Application of Analytic Hierarchy Process to Application Portfolio Rationalization Decisions

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Abstract

As organizations grow and mature, IT plays an increasingly strategic role in every function. Over time, the IT landscape becomes increasingly large and complex with a huge basket of applications. Periodic application portfolio rationalization (APR) helps CIOs weed out non value adding and non performing applications and enhance portfolio for meeting business goals.

This Article discusses and demonstrates the use of a statistical technique called AHP (Analytic Hierarchy Process) which can be used by CIOs to improve decision making during the APR exercise.

Application Portfolio Rationalization

As organizations mature, information technology starts playing a strategic role in every function of the organization, which inevitably leads to an increasingly large and complex application portfolio. Just as a good investment manager has to relook and restructure his investment portfolio from time to time to ensure healthy returns, it becomes essential also for a CIO to keep evaluating his application portfolio on a regular basis and weed out the below par performers and the non-value adding applications. Periodic APR (application portfolio rationalization) exercises help a CIO keep an optimal application portfolio aligned to the strategic needs of the organization.

To create an optimal portfolio through an APR exercise, a 360* assessment must be carried out to arrive at an end state decision (in terms of retaining, decommissioning, migrating, upgrading etc.) for each application based on the inputs from various stakeholders. Each application has to be evaluated using multiple parameters such as business value, technical health, risk and cost which may themselves be a function of multiple sub parameters. For example – the business value of an application may depend on whether it supports a core business process or not, how many users it has, what is the impact of the application's unavailability on the company etc. Technical health may depend on an application's age, complexity, technology used and so on.

The end state decision of each application in the portfolio thus hinges on the evaluation of multiple and often conflicting criteria (for e.g. a more costly application may also have a better technical health). Also, the nature of the parameters to be evaluated not only varies significantly, they are usually expressed in different units and are sometimes difficult to quantify. Besides, the importance of different parameters to be considered for analysis varies widely (e.g. the degree of financial impact an application has may be a much more important parameter than the number of its users.). Thus assigning the correct relative importance to each parameter becomes vitally important to ensure the correctness of the analysis and the validity of the final recommendations.

This Article proposes the use of a statistical technique known as AHP (Analytic Hierarchy Process) to improve and assist decision making during the APR exercise. It particularly emphasizes and demonstrates the use of AHP in quantifying the relative importance of each parameter contributing to the final decision. Using a statistically proven technique for deciding factor weights, helps in to reduce the subjectivity involved in the decision making process and thus helps optimize decisions..

Why AHP

Wikipedia describes AHP as a "structured technique for organizing and analyzing complex decisions." It further mentions that AHP "has particular application in group decision making, and is used around the world in a wide variety of decision making situations, in fields such as government, business, industry, healthcare and education."

AHP was developed by Dr. Thomas Saaty in 1980 as a tool for solving technical and managerial problems. AHP provides a means of decomposing a decision problem into a hierarchy of smaller and smaller sub problems which can be analyzed independently through simple paired comparison judgments which are then combined to obtain the best decision outcome.

The advantages of applying AHP in APR (or other similar multi-criteria decision making scenarios) are:

- AHP provides an accurate and efficient approach for deciding the factor weights which also takes into consideration the intuitive nature of human decision making. Thus, inputs from clients, subject matter experts and others as to the relative importance of the different parameters (which are intuitive in nature) used in preparation of the comparison matrix which ultimately yields the factor weights.

- It can be applied to both quantitative and qualitative factors.

- The output of AHP is weights in the ratio scale which is more useful and precise than ordinal scales produced by certain other methodologies. For example – if the weights of two factors are 20% and 40%, we can say with confidence that the second factor is twice as important as the first. Such precision is not possible in ordinal scales.

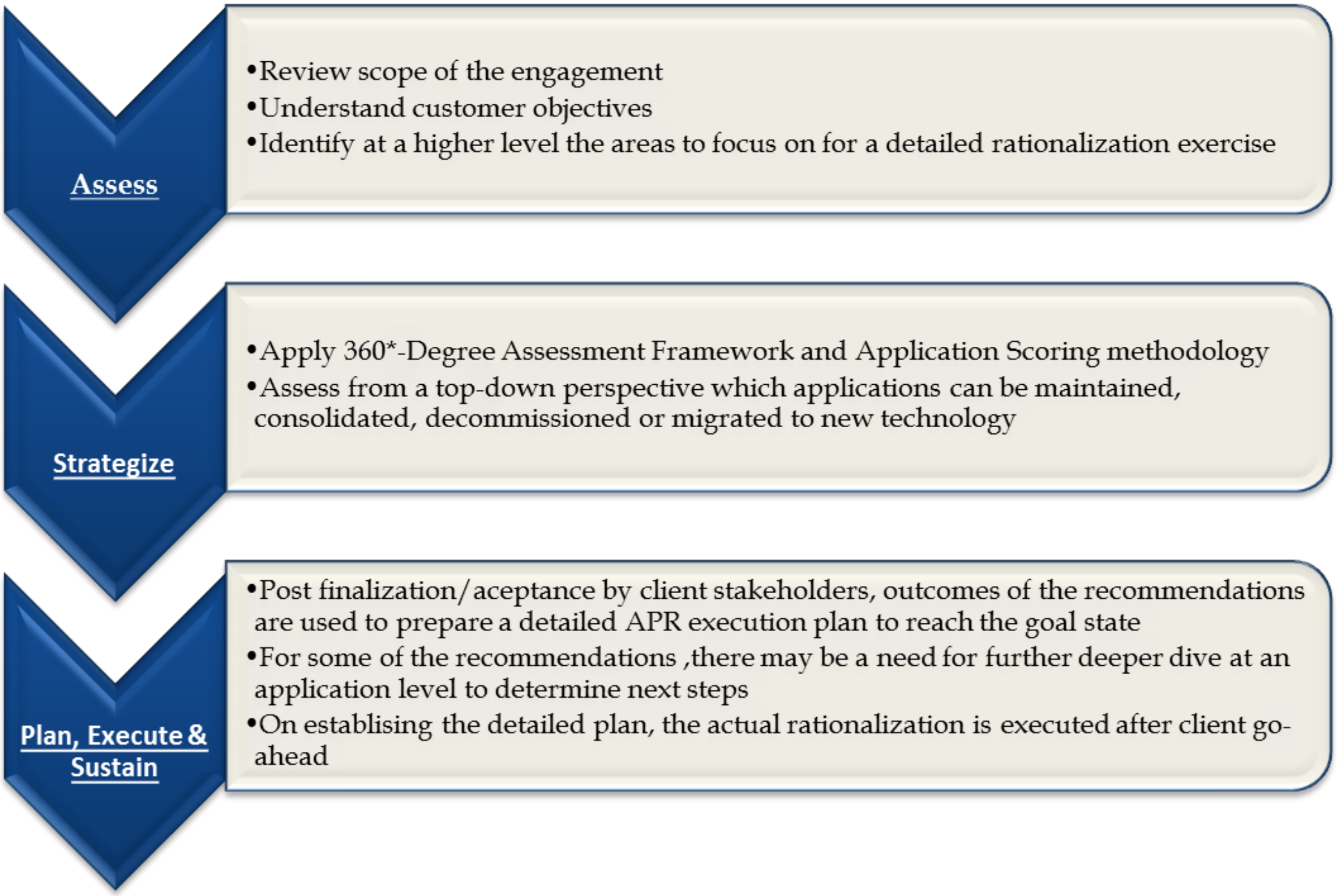
- It is much easier to compare the parameters / factors two at a time and decide their relative importance (which is what is done in AHP) than to compare multiple parameters simultaneously and try to accurately decide their weight values. This is especially true when the number of parameters is large or there are multiple levels of parameters and sub parameters.

- AHP is relatively simple and easy to use and has a consistency checking feature built into the methodology which can eliminate the possible inconsistencies revealed in the criteria weights.

The following sections briefly describe an approach for Application Portfolio Rationalization (APR) and how AHP can be used to aid APR decision making.

Application Portfolio Rationalization (APR) Approach

At a high level, an Application Portfolio Rationalization (APR) exercise can be thought to consist of the following main stages



A key assignment of the second stage of APR is to carry out a comprehensive scoring exercise. Scoring is the process of converting the IT stakeholders' opinions on the business, technical and risk qualities of an application into a numeric value. There may be multiple parameters / criteria within each of these areas (many of which are qualitative in nature) which are used for evaluation of the applications. Many of these parameters may themselves be composites of sub parameters / criteria. Weighted sums of these are considered for obtaining the business value, technical value, risk value and cost scores as shown below.

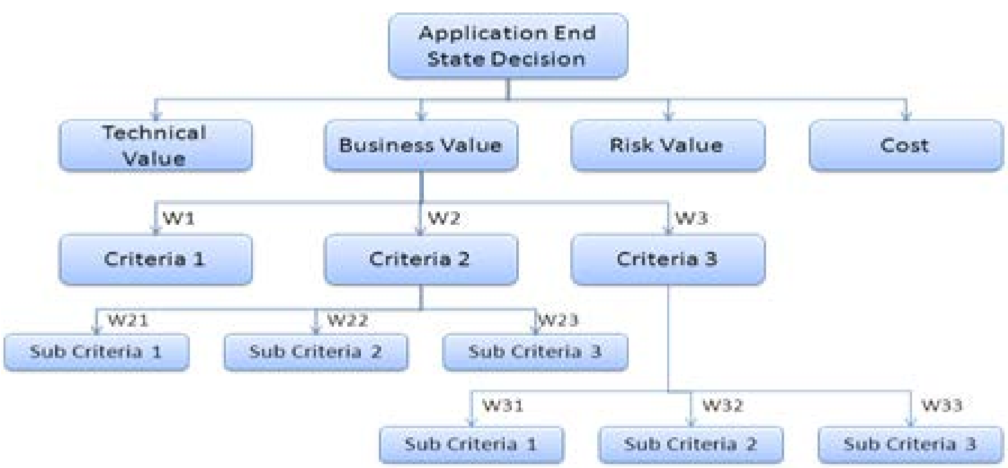


Figure 1: APR Scoring Exercise

Based on the scores, the applications are plotted on an X-Y scatter plot as shown below. The position of the applications in different quadrants indicates the possible end state recommendation for the application based on the parameters considered. The final recommendation is given based on the analysis of the above results and a further case to case drill down of each application details.

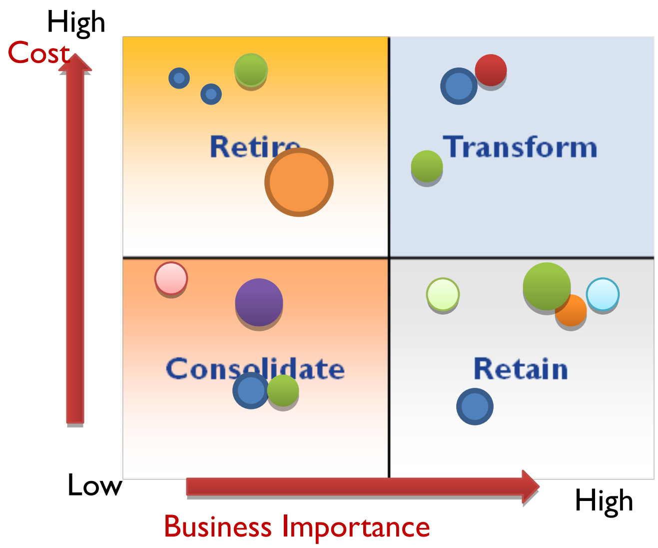


Figure 2: Application End State Recommendation

AHP Methodology

The AHP process consists of the following steps:

Figure 3: AHP Process steps

Determine Criteria Hierarchy

This is the first step of the AHP technique, and it consists of breaking the problem into a set of criteria and sub criteria. Thus, when we apply AHP to our APR methodology, we have to determine the criteria hierarchy for all of our top level parameters (i.e. business value, technical value, risk, cost etc.)

The following diagram shows a possible criteria hierarchy for the "Business Value" parameter.

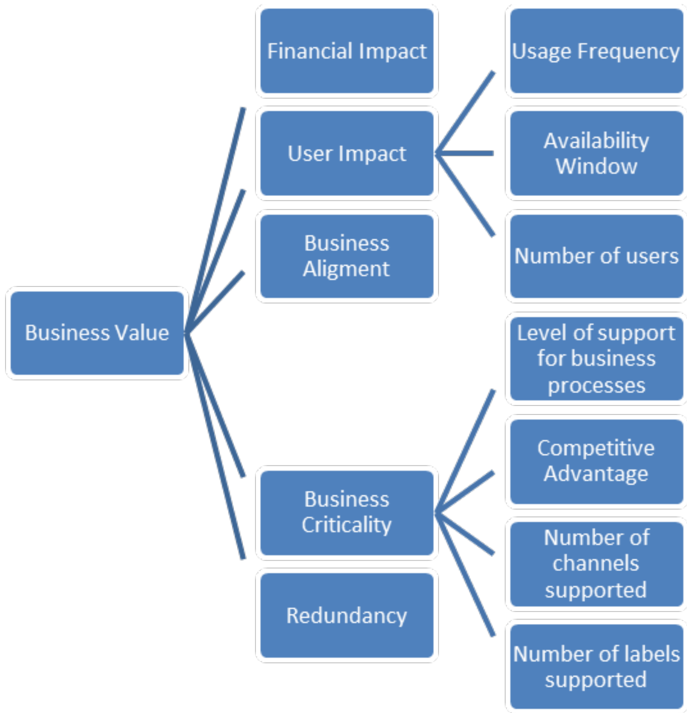


Fig 4: Possible Criteria Hierarchy for the Business Value Parameter

Perform Pair – wise Comparison

For each set of criteria, paired comparisons have to be carried out. This is the stage where the subjective and qualitative notions about the importance of each parameter are quantified by putting them on a 9 point ratio scale with 1 indicating equality (both criteria are equally important) and each subsequent number indicating higher importance of one criterion over the other with 9 indicating absolute (highest possible) superiority of one criterion over the other. These pair-wise comparisons are represented in the form of a "comparison matrix" for each parameter.

The comparison matrix for "business value" is shown below as an example[1].

BUSINESS VALUE	Financial Impact	User Impact	Business Alignment	Business Criticality	Redundancy
Financial Impact	1	5	3	1	6
User Impact	1/5	1	1/2	1/3	3
Business Alignment	1/3	2	1	1/3	3
Business Criticality	1	3	3	1	5
Redundancy	1/6	1/3	1/3	1/5	1

Table 1

[1] Please note that the use of a reciprocal value in the matrix indicates that the 2nd criterion is more important than the first.

Obtain Priority Vector

From the comparison matrix, we will have to calculate the priority vector which will ultimately give us the priority or weights of each parameter. The priority vector is the normalized Eigen vector of the comparison matrix. The values of the priority vector corresponding to each of the parameters give us the priority or relative weights of each parameter.

A sample priority vector obtained for "business value" is shown below.

BUSINESS VALUE	
Parameters	Calculated Priority / Weight
Financial Impact	37.5%
User Impact	10.2%
Business Alignment	14.2%
Business Criticality	32.9%
Redundancy	5.2%

Table 2

Priority vectors also have to be created for those sub parameters which are themselves a composite value of other parameters. For example – in the business value criteria hierarchy shown previously, 2 sub parameters – "business criticality" and "user impact" were composite parameters. Thus priority vectors have to be created for these two. The examples are shown below:

BUSINESS CRITICALITY	
Parameter	Calculated Priority / Weight
Level of support for business processes	7.9%
Competitive advantage	60.4%
Number of channels supported	20.9%
Number of labels supported	10.8%

Table 3

USER IMPACT	
Parameter	Calculated Priority / Weight
Usage Frequency	26.0%
Availability Window	10.6%
Number of Users	63.3%

Table 4

Check for Consistency

The consistency check is an essential feature of the AHP methodology which aims to prevent the possibility of inconsistency in the criteria weights. This is measured by the consistency ratio (C.R.). C.R. of less than 0.1 or even marginally above 0.1 is considered acceptable. Values much higher than 0.1 are considered inconsistent and in such cases, the comparison ratings must be reconsidered..

The priorities or weights obtained directly from the priority vector are called the local priorities. However, in case of sub criteria, the actual contribution to the overall score is based on its global priority, which is obtained by multiplying its local priority with the priority / weight of its higher level criteria.

The example below shows the constituents of the top level parameter "business value" along with their global and local priorities.

Criteria	Local Weight	Sub Criteria	Local Weight	Global Weight
Financial Impact	37.50%	NA	NA	37.50%
User Impact	10.20%	Usage Frequency	26.05%	2.66%
		Availability Window	10.62%	1.08%
		Number of Users	63.33%	6.46%
Business Alignment	14.20%	NA	NA	14.2%
Business Criticality	32.90%	Level of support for business processes	7.90%	2.60%
		Competitive advantage	60.36%	19.87%
		Number of channels supported	20.90%	6.88%
		Number of labels supported	10.84%	3.55%
Redundancy	5.20%	NA	NA	5.20%

Table 5

The overall business value score for any top level parameter (business value, technical health, risk, cost etc.) is thus a weighted sum of the parameter scores with the weights obtained using AHP.

An Example

The following example provides a small demonstration of the significance of assigning correct weight values to different parameters while evaluating applications for portfolio rationalization (or in fact, any complex multi criteria decision making scenario).

We have two applications “App A” and “App B” which have been scored on the various business value parameters described in figure 4. An ordinary approach wherein we try to find the better application by calculating a simple average of all the parameter scores gives an almost equal overall score for each application (in fact, “App B” scores slightly higher).

But when we use AHP to calculate the factor weights and then use the weighted scores to compare the applications, we see that “App A” scores significantly higher than “App B”. If this was a real life APR scenario, “APP A” would probably be a strong candidate for “retain” whereas “App B” could be a possible candidate for “decommission”.

Criteria	Sub Criteria	App A Score	App B Score	AHP Weights (%)	App A Weighted Score	App B Weighted Score
Financial Impact	NA	70	44	37.50	26.25	16.50
User Impact	Usage Frequency	35	85	2.66	0.93	2.26
	Availability Window	44	89	1.08	0.48	0.96
	Number of Users	71	63	6.46	4.59	4.07
Business Alignment	NA	65	41	14.20	9.23	5.82
Business Criticality	Level of support for business processes	71	67	2.60	1.85	1.74
	Competitive advantage	89	45	19.87	17.68	8.94
	Number of channels supported	59	59	6.88	4.06	4.06
	Number of labels supported	45	77	3.55	1.60	2.73
Redundancy	NA	68	52	5.20	3.54	2.70
Overall Score		**61.7**	**62.2**		**70.20**	**49.79**

Table 6

The significant variation in scores clearly show that assigning correct weightages to the different parameters is one of the most important factors influencing the outcome of any APR exercise. To a large extent, the parameter weight values influence (and even change) the application end state decisions which in turn have long term implications in an organization's IT strategy and landscape.

Conclusion

AHP provides a comprehensive and rational framework for structuring a decision problem, for representing and quantifying its elements, for relating those elements to overall goals, and for evaluating alternative solutions. Rather than prescribing a "correct" decision, the AHP helps decision makers find one that best suits their goal and their understanding of the problem.

This Article attempted to demonstrate how AHP can be used for improving decision making in an APR engagement by converting qualitative judgment about the relative importance of different parameters into quantitative weights which can be used directly for decision making. However, the idea behind the exercise is to show the usefulness and applicability of AHP to multi criteria decision making problems so that we can effectively apply it to many other business scenarios which we encounter during our professional lives.

References

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