Intelligent System for Automatic Selection of Teleworking Jobs

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ABSTRACT: According to increase usages of teleworking, the necessity of a deep revise in decision making mechanisms of this subject should be mentioned. This work provides key indexes defines for selecting teleworking job candidates. The extracted indexes have been weighted using experts' opinion and in the last phase a software is developed based on data extracted.

KEYWORDS: Green Economics, Teleworking, Decision support systems, Human resource management, Computer software

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1. INTRODUCTION

Telework is an alternative work relationship with demonstrated positive benefits for individuals and society, yet it has not been implemented with enthusiasm by most organizations. This could be due to the lacking, consolidated evidence for management regarding whether or not telework is a good thing for the firm (Brittany Harker Martin et al., 2012). For more than 20 years now, some organizations have allowed workers who interact heavily with computerized information to work off-premises, on a routine basis (Pliskin, 1997).

Depickere (1999) argues that teleworking seems to have led to new forms of management, where managers seek to build a culture in which the worker independently performs tasks to the required level of quality and completeness (Jackson et al., 2006). Pasi Pyörä (2011) although mentioned that telework has the best prospects of success if from the outset all the people involved know what to expect and are prepared to deal with any problems and fears associated with the new work culture.

Since the variety of job specifications which can fall under the heading of teleworking range from the low skilled (and perhaps alienating) such as routine word processing, to high skilled (design and creative) jobs and According to increase formal and informal usages of teleworking and other aspects of flexible work (Kossek et al., 2009) . And to achieve the goal of teleworking employees, In order to perform assigned duties without their physical presence in the workplace, with the Approach of increase productivity, labor flexibility, and reduced traffic volume, the necessity of a deep revise in decision making mechanisms of this subject should be mentioned. According to the above, In order to integrate Decisions to implement in Enforcement agencies, the necessity of defines key indexes for selecting teleworking job candidates and in the next phase automation of the decision with an intelligent Software system is very important.

One of the most important challenges for the development of teleworking is the selection of suitable jobs in the essence and spirit of teleworking. Given the diversity of jobs and variety of their natural factors, Possibility of integrating these factors and to assess and select the jobs mechanized, that was the author concern and if becoming a decision support system, would be a great help in Decision making for Managers and decision makers from public and private.

2. LITERATURE REVIEW

In the software implementation Part, using a combination of AHP and linear, Integer and goal programming although is newer from Pure AHP, but it is widely accepted by researchers. On the other hand, many Papers are indexed on Expert Systems in international journals. The field of these papers are scattered from management and financial consulting (Jones, 2003) to Construction (Golabchi, 2008) and from agriculture (Lorestani et al., 2007) to psychology (Mansoorizadeh et al., 2008). However, our study (based on observations taken), is distinct from the work of others in server aspects: Firstly, according to the study carried out, weighting and ranking of Evaluation measures AHP-assisted have not be done before. Secondly, to implement our model, we will attempt to produce software and in this way will not use common shells such as VP-Expert.

Dare to say almost all the research has been conducted in various countries, based on this approach. As examples can be noted to the annual reports of the Federal Government America (for example: Federal Employee Viewpoint Survey, 2010 about teleworking in which mentioned: “The EVS (Employee Viewpoint Survey) has been administered Government wide to Federal employees since 2002 and, for the first time in 2010, includes an item that specifically asks employees to describe their participation in telework2. The methodology for data collection is well-documented elsewhere (see http://www.fedview.opm.gov/). To summarize, the EVS was administered to full-time, permanent employees of Departments and large agencies and the small/independent agencies that accepted an invitation to participate in
the survey (approximately 82 total agencies). Of the 504,609 employees receiving surveys, 263,475 completed and returned the survey for a Government wide response rate of 52 percent. The EVS includes questions that provide employee perceptions regarding how well the Federal Government is running its human resources management systems. Beginning in 2010, there were two items on the EVS that addressed telework. The first item asked respondents to choose an answer option that best describes their participation in telework, with response options to identify teleworkers versus non-teleworkers, as well as reasons for non-participation. The second item has appeared in earlier versions of the EVS and asked respondents to rate their level of satisfaction with the telework program in their agency. Analysis of the EVS data allows for expansion upon data supplied by agencies drawing upon Federal employee perspectives. Further, analysis of telework items with respect to other EVS survey questions allows for some determinations to be made about telework as it relates to important workplace outcomes. Another example is the research of Tamas Forgacs (Forgacs, 2010) in which he noted that: “The world of employment is undergoing radical transformation due to technological progress and the establishment of information society. While the number of traditional jobs is on the decrease, employers are on the lookout for ever newer - and possibly cheaper - employment alternatives to maintain or to strengthen their positions in the global competitive environment. Based on SIBIS (2003) research the number of teleworkers employed in EU member states was 13% on the average, with the same index in the USA showing 25%. The research project an annual 20-30% growth. If one understands the spread of telework, it becomes possible to create a proactive environment by conscious planning - an environment where social demands would harmonies with corporate requirements, whereby the spread of telework could be promoted on a sustainable basis of economic rationality. Based on the SIBIS project results and knowing the experience of Western countries (Clear, 2005; Valsecchi, 2006; Hislop, 2007; Martinez-Sanchez, 2007), a significant progress of telework can be projected in Hungary and Central and Eastern Europe. Trends of the spreading of telework could - with conscious planning - help achieve the goals of regional economic and employment objectives. Using telework is primarily a decision made by employers, which could, however, be positively affected by an appropriately motivating environment. A system of incentives can only be successful if it supports employers’ decision-making processes with positive elements, and creates a sustainable environment. To get to that point, though, one should first of all establish the advantages and disadvantages perceived by employers, the industries and jobs, which employ telework, and present telework employers’ primary objectives. By getting to know presently existing telework employment practices and the opinions of decision-makers, incentive strategies can be established to reinforce positive employers’ decision-making factors, while cutting down on the possible hindrances of the spreading of telework. This study wants to contribute to this process. As a result of our empirical research findings, we could gain a somewhat deeper insight into the mechanisms of employers’ decision-making processes and into their attitudes towards telework. Based on the opinions expressed by about 500 corporate managers, one important finding is that most companies closed towards telework could not supply an adequate reason for their reticence. The main grounds for such reservations are a lack of demand of telework as well as a lack of adequate information on it.” All of them were based on employee-centered approach and have been evaluated Employee from different directions. Also (Lee et al., 2007), (Rajab Beigi, 2007), (Kossek et al., 2009) and numerous other studies can be noted. Therefore, our research can be claimed as an invention and it can be argued that a similar research has not been published so far. As mentioned, almost all research has been Conducted with Employee approach and Based on our research, in limited resources such as (Verbeke et al., 2008), (Azadi and Naseri, 2007) and (LWC, 2011), Few Criteria are mentioned based on authors understanding. Or as an example, in (Lewn, 2007) that this issue has been discussed at length, has pointed to a database in America's government which has descriptions for various job in factors such as
flexibility and is divided into two parts: in the office and teleworking (Fixed and regardless of the organizational considerations).
In that study, the method of data collection, validation and comparison or any decision support system on that case has not been mentioned. These researches led to the conclusion that almost certainly less scrutiny and detailed research on the paper subject has been done, or at least not published.

3. THEORETICAL FRAMEWORK

3.1. Telework

3.1.1. The definition of remote working or teleworking

The official definition of “telework” can be found in the Telework Enhancement Act of 2010 (the Act): "[t]he term 'telework' or 'teleworking' refers to a work flexibility arrangement under which an employee performs the duties and responsibilities of such employee's position, and other authorized activities, from an approved worksite other than the location from which the employee would otherwise work."

In practice, "telework" is a work arrangement that allows an employee to perform work, during any part of regular, paid hours, at an approved alternative worksite (e.g., home, telework center). This definition of telework includes what is generally referred to as remote work but does not include any part of work done while on official travel or mobile work.

REMOTE: In the past, agencies have sometimes used this term to describe a work arrangement in which the employee resides and works at a location beyond the local commuting area of the employing organization's worksite or to describe a full-time telework arrangement. For reporting purposes, these employees should be included as teleworkers.

MOBILE: Work which is characterized by routine and regular travel to conduct work in customer or other worksites as opposed to a single authorized alternative worksite. Examples of mobile work include site audits, site inspections, investigations, property management, and work performed while commuting, traveling between worksites, or on Temporary Duty (TDY).

You may also be familiar with the terms "telecommuting" and "flexible workplace" and both are sometimes used to describe what we now generally refer to as “telework.” While “remote” and “mobile” work are also terms that are sometimes used as synonyms for telework, they tend to operate differently than telework as is apparent in the detailed operational definition.

For consistency, OPM recommends that all agencies use the term “telework” for reporting purposes and for all other activities related to policy and legislation, as defined in the Act. (Guide to Telework in the Federal Government, 2011)

3.1.2. Benefits of teleworking

As with any business decision, ideally, prior to choosing a virtual working arrangement, the purpose and benefits sought for all stakeholders need to be clearly understood. The description of virtual organizations being revolutionary in nature and unconstrained by the material aspects of organizational structures, a view noted by Thorne, needs to be tempered by considering the benefits and challenges posed by virtual working arrangements. Virtual working arrangements are not suitable for all employment types and need to be assessed by organizations in terms of appropriateness prior to embarking on any such arrangement (Baruch & Yuen, 2000; Morgan, 2004; Watad & Will, 2003).

Baruch (2003), Heneman and Greenberger (2002) and Ingham (2006) note that when considering virtual working arrangements, the main benefits sought by organizations relate to reducing the costs of physical accommodation, the streamlining of operations, increasing productivity and attracting and retaining employees through greater employee flexibility and loyalty. O'Brien and Hayden (2007) add two further reasons for the promotion and development of virtual working arrangements, (1) allowing organizations to manage variable workloads to deal with peak periods of demand and (2) creating additional and suitable coverage over the
weekends or holidays for specific business areas. Kowalski and Swanson (2005), Morgan (2004) and Shekhar (2006) suggest that such practices also lead to greater customer service over extended hours, improved speed with which organizations can respond to and resolve customer issues as well as enable the sourcing of specialized staff who may be spread across the globe. (Baard, N et al., 2010).

While the above mentioned benefits apply to virtual working arrangements, the specific benefits of teleworking include an increase in productivity (Siha & Monroe, 2006) and a willingness on the part of employees to work harder (Kowalski & Swanson, 2005; Mann, Varey & Button, 2000). In this regard, Kepczyk (1999) states that quieter, more focused work environments with fewer interruptions, the freedom to work in comfort and the absence of office politics are often translated into increased employee productivity. Ilozor and Ilozor (2002) report that job satisfaction is higher in teleworkers than in other employees because of a reduction in stress levels. (Baard, N et al., 2010).

Telework provides an effective tool to employees seeking to achieve the balance among personal, work, and community responsibilities. It ultimately allows employees to achieve peak performance and meet the goals of flexible workplaces. Moreover, telework programs are integral to advancing other important national initiatives such as building capacity in the Federal workforce to continue agency operations in the event of snowfall or emergency. Telework plays an instrumental role in realizing sustainable environmental policies and, with collaboration and transparency fundamental to telework, these programs can facilitate the goals of open government. Telework also provides necessary access to pools of skilled employees through wider employment opportunities for the disabled.

3.2. Decision Support System (Decision Assistant)

Decision support systems, is called to specific types of automated (or semi-automatic) applied information systems which provide the required Managers informations to support decision-making process. However, these systems are not directly involved in decision making, but, given the opportunity to managers for use some of the calculations, analysis and estimates to make decisions faster and easier. So, the main decision support systems objectives are to reduce ambiguity and misinterpretation, increasing the speed of decision making and increase the desirability, reliability and accuracy of decisions and choices.

3.3. Expert systems as a decisions support system

It can be claimed that the expert systems are the most important applications or in other words Instruments of decision support systems. These systems are a kind of software or computer program which are modeling some of specialist and expert human capabilities in various fields such as reasoning, evaluating, predicting, problem solving, diagnosis and conclusions. Designs of an expert system require specialist knowledge and identify the logic and methodology of working in the real world.

3.4. AHP (Analytical Hierarchy)

This technique allows a hierarchical problem formulation and weights criteria based on Paired comparisons. AHP technique has many applications (Razmi et al., 2004).That is one of the multiple criteria decision analysis and evaluation techniques used extensively in the field of environmental science, earth and space planning. (Karam and Mohammadi, 2009)

AHP was developed during the 70th century by the Saaty. (Saaty, 1980).

This process was introduced by Saaty for identify scarce resources and also planning requirements for military (Saaty, 1994). And then used by various researchers in evaluating and planning. Among the important works done using this method (Bojorquez – tapia, 2001) can be noted. AHP ever since its introduction become one of the most used methods to a Multi Criteria Decision and used to solve unstructured problems in different areas of human needs and interests, such as politics, economics and social sciences and management. (Lee et al., 2008)
4. Research Methodology

4.1. Research Goal
The purpose of this leading research is that in the first, by detailed examination of the nature of the jobs, Common factors in the decision and Consult the Experts extract the proper evaluation parameters of jobs teleworking and then with Several public-private cooperation in the field of teleworking And by taking advantage of AHP, Scoring the Indexes. The result of this stage will be providing a full weighted assessment form.

The results obtained here can be used independently from the rest of the research, but these steps will not suffice, and with the goal of providing the capability for system expansion, a decision support model that uses the AHP output, will be designed. After the turn of the conceptual design model, it's time to implement a model. Our efforts in this phase will be software to support decisions of selecting suitable jobs for teleworking.

In summary, this study identified the primary goal of extracting and tunable selection criteria for jobs in teleworking and in the next place, the implementation of an automated decision support system to evaluate and provide output based on the all of the above criteria.

4.2. Research questions or hypotheses
Leading research is as type of applied and Prepare as an intelligent system to automatic selection of jobs that suitable in teleworking for public and private organizations usage.

The research questions are as follows:
Firstly, what are the proper selection criteria for suitable jobs to teleworking?
Second, how is Weight ratio of these criteria together?
Thirdly, is it possible with decision support system software, mechanize the Review and scoring process and the final selection of appropriate or inappropriate jobs for teleworking?

5. Theoretical or Empirical Research Findings

5.1. Extracting the important criteria in the evaluation process
In response to the first research question, important criteria in the evaluation process for teleworking jobs has been Extracted With a wide review of articles and theses in the world especially America Federal Government Resources (Federal Employee ViewPoint Survey, 2010) And the use of observation and consultation with experts.and then these criteria were organized into a hierarchical graph (The following criteria, are the final criteria after confirming the Experts that will be explained later):
Availability of equipment outside the organization
How much the availability of the resources needed to carry out the job?
How much the job requires the use of IT and ICT?
How much the job done is dependent on Physical Laboratory equipment?
How much doing the job is dependent on Industrial Machinery?
Type of Information
How much job needs to digital information?
How much job needs to print information (including some bank records and administrative)?
What is the volume of data required during work?
Communications mode
How much job related discussions and in-person visits with the stakeholders?
How much job stakeholders have the ability to communicate through the Internet?
How much job stakeholders have the ability to communicate over the phone?
Electronic infrastructure of the organization and the city
How much the organization has access to broadband and video conferencing?
How much residents in the city of job Location, have access to broadband?
Job characteristics
How much job can be done part time?
How much can you make floating working time?
How much is possible to evaluate employee performance in electronic form?
How much Employed has the Ability to plan and manage tasks?
How much possible doing job individually?
Fit physical condition and working Sentiment
Do Employed Injuries sutiable for work?
Is the employee's personal desire to teleworking?

At this stage, a questionnaire was formulated to verify the extracted parameters by experts with the Delphi method.
The usual process of quantitative research approach is the study of the resources to select appropriate theory, making hypotheses and then testing their statistical analysis. In contrast, in the qualitative approach, May be there is no theory related to the study, or Scholar does not desire to limit his research to available theories. Thus, a qualitative approach can be used in order to build a new theory to explain the phenomenon, or describe new patterns that are found in the data. In quantitative approach, the data must be clear and precise. Thus, the original data that are collected will be quantitative. However, in qualitative approach, the emphasis is on the quality and depth of data. So data that are collected, are essentially qualitative (Pulido and Martinez, 2005). The Delphi technique, mainly developed by Dalkey and Helmer (1963) at the Rand Corporation in the 1950s, characterized as a method for structuring a group communication process so that the process is effective in allowing a group of individuals, as a whole, to deal with a complex problem.
The Delphi method is carried out in partnership with people who have expertise in their subject. These people are known as the Delphi panel. It is clear that there is wide variation in numbers of participants. Guidance suggests that numbers of participants will vary according to the scope of the problem and resources available. In The Delphi panel that members must be subject specialists, these limitations may increase. On the other hand, creating consensus among the members as to the goal of this method is difficult when they number increased. When there is heterogeneity among the panel members, about 10 to 20 members is recommended (Cuhls, 2007), (Mashayekhi et al., 2004). To validate the extracted parameters as noted in this study, we used the Delphi technique, and the Panel members were selected as a convenient sample with the combination of targeted or judgmental methods and chain.
Panel members included five Master of SA Iran Co., Seven Master of Iranian Post Company and three Master of BWF Co. (bwf.ir), all active in teleworking areas.
After the the first step of questionnaire distribution and collection, the researchers concluded that the adequacy requirement is done at the first phase, and no longer need to perform the next steps, so criteria were confirmed by experts in this field.

5.2. Developing, distributing and collecting Questionnaire to paired comparisons Criteria
In order to answer the second research question, criteria are scoring by use of AHP Approach and in collaboration with experts that had participated in the Delphi panel.
In this stage, based on criteria extracted in first stage, Questionnaire for paired comparisons of criteria and determine their impact on job evaluation has been prepared and distributed among experts.
When the criteria value is calculated to each other, there is the possibility of inconsistency in judgments. Therefore it is necessary to use a scaling to reveal the inconsistency of judgments. One of the advantages of AHP is the possibility of investigating inconsistency in judgments for adjustment coefficient of the criteria and sub-criteria.
Mechanism which this model considers for investigating inconsistency in judgments, is calculating the factor called "inconsistency coefficient" that obtained from inconsistency division to stochastic. If this ratio is less than one-tenth, and consistency of judgment is accepted, otherwise it is necessary to revise the judgment (Bowen and William, 1993). After gathering the questionnaires, 15 completed questionnaires were collected and one of them was excluded because of the high inconsistency rate and 14 questionnaires entered to the Expert Choice software with the hierarchy chart.

Figure 1. Hierarchy chart

Figure 2. Paired comparisons questionnaire of sample participant
5.3. Merge Paired comparisons results and obtain the weight of each index

The software weighted criteria, after integrates the results of all participants paired comparisons.

Figure 3. The final weights for each of the indicators that are arranged in descending order

![Figure 3](image)

Incompatibility factor in all comparisons was 0.04, which indicates the reliability of achieved participants' comments outcome.

Figure 4. Matrix of paired comparisons of Sa Co. Participants

![Figure 4](image)
Figure 5. Equation

\[ U_k = \sum_{i=1}^{s} v_i e_i \]

As in above Equation \( U_k \) is the qualification of the job \( k \) to teleworking that would be a number between 0 to 10 and software user will be announced by linguistic variables.

Here we can say that the first phase of the study ended and the results obtained so far can be investigated independently of the rest, and resolves many of the problems mentioned in the introduction to the paper.

5.4. Production software system

Finally, to achieve the final research question, obviously if the result of all these efforts converts to software, our goal has been reached.

Our expert system named ‘An INTELLIGENT SYSTEM FOR AUTOMATIC SELECTION OF SUITABLE JOBS FOR TELEWORKING’ developed in the Visual Studio .Net 2010 Environment by C # language and database design based on XML, including multi-step process which will be discussed below.

User first log in the system by entering specific user name&password then with a File menu select the 'New Job' submenu that will be dealt with below.

In this step, enter the name of the job and encountered ' Is the job you are looking for has one of the following characteristics?' question. With this question, the jobs which are incompatible with teleworking nature have been identified and will not be discussed.
Now, if user finds the job suitable for teleworking nature and had 'no' answer to the above question, Can then be entered into the first stage of questions which are relating to the first part of criteria (Availability of equipment outside the organization).

Figure 7. Data entering mode of the first section of criteria

As is clear from the above, User enters the answers into the software at this stage, and in all other stages, with the linguistic variables. And at any moment can also see the results of operations up to that time using the 'Calculate Result and Save' button. (Obviously, the questions which are not answered yet by user will be considered to be zero.)

The user operation is performed on all six criteria groups to come to the final stage and pressing the 'Calculate Result and Save' button, then software calculates and displays the result based on the User's Scores to criteria in the previous section.

For calculating the operation result, software calculated scores average for each criterion. Then, multiplies each criterion score on its weight (The output of Expert Choise software) and Sigma scores of groups will be the final score for the Specified job.
As you can see the result will be displayed to the user with both linguistic variables and the score between 0 and 10. The next feature of software is archiving jobs that have been evaluated. It provides jobs Comparability for decision-makers and allows the organization to plan based on resources constraints to prepare infrastructures for more suitable jobs to teleworking. This saves time and money and is effective to increase your productivity.
5.5. Analysis of results
As mentioned in the previous sections, the author did not encounter similar examples of decision support software for teleworking to compare the system in terms of functional properties to them, but instead tried to greater reliance on expert opinions, and consider the inconsistency rate in experts opinions refinement process, to increase our confidence in the accuracy of the decision support system judgments.

The most important factor to validate the data was the use of expert opinion on the description of the Delphi panel. Also In this field, to assess the validity of the Expert Opinions the measure named inconsistency rate was used. The inconsistency rate of Overall participants assessed by Expert Choice software was 0.04 and due to its distance to 0.1, the validity of the extracted results has been proved. As well the inconsistency rate of each participant assessed and one of them with higher inconsistency rate was excluded from total opinions and thereby each participant opinion assessed and validated.

6. Conclusions and Suggestions
As mentioned, Approach to previous researches in the field of teleworking is often Employee-centered approach and less attention has been paid to Job-centric approach and in cases where this approach has been studied, Jobs in proportion to teleworking had not been analyzed and published in the systematic and scientific characteristics.

Therefore, in this study, effective criteria in the selection of suitable jobs for teleworking, were obtained based on observations and sources mentioned above and then approved by experts in scientific method.

Next, the derived criteria weighted by using the experts’ panel and in the final phase software were produced based on the extracted information in previous phases.

Also, due to the archiving feature of scores obtained in the different jobs, the organization will also have the ability of jobs prioritization to provide suitable infrastructure for teleworking.
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