Performance Assessment of Agricultural Research Organisation Priority Setting by using Balanced Score Card (BSC) & Analytic Hierarchy Process (AHP) technique

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Abstract: *Assessment of research priority setting in agriculture is important in planning for organizational development. The potential of agricultural research, education, and training has attracted considerable attention in many developing countries. However, without clear focus and coherent research policies the public sector is unlikely to reap the full benefits of the new technology. This paper reports on a priority-setting exercise for agricultural research in National Academy of Agricultural Research Management (NAARM) - ICAR, based on the Analytic Hierarchy Process (AHP). Three main functions performance evaluation of R&D, Training and Education have been prioritized using Balanced Score Card (BSC) model that consists of three hierarchies to evaluate their potential contribution to organizational development objectives, chances of research success, and expected adoption rates, respectively. The final scoring shows a clear grouping of the research alternatives. The conceptual framework is to develop decision criteria. All proved to be useful tools to improve the priority setting process.*
Keywords: *analytic hierarchy process, agricultural research, education, training, priority setting, public sector, research management.*

I. Introduction:

Priority setting is as critical step for an efficient research planning. This could help the decision making process of what to invest, where to invest, when to invest, and how much to invest; in other words, towards an optimal agricultural science resources allocation (Braunschweig, 2000). A formal approach for priority setting could furthermore improve efficiency and credibility of decision makers. However, several priority settings in the public sector have not undergone systematically (Setboonsarng *et al.*, 1991).

Over the years, several frameworks have been developed to address the management of organizational assets, both tangible and intangible. For tangible Balanced Scorecard (BSC) and the Intangible Assets Monitor (IAM) and the Skandia Navigator can mainly used to framework. Kaplan and Norton (1996) defined Balanced Scorecard (BSC) as a multidimensional framework for describing, implementing and managing strategy at all levels of an enterprise by linking through a logical structure, objectives, initiatives and measures to an organization's strategy. The resulting scorecard provides the details of an enterprise view of an organization's overall performance. It complements the financial measures with other key performance indicators around customer perspectives and internal business process, and around organizational growth, learning and innovation. It may be noted that the BSC is not a static list of measures, but rather a logical framework for implementing and aligning complex programs of change, indeed for managing strategy focused organizations. In summary, a scorecard is to be used to facilitate the translation of strategy into action.

The four basic perspectives of the organizational BSC are: 1. Financial; 2. Customer; 3. Internal Business Process; 4. Learning & Growth.
1. **Financial:** This perspective typically relates to profitability - It is measured for instance by plan allocation of total budget, non-plan allocation of total budget, plan expenditure of total budget, non-plan expenditure of total budget, revenue generation on total budget. Finance is essential in summarizing the economic consequences of strategy implementation.
2. **Customer:** This perspective includes several core or genetic measures of successful outcomes from the organizational strategy, like for instance, international consultancy projects, national consultancy projects, on-going research projects, R&D projects time over run, R&D projects cost overrun. It identifies the customer and research segments in which the business desires to compete.
3. **Internal processes:** This perspective focuses on the internal process that will have the greatest impact on research projects on achieving an organizations financial objective. It is measured for instance staff strength, frequency of review meetings, books/bulletin/Manual/Policy papers, collaborations with national

institutes, collaborations with international institutes. It identifies the critical internal processes for which the organization must excel in implementing its strategy.

4. **Learning and Growth:** This perspective identifies that the organization has to build and manage to create long-term growth and improvement through people, systems and organizational procedures that the organization must build to create long-term growth and improvement. It is a measure for instance scientists participation in seminars/ workshops/symposia/conference/meeting/foreign visits, papers presented per scientist, programs on new skills, awards and recognitions, scientists published articles in journals.

The execution of this strategy is then monitored through an internal performance measurement framework with a set of goals; drivers and indicators (both lag and lead types) grouped into each of the four perspectives. The other key objective of a BSC is to tell the story of the organizations strategy.

Lead vs. Lag indicators:
For developing a Balanced Scorecard (or any other performance management system), it is recommended to use a combination of Leading and Lagging Indicators. Kaplan and Norton call these "Performance Drivers" and "Outcome Measures".

The idea is that Lagging Indicators without Leading Indicators tell you nothing about how the outcomes will be achieved, nor can you have any early warnings about being on track to achieve your strategic goals.

Similarly, Leading Indicators without Lagging Indicators may enable you to focus on short-term performance, but you will not be able to confirm that broader organizational outcomes have been achieved. Leading Indicators should enable you to take pre-emptive actions to improve your chances of achieving strategic goals.

Leading Indicators are often captured at the level of individual processes, whereas Lagging Indicators may be the result of changes in a number of Leading Indicators. So, a process cycle-time or error rate might be Leading Indicators, measured at the process level and Customer Satisfaction would be a Lagging Indicator, measured at the organization level.

If you are measuring "activity" (i.e. at a process level), it is more likely that you are using Leading Indicators. The closer you move to process inputs and activities, the closer you get to Leading Indicators of downstream, (Lagging) performance. If you are measuring aggregated effects, or outcomes, at an organizational level, you are more likely to be using Lagging Indicators.

Remember, the overall purpose of selecting metrics is to enable you to track performance towards your goals. So, you should aim to identify and then control those metrics that drive you towards your ultimate goals.

Lead and Lag relations among indicators of performance:
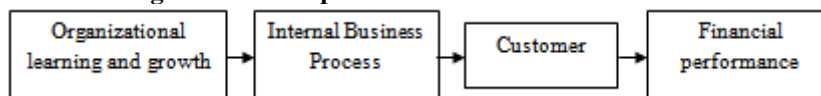
Source: Author

The above figure represents the measures of final outcome of management plans and their execution.

Research Priority Settings:
NAARM has made a strong commitment to set clear and rational agricultural research priorities and to translate those priorities into resource allocation decisions. Fulfilling this commitment is crucial to the institute's future success. As the resources available for agricultural development become increasingly scarce, it is essential that the institute can clearly and quantifiably demonstrate the value of agricultural research in promoting national agricultural development objectives, particularly in comparison to competing claims for public and contributor resources. Further, the clear and rational presentation of priorities will allow NAARM to take a more pro-active approach in soliciting contributor support for areas identified as vital to national agricultural development efforts. Such a presentation will, in turn, increase the institute's control over its research agenda and further increase the flow of innovations with a demonstrable impact on agricultural development. The plan of action is formulated with recommendations on how NAARM should processed to develop institutional structures, criteria, methods and information based within an integrated priority setting framework.

Institutional structure:
The academy is changed with identifying the long range research needs in various areas, including agriculture, training, education, and assessing technology transfer linkages between the private sector and public

universities. The competitive edge in R&D though closer interactions between academic institutions and the private sector in the setting of research priorities and most likely in making available adequate support of funds. We recognized that our competitive strength in national and international level depends on the quality and effectiveness of a carefully planned research and development, communication system. The academy is confident that the efficiency of our resource utilization and effectiveness of training programs will benefit as a result. It is important to review existing programs and make sure that there is a process for applying knowledge and technology already available as it is to set priorities for future research.

Over time period the demands on agricultural research and education system have been fast changing. Priority setting in any system requires professional expertise. The agricultural system is now faced with the task of not only increasing the productivity of selected crops but also to address issues such as increasing disparity in agricultural growth, maintaining and enhancing the quality of natural resource base and reducing environmental degradation, poverty alleviation, emerging trade regimes, etc. These developments are useful for rationalization of allocation of current and future resources for enhanced research efficiency. Institutionalizing a systematic analysis of agricultural research priorities and integrating it with an effective monitoring and evaluation (M&E) system, therefore, holds a key to make the system efficient and effective.

Strategic research prioritization techniques:

Agricultural research prioritization is a process of ranking a set of potential research activities so that the scarce research resources may be allocated to these activities as per the ranking. This process is undertaken to align the resource allocation with the national objectives and to improve the effectiveness and efficiency of the scarce research resources. It also aims to improve the transparency and accountability in the research system with respect to resource allocation, monitoring and evaluation.

Foundation of Research prioritization:
1. The primary objective of prioritizing options is to allocate scarce research resources efficiently, i.e., to maximize the benefit for the society expected from public expenditures for research.
2. A good priority setting approach will allow information on national policy objectives to flow downward.
3. Information on researchable problems to flow from the bottom up to influence higher levels of priority setting.
4. Institutionalization of priority assessment mechanism at different levels would enhance transparency, ownership and accountability, thereby contributing to the effectiveness and efficiency of the research system.
5. Systematic and objective approaches lead to a more efficient resource allocation than the informal mechanisms such as collective judgment or beliefs of individual scientists.
6. There's always a higher demand for research resources like scientific and technical manpower, capital assets and contingencies then their availability.

Research prioritization being a relatively interesting concept, there are apprehensions among some scientists and researchers about it. The main arguments against research prioritization are summarized.
1. Research is an uncertain economic activity with unpredictable outcomes. Any pre-judgment of research activity is not fair. If scientists have to convince their peers or researchers about the desirability of the research activities they wish to take up, they may tend to shift from basic and upstream research to applied and downstream research.
2. The informal mechanisms used for research resource allocation in the past have been quite effective in meeting the national priorities.
3. The best research prioritization approaches cannot guarantee a close correspondence between the ex-ante assessment and ex-post impact of any research activity.
4. The methodologies suggested by social scientists and economists are only a plan to take away the decision making powers and prerogatives of the researchers.

Despite such apprehensions and objectives voiced by some scientists and researchers, the priority assessment procedures are finding increasing application and acceptance in the western countries. The National Agricultural Research system (NARS) has decided to make use of the funding under National Agricultural Technology Project (NATP) for Organizational and Management (O&M) reforms to improve the transparency, accountability and efficiency of the system. The process of priority assessment, monitoring and evaluation (PME) are sought to be strengthened through sensitization, capacity building and institutionalization of the necessary procedures. Priority assessment at different levels of research planning is the first step in ushering the O&M reforms in the NARS.

Research Resources allocation and Research Prioritization:

Research Resources allocation and Research Prioritization processes are interlinked. In every research resource allocation, there may be an implicit prioritization, whether it is made explicit or not. In general, a method of percentage increase is followed in allocating resources in the government departments. If the research organization gets a ten per cent higher allocation in the current year over that of the previous year, the tendency is to enhance the allocations to different institutes or research programs by the same ten percent. However, some marginal variations can be made here and there as exceptions. But this method of allocation places immense faith on the past resource allocation decisions. Another reason for this method of allocation is that the normal increases in the committed expenditures like salaries, labour charges etc. are to be taken care of.

Analytical Framework for Assessment of Agricultural Research Priority Setting:

The Balanced Score Card (BSC) framework has been used effectively in the past in research development and academic development studies as it provides a means to quantify characterize structure and analyze strategic measurement systems. For this reason, the framework is also adopted in this study to measure the performance of a research organization system through appropriately designed indicators and indices.

Balanced Score Card framework:

The Balanced Score Card (BSC) framework is scalable, and enables better judgment, insight, and accountability in planning for organizational development. BSC translates the vision and strategy of a business unit into objectives, measures in the financial, customer, internal business process, learning and growth perspectives. Balance between four capital assets, and the various components of each type of asset, is also important, because minimum levels of one asset may be necessary to effectively make use of another.

**Fig 1. Balanced Scorecard strategic framework for R&D in NAARM**
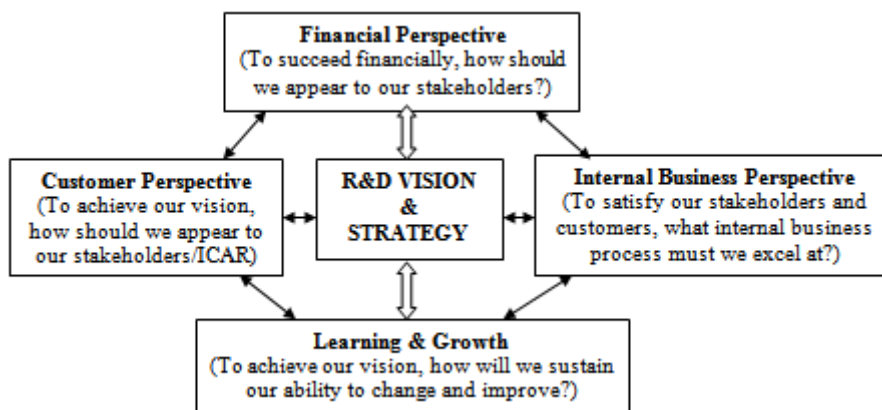
Based on this research, it has been found that a Balanced Scorecard framework using about 20-25 measures is the usual recommended best practice. We selected 20 measures for Research and Development in NAARM, Hyderabad. The following table presents the selected measures under four different perspectives.

Table 1. Research Performance measure through BSC technique

| Perspective	No. of measures	Weight
Financial	5	33.83 %
Customer	5	17.99 %
Internal Business Process	5	26.42 %
Learning and Growth	5	21.75 %
Total	20	100 %

Fig 2. Web-based Research Performance on 4 key perspectives
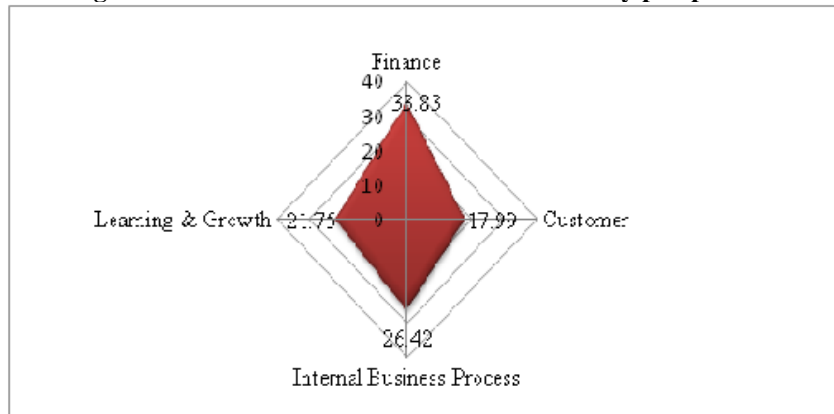
The above figure represents the need for balancing the number of measures, because the process perspective is the primary domain through which organizational strategy is implemented. According to goal orientation the measurable indicators considered in BSC, the financial aspects covering (33.83%), internal business process (26.42%), learning and growth (21.75%) and customer perspective (17.99%) performance weighted. There is a big gap observed in between customer and organizational learning & growth is about to 30-40 per cent, which gives an opportunity to expand the research development in these two areas in NAARM. Future focus should not be limited to the finance and internal business process and it could be concentrated on other two aspects also.

Strategy Mapping:

Fig. 3. The strategy map represents how an organization creates value
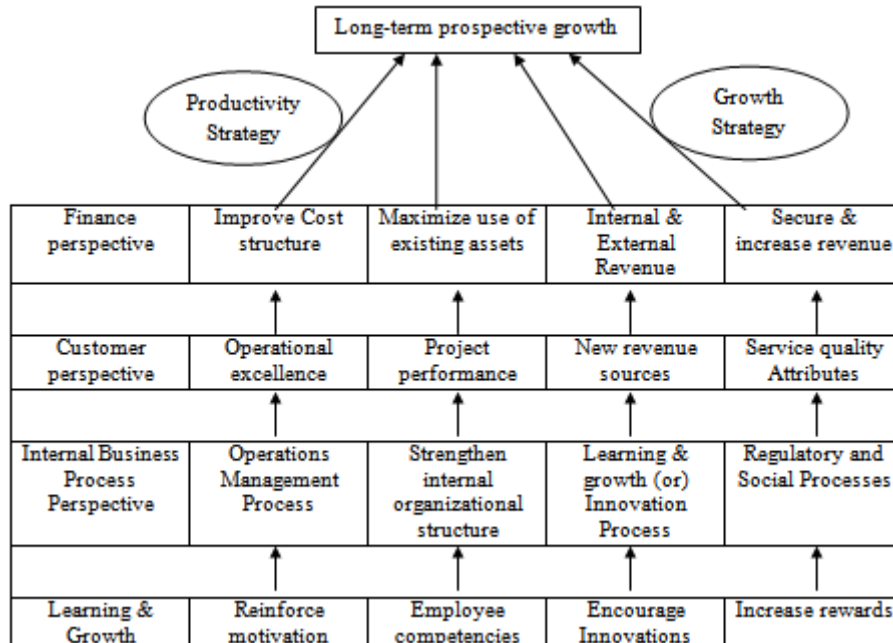
The strategy map brings together the strategic objectives of organization to illustrate causal linkages within their relationships. Within the business application, strategy maps and the Balanced Scorecard approaches have been proven to be effective tools of business communication and strategic management in aligning and integrating the strategic goals of various levels within an organization (Chan, 2009: 349-363; Paladino, 2007b:38; Wu & Liu, 2010: 27-47).

The strategy map allows senior scientist and managers to see how attaining strategic objectives at the departmental or employee level assists an organization to achieve better internal business processes, customer satisfaction and ultimately its financial objectives. A strategy map identifies the specific capabilities in the organizations intangible assets such as human capital, information capital and organization capital that are required to deliver exceptional performance in the critical internal process. The given analysis indicates that the

strategy map is a critical component in the design of performance measurement systems based on the Balanced Scorecard model. The strategy map has turned out to be as important innovation as the original Balanced Scorecard model itself. The visual representation of an organizations strategy is both natural and powerful, as one sees the progression of the interrelationships of perspectives towards meeting organizational objectives.

The strategy map acts as an instrument in understanding the relationship of perspectives better, as one can easily study the map critically. A strategy map gives a clear direction and shows the linkages between all the critical elements in each corporate perspective of the Balanced Scorecard model.

Conceptual Framework of NAARM Performance:

The measurement of NAARM performance requires measurement along many dimensions. In fact, there is no consensus about what are the key indicators for catch-up in the multidimensional ICAR institutes structure. We need an indicator system that responds clearly to certain general principles such as relevance and feasibility in relation to the available time and resources (Oakes, 1989). We need an indicator system that is reliable and provides accurate information and allows comparison across time periods and among research organizations. Recognition is the need to measure multiple dimensions of NAARM has finally led to the attempt to get some agreement on an indicator system to enlighten national agricultural research policies. The present paper contributes by establishing classification criteria for some of the existing indicators on which there is no widespread agreement. The focus in the analyses is on achieving a degree of consensus among a group of experts about which are the best/most appropriate indicators to analyze NAARM performance. To achieve agreement about what indicators are the key ones for evaluating performance, the designed set of quantitative and qualitative indicators used to evaluate. We compiled a comprehensive list of indicators to evaluate NAARM activities, with special attention to Indian Agricultural system. The list of indicators was constructed on the basis of whether they were informative about:

- Research, training and educational knowledge transfer (the three main missions of NAARM);
- Resources, processes or results (type of indicator);
- Level of importance in an evaluation process.

II.   Methodology:

Identify which from a group of 20 indicators used for the evaluation of NAARM are most appropriate:

- To analyze NAARM missions (research, training and education knowledge transfer)
- To indicate the typology of each indicator (input, process or output indicator);
- To score their relevance for the evaluation process.

In this study, data was analyzed using Analytical hierarchy process (AHP) which continues to be the most highly regarded and widely used decision making process.

NAARM Vision and Mission:

- **Vision:** NAARM will be India's premier institute in agricultural research management that enables NARS adapt to change through continuous innovation.
- **Mission:** To enhance leadership, governance and innovation capacities of NARS through capacity strengthening, education, research, consultancy and policy support.

Balanced Score Card (BSC):

The Balanced Scorecard (BSC) is a method that could easily connect directly to various performance measures (criteria) of a BSC with the stated goals and objectives of NAARM. Specifically, it explains in great detail how the multi criteria method of Analytical Hierarchy Process (AHP) could practically facilitate this connection. It analyses how an organization could arrange the various performance criteria in such a way that could be capable of controlling its stated goals and objectives through the implementation of its strategy.

The first step is to connect two methods of BSC and AHP and the second step is the formation of the proposed framework, which actually facilitates the formal and quantitative links between the organization's stated performance criteria and its overall strategic planning process: its mission, goals, objectives, and the specific strategy it follows for the attainment of these goals and objectives.

Balanced Scorecard should have an approximate mix of outcomes (covering indicators) and performance drivers (leading indicators) of the organizational development strategy. BSC translates the organizational development strategy into a linked set of measures that define the long term strategic objectives, as well as the mechanisms for achieving those objectives.

Analytical Hierarchy Process (AHP) allows decision makers to model a complex problem in hierarchical structure showing the relationships of the goal, objectives (criteria), sub objectives, and alternatives. Thus, a typical hierarchy consists of at least three levels, the goals, the objectives, and the alternatives.

The proposed BSC – AHP framework:

Table 2 below describes the steps required to link the performance measures of the BSC to (1) the overall mission (or overall Goal) and the objectives (or strategic challenges) of the organization, and (2) a specific strategy designed to help the organization achieve its objectives and mission. This process begins with the construction of an AHP model that directly links, as we shall analyze shortly, the organization's performance measures to its objectives and mission (step 1). After creating this linked hierarchy, we then use the AHP to determine the relative weight (or importance) of each individual performance measure to the organization's ability to succeed in its objectives and mission (step 2). The relative weights of the performance measures determined in step 2 then allow us to develop an index, which collectively uses the key performance measures to track the organization's performance (step 3).

Table 2. Steps required linking the performance measures of the BSC

Steps	Task
Step 1	Construct AHP model linking organization mission and objectives to BSC
Step 2	Use AHP to determine the 'weights' or relative importance of individual key performance measures.
Step 3	Compute the index of the performance measures to monitor overall organization's performance.

Prioritize operations relative to strategic plan:
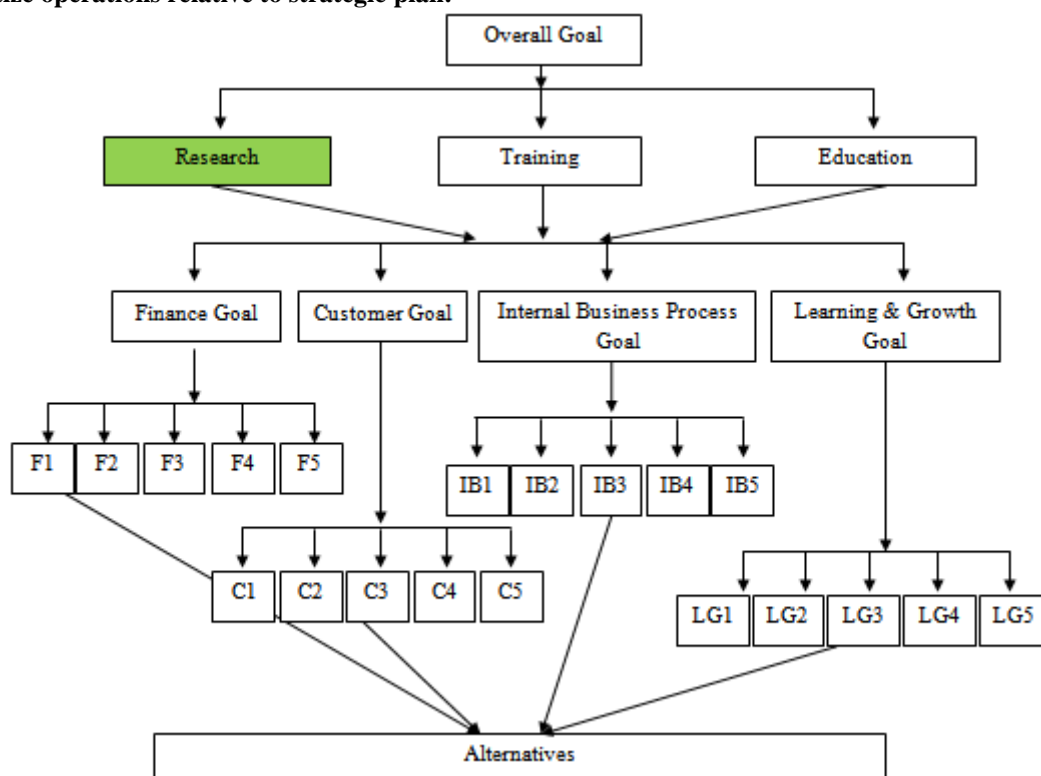
Table 3. Balanced Scorecard indicators for R&D in NAARM

S.No.	Research Indicator	Calculated priority weight	Measures/ weightage
	Financial (F)		
1	Plan allocation % of total budget	100%	5
2	Non plan allocation % of total budget	100%	5
3	Plan Expenditure % of total budget	99.99%	5
4	Non plan Expenditure % of total budget	99.95%	5
5	Revenue generated % of total budget	21.30%	1
	Customer (C)		
1	% of International consultancy projects	7.69%	1
2	% of national consultancy projects	68%	4
3	No. of ongoing research projects (Externally-aided projects)	41.00%	3
4	% of R&D projects time over run	7.14%	1
5	% of R&D projects cost over (Nil)	100%	5
	Internal Business Process (IBP)		
1	% of staff filled	74.24%	4

2	Frequency of review meetings	50%	3
3	Books/bulletin/Manual/ Policy paper	80%	5
4	Collaborations with national institutes	50%	3
5	Collaborations with international institutes	75%	4
	Learning & Growth (L&G)		
1	% of scientists participation in seminars/workshops/ symposia/conference/meeting/Foreign visits	68.97%	4
2	% of papers presented per scientist	30%	3
3	% of programmes in new skills	67.00%	4
4	Awards and recognitions	60.00%	4
5	% of scientists published articles in journals	44.83%	3

The performance of research indicators and priority weight was done through a 5-point rating scale in which 1 stands for Poor performance (Upto 20%), 2 for Fair (21% - 40%), 3 for Good (41% - 60%), 4 for Very Good (61% - 80%), and 5 for Excellent (81% - 100%).

AHP Pair wise comparison matrix:
Goal: Prioritize valuation approach of NAARM performance assessment
Step I
A three –level hierarchy to link the performance measures of the BSC to the organization's mission and objectives.
1. The organization's mission or overall goal
2. The organization's objectives or strategic challenges (Hamel and Prahalad, 1996: 149)
3. The key performance measures of the BSC

Priority Weights of Performance Criteria:

		j					
		F	C	IBP	L&G	GM	W
i	F	1	8	9	5	4.3559	0.6637
	C	1/8	1	6	4	1.3161	0.2005
	IBP	1/9	1/6	1	7	0.6000	0.0914
	L&G	1/5	1/4	1/7	1	0.2907	0.0443
					TOTAL	6.5627	1.0000

1. We prioritize five research and control gaps
2. Set up a table - each pair wise comparison table – each element is paired with every other element
3. We need only fill in the yellow shaded area
   $n(n-1)/2 = 5(4)/2 = 10$

Number of gaps	1	2	3	4	5	n
number of comparisons	0	1	3	6	10	$\dfrac{n(n-1)}{2}$

Why Analytical Hierarchy Process (AHP):
      The AHP, developed by the mathematician, Thomas L. Saaty (1980), is a practical and effective method for solving multi-criteria decision problems. It is a flexible and powerful tool for handling both qualitative and quantitative multi-criteria problems. Its decision model is based on structuring the elements of the observed problem in terms of how the alternative solutions influence decision criteria, satisfaction of which will show how much particular solution contributes to the accomplishment of the main objective of a decision problem. The AHP uses a multi-level hierarchical structure of objectives, criteria, sub-criteria and alternatives. The typical problem examined by the AHP consists of a set of decision criteria. The pertinent data are derived by using a set of pair wise comparisons. These comparisons are used to obtain the weights of importance of the decision criteria and the relative performance measurements of the alternatives in terms of each individual decision criterion. The hierarchical organization structure of the AHP arranges a decision problem in clusters at different levels; higher level elements transmit influence to lower ones, or lower level elements contribute to the functioning of the higher level ones (Guo and He, 1999).

      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". The AHP is a multi objective, multi criteria decision making approach which employs a pair wise comparison procedure to arrive at a scale of preferences among a set of alternatives, it is necessary to break down a complex unstructured problem into the component parts into a hierarchic order. It is a process involving discussions,

learning and checking and also a powerful tool to support good decision making. Unique feature is possibility to calculate a measure of inconsistency for each set of judgments. The property enables to identify errors and to revise adjustment.

Principles of AHP:
➢ decomposition of a complex unstructured problem
➢ comparative judgments about its components
➢ synthesis of priorities derived from the judgments

The goal, criteria, sub criteria and options (projects) identified, judgments are made to compare the all criteria in pairs with respect to goal and options (projects) with respect to each of the criteria at the next higher level. Relative comparisons are based on hard data as well as on the intuition, experience and expertise of decision-makers. AHP explicitly allows for subjective judgments, recognizing their legitimate role in *ex ante* analysis. Once the verbal judgments are made they are translated into numbers by means of a fundamental scale presented in Table 4.

For qualitative data such as preference, ranking and subjective opinions, it is suggested to use scale 1 to 9.

Table 4. Fundamental scale for AHP

Intensity of Value	Interpretation
1	Requirement i and j are of equal value
3	Requirement i has a slightly higher value than j
5	Requirement i has a strongly higher value than j
7	Requirement i has a very strongly higher value than j
9	Requirement i has an absolutely higher value than j
2, 4, 6, 8	These are intermediate scales between two adjacent judgments
Reciprocal scale i.e. 1/3, 1/5, 1/8 etc	If requirement i has a lower value than j

➢ In the yellow highlighter cells, type in the intensity value number
➢ If "i" is higher than "j", type the integer
➢ If "i" is lower than "j", type an equal sign follows reciprocal (=1/5)

Table 5. Performance made on 1- 9 scale

AHP scale of importance for comparison pair (aij)	Explanation	Numeric Rating	Reciprocal (decimal)
Extreme Importance	The evidence favoring one activity over another is of the highest possible order of affirmation	9	1/9 (0.111)
Very strong to extremely		8	1/8 (0.125)
Very strong Importance	An activity is favored very strongly over another; its dominance demonstrated in practice	7	1/7 (0.143)
Strongly to very strong		6	1/6 (0.167)
Strong Importance	Experience and judgment strongly favor one activity over another	5	1/5 (0.200)
Moderately to strong		4	1/4 (0.250)
Moderate Importance	Experience and judgment slightly favor one activity over another	3	1/3 (0.333)
Equally to moderately	Two activities contribute equally to the objective	2	1/2 (0.500)
Equal Importance		1	1 (1.000)
Reciprocals of above (If activity *i* has one of the above non-zero numbers assigned to it when compared with activity *j*, then *j* has the reciprocal value when compared with *i)*	A reasonable assumption		
If the activities are very close	May be difficult to assign the best value but when compared with other contrasting activities the size of the small numbers would not be too noticeable, yet they can still indicate the relative importance of the activities.	1.1 – 1.9	

The paired comparison scale between the comparison pair (aij) of two items (items i and item j) is as follows:
(item i) 9-8-7-6-5-4-3-2-1-2-3-4-5-6-7-8-9 (item j)
The preference scale for pair-wise comparisons of two items ranges from the maximum value 9 to 1/9 (0.111 in decimal from). Let aij represent the comparison between item-i (left) and item-j (right). If item-i is 5 times (strong importance) more important than item-j for a given criteria or product, then the comparison aji = 1/aij = 1/5 (0.200) or the reciprocal value for the paired comparison between both items.

To find out corresponding sets of weights, the pair-wise comparison is done where element i with element j is placed in the position of aij in the reciprocal matrix A as shown below:

$$A= \begin{bmatrix} a11 & a12.. & a1n \\ a21 & a22.. & a2n \\ . \\ . \\ . \\ . \\ an1 & an2.. & ann \end{bmatrix}$$

The consistency ratio is determined and sensitivity analysis can be done by AHP computer programme known as "Expert Choice" (Forman and Satty, 1991).

In developmental context to prioritize options, first we identify problems and opportunities that deal with the causes and consequences. The next step is screening of options that examines the proposed solutions against the relative impact of each of them in terms of income generation and improved resource development, chances of research success, and expected adoption rates, respectively. It is most effectively organized in a stepwise manner by following 3 steps one make sure to arrive at the best decision in the best manner.

Step 1 : Defining objectives and options

A sector or sub sector analysis followed by defining research objectives e.g. at national level; objectives have often been grouped in 4 categories i.e. income generation and improved resource development, chances of research success, and expected adoption rates, respectively. At research level, efficiency of research technology management, address emerging concerns in agriculture, facilitate organizational effectiveness, enhance administrative and financial management in the system, forge and strengthen partnerships, linkages and networking at regional, national and global levels may be the research objectives. The research alternatives must be identified and defined by analyzing constraints and opportunities. To assess the research alternatives the evaluation criteria need to be formulated. These criteria normally correspond with measurable indicators for research objectives. When there are several criteria, criteria weighing may be required.

Step 2 : Choosing right method

With limited resources, research should clearly be taken only on those alternatives that contribute most to the research objectives. To choose critically, one should estimate how the research alternatives perform on the measurable criteria, often the initial rank order is submitted to sensitivity analysis.

Step 3 : Preparing for implementation

Priorities are set in order to be implemented. The priorities thus need to be transformed into a resource allocation plan. Finally the process followed and results obtained into here should be submitted to the wider validation.

Procedure of prioritizing options at organization level:
Following steps to be followed to prioritize options and allocate resources at organization level
1. Preferential ranking of problems of the research, use analytical tools.
2. Selected problem examined for Problem-Causal analysis, identify intervention points.
3. Formulate research questions based on research hypotheses.
4. Identify research alternatives, resource allocation plans.
5. Generate criteria to evaluate options, check relevancy and applicability of these criteria, find out indicators for these criteria which can be measured either using data, experiences of other countries, expertise and intuitions of team members.
6. Evaluate options using analytic methods, which can be understood by following hypothetical example of Analytic Hierarchy Process (AHP).

Step I: Decomposition of unstructured problem into hierarchy level
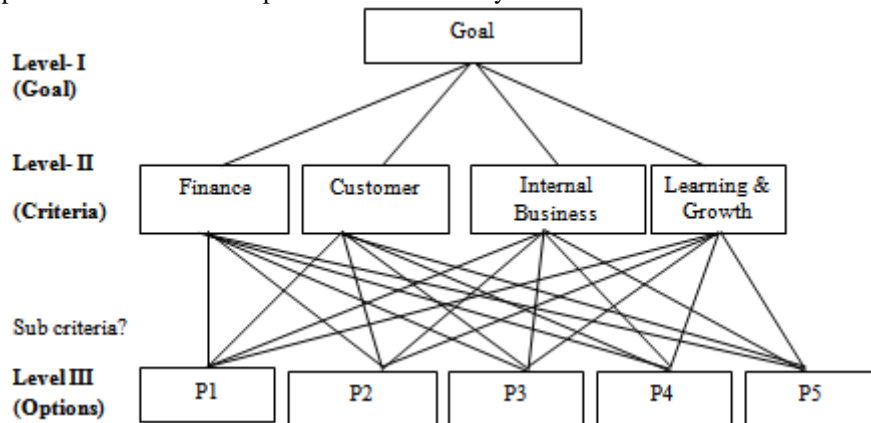
Step II: Judgment matrix for pair wise comparison of criteria (C) with respect to goal
Finance - C1,   Customer - C2, Internal Business Process - C3, Learning & Growth - C4

From the Introduction that the organization has four factors in mind: finance, customer, internal business process, learning and growth; F, C, IBP, L&G respectively. The factors chosen should be independent, as required by Saaty's mathematics.
First we provide an initial matrix for the organization's pair wise comparisons in which the principal diagonal contains entries of 1, as each factor is as important as itself.

Performance measures (criteria) with respect to Goal

	C1	C2	C3	C4	GM	W
C1	(A11) 1	(A12)	(A13)	(A14)	a	X1 =a/T
C2	(A21)	(A22) 1	(A23)	(A24)	b	X2 =b/T
C3	(A31)	(A32)	(A33) 1	(A34)	c	X3 =c/T
C4	(A41)	(A42)	(A43)	(A44) 1	d	X4 =d/T
TOTAL					T	1.00

Step III: Option with respect to criteria-1 .. To.. 4
Judgment matrix for pair wise comparison of options with respect to criteria
Options of valuation approaches to be prioritized (P1, P2, P3, P4, P5….)
P1 - Enhancing institute revenue generation
P2 - Professional methodology of valuation
P3 -Transparency in valuation process
P4 – Efficiency of resources
P5 – Improved collaboration in research

1. Options with respect to first criteria - C1. ------------------

	P1	P2	P3	P4	P5	GM	National priority
P1	1	5	1/8	6	1/7	0.8826	0.159
P2	1/5	1	1/7	1/9	6	0.4529	0.081
P3	8	7	1	5	1/9	1.9888	0.357
P4	1/6	9	1/5	1	7	1.1600	0.208
P5	7	1/6	9	1/7	1	1.0845	0.195
					TOTAL	5.5687	1.000

2. Options with respect to second criteria - C2------------------

	P1	P2	P3	P4	P5	GM	National priority
P1	1	3	1/7	1/5	1/9	0.3942	0.0628
P2	1/3	1	1/5	1/4	7	0.6507	0.1037
P3	7	5	1	8	1/6	2.1568	0.3437
P4	5	4	1/8	1	1/8	0.7924	0.1263
P5	9	1/7	6	8	1	2.2807	0.3635
					TOTAL	6.2749	1.0000

3. Options with respect to third criteria - C3--------------------

	P1	P2	P3	P4	P5	GM	National priority
P1	1	1/6	1/3	9	1/5	0.6310	0.0840
P2	6	1	4	8	5	3.9487	0.5254
P3	3	1/4	1	1/7	1/9	0.4122	0.0549
P4	1/9	1/8	7	1	1/4	0.4755	0.0633
P5	5	1/5	9	4	1	2.0477	0.2725
					TOTAL	7.5151	1.0000

4. Options with respect to forth criteria - C4--------------------

	P1	P2	P3	P4	P5	GM	National priority
P1	1	4	1/8	6	1/9	0.8027	0.1407
P2	1/4	1	1/5	9	7	1.2579	0.2204
P3	8	5	1	1/4	1/7	1.0739	0.1882
P4	1/6	1/9	4	1	1/5	0.4307	0.0755
P5	9	1/7	7	5	1	2.1411	0.3752
					TOTAL	5.7064	1.0000

Step IV: Synthesize to obtain Priority

Options	Priorities with respect to criterion (weights in brackets) ⟹				Global Priority
	C1 (X1=)	C2 (X2=)	C3 (X3=)	C4 (X4=)	
P1	X1C1 (1)	X1C2	X1C3	X1C4	G1=
P2	X2C1	X2C2 (1)	X2C3	X2C4	G2=
P3	X3C1	X3C2	X3C3 (1)	X3C4	G3=
P4	X4C1	X4C2	X4C3	X4C4 (1)	G4=

G1 = X1C1.X1 + X1C2.X2 + X1C3.X3 + X1C4.X4
G2 = X2C1.X1 + X2C2.X2 + X2C3.X3 + X2C4.X4
G3 = X3C1.X1 + X3C2.X2 + X3C3.X3 + X3C4.X4
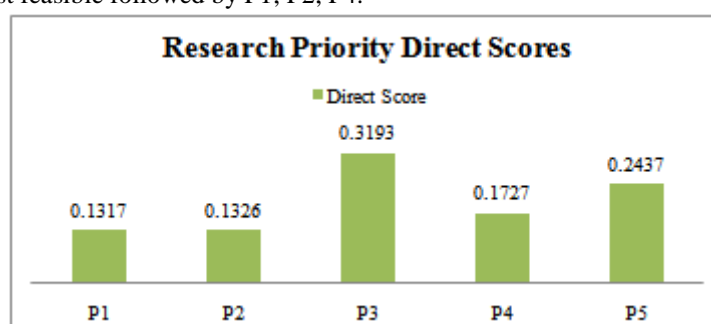G4 = X4C1.X1 + X4C2.X2 + X4C3.X3 + X4C4.X4
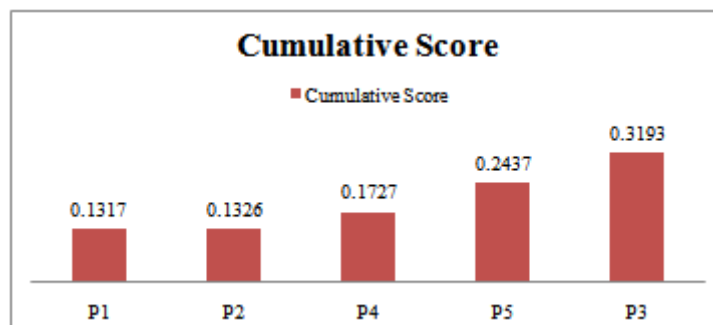G5 = X5C1.X1 + X5C2.X2 + X5C3.X3 + X5C4.X4

Step IV: Synthesize to obtain Priority
Matrix of Local priorities, weights and final ranking of the options

Options	Priorities with respect to criterion (weights in brackets) ⟹				Global Priority
	C1 (X1=)	C2 (X2=)	C3 (X3=)	C4 (X4=)	
P1	0.1052023	0.0125995	0.0076765	0.0062316	0.1317098
P2	0.0539767	0.020796	0.0480414	0.0097653	0.1325794
P3	0.23704	0.0689274	0.0050154	0.0083368	0.3193197
P4	0.1382555	0.0253256	0.005785	0.0033432	0.1727093
P5	0.1292578	0.0728899	0.0249128	0.0166213	0.2436818
TOTAL	0.6637324	0.2005385	0.091431	0.0442981	1

Thus P3 and P5 is most feasible followed by P1, P2, P4.

Research Priority Direct Scores
■ Direct Score

P1	P2	P3	P4	P5
0.1317	0.1326	0.3193	0.1727	0.2437

Research priority of direct score can clearly compare values on an absolute scale and in case of cumulative score 2 of 5 gaps meet almost 75% of our total value of global priority.

III. Conclusion:

In this paper, indicators of research practices are classified into four categories: financial, customer, internal business process, learning and growth. The criteria are both qualitative and quantitative for our case; AHP is used to evaluate decision process. According to AHP's results, the criterion research quality is determined as the most important criterion and the criterion professional methodology of valuation is determined as the least important sub-criterion. The ranking of criteria is determined research quality - transparency in valuation process, improved collaboration in research, efficiency of resources from the most important to the least important.

In this paper, AHP methodology is used to determine the best practice for organizational development. According to obtained results, the transparency in valuation process is determined as the best alternative, while improved collaboration in research is determined as second best alternative and professional methodology of valuation is the worst alternative.

Acknowledgements:

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