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Reliability based budgeting with the case study of TV broadcast

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Abstract

Planning budget will help to identify wasteful expenditures, adapt financial situation changes quickly, and achieve financial goals. The reliability based budgeting has a great importance for broadcasting industry. In this study, several kinds of failure modes in TV broadcasting system have been detected based on recorded data. The risk priority number is used, for prioritizing the risks that are related to the reliability.
We presented a multi-criteria decision making by analytic hierarchy process that has been used for prioritizing the proposed improvement options subject to budget requirement. The results indicate that human factor has more importance in the reliability of the system of TV broadcast that can be improved by education.
Keywords: Failure Modes and Effects Analysis, Analytic Hierarchy Process, Risk Priority Number, reliability, TV broadcasting system

1- Introduction

Providing technical services with high quality and standards in the field of broadcasting with respect to the customers and media audiences, to maintain and improve market share are inevitable. Technical infrastructure broadcast television networks in compared with industrial plants seem as equipment and factory production line that is necessary for stable and continuous production of high quality product is a special feature. Reducing errors and non-errors in the field of broadcasting systems is very important. Research over the last years conducted by researchers showed that there was no clear roadmap regarding the reliability of TV broadcast systems. In this paper we present an integrated analytic hierarchy process-linear programming (AHP-LP) model in order to Reliability based budgeting for TV broadcast systems.

The analytic hierarchy process (AHP) methodology, which was developed by Thomas Saaty (Saaty T. , 1980), is a powerful tool in solving complex decision problems. The AHP supports the analysts to organize the critical forms of a problem into a hierarchical structure same as a family tree. By reducing complex decisions to a series of simple comparisons and rankings, and then combining the results, the AHP not only helps the analysts to arrive at the best decision, but also provides a clear rationale for the choices made(Chin & Tummalo, 1999), (Zaim, Turkyilmaz, Acar, & Demirel, 2012).

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In the AHP, the decision problem is structured hierarchically at different levels with each level consisting of a limit number of decision elements. The upper level of the hierarchy represents the overall goal, while the lower level includes all the possible alternatives. One or more intermediate level embodies the decision criteria and sub-criteria (Partovi, 1994).

AHP applications have been widely grown in past two decades. The trend of AHP related researches is presented in figure 1. AHP applications categorized by (Vaidya & Kumar, 2006), in seven themes consist of selection, evaluation, benefit–cost analysis, allocations, planning and development, priority and ranking, and decision-making. Also, the areas of AHP applications are demonstrated in figure 2.

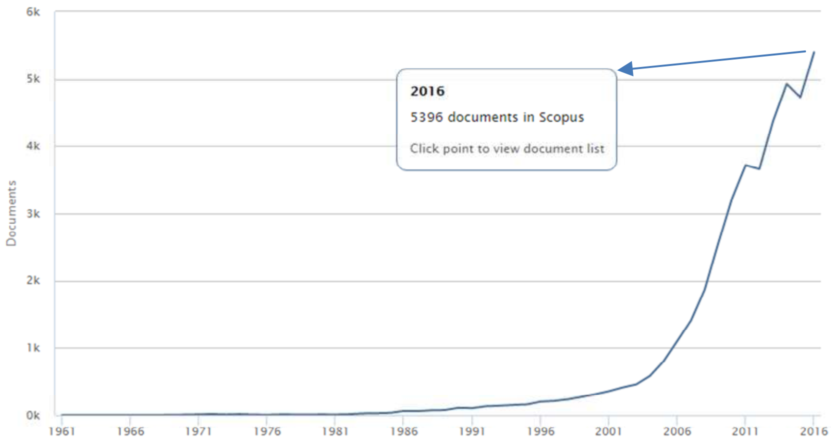

Figure 1. Trend of AHP related researches according to (Scopuse, 2017)

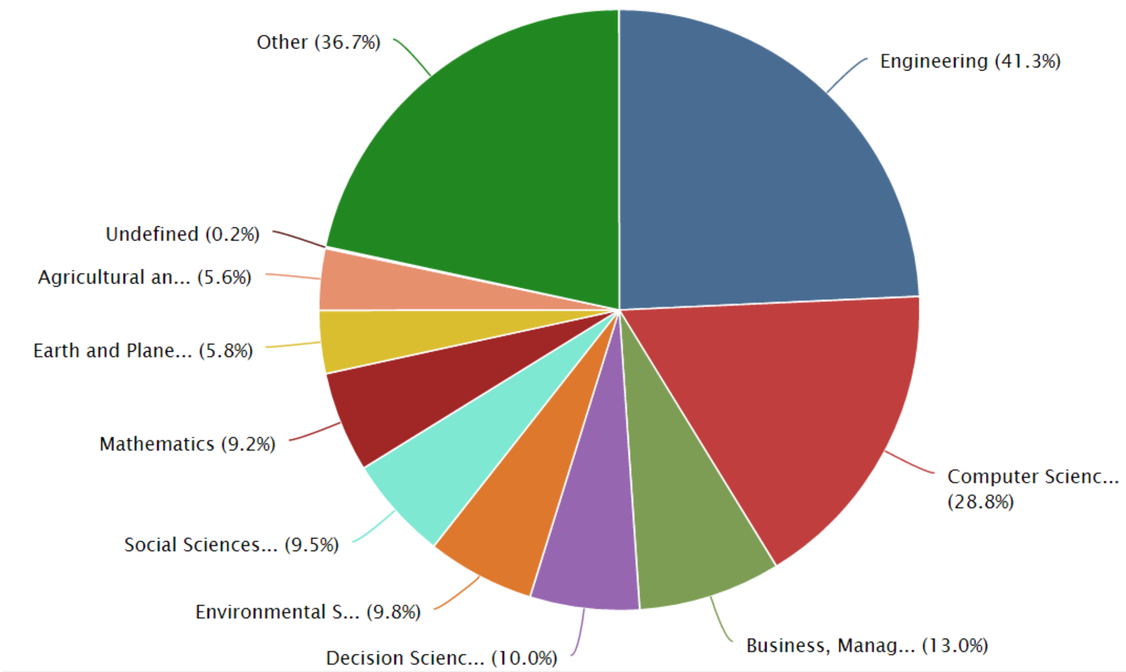

Figure 2. The areas of AHP applications according to (Scopuse, 2017)

Despite the widely application of AHP, only in a few cases, AHP capabilities are considered in budgeting problems. For example capital budgeting in hospital management using the analytic hierarchy process is studied by (Murat & Shahriar, 1991). An Integrating Analytic Hierarchy Process (AHP) into the budgeting models of public sector organizations is also presented by (Robert & Thomas, 1994).A capital budgeting problem for preventing workplace mobbing by using analytic hierarchy process and fuzzy 0–1 bi-dimensional knapsack model is presented by(Esra, 2011).None of these researches are not reliability related to budgeting problem.

Safety risk assessment considered by (Aminbakhsh, Gunduz, & Sonmez, 2013), using analytic hierarchy process (AHP) during planning and budgeting of construction projects. There are some other researches with low relation to budgeting problem. But according to our knowledge, despite the great interest on the area of TV broadcast systems, no study has been reported related to budgeting problems of these systems. Figure 3 demonstrates a visualization project that reveals the shape of science (s) in the area of TV broadcast systems.

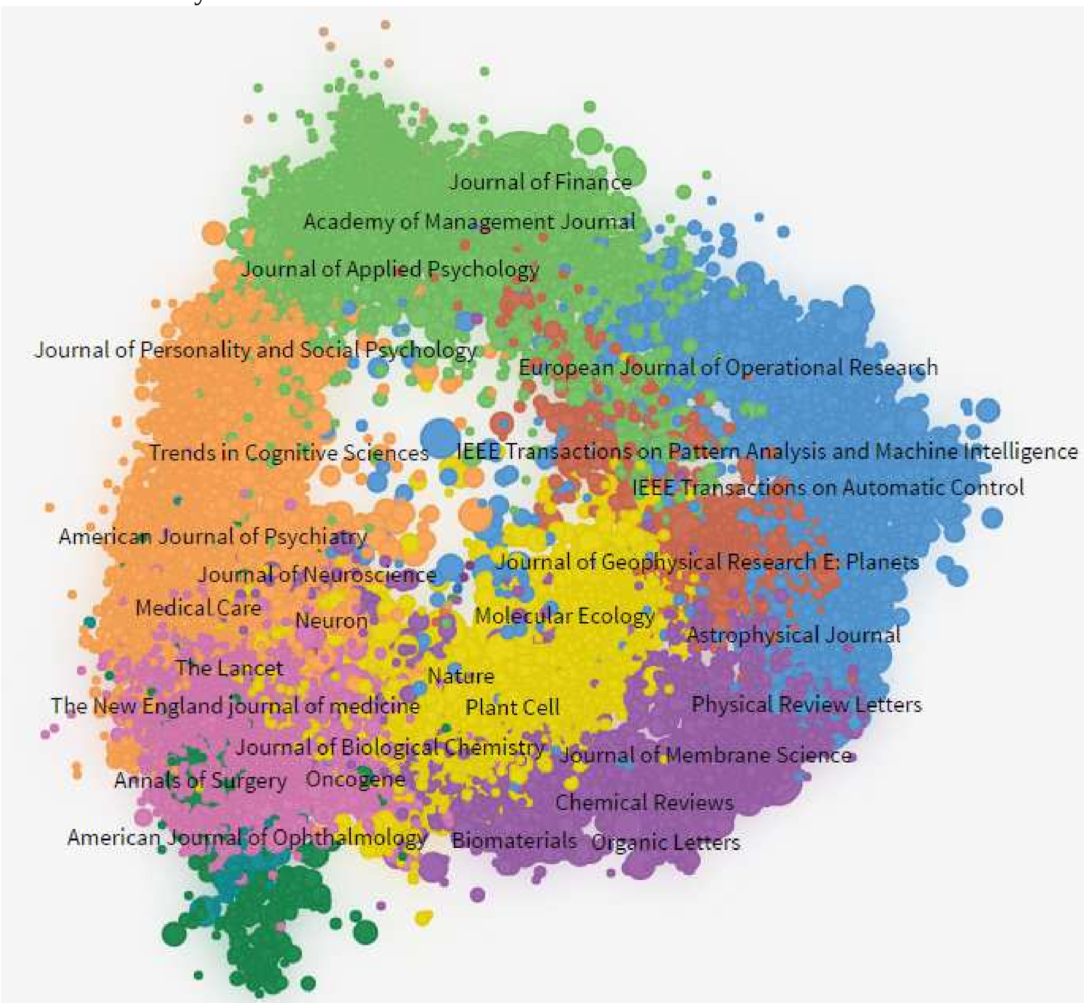

Figure 3. The shape of sciences in the area of TV broadcast systems according to (scimago, 2017)

The Shape of Sciences shows an intuitive image of the interconnection between different areas by the position of journals. In this research we present an integrated analytic hierarchy process-linear programming model in order to Reliability based budgeting for TV broadcast systems.

2- The AHP process for broadcast systems

AHP usually contains three steps. The first is to make the problem into a hierarchical framework with successive levels of perspectives, criteria, sub criteria and alternatives. The items of choice are placed at the bottom level. Such structuring requires some experience with AHP techniques, but the following guidelines are helpful:

- Start structuring from top to down. First specify an overall goal, then perspectives, criteria, sub-criteria and the alternatives that have an impact on the goal or will help to achieve that goal. Here, we use the terms in the public sense (Hajshirmohammadi & Wedley, 2004).

Include no more than nine items under each node of the hierarchy. If more than nine items are needed, consider further decompositions into levels such as criteria and sub-criteria below those main criteria.

Seek economy. Include all related factors but no more than the relevant factors. Too many nodes in the hierarchy cause the analysis to be boring. Once the hierarchy has been structured, the second step is to establish ratio priorities for each node of the hierarchy. This is done through paired comparisons of the child items below a parent node. The comparisons are done with regard to the importance or portion of the item to the parent node. Hence, this comparison analysis is generally conducted from bottom to top. Once sufficient comparisons have been made for a node, the principal eigenvector of the comparison matrix is standardized so that it sums is equal to one, becomes the ratio measure of the relative importance of each item. Since these preferences reflect the relative importance of the items that are just below a parent node, they are called local weights.

AHP’s final step is to sum the local weights into a composite priority that measures the impact of all factors. This is done via the rule of hierarchic composition that first multiplies local weights by the product of all higher-level priorities joining the aim node to the top-most node. Within the hierarchy, this process converts the local weights into global weights that measure the importance of each node in the total hierarchy. These global weights are then summed for a specific alternative to yield a compound priority that measures the joint impact of all criteria and outlooks. The alternative with the highest composite weight is selected (Saaty & Alexander, 1989).

In this study to evaluate the criteria's functions, functional failures, failure mode and effects of the failure of the broadcasting industry will be evaluated. As mentioned, each physical as set has several different functions. If the purpose of maintenance is ensuring the ability to perform functions by the equipment, then all of these functions should be compared with the desired performance standards. Various functions of the broadcast can be divided as follow:

-Live broadcast from the studio
- Live from an external place (incoming live program from outdoor)
- Broadcasting the recorded programs

These include the main functions of broadcast. Performing each of these above functions will occur with a wide array of equipment and human factors.

Failed equipment cannot perform what users want to do. As the equipment may do several functions, and each of these functions may fail, it can be concluded that each of equipments may damage from various types of failure. The border between satisfactory performance and failure will be determined by the performance standard. Functional failure or inability of equipment to do on standard performance according to the laws and technical regulations, are divided in the following titles:

- Audio and video disconnection
- Video disconnection
- Audio disconnection
- Lack of video quality
- Lack of audio quality
- Delay in starting the program

As previously was mentioned, any incident which results in a functional failure is called a failure mode. In this study, the failure modes are divided based on the functional failures as follows:

- Problem on files and recorded disks
- Lack on technical equipment (including video mixer, audio mixer, and play out server, video disk recorder, interface equipments, and character generator)
- Lack of production equipments (including microphones, production studio, TV OB van)
- Lack of live land and satellite communication lines

- Problems in technical and production human operation

So define the effects of a failure, describes the events of a failure mode when an event occurs. When we describe the effects of a failure, the following must be recorded:

- What evidence is in the event of failure
- How are the safety and environment threat
- How are the production or operations may be affected
- What are the physical damage caused by failure
- What should be done to repair failure (Moubray, 1389)

Based on the above mentioned issues and the various functional failures performance and to obtain the expert opinion, the main failure modes of television broadcasting system are summarized in table 1 as follow:

Table 1. Main failure modes

Failure mode		
Human Factors	**General factors**	**Partial factors**
	Technical operator	Technician
		Engineers
	Production operator	Production operator
Technical equipment	Broadcast equipment	Video mixer
		Audio mixer
		Video disk rec.
		Play out server
		CG
		Broadcast interface equipment
		Main control room equipment
	Product equipment	Product studio
		microphone
		OB Van
	Live communication line	Terrestrial communication line
		Satellite communication line
Disk & files	PD	PD
	file	File

3- Case study

There are several methods to optimize the row-parallel systems, with the aim of maximizing the reliability within the confines of factors such as budget, space and so on. By adding to the number of components in parallel, will increase system reliability, but due to limitations of the system, the number of components in a system of parallel, which can be approved, will be limited. Factors such as approved budget to purchase the system, the cost to build the system, the maximum size or weight of parallel systems, all factors that the number of components (spare) will be limited within the system (Hajshirmohammadi, 1383).

The method of getting a machine in the system or parts of machine structure effects on systems reliability. Thus, when we study the arrangement of the machines in a system, we must keep in mind two things:

- Internal dependence on the car in the group
- The physical structure of a machine alone (Saliminamin, 1370).

Assess the current state of the broadcasting system, cycle and process of audio and video signals transfer in a TV channel leads to determinate serial and parallel routes, original and spare equipment were established that the system in the form of an image on the system configuration is shown in figure 4.

In the current system, some equipment's, such as camera, video player, and TBS, at least have one reserve system. Also besides video mixer, has an emergency video switcher to avoid cutting video.

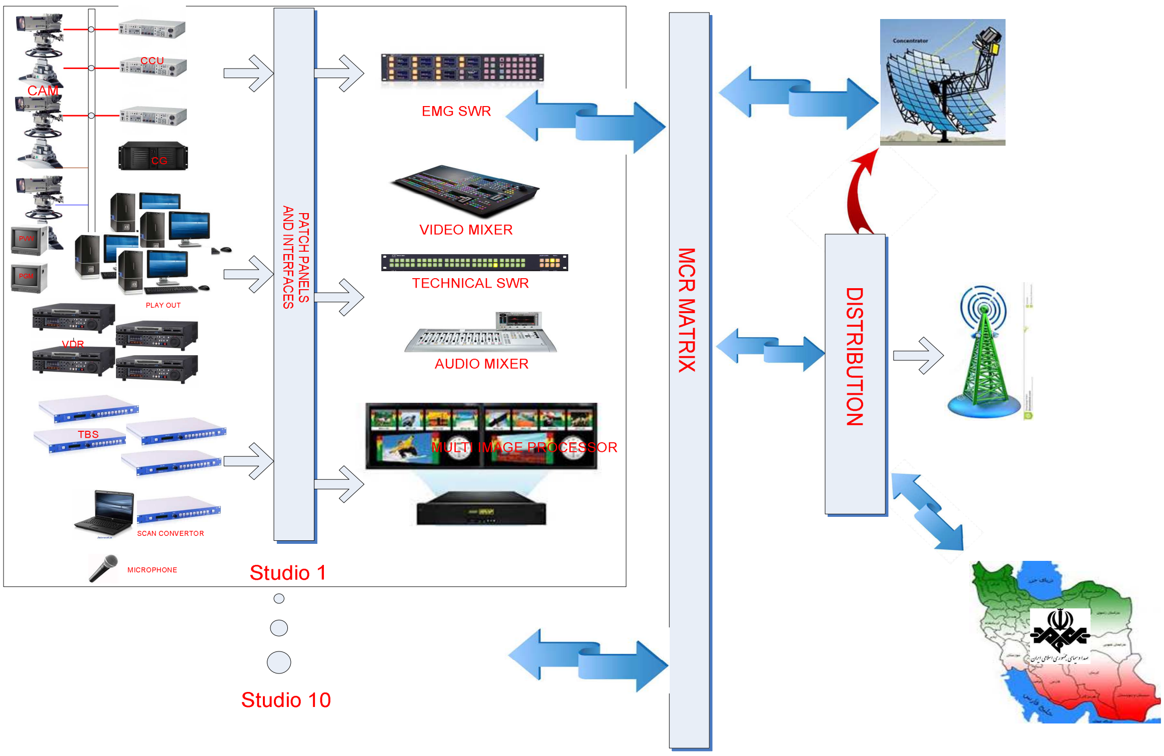

Figure 4. Configuration of TV broadcast

According to table 1, examining the technical errors reports daily broadcast in a 5 years period, examining the system configuration in figure1, the opinion of experts, 10 strategies and improved options to remove or reduce failure on broadcast function are recommended as follows:

Options to optimize the reliability and stability of the TV broadcast system:

1- Training the production and technical personnel of broadcast
2- Improving the quality of files and fixing the bugs related to tape and record by applying technical quality control station
3- Procurement and installation of reserve audio switcher
4- Preparation and use of two microphones for each host or guest in a live program
5- Replacement of interfaces and connectors equipment
6- Replacement of broadcast video mixer
7- Reducing the broadcast of unnecessary live programs and paying more attention to the broadcast of produced programs
8- Using synchronized playback of two servers, in a simultaneous and reserve manner and also application of some software modifications with regard to the required technical infrastructure
9- Replacement of character generator computer system
10- Continuous control over the way of the function of technical personnel of broadcast

Due to financial, time, space and etc constraints, run of all options simultaneously, or in a period without determining priorities of each option, will not be appropriate and possible in some conditions. Due to the limitations of RPN method, use of this method and its arising results in setting priorities of improvement options, is not free from defect. In this study, action will be taken with the use of multiple attribute decision making models.

In this issue, the purpose of prioritization of improvement of broadcast function options, in order to optimize the reliability and stability of the broadcast system, is based on the main criteria of RPN method, means the severity of damage, the possibility of occurrence and the detection of failure.

Sub-criteria associated with the main criteria have been determined by soliciting the opinion of experts, for main criteria of the severity of damage titles: the cost of damage, time and dissatisfaction of contact, social consequences (security, political) and dissatisfaction of the producer of program.

Subjective weighting is still the most common method of weighting and AHP method, due to being relatively easier, more flexible and having less need to cognitive skills, is more prevalent (Liu, Liu, & Liu, 2013).

Through AHP, the importance of several attributes is obtained from a process of paired comparison, in which the relevance of the attributes is matched two-on-two in a hierarchic structure (Vaidya & Kumar, 2006). However, the pure AHP model has some shortcomings (Yang & Chen, 2004). The AHP method creates and deals with a very unbalanced scale of judgment. The subjective judgment by perception, evaluation, improvement and selection based on preference of decision-makers have great influence on the AHP results (Sun, 2010).

Thomas Saaty presents the Analytic Network Process (ANP) a more recent extension of AHP (Saaty, 1996). AHP is a theory of measurement that uses pairwise comparisons along with expert judgments to deal with the measurement of qualitative or intangible criteria. The ANP is a general theory of relative measurement used to derive composite priority ratio scales from individual ratio scales that represents relative measurements of the influence of elements that interact with respect to control criteria. The ANP captures the outcome of dependence and feedback within and between clusters of elements. Therefore AHP with its dependence assumptions on clusters and elements is a special case of the ANP. The standard mode for synthesizing in the ANP where criteria depend on alternatives and also alternatives may depend on other alternatives is the distributive mode.

The AHP is a special case of the Analytic Network Process. The dominant mode of synthesis in the ANP with all its interdependencies is the distributive mode. The ANP automatically assigns the criteria the correct weights, if one only uses the normalized values of the alternatives under each criterion and also the normalized values for each alternative under all the criteria without any special attention to weighting the criteria. Figure 5 demonstrates that how a hierarchy compares to a network.

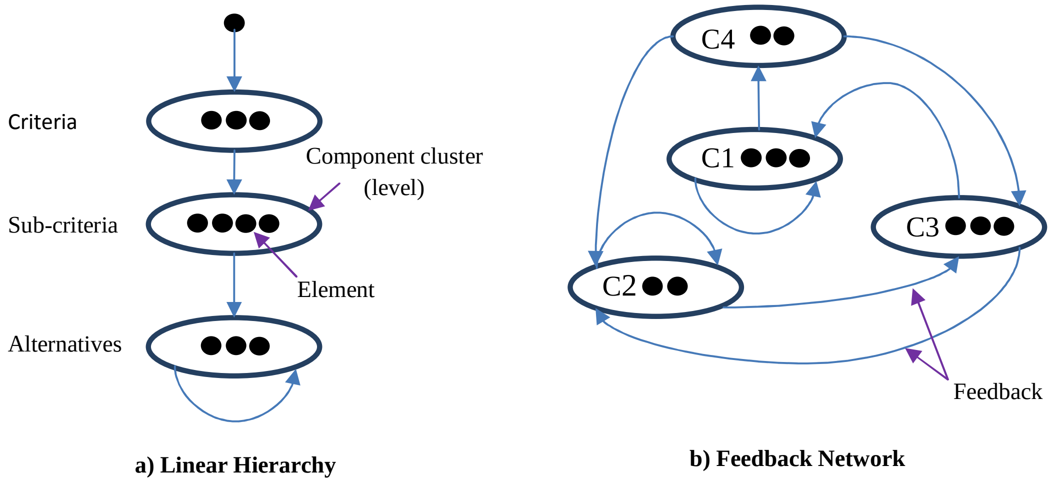

Figure 5. How a hierarchy compares to a network

The dominant mode of synthesis in the AHP, where the criteria are independent from the alternatives is the ideal mode. By the experts opinions and according to statistical analyses in this issue, since the elements of each level is only dependent from the elements of higher levels, the importance coefficient of each level is determined according to the higher level of the Analytic Hierarchy Process, and ANP technique does not need. Hierarchical structure tree of this issue is according to the figure 6.

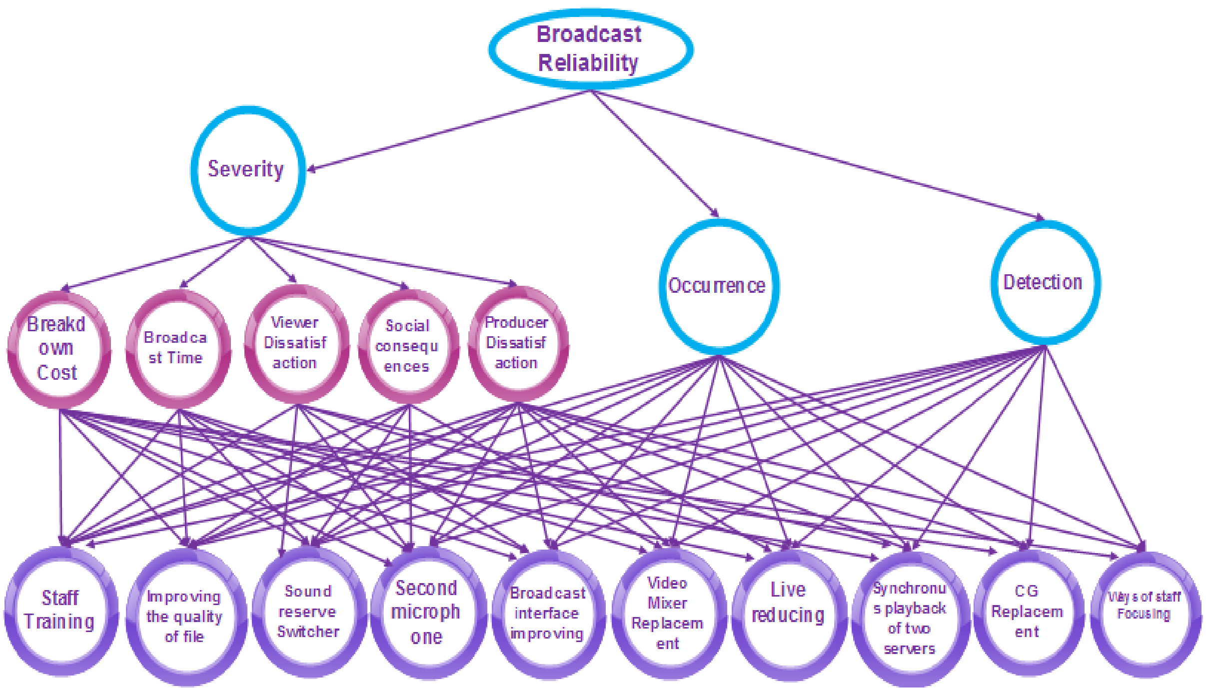

Figure 6. Hierarchical structure tree

With taking the advantages of the experts opinion, using the report of technical problems and damages statistics of the system of the past five years, the appropriate action takes concerning the completion of pairwise comparison matrix of main criteria relative to the objective, pairwise comparison matrix of sub-criteria of damage severity to it, pairwise comparison matrix of improvement options relative to the cost of damage, time, dissatisfaction of the contacts, social consequences and dissatisfaction of the producer and Pairwise comparison matrix of improvement options relative to the possibility of occurrence and ability of recognition. Finally, by calculating the above values, the final weight for each of the proposed options is determined.

4- Prioritization of improvement options with the AHP method

At first, we form the pairwise comparison matrix of three main criteria of this issue, i.e. the severity of damage, the possibility of occurrence and the detection of failure, relative to the target, i.e. increasing the reliability and stability of broadcast system. By taking the advantage of experts opinion and numerical values of Likert scale (from number 1 with the same preference, to number 9 quite preferable), the numerical values of each of them will be determined and the relevant matrix will be completed according to the table 2.

Table 2. Pairwise comparison matrix of main criteria relative to the target

	Severity	**occurrence**	**Detection**
Severity	1	7	8
Occurrence	0.1428	1	6
Detection	0.125	0.1666	1

Subsequently, in addition to examining and comparing the 10 proposed options and solutions, and acquisition of expert's opinion, the required actions will be examined with sub-criteria (means: the cost of damage, time, contacts dissatisfaction, social consequences, dissatisfaction of the program producer) as well as the main criteria of the possibility of occurrence and the ability of recognition and formation of pairwise comparison matrix.

The numbers arising from the experts opinion in evaluation of pairwise comparison of options with each other, relative to the different sub-criteria, are converting to numerical values without scale and then the average values in each row is determined and finally the results of the AHP calculations are shown in following relations:

By multiplying of 10*5 matrix resulted from the pairwise comparison of options relative to the sub-criteria with 5*1 matrix related to the pairwise comparison of the sub-criteria relative to the criteria of damage severity, the 10*1 matrix is resulted, which is related to the priority of improvement options relative to the criteria of damage costs:

$$\begin{bmatrix} 0/138 & 0/179 & 0/126 & 0/179 & 0/0667 \\ 0/1154 & 0/063 & 0/186 & 0/063 & 0/178 \\ 0/0647 & 0/063 & 0/0698 & 0/063 & 0/062 \\ 0/02 & 0/063 & 0/0442 & 0/063 & 0/062 \\ 0/1427 & 0/063 & 0/146 & 0/063 & 0/062 \\ 0/17 & 0/063 & 0/0794 & 0/063 & 0/062 \\ 0/0594 & 0/063 & 0/011 & 0/063 & 0/062 \\ 0/039 & 0/063 & 0/051 & 0/063 & 0/062 \\ 0/04 & 0/063 & 0/031 & 0/063 & 0/062 \\ 0/021 & 0/32 & 0/255 & 0/319 & 0/318 \end{bmatrix} \times \begin{bmatrix} 0/0293 \\ 0/0998 \\ 0/2781 \\ 0/5345 \\ 0/0583 \end{bmatrix} = \begin{bmatrix} 0/15651 \\ 0/10545 \\ 0/06488 \\ 0/05645 \\ 0/08836 \\ 0/07064 \\ 0/04837 \\ 0/05890 \\ 0/05337 \\ 0/27583 \end{bmatrix}$$

In following, a matrix with the dimension of 10*3 is formed. In this matrix, the first column values are related to above 10*1 matrix, and two other columns are related to the prioritizing of the options relative to the possibility of occurrence attribute and the detection of failure. Then the matrix is multiplied into the 3*1 matrix resulted from the pairwise comparison of three main criteria:

$$\begin{bmatrix} 0/15651 & 0/101 & 0/29 \\ 0/10545 & 0/106 & 0/098 \\ 0/06488 & 0/032 & 0/04 \\ 0/05645 & 0/073 & 0/041 \\ 0/08836 & 0/185 & 0/042 \\ 0/07064 & 0/024 & 0/039 \\ 0/04837 & 0/091 & 0/105 \\ 0/05890 & 0/055 & 0/041 \\ 0/05337 & 0/019 & 0/317 \\ 0/27583 & 0/312 & 0/272 \end{bmatrix} \times \begin{bmatrix} 0/7264 \\ 0/2117 \\ 0/0619 \end{bmatrix} = \begin{bmatrix} 0/153022 \\ 0/105105 \\ 0/056379 \\ 0/058997 \\ 0/105949 \\ 0/058808 \\ 0/0609 \\ 0/056966 \\ 0/062413 \\ 0/28325 \end{bmatrix}$$

According to the above calculations, Table 3, indicates the values related to the calculations of final weight of improvement options:

Table3. Final weight of improvement options

Final weight	**X_i**	**Improvement option**
0/153022	x_1	Training of staff
0/105105	x_2	Improvement the quality of files
0/056379	x_3	Installation of audio reserve switcher
0/058997	x_4	The use of two microphones
0/105949	x_5	Broadcast interface improvement
0/058808	x_6	Replacement of video mixer
0/0609	x_7	The reduction of live programs
0/056966	x_8	Synchronous playback of two servers
0/062413	x_9	Replacement of CG
0/28325	x_{10}	Making infrastructure for the focus of human resources

Then, in order to reach a mathematical decision-making model, due to the large scope of technical set and available credit limits, the amount of budget that could be allocated to examined channel for the purpose of increasing the stability of the broadcast system, is determined among the total budget of the collection and by selecting the assumed value for the total allocable budget, with the method of AHP.

5-Calculatation of allocation of budget between channels

In this study, 10 channels with a variety of different devices and programs are intended; the condition for each of them in a specific function in terms of channel (national or local, inland or extraterritorial), information type of content, the audience and the sensitivity of organizational has been defined.
To determine the priority in the allocation of budget in different channels, with the opinion of experts, three criteria such as current situation, organizational sensitivity and audience opinion were determined as the main criteria of problem solving.

The current situation represents the current state of broadcast equipment in the mentioned channel and organizational sensitivity represents the importance of the channel among other channels in terms of the criteria and priorities of the application area. The purpose of audience's interest is the attention of the audience to view programs and priorities of customer's choice in face of this channels collection.
In this problem, the aim of decision is to find budget allocation priority, among 10 TV channels based on the three criteria above. With the opinions of experts and quantify the index values, the pair-wise comparison matrix of criteria compared to target of decision making with an average row is ready in table4.

Table 4. Pairwise comparison matrix of criteria relative to the purpose

	present situation	organizational sensitivity	audience comment	average row
Present situation	1	0/143	0/333	**0/083**
Organizational sensitivity	7	1	5	**0/723**
Audiences comment	3	0/2	1	**0/193**
Summation	11	1/343	6/333	

Then, the pairwise comparison matrix of 10 channels relative to the criteria of present situation of equipment, the organizational sensitivity and the audiences opinion, by taking advantage of the experts opinion, after quantifying the values and together with the average of rows for each of them, the obtained results are as follows:
By multiplying of 10*3 matrix ,related to the weight of options(the 10 channels to be examined) relative to the criteria, in the 3*1 matrix, related to the weight of the main criteria relative to the target or purpose, the following 10*1 matrix is resulted:

$$\begin{bmatrix} 0/055144 & 0/320137 & 0/221258 \\ 0/06399 & 0/083124 & 0/133202 \\ 0/209257 & 0/210207 & 0/229867 \\ 0/33569 & 0/023676 & 0/024198 \\ 0/152258 & 0/062255 & 0/156535 \\ 0/038807 & 0/012938 & 0/054742 \\ 0/067923 & 0/035053 & 0/028899 \\ 0/08486 & 0/017199 & 0/045412 \\ 0/180755 & 0/096052 & 0/055758 \\ 0/113428 & 0/13936 & 0/05013 \end{bmatrix} \times \begin{bmatrix} 0/083 \\ 0/723 \\ 0/193 \end{bmatrix} = \begin{bmatrix} 0/278739 \\ 0/91119 \\ 0/213712 \\ 0/024574 \\ 0/87859 \\ 0/02314 \\ 0/036558 \\ 0/028243 \\ 0/09521 \\ 0/119847 \end{bmatrix}$$

Based on the above calculation, the weight ratio of the allocable budget to the mentioned 10 channels which are examined by the AHP method will be in the form of table5.

Table 5. The final weight (coefficient) of allocable budget to each channel

channel	Ratio of allocated budget
A	**0/2787**
B	**0/0911**
C	**0/2137**
D	**0/0246**
E	**0/0878**
F	**0/0231**
G	**0/0366**
H	**0/0282**
I	**0/0952**
J	**0/1198**

As was mentioned in the previous section, assuming that the total allocable budget for maintenance of programs and repair repairing ten under examining channels would be 5 billion Rial. The allocable budget to the selected channel A, by using the above AHP method of decision-making, will be as following: B = 5,000,000,000×0/2787= 1,393,500,000 Rial.

6- Problem solving

After determining the budgetary constraints of the problem, in this section we use Lingo software to solve the decision making model as below:

$$Max\ Z = 0.153022\ X_1 + 0.105105\ X_2 + 0.056379\ X_3 + 0.58997\ X_4 + 0.105949\ X_5 + 0.058808\ X_6 + 0.06609\ X_7 + 0.056966\ X_8 + 0.062413\ X_9 + 0.28325\ X_{10};$$

$s.t.$

$$4500000\ X_1 + 1365000000\ X_2 + 150000000 X_3 + 120000000\ X_4 + 500000000\ X_5 + 6000000000\ X_6 + 15500000\ X_7 + 20000000\ X_8 + 500000000 X_9 + 200000000\ X_{10} \leq 1393500000$$

$X_1, X_2, X_3, X_4, X_5, X_6, X_8, X_9, X_{10} = \{0,1\}$

$0 \leq X_7 \leq 50,$

Excluding X_7 with the variation between [0, 50], other variables are {0,1}. For example $X_3 = 1$ means that audio reserve switcher should be installed with the cost of 150000000 and accordingly $X_3 = 0$ means that audio reserve switcher is not a priority and its assigned budget is 0. Other variables are similar to X_3, for example X_1 demonstrate staff training project with an estimated specific budget.

Due to the anticipated time needed to implement any of the options and the possibility of performing simultaneously, the time limit specified above, in the later stages of problem solving can be neglected. So the problem in terms of above objective function, budgetary constraints and condition of decision variables is modeled by using language programming in Lingo software. After defining the model in software, we solve the problem by applying software. According to solution model, a window with details of model solving, such as the number of steps to reach the optimal solution, value of variable and function optimization, cost reduction and etc, is presented in figure7.

```
Global optimal solution found.
Objective value:                              4.184587
Objective bound:                              4.184587
Infeasibilities:                              0.000000
Extended solver steps:                               0
Total solver iterations:                             0


                     Variable           Value        Reduced Cost
                           X1        1.000000          -0.1530220
                           X2        0.000000          -0.1051050
                           X3        1.000000          -0.5637900E-01
                           X4        1.000000          -0.5899700
                           X5        0.000000          -0.1059490
                           X6        0.000000          -0.5880800E-01
                           X7        50.00000          -0.6090000E-01
                           X8        1.000000          -0.5696600E-01
                           X9        0.000000          -0.6241300E-01
                          X10        1.000000          -0.2832500

                          Row    Slack or Surplus      Dual Price
                            1        4.184587            1.000000
                            2       0.1240000E+09        0.000000
                            3        0.000000            0.000000
```

Figure7. model reporting solution

In figure7 it can be seen that the optimal solution of Lingo software is global type and the value of the objective function is 4.184587

Then the variable of value in the optimal solution, which includes the decuple improve options are listed. The value of 2,5,6 and 9 variables, are zero, which indicates that the corresponding options, including measures related to improve the quality of the files, the interfaces of equipment, video mixer replacement and change the CG system, according to limitations of the problem has run out. The corresponding value of other variables (options 1, 3, 4, 8 and 10) are one, and the seventh variable about the number of changing the programs from live to production is also listed 50. This represents the priority of change the total fifty programs from live to production.

7- Results and innovation

One of the important results of this study is the role of human factors in the stability and reliability of the system. Despite the complexity and diversity of the systems in this field, the role of human factors in different parts of this system, including control activities, switches, broadcast video resources and technical evaluation of content, is more effective than weakness in the systems.

In the previous studies, increasing system reliability is generally related to the field of production, while in this study, improving the reliability and stability is about a service collection. Presenting a TV programs include some actions and facilities such as content, video, audio, timing, subtitling, logo, and etc, is different with good producing.

8- Conclusions and suggestions for future work

In the current paper we focus on the reliability improvement of a TV channel subject to budget limitation. If we expand the area of the study, it is possible to determine the improvement solution for reliability of TV center. Moreover, according to the role of human factors in the stability and reliability of the system, by studying the time human factor causes problems in daily bug reports of broadcast, and with statistical analysis, more practical strategies to reduce the forms can be presented.

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