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A Decision Support System for Selecting Innovative Employee

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ABSTRACT

Technological innovations (artificial intelligence, IoT, robotics, etc.) have begun to change the way companies do business. Businesses will need to develop a change management plan in personnel qualifications, leadership structure, organizational climate, and many other aspects to keep up with these changes. Recruiting people who are open to innovation and to change, assigning employees with the appropriate innovativeness level to jobs that require being innovative, and encouraging employees to behave innovatively in the organization will be the most important parts of the plan. Therefore, both the individual innovativeness and innovative work behavior (IWB) of employees and leaders will become even more important for businesses in the near future. Based on this view, this study was carried out with the aim of developing a decision support system (DSS) that will support organizations in recruiting highly innovative employees and managing innovative behaviors of employees. To achieve this, DSS measures the individual innovativeness of job applicants and the IWB of corporate employees. Individual innovativeness and IWB are evaluated in the DSS by scoring based on statistical analysis methods. The DSS developed in this study helps the company to stay on an innovative line by increasing its innovation potential and to keep up with the destructive changes predicted that the future will require. This paper makes a contribution to linking the HRM literature and innovation literature.

KEYWORDS: Change Management, Decision Support System, İnnovative Work Behavior, İnnovativeness, Human Resources Management.

1. INTRODUCTION

With the widespread use of the internet in the 20th century, advances in technology, changes in customer demands, the increasing importance of the concept of innovation, and the increased value given to information, businesses have begun to experience the change in all areas. According to Morgan (2000), this is just the tip of the iceberg. Because the fourth industrial revolution (industry 4.0) with disruptive technologies such as artificial intelligence, robotics, smart factories, augmented and virtual reality, Internet of Things, 3D printing has been at the doorstep of companies (Lasi *et al*., 2014; Benešová and Tupa, 2017; Liao *et al*., 2017; Moeuf *et al*., 2019). In this age driven by digital technologies, the scarcest and most valuable resource will not be ordinary labor or ordinary capital, but people who can create new ideas and innovations (Brynjolfsson *et al*., 2014; Xu *et al*., 2018). There are many studies in the literature supporting this view.

Peng *et al*. (2020) discovered that, while R&D investment persistence has a negative impact on a company's future performance, human capital can help to mitigate this negative relationship. They also added that the importance of managers' experience for a firm's long-term innovation success is revealed by the impact of human capital on innovation investment persistence. Rogers (2003) and Bongomin *et al*. (2020) predict that individuals who are in demand in the 21st century business world will be the ones that will be able to access needed information, solve problems, actively communicate, and demonstrate their innovative attributes in all circumstances. Purzer *et al*. (2014) emphasized that the innovative capacity of engineers who create and implement innovation is essential for the USA to regain the power it lost in innovation. In their study, they determined that deep knowledge, curiosity, vision and leadership features are critical to the innovativeness of engineers. Gehrke *et al*. (2015) prioritized the workforce qualifications and abilities to be needed in the factories of the future. The ability to adapt and change is in the first priority group, whereas confidence in new technologies is in the second priority group. Like Gehrke *et al*. (2015), Haeffner and Panuwatwanich (2018) also state that the manufacturing

workforce of the future should be open to innovation and embrace new technologies. Hecklau *et al.* (2016) also state that employees should be able to undertake more strategic, coordinated and creative activities in this age. In the "Future of Jobs" report published by the World Economic Forum in 2016, it was predicted that the top three skills needed in the future will be complex problem solving, critical thinking and creativity. The future need for these skills was emphasized even more strongly in the report, which was renewed in 2020 (World Economic Forum, 2016). All these qualities considered to be needed in the future are united under innovativeness. While innovativeness refers to states of individuals such as taking risks towards novelty, adapting, accepting, tolerating, and being open to new experiences (Korucu and Olpak, 2015) it also encompasses creativity.

This acceleration in change and the disruptive technologies of the future will make the problems of inability to innovate, resistance to change, and adaption to change that have been encountered by organizations for some time even more fundamental for organizations. The success of organizations during this process will depend on their openness to change and their ability to innovate (Lasi *et al*., 2014; Lee *et al*., 2018; Petrillo *et al*., 2018). Innovative employees will support their organizations by using their innovation skills to increase the organization's speed of innovation, and their willingness for change to accelerate the change process (Moeuf *et al*., 2019). Innovative leaders will also be able to increase the rate of innovation in the organization by increasing employees' innovative behaviors through behaviors such as innovative role modeling, support for innovative behaviors, guidance, and counseling (de Jong, 2004; Shamim *et al*., 2016)

While the business world of the future expects employees to have new qualifications and skills (World Economic Forum, 2016), the human resources (HR) management that is supposed to find, select, place, and develop these new skilled employees will also be affected by this situation. To adapt to the new technology concept of the future, managers must design HR practices to foster innovation and learning in the organization (Shamim *et al*., 2016). According to Binh and Linh (2017), human resource management (HRM) makes a significant contribution to a company's long-term technological evolution by using both internal and external factors. Recruitment activities and personnel rotation, which are also the subject of our study, are among the internal factors of their work, while networking with training institutions and personnel exchanges are among the external factors. According to Shamim *et al*. (2016), recruitment during this process should be based on various skills and heterogeneous knowledge, and these should be tested in the screening process before selecting an applicant (Chang *et al*., 2011). Organizations should make great efforts to select the right applicant for each job by following comprehensive recruitment and selection procedures (Ma Prieto and Pilar Perez-Santana, 2014). Shamim *et al*. (2016) state that when recruiting innovative employees, HR managers need to focus on identifying the traits required for innovative behavior. Intarakumnerd (2017) underlines that HRM can include methods for recruiting the right people to promote innovation, training for dealing with innovation challenges and skill development, payment and reward schemes, and toolkits for carrier development.

Despite the fact that the link between human resources management (HRM) and innovation has been recognized, Ueki (2017) claims that innovation literature and HRM literature have not been satisfactorily integrated. The present study aims to fill this gap by presenting a decision support system (DSS) to assist organizations in ensuring the employment of innovative employees, which is considered one of the skills needed in the technological transformation process, and in measuring the innovativeness of present employees. The developed DSS identifies and reports the individual innovativeness level of job applicants and suggests the most innovative applicant for hiring. On the other hand, it identifies and reports the level of both individual innovativeness and innovative work behavior (IWB) of employees and suggests the top three employees who are the best fits for the innovativeness criteria required when assigning employees to the desired department. In addition, managers will be able to examine the factors that influence employees' innovative behavior through the developed DSS, to continue their support for factors with positive effects and to develop regulations promoting innovative behavior over factors with negative effects. In this way, managers will be able to both understand whether their company truly has an innovative culture and have more accurate information about the factors that inhibit and motivate this culture and also determine who are to be retrained based on impartial and scientific methods.

It has been noted that soft skills will be more important than hard skills in a digitalized and automated future (Shamim *et al*., 2016; Karacay, 2018) as it is a characteristic that distinguishes humans from machines (Fareri *et al*., 2020). In this direction, innovativeness was taken as a basis while developing the DSS in the study, considering that (1) innovativeness includes more than one social skill such as creativity, communication, and leadership, and (2) it is important for managers to self-evaluate their businesses with these values in mind. To understand the theoretical background of the study, the second section of the article includes brief information about individual innovativeness, IWB and the use of DSS in human resources. The method used, the studies done and the path followed in developing DSS are given in the third section of the article, with each stage under separate subheadings. The conclusion section of the article refers to the contributions to the literature, the managerial effects of the developed DSS, and suggestions for future studies.

2. THEORETICAL FRAMEWORK

Even if a business has innovative employees, to get the maximum benefit from them, it must also create the environment in which they will exhibit this behavior. This can be achieved with the introduction of an innovative culture in the company, organizational support for innovation, proper and effective leaders, and similar factors. In this way, innovative behavior created will allow individuals to use their innovativeness effectively and minimize the risk of change. Therefore, innovative behavior is as important as individual innovativeness. This section briefly discusses individual innovativeness, IWB and DSS that form the basis of the study.

2.1. Individual innovativeness

There are different approaches towards individual innovativeness, which is seen as the innovation of individuals. Considering the definitions in the literature, innovativeness is handled as a feature in some studies while it has been defined in terms of the degree of adoption of innovations in some studies. Additionally, it has been considered as a comprehensive behavior in some studies.

Everett Rogers laid the groundwork for innovativeness with his 1962 work 'Diffusion of Innovations', arguing that innovations spread among the members of a social system over time through specific communication channels. According to Rogers, innovativeness is the degree to which an individual or unit adopts new ideas relatively earlier than other members of the system. As can be understood from the definition, individuals are at different levels of innovativeness according to Rogers. While some individuals (innovators) are willing to try new ideas and take risks, and have the vision to be the first to adopt innovations and initiate innovations in society, other individuals (early adopters) ensure the diffusion of innovations by providing information and educating other members of society about innovations. While some individuals (early majority) think for a while before adopting innovations, others (late majority) do not adopt innovations until most of the society adopts them. Other people (laggards) represent the segment that avoids innovation the most, and this segment consists of people who are prejudiced against change and tend to adopt innovations last (Rogers, 2003).

Hurt *et al*. (1977) discussed innovativeness based on change and defined it simply as the desire for change, and they developed a 20-item scale to measure it. The scale, which is also used in our study, is still one of the most widely used scales for measuring individual innovativeness.

2.2. Innovative work behavior (IWB)

The literature suggests that innovativeness at work is viewed as innovative work behavior rather than individual innovativeness. For an employee to be regarded as innovative within the organization, it is not enough for the employee to have only the ability to innovate. The employee must also have the reason, willingness and motivation to drive himself to innovate, because innovating in an organization is a 'necessary-but-not-required' field of activity for most employees (Tierney *et al*., 1999). Thus, innovativeness manifests itself as IWB in the employee, and IWB can be seen as a multidimensional and comprehensive entity capturing all behaviors that employees can contribute to the innovation process (de Jong and Den Hartog, 2007).

Scott and Bruce (1994), based on Kanter (1996/1988)'s definition of innovation, stated that IWB begins with the introduction of the problem and the generation of new or adopted ideas or solutions, and continues with the individual seeking support for the idea and attempting to build a coalition of supporters for it. Afterward, they stated that IWB ends with the production of a prototype that can be touched or experienced so that the innovation can be mass-produced, turned into profit, or institutionalized and thus disseminated. According to Janssen (2000), IWB can be described as 'intentional creation, introduction and application of new ideas within a work role, group or organization, in order to benefit role performance, the group, or the organization'. Amo and Kolvereid (2005) defined IWB as the attempt by employees to introduce new processes, new products, new markets, or a combination thereof into the organization. Based on the definitions, it can be said that IWB can manifest itself at every stage of innovation (de Jong and Den Hartog, 2007). Also, a review of the literature reveals that IWB is usually determined based on innovation processes.

There are many factors (climate, leader, organizational rules, etc.) that influence and direct IWB, as well as factors that influence and direct employees' behavior within the organization. Innovative employees may not behave as innovative as they are if they work in a non-innovative organization, in a job that does not require innovativeness, or if they work with a manager who has a negative attitude towards innovativeness or innovation. In line with this perspective, factors that influence IWB have been studied in the literature (Janssen, 2000; de Jong and Den Hartog, 2007; 2010; Yuan and Woodman, 2010; Çapraz *et al*., 2014). As a result of the studies, it has been suggested that the factors influencing IWB emerged at three levels such as individual, group, and organizational (Çapraz *et al*., 2014) and some characteristics of IWB have been revealed (Scott and Bruce, 1994; Çapraz *et al*., 2014). Few studies have considered IWB as a structure that encompasses all characteristics. The characteristics of the IWB which were compiled from the literature are listed in Table I.

Table I. 16 characteristics of innovative work behavior and related studies in the literature.

Characteristics	**Explanation**	**Studies in the Literature**
Intrinsic Interest	The employee's interest in creativity, problem-solving, and analytical thinking enables innovative behavior.	Tierney et al. (1999), Yuan and Woodman (2010), Çapraz *et al.*(2014)
Idea Generation	The employee may exhibit innovative behavior by generating new ideas or new working methods, techniques, or tools for problems or difficult situations.	Scott and Bruce (1994), Janssen (2000), Dorenbosch *et al.* (2005), de Jong and Den Hartog (2010), Messman and Mulder (2012), Çapraz *et al.* (2014), Ali and Buang (2016), Lambriex-Schmitz *et al*. (2020)
Supporting Ideas	The employee may demonstrate innovative behavior by gaining support for new ideas or mobilizing key people.	Scott and Bruce (1994) Janssen (2000), Kleysen and Street (2001); Dorenbosch *et al.* (2005), de Jong and Den Hartog (2010), Çapraz *et al.* (2014), Ali and Buang (2016)
Implementation-Oriented Work Behavior	The employee may demonstrate innovative behavior by applying and implementing new ideas by removing obstacles to implementation.	Scott and Bruce (1994), Janssen (2000), Kleysen and Street (2001), Dorenbosch *et al.* (2005), de Jong and Den Hartog (2010), Çapraz *et al.* (2014), Ali and Buang (2016)
Awareness	Employees' ability to innovate depends on their ability to take advantage of innovation opportunities (e.g. unexpected failures, disruptions in processes, changing conditions) and on their awareness of developments in the business environment.	Çapraz *et al.* (2014)
Creativity-Oriented Work Behavior	The employee may act innovatively by actively thinking and working on situations such as improving business arrangements, finding new methods of communication, removing obstacles to collaboration.	Dorenbosch *et al.* (2005)
Innovativeness As A Job Requirement	Employees whose jobs require innovation will be more innovative than the rest of the employees.	Yuan and Woodman (2010), Çapraz *et al.*(2014)
Reputation as Innovative	Employees who have an innovative reputation are motivated to innovate more as it positively impacts their business and maintains their reputation.	Yuan and Woodman (2010), Çapraz *et al.*(2014)

Expected Positive Performance Outcomes	One of the main reasons people innovate in the workplace is to achieve performance gains, such as increased productivity and quality of work, reduced error rates, increased ability to meet goals and objectives, and improved overall job performance (Rogers, 2003)	Yuan and Woodman (2010), Çapraz *et al*.(2014)
Expected Image Gains Expected Image Risks	The innovative behavior of employees is influenced by the image expectations in the corporate environment. An employee who thinks that being innovative makes him/her look bad would not exhibit innovative behavior.	Yuan and Woodman (2010), Çapraz *et al*.(2014)
Innovative Output	In some studies performed in R&D units (Scott and Bruce, 1994; Tierney et al., 1999; etc.), innovative behavior is shown to be measured by variables such as the number of patents and invention descriptions. Therefore, we can say that the output of work is a determinant of innovative behavior.	de Jong and Den Hartog (2010), Çapraz *et al.* (2014)
Leadership	According to Yukl (2010), leaders have a strong influence on employees' work behavior, also including innovative behavior. Leaders influence employees' innovative behavior through innovating role-modeling, presenting a vision, supporting innovation, recognizing innovative behavior, rewarding innovative behavior, providing resources, and assigning tasks.	Scott and Bruce (1994), Tierney *et al*. (1999), de Jong (2004), de Jong and Den Hartog (2007; 2010), Yuan and Woodman (2010), Çapraz *et al*. (2014), Ali and Buang (2016)
Organizational Support for Innovation	The organization's attitude towards innovation and innovativeness may influence the employee's innovative behavior.	Scott and Bruce (1994), Yuan and Woodman (2010), Çapraz *et al*. (2014)
Innovative Climate	Organizational factors such as workplace relationships and cohesion among employees, management incentives, and the availability of resources to the employee can influence the employee's innovative behavior.	Siegel and Kaemmerer (1978), Dorenbosch *et al.* (2005), Nybakk et al. (2011), Turgut and Beğenirbaş (2013), Çapraz *et al*. (2014), Ali and Buang (2016)
External Work Contacts	External work contacts such as connecting with customers, attending events such as conferences, communicating with other companies and university staff have an impact on innovation behavior by providing employees with more innovation opportunities and increasing their creativity.	de Jong and Den Hartog (2007; 2010), Çapraz *et al*. (2014)

2.3. Decision support systems in HR

Decision support systems come into play if managers cannot make traditional decisions based on the information they already have about complex problems. Turban (1995) defined Decision Support Systems (DSS) as "computer-based information systems designed to help with difficult and complex decisions with intensive end-user participation". In general, DSS is a system that helps decision-makers make decisions based on information obtained from data and reports using various models through information technologies. Basically, DSS consists of databases and mathematical models that contain data and allow access through regular storage. Turban (1995) stated that DSS consists of the following six components: data, information management, model management, manager (decision maker), expert knowledge manager, and dialogue manager. In this

structure, it is the unit in which the operations related to data management, input and storage of data in the system are performed. Model management is software that provides analysis capabilities with data and mathematical models in the system. The dialogue manager is the interface that establishes communication between the end-user and other interfaces. The knowledge management subsystem is an expert system for finding solutions to problems that require expert solutions.

The application goals of DSS are manifold: inventory control, purchasing decisions, site selection, project selection, personnel management, etc. While there are several applications of DSS in human resource management in the literature, most of the work has been done on employee selection for recruitment (Verina *et al*., 2018; Suryanto *et al*., 2018; Mihuandayani *et al*., 2020; etc.). According to Yalçın and Pehlivan (2019) the selection of qualified personnel has been extremely important for the organizational success of the companies as the most important link of HRM chain is to complete the personnel selection process. For this reason and due to the uncertainty and ambiguity in the personnel selection problem, decision makers need tools like DSS to support the process.

3. METHODOLOGY

So as to develop the DSS that ensures the employment of employees with high individual innovativeness and performs innovativeness-based personnel selection, the mechanism of the system that calculates the degree of innovativeness of employees/applicants was first designed. The DSS draft model created along these lines is shown in Figure 1.

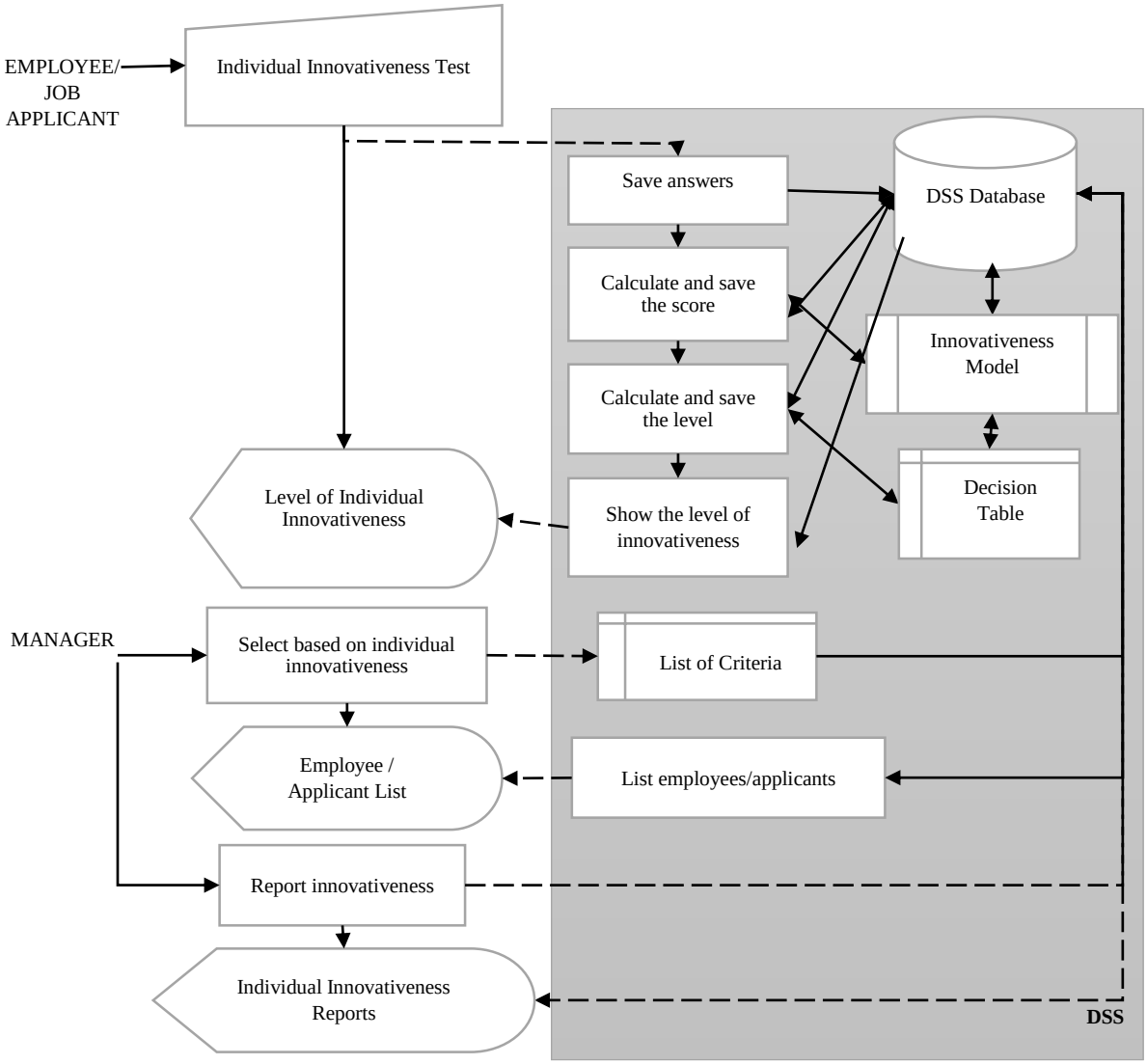

Figure 1. Flow chart of draft model for DSS.

Following the information from the preliminary literature research, employee's innovativeness in the organization is considered as IWB while the innovativeness of the individuals is considered as individual innovativeness. Because IWB differs from individual innovativeness, as it is affected by individual, group and organizational factors. In this case, the design model should be supplemented with an IWB model to evaluate the innovativeness of the employees.

In this line, the study was carried out in three stages as theoretical, research and implementation so that the draft model is given in the Figure 1, DSS, can be developed in a way that enables to evaluate applicants' innovativeness as individual innovativeness and the innovativeness of the employees within the framework of both individual innovativeness and IWB. The working methodology flow chart is presented in Figure 2.

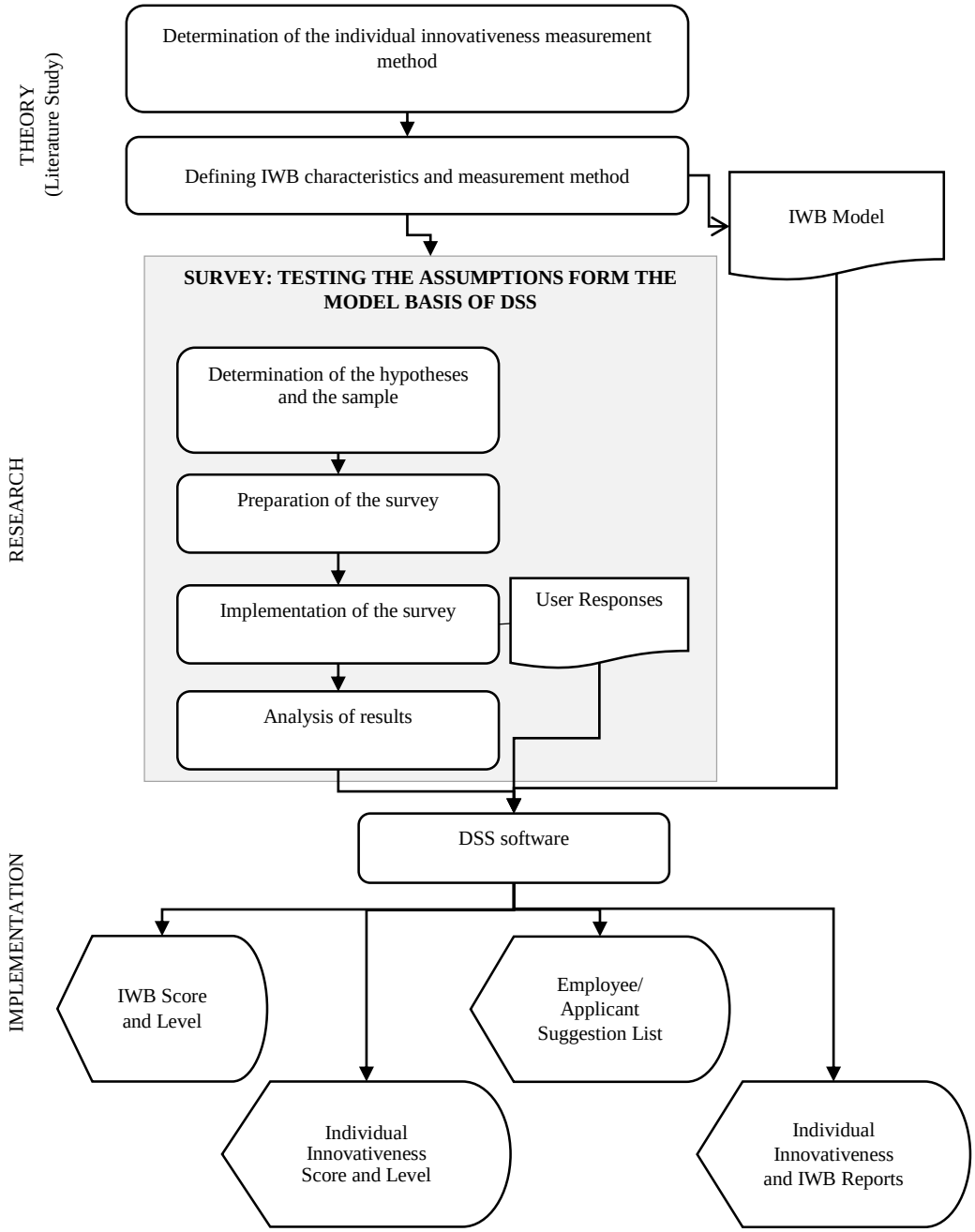

Figure 2. Working methodology flowchart.

In the final draft, the model base of the DSS includes two different models: the individual innovativeness model and the IWB model. In the theoretical stage, the measurement methods for individual innovativeness and IWB were chosen to build these two models. Since IWB is seen as a multidimensional structure in the literature and there are different antecedents that reveal this behavior, its characteristics were determined for its measurement.

During the research stage, a survey was conducted to test the accuracy of the assumptions forming the model basis of the DSS. The data collected through the survey was subjected to statistical analysis through SPSS PASW 18 and MS Office Excel 2016, and the final model of the DSS was developed according to the analysis results.

In the implementation stage of the study, the DSS database was created, interfaces were designed and coded. This stage is completed via Visual Studio 2017. Table II shows which techniques and tools are used in the elements of the DSS.

Table II. Components of DSS and tools - methods used.

Component	Tools	Methods
Model base	SPSS PASSW 18, MS Office Excel 2016	Survey, Individual Innovativeness Scale, IWB Scale, Statistical Analysis (sign test, t-test, etc.), Math Formulas
Database	MS SQL Server	Entity Relationship Diagram
Dialogue Management	Visual Studio 2017 (C# language)	Screen Hierarchy Diagram, Decision Tables, Flow Chart

3.1. Deciding on individual innovativeness measurement

The Individual Innovativeness Scale with 20 items developed by Hurt *et al*. (1977) was used so as to measure individual innovativeness in the DSS. The scale was designed as a five-point Likert scale (1: strongly disagree, 2: disagree, 3: undecided, 4: agree, 5: strongly agree). The scoring instructions on the website (Dr. James C. McCroskey, "Individual Innovativeness", 2021) were followed to score the scale. In classifying the scores, Rogers (2003)' innovativeness classification with five categories was used.

3.2. Deciding on innovative work behavior measurement

IWB was measured via 16 characteristics listed in Table I in DSS. For each characteristic, valid scales were obtained from the literature. It has been observed in the literature that various methods are used to measure IWB: managerial evaluation (de Jong and Den Hartog, 2010; Yuan and Woodman, 2010), self-report (Dorenbosch *et al*., 2005) and the combination of different methods (Scott and Bruce, 1994; Janssen, 2000). In this study, the use of self-report type was preferred due to (1) evaluation of IWB as an optional behavior, (2) ease of implementation, and (3) the fact that IWB characteristics affect IWB through the employee's perception of the characteristics. The scales were performed as a five-point Likert scale (1: strongly disagree, 2: disagree, 3: undecided, 4: agree, 5: strongly agree). The studies that the scales adapted from and the Cronbach's alpha values of the scales are shown in Table III.

Table III. Scale information about innovative work behavior's characteristics.

Variables	Scale Adapted From	Statement Count	Cronbach's Alpha (α)
Innovative Work Behaviour	-	120	0,974
Intrinsic Motivation	Tierney et al. (1999) (*α=0.74)*	*5*	*0,879*
Idea Generation	Janssen (2000)	*3*	*0,910*
Supporting Ideas	Janssen (2000)	*3*	*0,902*
Implementation-Oriented Work Behaviour	Dorenbosch *et al*. (2005) (*α=0,88)*	*6*	*0,899*
Awareness	Çapraz *et al.(*2014)	*2*	*0,843*
Creativity-Oriented Work Behaviour	Dorenbosch et al. (2005) (*α=0,90)*	*10*	*0,958*
Innovation as A Job Requirement	Yuan and Woodman (2010) (*α=0,85)*	*5*	*0,817*
Reputation as Innovative	Yuan and Woodman (2010) (*α=0,78)*	*2*	*0,896*
Expected Positive Performance Outcomes	Yuan and Woodman (2010) (*α=0,77)*	*3*	*0,778*
Expected Image Gains	Yuan and Woodman (2010) (*α=0,86)*	*4*	*0,927*
Expected Image Risks	Yuan and Woodman (2010) (*α=0,77)*	*2**	*0,907*
Innovative Output	de Jong and Den Hartog (2010) (*α=0,82)*	*6*	*0,864*
Leadership	Çapraz *et al.(*2014)	*26*	*0,978*
Organizational Support for Innovation	Scott and Bruce (1994)	*22*	*0,861*
Innovative Climate	Nybakk *et al.* (2011) (*α=0,90)*	*16*	*0,803*
External Work Contacts	de Jong and Den Hartog (2010) (*α=0,85)*	*5*	*0,830*

* There are 3 items in the original scale. In the test, the item that decreased the alpha value was removed from the scale because the alpha value of the 3-statement scale was very low (α = 0.29).

The model in Appendix A was formed to calculate the score for IWB.

3.3. Testing the assumptions forming the model basis of DSS

In constructing the dual model basis of the DSS, the following assumptions were made:

- Assumption 1: Factors that influence IWB occur at three levels, namely individual, group, and organizational. The characteristics of IWB are determined based on these levels. If these key factors do not influence innovative behavior, the relevant characteristics are also ineffective in defining IWB.
- Assumption 2: Characteristics of IWB identified by the main factors are associated with IWB. The characteristics that is not associated with IWB are ineffective in revealing this behavior.
- Assumption 3: Innovativeness at work is different from individual innovativeness and manifests itself as IWB. If IWB is not different from individual innovativeness, there is no need to use a dual model structure in the DSS. The individual innovativeness model will be sufficient for both employees and applicants.

In order to conduct survey research to test these assumptions, three research hypotheses were defined and a survey form was prepared according to them. The survey was conducted with a total of 59 respondents from one public institution and two private companies. The survey was administered online for private companies, while it was administered via the survey form for public institutions. Most of the respondents (51) have less than 10 years of work experience and they work in different units. As a result of the survey, the individual innovativeness scores of the respondents range from 23.00 to 92.00, with an average of 69.31 at a 15.93 standard deviation. IWB scores range from 8.52 to 85.99, with an average of 62.00 with a standard deviation of 16.08. Research hypotheses and analysis results are presented in Table IV.

Table IV. Research hypotheses and analysis results.

Controlled Assumption	Hypothesis		Analysis	Result*
Assumption 1	H0-1	The main factors influencing the innovative behavior of the employee (personal characteristics, participation in innovation processes, leadership, organizational climate, work qualities and image concern) do not differ by job title and work experience in the organization.	One way ANOVA, Kruskal Wallis	FAILED TO REJECT *(p<0.05 only for climate factor)*
Assumption 2	H0-2	There is no significant correlation between the identified 16 characteristics of IWB and IWB based only on innovation process characteristics (idea generation, support, etc.).	Correlation	REJECTED *(p<0.05 for 13 characteristics)* FAILED TO REJECT *(p>0.05 for Innovative Climate, Organizational Support for Innovation and Expected Image Risks)*
Assumption 3	H0-3	There is no significant difference between innovative work behavior and individual innovativeness.	Wilcoxon Marked Ranks (Scores), Chi-Square Conformity (Levels)	REJECTED (p<0.05)

*for α=0.05

In order to test Assumption 1, respondents were asked to indicate on a five-point Likert scale (1: absolutely not affect, 2: not affect, 3: undecided, 4: affects, 5: absolutely affects) whether the main factors personal characteristics,

participation in innovation processes, leadership, organizational climate, work qualities, and image concern influence IWB and the Likert mean of each factor was used for analysis. While the factor with the lowest mean was image concern with a mean of $\bar{X}$=3.69, the factors with the highest mean were leadership and personality with a mean of $\bar{X}$=4.63. All factors are considered by the respondents as influencing IWB. When it was revealed that the respondents thought that all factors affect innovative behavior, it was investigated whether this thought was affected by the job title and job experience. According to Table IV, as a result of the analysis, the H0-1 hypothesis could not be rejected except for the organizational culture factor. In this line, it is believed that six factors influence IWB regardless of title and experience generally (educators think that the organizational culture factor influences innovative behavior more than managers and workers, and technical personnel think that only workers). In this case, assumption1 has been confirmed.

Assumption 2 was tested by examining the influence of characteristics' means on the mean of classic IWB, the basis of innovation dimensions such as idea generation and idea support. According to Table IV, H0-2 could not be rejected for these characteristics: innovative climate, organizational support for innovation, and expected image risks. These three characteristics are not excluded from the model due to the fact that these characteristics cannot be directly related to innovative behavior, they are not consistent with the relevant studies in the literature (Scott and Bruce, 1994; Yuan and Woodman, 2010; etc.).

Assumption 3 was tested for both individual innovativeness scores and individual innovativeness levels. According to Table IV, H0-3 was rejected for both score and level. In this case, it can be said that IWB is different from individual innovativeness.

As a result of the hypothesis testing, all the assumptions that make up the DSS model base were basically confirmed.

3.4. Generating the final working model for DSS

As a result of the hypothesis testing, all assumptions forming the basis of the DSS model were generally verified, and in line with the objective of the study, it was understood that a two-model DSS was required to determine innovativeness. Along these lines, the IWB model created in Section 3.2 (Appendix A) was adapted to the DSS as a second model. The final model obtained by developing the draft model is presented in Figure 3.

Once the model for measuring the innovativeness of DSS was established, the reporting framework was also established with the innovativeness-oriented selection of the employees and applicants. As shown in Figure 3, the applicant suggestion is made only according to the individual innovativeness level and self-perceived innovativeness level, since the innovativeness of the applicants is measured only based on individual innovativeness. The applicants in the system are first ranked from high to low individual innovativeness level, and the applicants with equal individual innovativeness are ranked from the high to low self-perceived innovativeness level among themselves, and then a suggestion list is generated.

In innovativeness-oriented employee selection, employee suggestion is based on the first three criteria that the manager considers most important among 23 innovativeness criteria (15 characteristics, 7 sub-criteria of leadership characteristics and individual innovativeness).

In the suggestion lists of applicants and employees, self-perceived innovativeness level is also included as information. This ensures that managers can understand how the employee/applicant evaluates her/his innovativeness (objectively, more innovative, less innovative) by comparing self-perceived innovativeness level with the level of innovativeness obtained from the test.

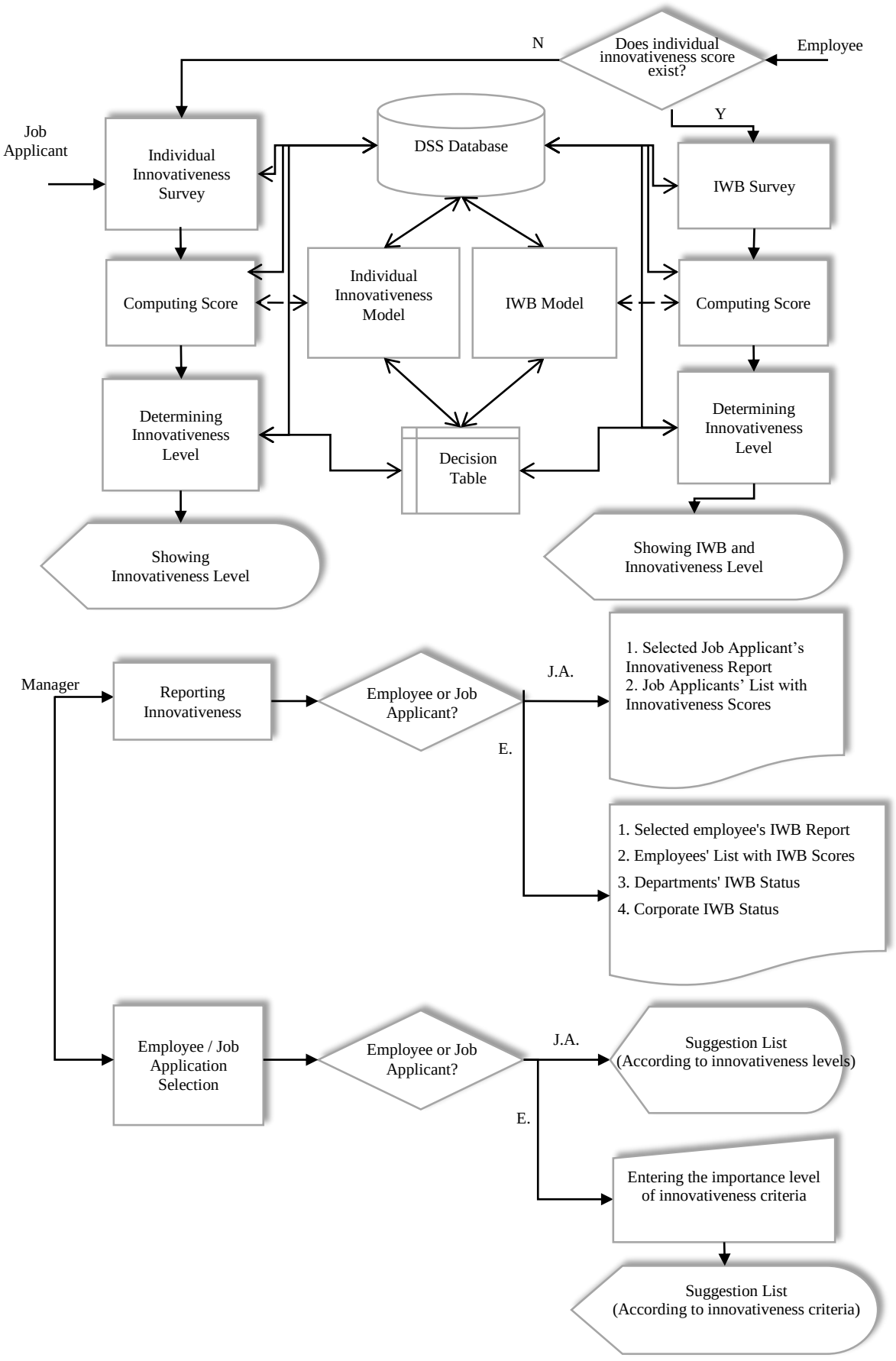

Figure 3. Framework for DSS.

3.5. Creating the database

MS SQL Server has been preferred as the database management system in DSS. The entity-relationship diagram of the proposed DSS is presented in Figure 4.

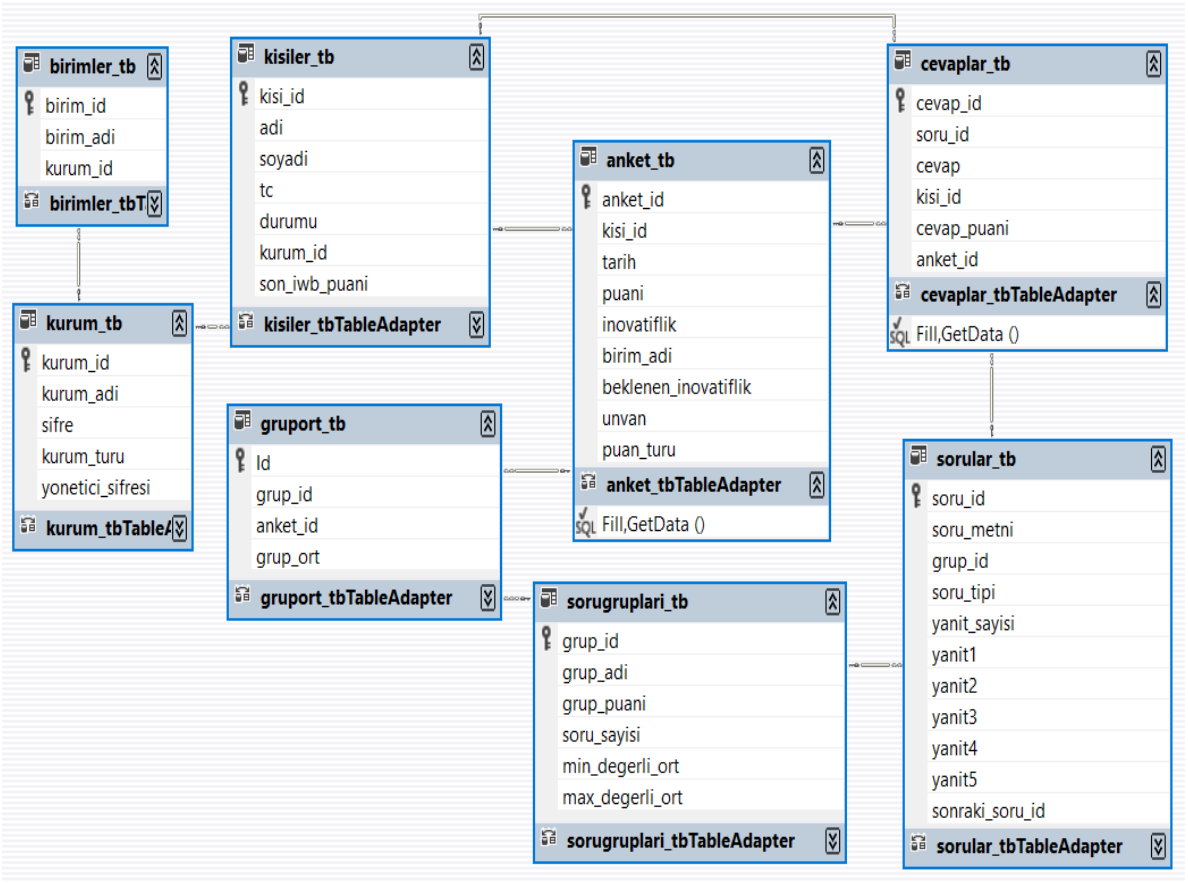

Figure 4. E-R diagram of DSS.

Eight related tables are used to hold data in the DSS:

- kurum_tb: The table that held the organization's information to use the program.
- birimler_tb: The table that held the units of the organization.
- kisiler_tb: The table that held the personal information of the employees / applicants whose innovativeness was detected.
- anket_tb: The table in which information on innovativeness tests answered by employees/applicants is recorded.
- sorular_tb: The table where the items in the innovativeness tests are kept.
- sorugruplari_tb: The table where IWB characteristics are kept.
- cevaplar_tb: The table in which the test answers of the employees/applicants are recorded.
- gruport_tb: The table in which the determined averages of the employees are recorded.

3.6. Preparation of the user interface

The user interface of the DSS, called IWB-DSS for short, was developed in the Visual Studio 2017 environment employing the C# programming language. The screen hierarchy diagram of the software can be seen in Appendix B.

There are two login options in the software: Company Log In and Admin Log In (Figure 5a). So as to enter the main menu, after selecting Company Log In, the organization is selected and the corporate password is entered in the corporate entry screen (Figure 5b). The DSS application is organized around the main GUI shown in Figure 5c, which provides all the basic functions to identify, capture, and report employee/applicant innovativeness and provide employee suggestions to managers following the innovativeness criteria.

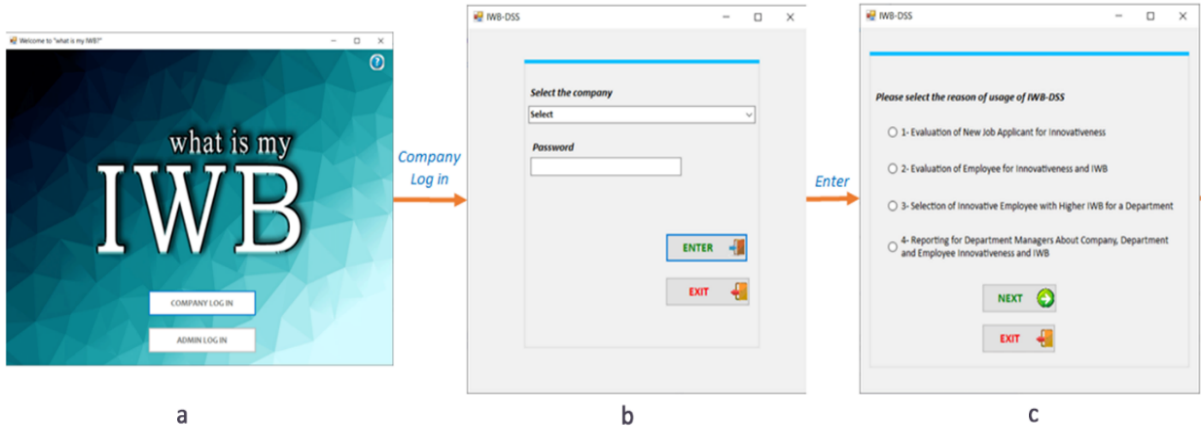

Figure 5. IWB-DSS start (a), login (b) and main menü (c) screens.

The first option of the main menu calculates the individual innovativeness score of the applicant applying for a new job (Figure 6). In this context, the applicant is first asked to indicate the self-perceived innovativeness (5: Innovator, 4: Early Adopter, 3: Early Majority, 2: Late Majority, 1: Laggard) along with personal information (Figure 6a). After entering the personal data, an individual innovativeness test with 20 items pops up (Figure 6b). In the relevant example, the applicant's innovativeness score was calculated as 58, that is, 'Late Majority' according to Rogers (2003) (Figure 6c).

Figure 6. IWB-DSS evaluation of a new job applicant for individual innovativeness.

The second option of the main menu includes the levels of calculation of both individual innovativeness and IWB of the employee (Figure 7). So as to calculate the score for IWB, the employee must first verify that her/his individual innovativeness score is registered in the system, as presented in Figure 7a. If no individual innovativeness score is found in the system, the employee is directed to the screen in Figure 7a to record the employee's innovativeness score. The employee whose individual innovativeness score is registered in the system is directed to the screen in Figure 7b, and information about the employee's job title, unit, and self-perceived innovativeness lev-el is recorded. After this process, in line with the screen in Figure 7c, the employee answers the 120-item IWB test. After completing the test, the employee is shown the degree of IWB both on the indicator and textually, as in Figure 7d, the individual degree of innovativeness is shown only textually. In the table below the level information on this screen, there are 120 IWB items and the answers given them by the employee. While the individual innovativeness score of the employee in the example was 58, the IWB score was calculated as 47. In this case, the necessary action can be taken by using the IWB-DSS reporting interface to determine which factor is negatively affecting the employee's innovative behavior.

Figure 7. IWB-DSS evaluation of employee for IWB.

In the third option of the main menu, the applicant or employee selection is based on the innovativeness of the placement or assignment. This area is for administrators only, as the confidentiality of personal data is maintained, and therefore this area can be entered with an administrator password. Since the innovativeness of employees in DSS is treated on the basis of both individual innovativeness and IWB, the selection of employees is based on innovativeness criteria. Therefore, the interface in Figure 8a asks the manager to enter the order of importance of the three criteria, which should be based on the selection in the table of 23 innovativeness. The employees registered in the system are listed according to these three criteria and a suggestion list is created. For clarity, the results are also supported by comparative graphs by criteria (Figure 8b).

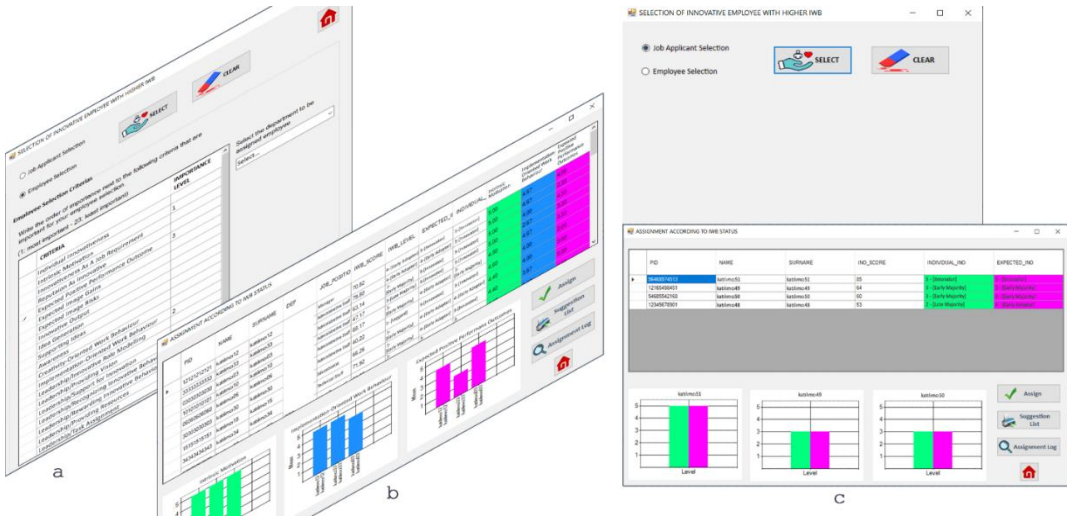

Figure 8. Innovativeness-based employee (a, b) and applicant (c) selection screens.

When selecting applicants, no information is requested from the manager, as suggestions are made only based on individual innovativeness. Among the applicants ranked according to their individual innovativeness, the results of the first three applicants with the highest individual innovativeness are also presented graphically (Figure 8c).

The manager completes the assignment/placement process by selecting the employee/applicant record in the selection interfaces that he or she wants to assign/place. Both the employee and applicant suggestion lists also incorporate information about employees' individual innovativeness and self-perceived innovativeness level to facilitate the manager's decision-making and increase the quality of the decision.

In the fourth option of the main menu, individual innovativeness and IWB are reported. This section is for administrators only, as the confidentiality of personal data is maintained, and therefore this section can be entered with an administrator password.

Different reporting interfaces are designed for applicants and employees. On the applicant report screen in Figure 9, the first table presented to the manager contains the applicants' personal information and individual innovativeness test scores. The answers for the individual innovativeness test for the selected applicant are presented in the second table. From this screen, the applicant list presented in the first table and the test report of the selected applicant can be printed.

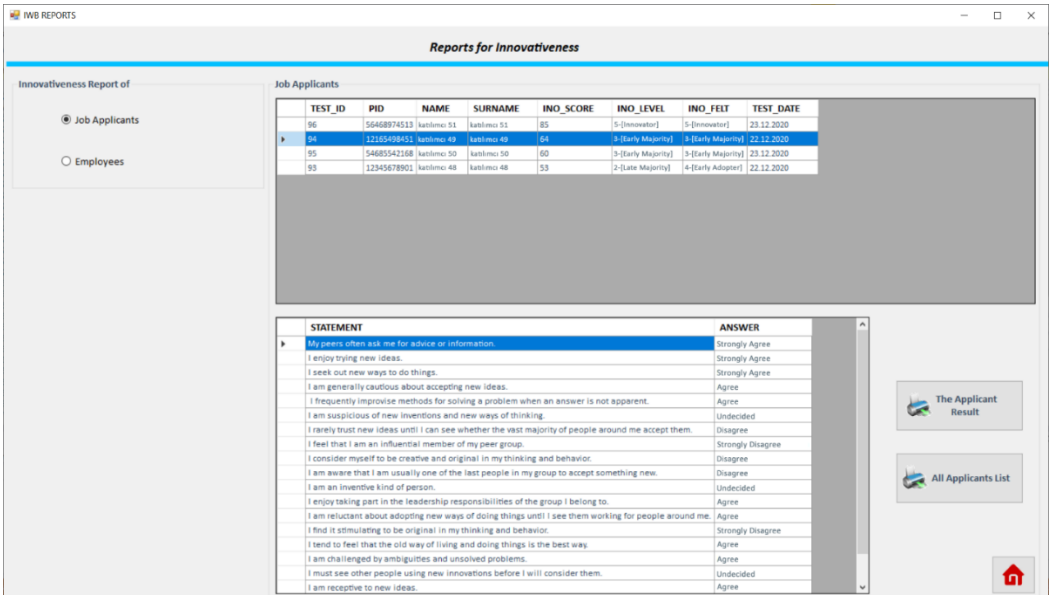

Figure 9. Applicant innovativeness reporting screen.

On the employee report screen shown in Figure 10, the information is presented in three separate tables. The first table contains the personal information of the employees and their innovativeness scores. When the manager selects the employee whose information he or she wants to view from this table, the second table lists the test information registered in the system for this employee. As an example, there is an individual innovativeness test (TEST = 'B') and an IWB test (TEST = 'I') of the employee selected in Figure 10. When the IWB test is selected from the second table, the third table lists the IWB characteristics' averages of the employee. To enable the manager to evaluate the employee's averages, the table also shows the lowest and highest averages of the characteristics. For instance, the average intrinsic motivation in the selected IWB test of the employee selected in Figure 10 is 3.80. The mean range of values for this characteristic is 1.00-5.00. In this case, the employee has received an above-average value from this characteristic. In this case, it can be judged that this characteristic has no negative influence on the employee's innovative behavior. From this screen, you can print the employee list presented in the first table, the selected employee's IWB test report, report of the characteristics averages of the unit, and report of the characteristics averages of the company.

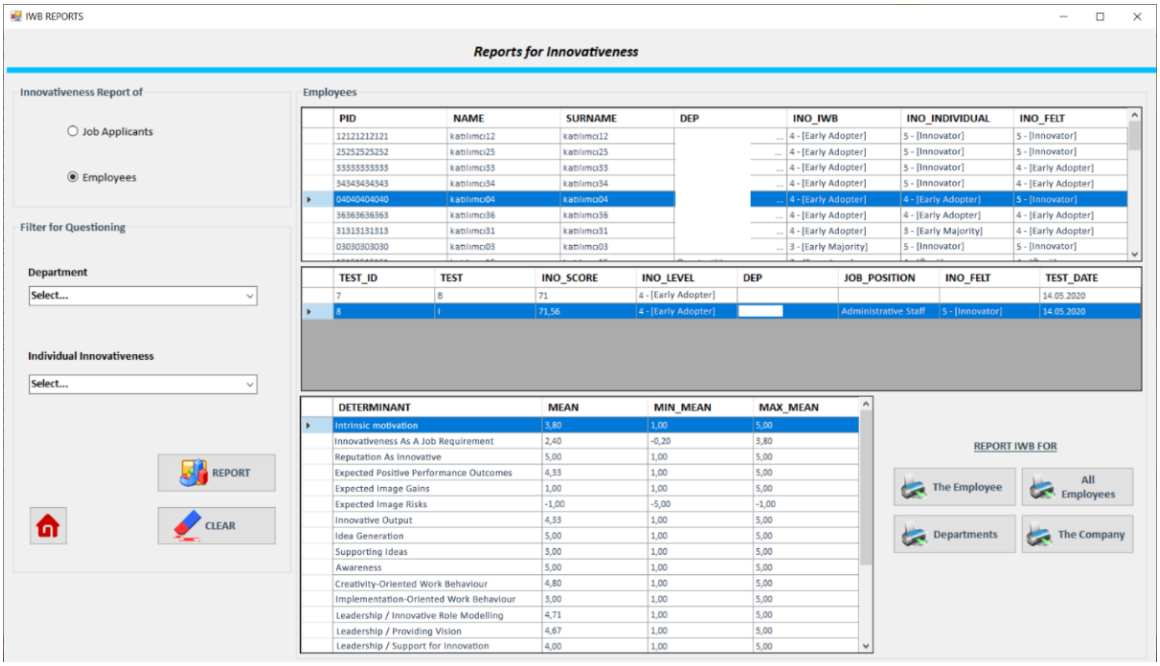

Figure 10. Employee innovativeness reporting screen.

4. CONCLUSIONS

In all transformations in the business world (industry 4.0, digitalization, process redesign, reengineering, etc.), the individual innovativeness of the implementers, those involved in the process, and those affected by the process play an effective role in the success of the change process. Employees with high individual innovativeness scores will quickly adapt to the process by quickly adopting the necessary change because their adoption time is short. So, the time required for the changeover is shortened and the cost of adapting the employee to the process is reduced. Nevertheless, as mentioned earlier, this will not be enough alone to manage change effectively. Factors such as organizational climate and leadership that influence the employee's innovative behavior within the organization should also be considered by managers.

In this study, a decision support system is proposed to assist organizations in ensuring the employment of highly innovative employees, measuring the innovation capabilities of present employees, and selecting the most suitable innovative employee for the vacant positions. This DSS, abbreviated IWB-DSS, on the one hand shows the level of individual innovativeness and IWB of employees, while on the other hand it enables managers to identify the non-innovative organizational climate, inadequate leadership in the company and similar risk factors that may negatively influence the innovative behavior of employees.

The advantages of the developed IWB-DSS are as follows: being easy to use, measuring according to scientific standards, being based on well tested criteria in the literature, being easy to implement and train, returning of a numerical result as a result of the measurement, informing the user about the result of the test, informing with the up-to-dateness of the innovativeness measurements, observing the change in IWB over time, installing the additional software required to run the program together with the program and not required an advanced computer to run the program. The disadvantages of IWB-DSS are that the system does not provide results without answering all the items in the test, the test must be answered all at once and is, therefore, time-consuming, and the application is not developed as a web or mobile application.

4.1. Contribution to the literature

The study is about developing a decision support system that makes personnel selection based on innovativeness. It contributes to both the literature on HRM and the literature on IWB in line with the literature reviews conducted during the DSS development phase and the information obtained during the assumptions review phases.

The study makes a contribution to filling the gap between the HRM literature and the innovation literature, identified by Ueki (2017). In line with this, it responds to Shamim *et al*. (2016)'s call that recruitment should be based on diverse skills and heterogeneous knowledge, that these skills should be tested in the screening process before selecting the employee candidate, and that recruiters should focus on identifying the qualities necessary for innovative behavior in order to recruit innovative employees. The study also responds to Intarakumnerd (2017)'s call that HRM should use methods of recruiting the right people to foster innovation.

Even though there are many studies in the literature on individual innovativeness or IWB, there are not many studies that deal with both together, as in this study. Moreover, while a score based evaluation of the individual innovativeness scale is available, no study was found that evaluated IWB as score based. The contribution of the study to the IWB literature is that a model has been proposed to measure IWB using scores, and by comparing individual innovativeness to IWB, it is aimed to reveal whether the employee can show innovative behavior as much as her/his innovativeness.

4.2. Administrative influences

The DSS developed in the study also has some administrative influences. Consistent with the reports of innovative behavior in the IWB-DSS reporting interface, managers can determine whether the employee is exhibiting innovative behavior at her/his innovativeness level. Furthermore, by examining the within-organizational factors that influence innovative behavior, they can control the factors that negatively influence innovative behavior. In this way, managers can examine each employee individually and reveal the factors that affect IWB in the company or department. This allows managers to more realistically evaluate risk factors in their change and innovation plans and more accurately predict the success of change and innovation. For example, out of 59 employees registered in IWB-DSS, 44 of them had IWB scores lower than individual innovativeness. Looking at the reports on the IWB of these employees, it can be seen that reputation as innovative, innovativeness as a job requirement and external work contacts characteristics are significantly below the average and the leadership characteristic is slightly below the average. On this basis, it is understood that employees may not be able to show their innovativeness at a sufficient level because they do not find the opportunity to innovate in their work, and that the perception of innovativeness left by the manager in the employee, may negatively affect employee's innovativeness, even if it is only slight. Following these conclusions, the manager should provide employees with opportunities to innovate, encourage their participation in innovation processes, and review their own innovativeness image to benefit from the innovative capacity of these employees.

Managers can follow up the change in the employee's innovative behavior by repeating the employee's IWB evaluation regularly; they can monitor the manager's impact on the employee's innovative behavior by repeating the IWB test when the unit manager or the employee's unit changes.

Thanks to the IWB-DSS selection interface, managers can select the most suitable one for the innovation vision of the company among applicants and the most suitable innovative

employee for the job/unit to be selected among employees. It is believed that IWB-DSS will help the company to stay on an innovative line by increasing its innovation potential and to keep up with the destructive changes predicted that the future will require, as assigning employees with the appropriate innovativeness level to jobs that require being innovative can increase the emergence of innovative ideas (Tierney *et al.*, 1999).

4.3. Suggestions for further studies

IWB-DSS can be further developed or differentiated by the following efforts:

- Conducting an additional study can increase the number of observations in the study that tests the model assumptions. In this way, having ensured construct validity by conducting factor analysis, the model base can be strengthened with regression analysis and further models can be tested. With the additional study, the scale for determining IWB can be shortened and implementation facilitated.
- As Messman and Mulder (2012) suggested, in addition to the self-report method, evaluations from supervisors and/or peers can be added to measure innovative behavior. In this way, IWB-DSS can provide information for 360-degree performance evaluation. Leadership characteristics (for managers) and personal characteristics (for employees) of IWB can be used as criteria in performance evaluation. In this case, IWB-DSS can be integrated with the company's ERP system, personnel evaluation system, etc. Even if it cannot be integrated directly, a warning that the IWB score should be updated can be issued in the application HR used by the organization if the employee's unit or manager is changed. Further, it can be used as a complete HR application by adding all the necessary criteria for personnel selection.
- In addition to innovativeness, it can be measured whether the employee is ready for the digital future by adding all the skills and competencies required for industry 4.0 or digital transformation.

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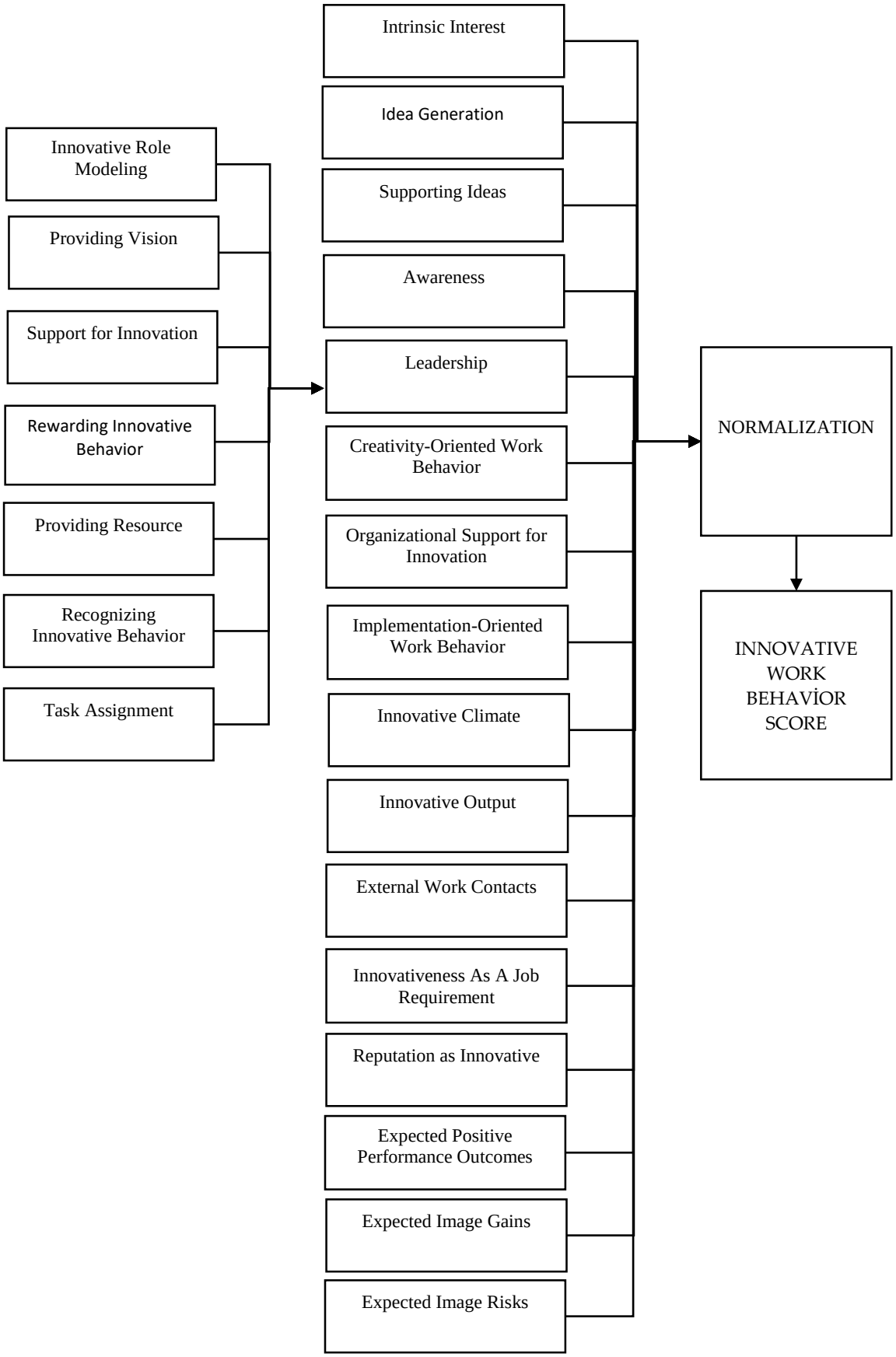
Appendix A. Model for IWB



Appendix B. IWB-DSS screen hierarchy diagram