | Global Ranks |
|----------|--------|-------|--------------|--------|-------|---------------|--------------|
| LG | 0.178 | 4 | LG1 | 0.383 | 1 | 0.068 | 4 |
| | | | LG2 | 0.230 | 2 | 0.041 | 14 |
| | | | LG3 | 0.182 | 4 | 0.032 | 18 |
| | | | LG4 | 0.204 | 3 | 0.036 | 16 |
| LD | 0.260 | 1 | LD1 | 0.187 | 2 | 0.049 | 7 |
| | | | LD2 | 0.190 | 1 | 0.049 | 6 |
| | | | LD3 | 0.162 | 4 | 0.042 | 11 |
| | | | LD4 | 0.158 | 5 | 0.041 | 13 |
| | | | LD5 | 0.170 | 3 | 0.044 | 9 |
| | | | LD6 | 0.132 | 6 | 0.034 | 17 |
| ST | 0.153 | 5 | ST1 | 0.252 | 3 | 0.039 | 15 |
| | | | ST2 | 0.180 | 4 | 0.027 | 19 |
| | | | ST3 | 0.274 | 2 | 0.042 | 12 |
| | | | ST4 | 0.294 | 1 | 0.045 | 8 |
| F | 0.180 | 3 | F1 | 0.325 | 2 | 0.059 | 5 |
| | | | F2 | 0.439 | 1 | 0.079 | 3 |
| | | | F3 | 0.235 | 3 | 0.042 | 10 |
| TSI | 0.229 | 2 | TSI1 | 0.542 | 1 | 0.124 | 1 |
| | | | TSI2 | 0.458 | 2 | 0.105 | 2 |

4.4 Sensitivity Analysis

In the sensitivity analysis, the weights of leadership category were changed since the analysis results indicate that the most important criterion is leadership activity. In the sensitivity analysis, the weight of leadership category was multiplied with coefficients (1, 0.9, 0.8, 0.7, 0.6, 0.5, 0.4, 0.3, 0.2, 0.1). The results were tabulated in Table S17. The difference between normal weight of leadership category (coefficient: 1) and adjusted coefficient was distributed to other criteria. Therefore, the behavior of the categories can be observed.

Table S17. Sensitivity analysis for leadership categories

| w | 1 | 0.9 | 0.8 | 0.7 | 0.6 | 0.5 | 0.4 | 0.3 | 0.2 | 0.1 |
|-----|------|------|------|------|------|------|------|------|------|------|
| LG | 0.18 | 0.18 | 0.19 | 0.20 | 0.20 | 0.21 | 0.22 | 0.22 | 0.23 | 0.23 |
| LD | 0.26 | 0.23 | 0.21 | 0.18 | 0.16 | 0.13 | 0.10 | 0.08 | 0.05 | 0.05 |
| ST | 0.15 | 0.16 | 0.17 | 0.17 | 0.18 | 0.19 | 0.19 | 0.20 | 0.20 | 0.20 |
| F | 0.18 | 0.19 | 0.19 | 0.20 | 0.21 | 0.21 | 0.22 | 0.23 | 0.23 | 0.23 |
| TSI | 0.23 | 0.24 | 0.24 | 0.25 | 0.26 | 0.26 | 0.27 | 0.27 | 0.28 | 0.28 |

The change of ranks of categories are illustrated in Figure S2. According to the sensitivity analysis, the evaluation change in leadership category is sensitive and the decision-maker ought to give an importance leadership category. Additionally, this condition was compared with Shete et al.'s (2020) study [41], and it was seen that the changes can be seen on the ranks of criteria and alternatives.

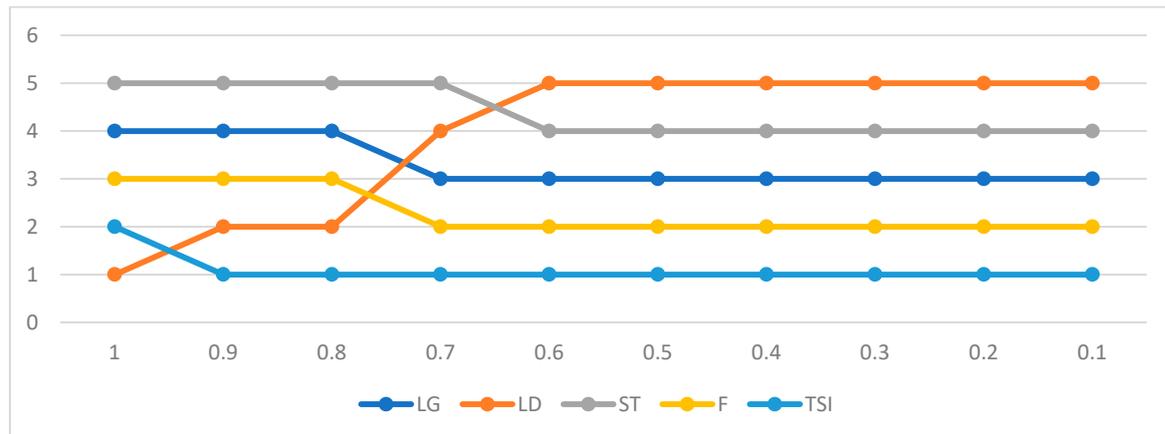


Figure S2. Rank changes in the process of sensitivity analysis (criteria)

Moreover, the changes in the weights of leadership category were reflected to ORAT activities. As a result of this operation, the global weights of criteria were calculated. After that, the ranks were determined by using the global weights as being in Table S18.

Table S18. Global ranks of ORAT activities

| LD | 0.26 | 0.23 | 0.21 | 0.18 | 0.16 | 0.13 | 0.10 | 0.08 | 0.05 | 0.05 |
|------|------|------|------|------|------|------|------|------|------|------|
| LG1 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |
| LG2 | 14 | 11 | 9 | 9 | 9 | 9 | 9 | 9 | 9 | 9 |
| LG3 | 18 | 17 | 15 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| LG4 | 16 | 15 | 12 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| LD1 | 7 | 9 | 13 | 14 | 15 | 15 | 15 | 15 | 15 | 15 |
| LD2 | 6 | 7 | 11 | 13 | 14 | 14 | 14 | 14 | 14 | 14 |
| LD3 | 11 | 14 | 16 | 17 | 17 | 17 | 17 | 17 | 17 | 17 |
| LD4 | 13 | 16 | 17 | 18 | 18 | 18 | 18 | 18 | 18 | 18 |
| LD5 | 9 | 13 | 14 | 16 | 16 | 16 | 16 | 16 | 16 | 16 |
| LD6 | 17 | 18 | 19 | 19 | 19 | 19 | 19 | 19 | 19 | 19 |
| ST1 | 15 | 12 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 |
| ST2 | 19 | 19 | 18 | 15 | 13 | 13 | 13 | 13 | 13 | 13 |
| ST3 | 12 | 10 | 7 | 7 | 7 | 7 | 7 | 7 | 7 | 7 |
| ST4 | 8 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 | 6 |
| F1 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| F2 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| F3 | 10 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| TSI1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| TSI2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

Against to changes in the rank of criteria, the sensitivity analysis results showed that global ranks are changing too much. In other words, TSI1, TSI2, F2, LG1 and F1 don't change, or they are not sensitive.

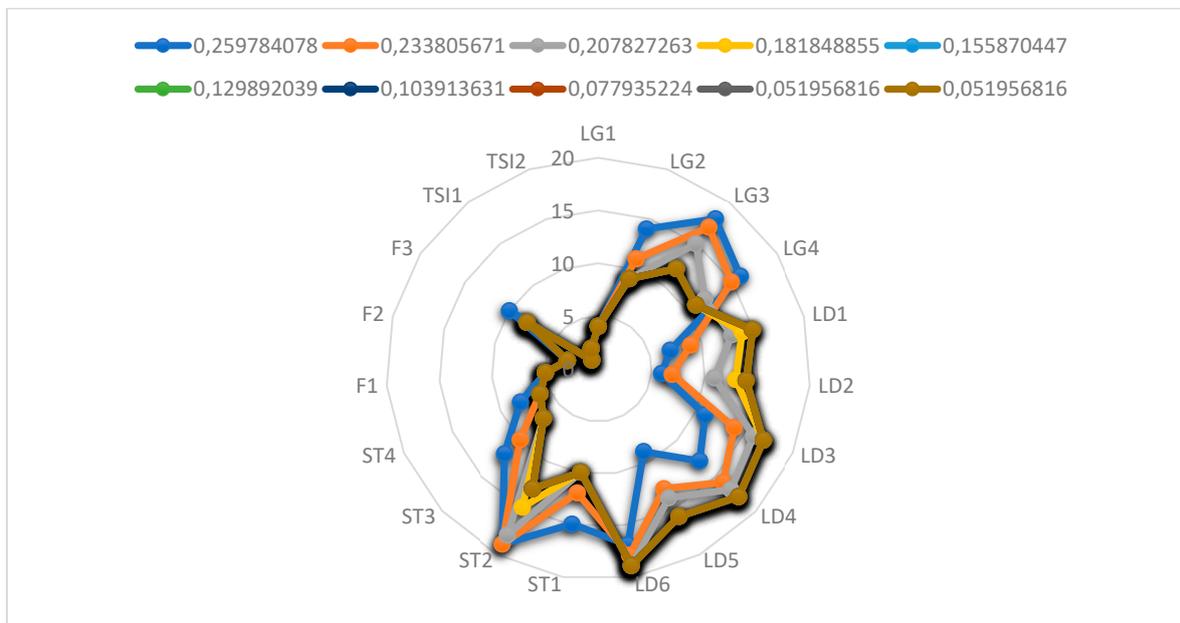


Figure S3. Rank changes in the process of sensitivity analysis (factors)

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