

## Presenting a Model for Giving Weight to Activities of Projects (Case Study: Homa CO.)

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### ABSTRACT

Over time, consistently one of the concerns of project managers has been quantitative evaluation of project activities and progress. The reason for this is the lack of tools and management in decisions based on measurable data. If there is no tool for measurement there is no possibility of control and in the absence of control, effective management is out of reach. Also the managers in order to motivate project members needed a way to determine the role of each of them in doing things. One of the assessment activities and assessing projects is allocating weights to the various activities of the project. By assigning weight to the activities percent of progress and contribution rate of each project and project members can be determine and could compare the activities provided with one another. This paper by presenting a model and identifying indicators to determine the weight of each activity; is trying to make the above goals. In this model, the AHP technique (AHP) is used, for this purpose indicators that each has a different value, weight or importance than others have been selected, the relative importance of each of these indices were determined and finally relative weight of activities must be determined based on the indices weight.

**KEYWORDS:** Weight, Activities, Homa Project, Index.

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### 1. INTRODUCTION

Since the formation of human civilization, the projects were part of human life. However, project management is almost a new concept and has passed only its rise for a few decades in the management literature. Perhaps the most important reason for paying attention to projects management is involving the "resource management" and especially their precious means "human resources".

Today, every business depends on timely actions and in the form of prescribed budget. In addition, the competition is intensified. If the Contract fails to timely perform its obligations or at the right time didn't reach to the desired goals, there is no doubt that dozens of other contractors are announced their willing to intervene immediately and fill his place. The definition of management is "to achieve desired results through people". Now if we know the project management as "achievement to project goals using available resources", we provided a short but meaningful definition of project management. Meaning of source is also money, materials, equipment, human force information. Over time, consistently one of the concerns of project managers has been quantitative evaluation of project and progress activities.

One of the methods of activities assessment and projects assessing, is assigning weight to various activities, including projects that has always been that complex issues that project stakeholders including employers, project manager, project team members and others are facing.

In the next sections, first generalities about the weight assigned to the activities have been presented and purpose of the blower and blower indicators presented and then some explanations about the methods of weight assignment to the project activities based on different criteria are given.

### 2. Weight Assignment to the Activities

Basically make systematic practice in evaluating projects and evaluate progress in its activities, particularly in project centered organizations are undeniable necessary. In this paper, to determine the weight of each activity is trying to reach to the above objectives. Certainly establishing such a system could have helped to project planning, increased customer satisfaction, accelerated the process of allocating resources to the project activities and make the decision process more systematic. Hence, presenting such a model in various organizations especially project centered organizations can be very useful.

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### 3. Goals of Giving Weight to Activities

One of the objectives to assign the weight to activities is determining project progress percent. In the employer and contractor sight this issue is one of the most important causes of weight assignment to activities. Contractor usually to show that the project has been successful, trying to determine the weights whether in each phase, progress is seen as his desirable one. On the other hand client wants that giving weight to activities have been in a way that the percentage of project progress were so close to reality as possible. As is clear by assigning weights to the various activities of a project calculation of the percentage of projects and under development projects progress, has been more logical and thus the possibility of achieving real project progress comes provide. Surely this is the most important reason to conduct further work in such projects. Nevertheless, giving weight to activities also facilitates the possibility of giving back the work for employer.

One of the goals of giving weight to activities is determining the contribution of each project member; now this individual can be a member of those projects or units are involved in the project. In other words, other reason to give weight to activities is obtaining an indicator for assessing the effectiveness of each individual or each part of the organization that is involved in the project and determining payment charged to them for implementation of the project activities, Mean that the weights is considered as inputs in the payment system in the project. Especially if the organization is project center, the whole or part of the project to be done by internal organization forces, then the weight assigned to project various activities will be more important in this case because the weights Will considered as an index to measure efforts and effectiveness for each section of organization.

Another goal for the weight assigned to different activities is to make a project possible to compare together pairs of these activities .Since the project includes a variety of activities that even possible to have some fundamental differences with each other, having a criterion that makes possible comparing these activities with each other, would be highly desirable.

### 4. Identifying Indicators to Give Weight to Activities

Total views of weight assigned to the various project activities, should be comprehensive. Giving weight indices in various projects are often different and it is the nature of the project that will determine how to allocate weights. The software to allocate different weight to the project activities, use different indicators. For example, in MSP software the weight of each activity and consequently the percentage of project progress, often reached based on duration of project activities.

Therefore, various indices can be proposed to assign weights for activities of a project. For example, cost of doing work is important in a project and the employer intend to confirm the contractor conditions based on the percentage of projects progresses scheduled to come from software. In such circumstances the giving weight index is cost. In other circumstances, other indicators can be used for giving weight .What is certain, is that each of these indicators, will bring their advantages and disadvantages. However, there are several indicators that used more common than other indices in the projects. To identify indicators not only refer to the literature of management and project control, but also the rating of the experts is used. Therefore, due to importance we provide a short description about these indices.

#### 4.1. Activity Cost

Common index in weights assigned to various project activities, is cost of the activity. The advantage of this index is that the percentage of progress achieved, are in accordance with the position and issues of contract cost among employers and employees. On the other hand, disadvantage of this method is that in some cases using this index alone couldn't estimate correct project progress. For example, in a project that has the purchase of foreign equipment in high prices by issuing purchase orders and contracts, the percentage of project progress as irrational increases, while actually there has not been done any development in projects and only the relevant contracts were signed. This example suggests that the other indicators should also take into account the activity costs.

#### 4.2. Time of Doing Activity

Due to the simple usage, use of this index has a high credibility. It seems like most cases, if the timing of various activities is prepared based on standards, using standard index of activity time would be suitable for giving weight to activities. Although in some cases using this index alone may be following errors. For example, suppose duration of carries a foreign equip-timing is equal to three months and other manufacturing activities, which is in the same important amount, takes about 1/5 month, so should take help from other criteria. It is worth mentioning here that the meaning of time, is person-hours required to do the job. However, it should be noted that constantly increasing numbers or hours of operation to perform an activity quicker is not ever possible. For example, may be the time required to perform the work is done in 100 person-hours, but at least 50 days for those activities is required. This is because the maximum time it used to do this is two hours per day. Thus, the index for time, considering the amount of people-time and time is needed for work.

#### 4.3. Realizing the Need of Doing Activities for Project

On the above index should be a lot careful to use. It is evident that to do a project performing all activities of the project is required. But to do a project successfully some activities should be more important than others. This could be due

to high risk in doing the activity or specific features of that activity, etc.. For example, if a project involves doing a specialized activity and also documenting it, in this case probably doing the activity has special importance higher than documenting it and certainly need to realize to achieve of the project is higher.

#### **4.4. The Critical Level of Activity/Floating Activities**

One of the cases in which have effect on the weight assigned to the activity, is the critical level of activity. Critical activity can be considered in aspect of the activity cost, duration and maturity to do the activity, data accuracy needed to perform those activities or other items. In other words the least an activity is floating the most the activity is critical. The point here should be considered is that high costs to do activities or high time of activity is not necessarily means more critically it is, also increasing the critical level of activity increases commitment to do that. In other words, this index actually related to the level of commitment that is necessary to do the job.

#### **4.5. Engineering and Technical Complexity (in the design, construction and other related operations)**

Technical and engineering challenges and complexities of doing activities, including indicators that should be recommended in assigning weight to the project activities. Indeed technically the more difficult and complicated would be any activity certainly the more weight will assigning to it. It is noteworthy that this index with the index 3, means realizing the need for project activities is positively correlated to some extent.

#### **4.6. Resource Requirements for Performing the Activity**

One of the important parameters, is resource level required to perform each activity. Certainly having too much of resources needed to do an activity has higher importance and consequently more weight to that activity is required. However, should note that a significant part of the resources required to perform an activity such as financial resources, time required, technical and engineering expertise, etc. are contained in other indices.

#### **4.7. Nature of Sub Requirements of Activity**

sub requirements of an activity can also be one of the indicators that need to allocate weights to the various project activities. If desired activity, has the bottleneck role or interprets many other outputs, the importance of this index will be higher. It should be noted that this index or index number 4, means the critical level of each activity, has a close relationship. This relationship can be shifted to the dimension of time or cost or other aspects of the desired activity.

#### **4.8. Risk of Activities**

One of the assumptions in doing a project, is that all of its activities will be done fully and by expected quality. This may require doing more than once because the activities expected minimum quality in the primary frequency didn't meet. This is interpreted as activity risk. Therefore, although all project activities will be done with a minimum expected quality but it is possible that due to the specific nature of the activity, due to good performing it requires spend more resources to do more about it or doing some activities about particular parts of it. Despite possibility of such a hypothetical activity risk means an activity done for second time or more or part of that activity to achieve the minimum acceptable quality. This index with indices 3 and 5, are overlapping the necessity of realization of projects activities and for engineering and technical complexities of the desired activity.

#### **4.9. Manageability of Activity**

However, little activity may exist in a project that this item is very important in them, but considering the index in weight assigned to this small number of activities is also important.

#### **4.10. Safety, Security Issues and Ergonomic Factors**

These issues are also effective the in weight allocation to the various activities in projects. Surely activities that had more hard work and were sensitive in term of security and had more restrictions in term of work are more important.

#### **4.11. Experts Opinion**

One of the best practice for giving weight that is suggested is use of project's experts opinion. In this way project's technical experts who have experience, take action to determine the activities importance and weight. If this method has properly guided could show good results. Disadvantage of this method is that usually in this method should use the various experts to determine the weight of activities and therefore biased on how experts thoughts will cause non-uniform weights. For example, the expert who has worked in less strictness will assign the weight of most activities around a specific number, but other experts who has mastered more in some issues and is also strict, will assign weights to activities with more distribution. In addition, individual or group experts may involve their prejudice in allocating weights to activities that this could effect on work progress according to the importance of giving weight to activities, and is weakness of this method.

#### 4.12. Management Comments

Purpose of this index, is considering to factors that may not be included in other indices. Since this index taken based on human (managers) mind to give weight to activities so consider other explored issues ignored by indices. However, should consider carefully the overlap between this index and experts opinion index and other indicators. For example, the cost and time required for performing an activity, realizing the necessity of activity and technical and engineering complexities, etc., that may affect on the management comments and it means consider to these cases more than once that it is necessary to be avoided. Therefore, management comments should be considered free of what is explicitly mentioned as indicators of giving weight to activities.

#### 4.13. Combination weight giving method

In this case, the combination of the above indices or other indices that could be different in different projects, are used for allocating weight to the activities. According to the above description seems that the combination method is superior of other methods due to its comprehensiveness. In fact, the only possible method of assigning weight to various project activities that can be consistently feasible will be combined model. In the next sections will provide further explanations regarding above. Here one of the important issues is reminded that should be considered in selection in different criteria is the overlap of indexes. Therefore it is necessary that in definition of indicators, precision and recall used a lot, so that avoid considering indices again and again. Indicators that were expressed in this section, may be in target projects, have a lot of influence, or should have negligible effect. To determine the importance of each of the above parameters, according to importance they have giving a specific weight to each of them. Also it should be noted that in allocating weight to the various project activities, have assigning weight only to the final level of activities, and a weight assigned to higher levels is reached from total weight of direct lower levels. The intention of the final level of activity is activities that there are no other activities or sub activities for them.

### 5. Using AHP Techniques in This Model

As mentioned in the previous section, one of the allocating weight methods, is combined weight allocating based on different criteria. In this model, the AHP technique (AHP) was proposed by Saati in 1970 is used. For this purpose, several indicators that may value, importance or weight of each of them vary against others have chosen and the relative importance of each of these indicators have determined, and ultimately have determined the relative weight of activities that must be determined based on the indices weight. According to the above description can be concluded that based on the AHP method the weight allocation process to the various activities of a project includes three phases, respectively, the following:

1. Determining the parameters of assigning weight to the various activities.
2. Determining the relative importance of each of these indices and also the relative importance of each of the activities in sight of each index. These steps include below cases: A - Building paired comparisons of criteria matrix B - Building of paired comparisons matrix of each index in terms of activities A - Making non-scale paired comparisons matrices (using AHP techniques) D - Calculating weight of each index and weight of each activity per each indicator E - Calculating rate of incompatibility of matrices.
3. Allocating weights to each activity based on defined criteria.

#### 5.1. First step: determining indicators

The first step is to determine the parameters required for allocating weight. The indicators are vary from a project to another project and from an organization to another organization. Thus, the necessity of defining them in each project seems essential. With the discussions took place before, it seems like the following indices can be sufficient and precision enough to determine the weight of each activity:

1. Cost of activity
2. Activity duration
3. Necessity of realization of activity for projects with regard to risk of activity
4. The level of activity critic in order to consider the nature of sub required of activity
5. Engineering and Technical complications
6. Safety and security issues and ergonomic factors
7. Reviews and managerial expertise

The first two indicators are quantitatively measurable, so in allocating amount to any of these two indicators for each activity, in practice there is no particular problem. The only problem that may be faced is impossibility of accurate estimates of costs or duration of activity that is necessary in such cases to estimate the desired value using different measurement techniques. On the other five indicators, must first define extensive and comprehensive range of different scenarios then express corresponding quality amount to each mode and then according to this range converting a qualitative comparison of activities based on five indicators to quantitative.

It is worth mentioning one of the things that must done more, is making justify people and giving a practical guidance on any of the above indices thus possibility of achieving more accurate results can be provided. This is due to the mentality of people who may be responsible for determining weights and values related to indicators and activities are not logically match on what is assumed in this paper. Therefore in order to justify people to achieve those desirable results making some special decisions is necessary.

Seems that above seven indicators are sufficient to determine the weight of each activity. To determine the above parameters first had tried to provide an acceptable recall and secondly prevent the occurrence of overlapping, Third indicators were selected to have high standardization ability. This is noted the parameters that for determining their values

there is not the required standards, are contained in the expert opinions - management. However, recommended, in case of standardization when the desired parameters had done, the indices had put outside of the field of expert opinions - management.

**5.2. Second Step: Determining the Relative Weight of Each Index and Relative Weight of Activity for Each Indicator**

Since human cannot understand a question completely and simultaneously can't analysis all the parameters, it is appropriate to analysis issue to some multiple sub problem and according to certain criteria, among them do "paired comparisons" and the relative superiority as an option to specify the other options. Then enter the results to their model of decision making and thus a proper understanding of the whole system can provide. The second stage includes several steps as follows:

**5.2.1. Formation of Paired Criteria Comparisons Matrix**

Initially formed matrix of indicators and indices are compared two by two together. (Table 1)

Table 1: paired criteria comparisons matrix

$X_1$	$X_2$	...	$X_n$
1	$X_{12}$	...	$X_{1n}$
$a_{21}$	1	...	$a_{2n}$
...	...	...	...
$a_{n1}$	$a_{n2}$	...	1

As seen in Table 1 each pixels of the above matrix represent the relative importance of indicators than the other. For example pixel in the first row and second column of this matrix represent the relative importance compared the first index to the second index.

**5.2.2. Formation of paired comparisons matrix of activities, according to each index (Table 2)**

Table 2: paired comparisons matrix of activities, according to each index

Index	$S_1$	$S_2$	...	$S_m$
$S_1$	1	$a_{12}$	...	$a_{1m}$
$S_2$	$a_{21}$	1	...	$a_{2m}$
...	...	...	...	...
$S_m$	$a_{m1}$	$a_{m2}$	...	1

Here each of the pixels of above matrix represents the relative importance of activity against the other. For example, pixel that is in the second row and third column of the matrix represent the relative importance of the second activity in return of the activity of the third activity for j criterion. It is obvious there are paired comparisons activities matrices in the number of indices. It is clear that elements of the main diameter of matrix are number one, because each index or any activity will be compared with itself. The elements below the main diameter are reverse of the elements of above diameter one by one. It should be mentioned allocation amounts to these indexes of matrix, takes place using expert opinions - managerial and then convert that qualitative opinion to quantitative amounts by using of Table 3.

Table 3: Converting the qualitative importance degree to quantitative Table

Indexes	Comparison Description
1	Importance degree of row i in comparison with the column j is the same.
2	Importance degree of row i in comparison with the column j is relatively lower.
3	Importance degree of row i in comparison with the column j is lower.
4	Importance degree of row i in comparison with the column j is relatively higher.
5	Importance degree of row i in comparison with the column j is higher.
6	Importance degree of row i in comparison with the column j is relatively too higher.
7	Importance degree of row i in comparison with the column j is too higher.
8	Importance degree of row i in comparison with the column j is relatively too much higher.
9	Importance degree of row i in comparison with the column j is too much higher.

**5.2.3. Making Non-scaled the Paired Comparisons Matrices (Using AHP Techniques)**

Formation of paired matrices, for making comparable different measures scales without being added the values of different columns, this matrix must be non-scaled. For this purpose the amount of each element of the matrix should be

divided into total amount of the related column of matrix to form a new matrix that the amount of each element must be between zero and one.

$$A_{ij} = \frac{a_{ij}}{\sum_{i=1}^m a_{ij}}$$

**5.2.4. Calculate Weight of Each Index and Each Activity for Each Index**

After making non-scaled the matrix to determine the relative weight of each index or relative weight of each activity according to each index, must calculate arithmetic mean for each rows of matrix.

**5.2.5. Calculating the Rate of Incompatibility for Matrices**

Before entering the third step is needed to calculate the rate of incompatibility of matrices to determine whether there is compatibility between paired comparisons matrices or not. Therefore the following steps are taken:  $D.W = \lambda W$

- Paired comparisons matrix will multiple to the obtained relative weights vector:
- Elements obtained in previous step are dividing Peer to Peer into the relative weights :

$$CV = \frac{\lambda W}{W} = \lambda$$

- Total values obtained in the previous steps are added together, and then divided to the number of amounts. Thus  $\bar{\lambda}$  obtained is the same as  $\lambda_{max}$  :

$$\frac{\sum \lambda}{n} = \bar{\lambda} = \lambda_{max}$$

- Using the following formula CI is achieved:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

- By a table (Table 4) has provided by Saati, RI extracted based on the number of matrices line:

Table 4: Table presented by Saati

n	1	2	3	4	5	6	7	8	9	10
RI	0	0	0.58	0.9	0.12	0.24	0.32	1.41	1.45	1.45

And then using the following formula CR is calculating:  $CR = \frac{CI}{RI}$

- If 10% < CR couple matrix elements are not compatible with each other and the matrix is required to be produced again.

If 10% > CR will be accepted, elements of this paired comparisons matrix was consistent with one another, means judgments about comparison has judged correctly. Therefore, paired comparisons matrices accepted and can be moved to the third stage.

**5.3. Third Step: Determining the Weight of Each Activity**

In this stage weights matrix of activities multiplying to the weights matrix of indicators and weight of each activity is determined. (Figure1)

$$S^* = \left\{ S_i \mid Maxw_{ij} \right\}$$

$W_{11}$	$W_{12}$	000	$W_{1n}$	$w_1$
$W_{21}$	$W_{22}$	000	$W_{2n}$	$w_2$
000	000		000	000
$W_{m1}$	$W_{m2}$		$W_{mn}$	$w_n$

Figure1: Multiplying to the weights matrix of indicators to the weight of each activity

Determine the relative importance of each index to another index or rate of the relative importance of each activity compared with other activities is one of the most important parts of various weight giving activities in a project. Performing this process is facing to some problems that the main of them can be pointed as following:

- obligation to assign only one number for weight of each index or activity
- differences in the nature of various activities and the lack of accurate calculation of them
- private opinions Inter into the browse forum

According to the above description it is clear that the process of producing the paired matrices is one of the challenging parts of weight allocation process the project activities. Therefore recommended to increase the accuracy of the work using AHP group technique, thus the paired comparisons matrices prepared by multiple experts and then the geometric mean of the following comments be obtained as the main matrix:

$$x'_{ij} = \left( \prod_{l=1}^k x_{ijl} \right)$$

In this formula:

$x'_{ij}$ : elements of the main matrix

K: quantity of Voters

$l$ : Number of Voters

$x_{ijl}$ : Elements of each matrix that determined by Voter l

### 6. Implementation Model (Case Study)

In this section the implementation of this model to determine the weight of project activities called "Homa project" is mentioned. The project contains 10 activities are as follows:

- 1.preliminary flight tests
- 2.Design and construction of three launching system
- 3.design and construction guidance and navigation system
- 4.Design and construction of telecommunications systems
- 5.Design and construction of six electric system
6. design and manufacture of cargo systems
7. Design and construction of ground control station
- 8.the design and supply the engine, propeller and fuel system
9. Design and construction of transportation systems and ground equipment,
- 10.field tests

Based model for allocating weights to each of these three activities were conducted as follows:

First stage: the first step should be to determine the parameters accepted for payment blower. After discussion and investigation regarding the appropriate parameters already mentioned blower according to the following indices of recall and precision sufficient to determine the weight of each activity have, therefore, in this same model, the benchmark indices were: 1.cost 2.activity - activity duration 3.activity necessary for realization of projects with regard to four risk activity 4.the critical level of activity needs to make the nature of the activity 5.Engineering and Technical complexity 6.safety issues, security and ergonomic factors 7. Reviews and managerial expertise.

Second stage: In this first stage between experts, three experts selected by their paired comparisons matrix indices and the paired comparisons matrices in terms of activities of each of the parameters were obtained. Then the above matrices and non-scaling methods hour at the end of this stage in terms of weight indicators and the activities of each index (average of each row) were calculated. The data matrix to ensure the accuracy of any inconsistency rate was calculated according to the rates that were less than 10%, were sure that the comments were true Voters and comparisons of logic is acceptable to consumers. Therefore, the weights were obtained at this stage was considered for the next stage. Weight indices in Table 6 and Table 6 in terms of activities of various parameters are given. (Table 5)

Table 5: Indices Weight

Indexes	Weight
1st	0.081
2nd	0.047
3rd	0.144
4th	0.364
5th	0.189
6th	0.118
7th	0.057

Table 6: Indices Weight according to Indices

Indexes	1st	2nd	3rd	4th	5th	6th	7th
1st	0.093	0.068	0.030	0.071	0.081	0.156	0.074
2nd	0.070	0.033	0.074	0.035	0.038	0.186	0.083
3rd	0.312	0.199	0.270	0.274	0.309	0.042	0.245
4th	0.102	0.122	0.154	0.073	0.093	0.0143	0.071
5th	0.057	0.054	0.090	0.040	0.033	0.041	0.073
6th	0.036	0.024	0.028	0.070	0.031	0.042	0.031
7th	0.060	0.050	0.029	0.067	0.118	0.041	0.029
8th	0.069	0.104	0.064	0.073	0.031	0.126	0.044
9th	0.073	0.056	0.068	0.032	0.030	0.127	0.120
10th	0.165	0.289	0.192	0.259	0.236	0.198	0.229

**- Forth step**

In the end product of weights matrix activity indices as weights in the matrix of figure 2 and table7 was obtained:

0.093	0.068	0.030	0.078	0.081	0.156	0.074			0.081
0.070	0.033	0.074	0.035	0.038	0.186	0.083			0.064
0.312	0.199	0.270	0.274	0.309	0.042	0.245	0.081		0.251
0.102	0.122	0.154	0.073	0.093	0.041	0.071	0.047		0.089
0.057	0.054	0.090	0.040	0.033	0.041	0.073	0.144	=	0.050
0.036	0.024	0.028	0.070	0.031	0.042	0.031	0.339		0.046
0.060	0.050	0.029	0.067	0.118	0.041	0.029	0.189		0.065
0.069	0.104	0.064	0.073	0.031	0.126	0.044	0.118		0.070
0.037	0.056	0.068	0.032	0.030	0.127	0.120	0.057		0.055
0.165	0.289	0.192	0.259	0.236	0.198	0.229			0.230

Figure 2: Multiplying to the weights matrix of indicators to the weight of each activity

**Table 7: Activity Weight**

Activities weight	Activity ID
%8.1	1
%6.4	2
%25.1	3
%8.9	4
%5	5
%4.6	6
%6.5	7
%7	8
%5.5	9
%23	10

**7. Conclusion**

One of the ways for evaluating activities and assessing projects, is allocation of weight to the project activities. For this purpose, weights should be determined in a way that demonstrates the importance of each projects activity. In other words, any activity that is more important in projects, has a higher weight and vice versa.

In this paper general weight assigned to the activities and purpose of allocating weight too them and consequently, weighting indicators were presented and then some explanations about the methods of weighting to project activities were presented based on different criteria. At last recommended model and process of the work for weight assigned to activities using the AHP technique described.

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