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Combining Simple Multiple Attribute Rating Technique and Analytical Hierarchy Process for Designing Multi-Criteria Performance Measurement Framework

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Abstract - The purpose of this article is to design specific type of multi-criteria performance measurement (MCPM) framework using the virtues of both simple multiple attribute rating technique (SMART) and analytical hierarchy process (AHP) notions. The article largely focuses on selection of key performance indicators (KPIs) using combined merits of these two methods. Identifying KPIs is one of the major challenges in designing of MCPM frameworks/models and it is one of causes of failure while firms are implementing performance measurement systems. The MCPM framework has been designed by considering the needs of all critical stakeholders as crucial input, namely customers, shareholders, environment & local community, employees and suppliers. Then the strategic objectives of the case studied company were outlined with help of strategy map; all potential performance measures were listed for each strategic objective. Six evaluation criteria were applied to identify 19 KPIs among 46 potential indicators. These criteria were compared each other using AHP; all possible performance indicators were evaluated against each criteria through SMART approach. The findings of this article reveal the importance of combining SMART and AHP for selection of KPIs during designing of MCPM framework. Besides, it also indicates how companies can apply the ideas of balanced scorecard (BSC) and performance prism in order to set strategic objectives. In general the findings are based on "Contingency Theory" which emphasizes that there is no one best approach to manage the whole and that it depends on various situational factors.

Keywords : *simple multi-attribute rating technique (SMART), analytical hierarchy process (AHP), key performance indicators (KPIs), multi-criteria performance measurement (MCPM), framework.*

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Combining Simple Multiple Attribute Rating Technique and Analytical Hierarchy Process for Designing Multi-Criteria Performance Measurement Framework

Fentahun Moges Kasie

Abstract - The purpose of this article is to design specific type of multi-criteria performance measurement (MCPM) framework using the virtues of both simple multiple attribute rating technique (SMART) and analytical hierarchy process (AHP) notions. The article largely focuses on selection of key performance indicators (KPIs) using combined merits of these two methods. Identifying KPIs is one of the major challenges in designing of MCPM frameworks/models and it is one of causes of failure while firms are implementing performance measurement systems. The MCPM framework has been designed by considering the needs of all critical stakeholders as crucial input, namely customers, shareholders, environment & local community, employees and suppliers. Then the strategic objectives of the case studied company were outlined with help of strategy map; all potential performance measures were listed for each strategic objective. Six evaluation criteria were applied to identify 19 KPIs among 46 potential indicators. These criteria were compared each other using AHP; all possible performance indicators were evaluated against each criteria through SMART approach. The findings of this article reveal the importance of combining SMART and AHP for selection of KPIs during designing of MCPM framework. Besides, it also indicates how companies can apply the ideas of balanced scorecard (BSC) and performance prism in order to set strategic objectives. In general the findings are based on "Contingency Theory" emphasizes that there is no one best approach to manage the whole and that it depends on various situational factors.

Keywords : simple multi-attribute rating technique (SMART), analytical hierarchy process (AHP), key performance indicators (KPIs), multi-criteria performance measurement (MCPM), framework.

I. Introduction and Background of the Problem

During the past three decades, various multi-criteria performance measurement (MCPM) models/ frameworks have been proposed due to various shortcomings of traditional finance based performance measures. Some of the proofs are balanced scorecard (BSC) (Kaplan and Norton, 1992 & 1996), performance prism (Neely and Adams, 2000), strategic measurement and reporting technique (SMART) pyramid (Lynch and Cross, 1991), integrated framework (Medori and Steeple, 2000), Sink and Tuttle (1989), performance measurement matrix (Keegan et al., 1989), Malcolm Baldridge award (1987), European foundation for quality management (EFQM) business excellence model (1992), results and determinants matrix (Fitzgerald et al.,1991), integrated performance measurement system (Bititci, 1994), integrated dynamic performance measurement system (Ghalayini et al., 1997), dynamic performance measurement system (Bititci et al., 2000), conceptual design of performance measurement and management system (Souza et al., 2005).

One of imperative challenges facing companies to implement MCPM frameworks is determining key performance indicators (Neely, 1999; Valiris et al., 2005). Many researchers have proposed performance measures/indicators should be a few and critical. For example, Kaplan and Norton (1996) mentioned performance measures should not be more than 25. Rompho (2011) also reviewed that one of important factors for design failure of performance measures is inclusion of too many indicators without identifying the critical few. In order to take appropriate actions it is advisable to limit number of performance measures /indicators (Jackson, 2000). Usually companies with over 20 key performance indicators are characterized with lack of focus, lack of alignment, and underachievement (Parmenter, 2010). Neely et al. (2002) and Tangen (2004) stress the messes of wrong performance measures due to the use large number performance indicators. It also added companies should prioritize performance measures and decide and focus on critical few performance indicators which are vital for the success of organizations. Besides the importance of having a few vital performance indicators and the challenges to identify these indicators are elaborated in many articles (Neely et al., 1997; Medori and Steeple, 2000; Murray and Richardson, 2004; Smith, 2005; Kreher, 2006; Thomas, 2007; Franceschini et al., 2007; Taticchi, 2010).

Although many articles and research have been undertaken regarding the substance of having a few

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performance indicators, few researchers have done research on the methodologies how to select these few critical performance indicators. Kaplan and Norton (1996) proposed "Strategy Map" to make causal relationship between company's key strategic goals. They argue performance measures should be derived from these strategic goals. Neely et al. (2002) focuses performance measures to incorporate critical stakeholder such as the influence of local community, regulators, suppliers and employees in addition to shareholders and customers. The application of MADM during designing of MCPM framework is very limited. On the other hand, only few researchers have unveiled the application of MADM for selecting decision alternatives (critical performance indicators). For example, Valiris et al. (2005) used SMART to identify KPIs for designing BSC and reviewed a few researchers applied AHP in order to select measures during designing of BSC, namely, Clinton (2002), Reisinger et al. (2003) and Searcy (2004).

But, nowadays gap is shown in applying combined effects of SMART and AHP for identifying KPIs during the development of MCPM frameworks. This article is designed to fill this gap. It combines the approaches (SMART and AHP) to select KPIs which represent all critical stakeholders that will affect the success organizations in the long-run. And also this paper combines the ideas of BSC (Kaplan and Norton, 1996) and Performance Prism (Neely and Adams, 2000). The theoretical foundation for this paper is Contingency Theory which is known as "it all depends" approach. In contingency view management approaches are dependent on unique situation, flexible, drawn on a variety of theories and experiences, and evaluated many in options to solve problems. Contingency management recognizes that there is no one best way to manage instead it combines different approaches depending on existing specific situation.

Based on this contingency view, the paper combines the advantages of SMART and AHP for identifying KPIs and also it integrates the benefits of BSC and performance prism at the stage of outlining the strategy map of MCPM framework. Referring these ideas, this paper aims to design specific type of MCPM framework by combining AHP method and SMART. The article largely focuses on selection of KPIs which is one of the major challenges in designing of MCPM frameworks. AHP is applied to make pairwise comparison among criteria/attributes that can be used to identify KPIs among all possible performance measures. Additive SMART is also realized to score each alternative (potential performance measure) against each attribute.

This paper is structured in a way that starting with brief introduction for the background of the problem. Secondly, fundamental concepts regarding MCPM particularly BSC and performance prism; multiple criteria decision making (MCDM) and MADM are addressed. Special features of multiple-attribute utility theory (MAUT) methods such as AHP and SMART are described in brief. Next methodology is briefly outlined to indicate how the MCPM framework is designed using combined approaches of AHP and SMART. Then designing of MCPM framework is presented with special focus of selecting KPIs. And finally essential conclusion and recommendations are presented.

II. Literature Review

a) *Multi-criteria performance measurement (MCPM) frameworks/models*

MCPM frameworks have been proposed following the limitations and critics of traditional cost and accounting performance measurement systems by various researchers. Among them the first ones to identify the shortcomings and to challenge the operating assumptions of traditional cost accounting systems were Kaplan (1983) and Goldratt & Cox (1986). Major limitations and critics are reviewed that traditional performance measures are historical to forecast future; solely focus on financial indicators; lacking integration of strategies with performance measures; short term and internal focused; highly distorted for future and long-term decision; lacking to ponder effects of customer and other key stakeholders; do not encourage decentralization; inhibits continuous improvement and innovation (Kaplan & Norton, 1992; Bititci, 1994; White, 1997; Neely, 1999; Neely et al., 2000; Kennerley and Neely, 2003; Gomes et al., 2004; Tangen, 2004).

Due to above mentioned dissatisfactions and critics in late 1970s and early 1980s on traditional finance based performance measures led both academicians and business practitioners to realize development of ``balanced'' or ``multi-dimensional'' or "integrated" performance measurement frameworks in late 1980s and early 1990s. And new frameworks were focused on non-financial, external and future looking performance measures (Bourne et al., 2000). According to Gomes et al. (2004) common words to describe recent performance measurement systems are balanced, integrated, linked, multi-faceted or multi-dimensional. Tangen (2004) underscored recent performance measurement system should support strategic objectives (derived from strategic objectives), have appropriate balance among financial and non financial measures, guard against sub-optimization (avoid productivity paradox), have limited number of performance indicators, be easily accessible, consist of performance measures that have comprehensible specifications (have a clear purpose and be defined in an unambiguous way). In addition, Neely et al. (1997) reviewed 22 recommendations that should be fulfilled for designing effective and efficient performance measurement framework.

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The characteristics of effective and efficient performance measures are described in (Neely et al., 1995 & 97; Artley, 2001; Gomes et al., 2004; Yuksel, 2004; Parmenter, 2010). These are summarized as follows: align daily activities to strategic objectives; have a balance between critical measures and have a limited number of performance measures; be easily accessible; have a clear purpose & a target for each performance measure and a timeframe for targets; guard against sub-optimization; developed by users; consider improvement for performance; combine leading and lagging indicators; and motivate employees.

As mentioned above, numerous performance measurement frameworks/models have been proposed to overcome the challenges during the past. Among them, most widely recognized are the balanced scorecard (BSC) (Kaplan and Norton, 1996) and the performance prism (Neely and Adams, 2000). BSC proposes four interconnected perspectives of performance measurement such financial, customer, internal business process, and learning and growth perspectives. Its main concern is that measures of internal business process performance and learning and growth should be derived from shareholders' and customers' views of performance. The BSC framework shown in figure 1 discloses how vision and strategies can be translated into four measurement perspectives.

Figure 1 : Translating Vision and Strategy: Four Perspectives (source: Kaplan & Norton, 1996)

According to Kaplan and Norton (1992 and 1996) the BSC minimizes information overload by focusing on most critical measures which are strongly aligned with companies' strategies objectives. Besides, it also guards against sub-optimization by forcing top managers to let them see in four crucial perspectives whether improvement in one area may have been achieved at expense of another (Kaplan and Norton, 1992). Despite BSC overcomes the major pitfalls of traditional measurement frameworks, it is not free from any critics. The important limitations of BSC are its emphasis on shareholders and customers and it fails to address the impact of crucial other stakeholders like community, employees, suppliers, competitors, regulators (Neely and Adams, 2000; Neely et al., 2002; Kennerly and Neely, 2003; Kennerley and Neely, 2004). Other shortcomings are also revealed in (Ghalayini et al. 1997; Epstein and Manzoni, 1998; Schneiderman, 1999; Olson and Slater, 2002; Meyer, 2002).

The performance prism proposed by Neely and Adams (2000) is also based on interconnected perspectives of measurement, illustrated by the facets of

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a prism as indicated in figure 2. It is intended to prevail over the limitations of BSC with considering all important stakeholders rather than focusing on shareholders and customers only. Performance prism focuses on the following critical questions. "Who are our stakeholders and what do they want and need? What do we want and need *from* our stakeholders? Then it prompts questions about what strategies are required to deliver value to these stakeholders. What processes need to be put in place to execute these strategies? What capabilities – bundles of people, technology, practices and infrastructure – are required to underpin these processes?"(Neely et al., 2002).

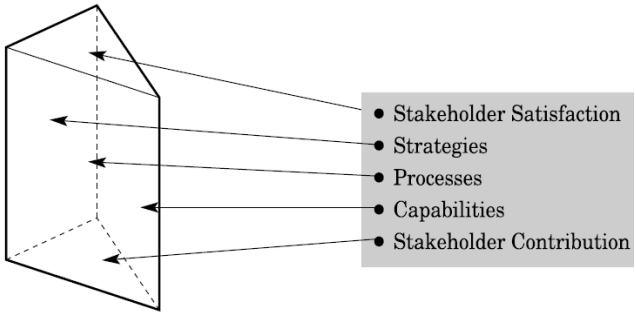

Figure 2 : Performance Prism (Source: Neely et al., 2002)

The performance prism considers more holistic view of different stakeholders such as customers, suppliers, employees, regulators, legislators, media and local communities. It also explicitly expresses organizations' strategies, processes and capabilities have to be aligned and integrated each other in order deliver real value to all of its stakeholders; organizations and their stakeholders have to recognize that their relationships are reciprocal i.e Stakeholders have to contribute to organizations, as well as expect something from them. Neely et al. (2001 & 2002) underscore performance measures should not be strictly derived from strategy rather wants and needs of all important stakeholders must be taken in to consideration and then strategies have to be devised. However, performance prism considers most of the shortcomings of many existing frameworks; it lacks how the performance measures are going to be realized (Tangen, 2004).

b) Multiple-Criteria Decision Making (MCDM)

Real decision making process is strongly related to the comparison of different points of view, some in favor and others against a certain decision i.e. decision is intrinsically related to a plurality of points of view (Figueira et al., 2005). Multiple criteria decision making (MCDM) is one of well-known modeling and methodological tools for studying multifaceted problems (Kahraman, 2008). It focuses on decision problems due to the presence of various decision criteria and interacting design constraints. MCDM is defined as decision making under the presence of multiple, conflicting criteria for judging the alternatives and the need for making compromises or trade-offs regarding the outcomes of alternate courses of action (Masud and Ravindran, 2009; Ehrgott et al., 2010). There are two broad approaches MCDM problems. These are multiple criteria selection problems or multiple attribute decision making (MADM) problems and mathematical programming problems or multiple objective decision making (MODM).

The focus of MADM is on selecting the best alternative(s) from a finite set of alternatives or to prioritize these set finite alternatives using their attributes. In MADM alternatives are discrete, predetermined and its final decision may be sorting, ranking, screening or selection alternatives based on their attributes. In MODM approach, decision alternatives are infinite and the tradeoffs among design criteria are typically described by continuous mathematical functions. MODM problems are typically modeled using precise mathematical equations, involving decision variables incorporated within constraints and objectives (Kahraman, 2008; Masud and Ravindran, 2009). A good example such problems is goal programming. However, the attention of this paper is applying MADM for ranking and selection alternatives from a set of finite alternatives.

c) Multiple attribute decision making (MADM)

MADM is one of well-recognized branches of decision making which can be viewed as alternative methods for combining the information in a problem's decision matrix together with additional information from the decision maker to determine a final ranking, screening, or selection among the alternatives except some of simple techniques (Kahraman, 2008). The general pay-off matrix for MADM is as shown in table 1.

Table 1 : Pay-off matrix for MADM

		x_1	x_2	. . .	x_n
		A_1	A_2	. . .	A_n
w_1	C1	a_{11}	a_{12}	. . .	a_{1n}
w_2	C_2	a_{21}	a_{22}	. . .	a_{2n}
.	.	.	.	. . .	.
.	.	.	.	. . .	.
.	.	.	.	. . .	.
w_m	C_m	a_{m1}	a_{m2}	. . .	a_{mn}

Where
m is number decision criteria
n is number of alternatives

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$C_1,.,C_m$ are m decision criteria/attributes

$A_1,..,A_n$ are n finite alternatives

a_{ij} is scored performance of the alternative A_i (i= 1…n)against criterion C_j(j=1…m)

$w_1,...,w_m$ are normalized weight assigned to the criteria

$x_1,...,x_n$ are values associated with the alternatives **after evaluating with m criteria**

The total "score" x_i for each decision alternative A_i against each criterion C_j in the above pay-off matrix can be calculated by applying the formula:

$$X_i = \sum w_j \, a_{ij}$$

Nowadays, numerous MADM methods are available. For example, Kahraman (2008) reviewed 19 different MADM methods. Similarly, Masud and Ravindran (2009) also reviewed seven methods of multiple criteria methods for finite alternatives. Comprehensively, there are two large **families of MADM approaches namely outranking and multiple attribute utility theory (MAUT) methods.**

Outranking methods were developed in late 1960s at the European consultancy company SEMA and they were used for solving multi-criteria real world problems (Figueira et al., 2005). Outranking methods compare two alternatives using pair-wise comparison or binary relationships. Preferences are usually modeled by outranking relations, *S,* whose definition is on the set of potential actions *A* such that *aSb* if there are enough arguments to decide that *a* is at least as good as *b* whereas there is no essential argument to refute that statement. The founder for outranking methods is Bernard Roy. The method was called ELECTRE I (Roy, 1990-91, 96; Figueira et al., 2005). Other families of ELCTRE such as ELECTRE I, II, III, IV, Tri, and IS have been devised successively based on the limitations of preceding versions (Roy, 1981, 90 & 96; Rogers, 2000; Bufardi et al., 2008; Ehrgott et al., 2010). Besides, other well-known classes outranking methods are PROMETHEE, ORESTE, QUALIFLEX, REGIME, ARGUS, EVAMIX, TACTIC and MELCHIOR (see Brans and Mareschal 2005; Martel and Matarazzo, 2005; Bufardi et al., 2008). These methods can be classified as European schools of multi-criteria methods since their contributors are many European scientist and the aim is not to find the optimal choice and they are not based on a powerful axiomatic foundation (Valiris et al., 2005). Their purpose is to determine a **subset of alternatives that can any alternative which is not part of the subset be outranked by at least one member of the subset and it is intended to make this subset as small as possible. Most of these methods are** important for some problems such as those involving environmental and social impacts assessment (Bufardi et al., 2008).

Multi-attribute utility theory (MAUT) studies the selection of optimum satisfactory solution and the best alternative solution which maximizes utility for the decision maker's stated preference structure (Kahraman et al., 2008). MUAT approach assigns a utility value which is a real number representing the preference of the considered action (Figueira et al., 2005). According to Keeney and Raiffa (1976) MAUT methods consist of aggregated utility values of alternatives against the different criteria by making a function that should be optimized by allowing complete compensation between criteria, i.e. the gain on one criterion can compensate the lost on another. They belong to American schools of multi-criteria methods which are focused on weighting methods to reduce a multidimensional evaluation to an aggregated utility (or value) function, with which the criteria between them are balanced (Valiris et al., 2005). MUAT models are classified additive and multiplicative utility models (Dyer, 2005; Kahraman et al., 2008). They also describe these models are based on alternate sets of axioms that have implications for their assessment and use. Well-recognized methods under this category are analytic hierarchy process (AHP) and simple multiple attribute rating technique (SMART). This article brings into play these two popular MUAT methods in order to choose KPIs at the time of designing a MCPM framework.

AHP was initially developed by Thomas Saaty (Saaty, 1980). It is a theory of measurement that uses pairwise comparisons along with expert judgments (Figueira et al., 2005) and it is a type of additive weighting method (Kahraman, 2008). AHP is one of the most widely-used MADM methods, which has been used in many different fields as a multi-attribute decision analysis tool with multiple alternatives and criteria (Demirel et al., 2008). It uses "pair-wise comparisons" and matrix algebra to weight criteria and the decision is made by using the derived weights of the evaluative criteria (Saaty, 1980). According to Saaty (2005) "AHP is a theory of relative measurement on absolute scales of both tangible and intangible criteria based on both of the judgment of knowledgeable and expert people. Pairwise comparisons are made by using a preference scale which assigns numeric values to different levels of preference. The standard preference scale used for AHP is shown in below.

Table 2 : Preference scale for pairwise comparisons (Source: Taylor III, 2006)

Preference Level	Numeric Value
Equally preferred	1
Equally to moderately preferred	2
Moderately preferred	3
Moderately to strongly preferred	4
Strongly preferred	5
Strongly to very strongly preferred	6
Very strongly preferred	7
Very strongly to extremely preferred	8
Extremely preferred	9

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AHP results are more consistent and accurate than other MAUT methods as the size of matrix is not greater than ten criteria. Its consistency deteriorates and it becomes tedious and time consuming when the numbers of factors are increasing. Additional limitation of AHP is the rank reversal phenomenon that simply by adding another alternative or criteria to the list of choices being evaluated, the ranking of two other options, not related in any way to the new one, can be reversed (Golden et al., 1989; Belton and Goodwin, 1996; Valiris et al., 2005)

Another simplest additive model of the MAUT methods is SMART. This method is widely used while comparing alternatives because of its simplicity (Kahraman et al., 2008). Edwards (1977) also proposed a simple method to assess weights for each of the criteria to reflect its relative importance to select the best alternative. The advantage of this method is that attributes are preferentially independent i.e. the decision maker's preference (or feelings) regarding the value of one attribute are not influenced in any way by the values of the other attributes (Fishburn, 1976). This characteristic is particularly useful when new alternatives or criteria are added to the existing comparison. Any further evaluations necessarily need not begin right from the start but the process can continue from the previous scores obtained (Valiris et al., 2005). SMART can also be applied for any number of alternatives or criteria without limitation. The disadvantage of SMART is that its priority and score result is not equally consistent with AHP.

d) Multi-criteria performance measurement and multi-attribute decision making

The application of MADM during designing of MCPM framework is very limited. Only few researchers have unveiled regarding the application of MADM for selecting decision alternatives (critical performance indicators). For example, Valiris et al. (2005) reviewed a few researchers applied AHP in order to select measures during designing of BSC, namely Clinton (2002), Reinsinger et al. (2003) and Searcy (2004). Reflecting mentioned above shortcomings of AHP, Valiris et al. (2005) disclosed a case company which had applied SMART to identify KPIs for the development of BSC. SMART has been also criticized due to its consistency limitation as compared to AHP. The intention of this paper is not to criticize these MUAT approaches (AHP and SMART) instead to reveal how companies could be benefited from merits of both approaches contingently. Research in this perspective is much unexplored. This article is designed to fill this gap and aimed to design a MCPM framework by applying AHP and SMART in combination in order to determine KPIs at the stage of designing MCPM frameworks.

III. Methodology

The research has been carried out by considering one of Ethiopian Brewery Company as a case study in order to design appropriate MCPM framework which is specific to the case company. At the beginning, performance measurement development committee was established with seven members who represent different functional units of the company. They were chosen from different departments such as marketing & customer service, finance, human resources, quality, production, technical and purchasing. For designing the MCPM framework, important features of two well-recognized performance measurement frameworks were considered namely BSC (Kaplan and Norton, 1996) and performance prism (Neely and Adams, 2000). During the designing process, the impacts of all important stakeholders and their values were incorporated ahead of devising company's strategic objectives i.e. applying the core ideas of performance prism. Then the vision and strategic objectives were stated based on Kaplan and Norton Balanced Scorecard (BSC) and the Strategy Map was outlined to indicate causal relationships among measurable strategic objectives. The basis for these strategic objectives was the needs of crucial stakeholders such as customers, shareholders, employees, suppliers and local community.

The next step was identifying key performance indicators/measures which are relevant for stated strategic objectives. For this purpose, six performance measurement evaluation criteria were determined. It was agreed the number KPIs should not be greater than 25 similar to BSC. These six evaluation criteria for performance measures were: Alignment with strategic objectives (ASO), Leading vs. lagging (LL), Consistency and continuity (CC), Focus on improvement (FI), Simplicity and clarity (SC), and Accessibility (Ac). They were preferred based on literatures from different sources.

1. Alignment with strategic objectives (ASO) - (Dixon et al.,1990; Lingle and Schiemann, 1996; Kaplan and Norton, 1996; Neely et al., 1997; Kennerley and Neely, 2003; Tangen, 2004; Valiris et al., 2005)
2. Leading vs. lagging (LL) - (Lingle and Schiemann, 1996; Neely, 1999; Bond, 1999; Amaratunga et al., 2001; Valiris et al., 2005)
3. Consistency and continuity (CC) - (Neely et al., 1997; Kennerley and Neely, 2003)
4. Focus on improvement (FI) - (Neely et al., 1997; Kennerley and Neely, 2003)
5. Simplicity and clarity(SC) - (Neely et al., 1997; Kennerley and Neely, 2003; Valiris et al., 2005)
6. Accessibility (Ac) - Neely et al., 1997; Kennerley and Neely, 2003; Tangen, 2004; Valiris et al., 2005)

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These six evaluation criteria were ranked using AHP method. Decision makers (members in the committee) assigned numeric preference values for each criterion by using pairwise comparisons in order to compute weight for each criterion.

Next all (46) possible non-financial decision alternatives (measures) for each strategic objective were listed using brainstorming by each member of the committee. After identifying all potential measures, a numeric score between 0 and 100 were assigned for indicating how well each decision alternative satisfies each criterion using SMART, where a score of 100 indicates extremely high satisfaction and 0 indicates virtually no satisfaction. Finally the total "score" X_i for each decision alternative A_i was calculated by applying the formula:

$$X_i = \sum w_j \, a_{ij}$$

Where

w_j = normalized weight assigned for each evaluation criterion C_j (j = 1…6) using AHP.

a_{ij} = scored performance of the alternative A_i against criterion C_j using SMART.

An alternative with the higher score of X_i is the better decision alternative.

Table 3 : All potential performance measures for strategic objectives

Strategic Objectives	Potential Performance indicators
Improve market share	Market share growth (A1)
	Market segmentation (A2)
	Strategic alliance (A3)
	Sales growth (A4)
	Sales per advertisement cost (A5)
	Sales per market survey cost (A6)
	Customer profitability (A7)
Increase customer satisfaction and potential customers	Satisfied customers (A8)
	Retained customers (A9)
	Customer complaints (A10)
	Incorporated ideas of customer (A11)
	Warranty claims (A12)
	Missed due dates (A13)
	New customers added (A14)
Sustain environmental and local community issues	Community complaints (A15)
	Sales per promotion costs (A16)
	Community involvement (A17)
	Implemented environmental obligations (A18)
	Scrapes & wastages reduced (A19)
Improve product quality, price and delivery time	Orders delivered on time (A20)
	Failure cost (internal & external) (A21)
	Raw materials defect rate (A22)
	Lead time (A23)
Improve operational processes	Capacity utilization (A24)
	Effectiveness (A25)
	Process efficiency (A26)
	Inventory level (A27)
	Equipment down time (A28)
	Product cycle times (A29)
Enhance employees' capability and satisfaction	Satisfied employees (A30)
	Accident frequency rate (A31)
	Employee complaints (A32)
	Rewarded employees (A33)
	Employee involvement (A34)
	Acceptable suggestions (A35)
	Absentees (A36)
	Employee turnover (A37)
	Employee productivity (A38)
	Innovations (A39)
	Employee skill level (A40)

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	Budget for training (A41)
	Employee awareness level (A42)
	Insurance expenditures (A43)
	Qualification growth (A44)
	Operating costs per employee (A45)
	Lawsuits with employees (A46)

IV. Designing Multi-Criteria Performance Measurement Framework

This part of the paper discusses practical case study of designing MCPM framework by applying important concepts of MCPM and MADM. The case company is one of well-performing Ethiopian brewery share companies. The MCPM framework was developed step by step with discussion of all committee members.

a) Establishment of vision and mission statements and strategic objectives

The strategic objectives have been stated based on the needs of all critical stakeholders rather than shareholder and customer perspectives. Neely et al. (2002) states "in order to survive and prosper in an increasingly complex and connected world, executives have to understand what their various stakeholders want and need from the organization and what the organization wants and needs from them". It also argues companies have to align their strategies, processes and capabilities for satisfying and delivering value to their stakeholders. Then the vision and mission statements and long-term stakeholder values of the case company were identified as stated below.

b) Vision

- The vision of Company is being a leading company in African markets by producing and supplying quality and standard beverages.

c) Missions

1. Producing and supplying variety types of quality beverages at required quantity, quality and price to local and foreign market;
2. Satisfying the needs of essential stakeholders such as customers, shareholders, employees, local community, regulators and partners by increasing market share, revenues, promotions, productivity, profitability and fulfilling environmental obligations;

d) Long-term stakeholder values

- Maintaining its goodwill and reputation
- Fulfilling environmental & social obligations
- Satisfying the needs of customers and employees

Depending upon these long-term stakeholder values, the under-listed strategic objectives were also outlined. These strategic objectives have been considered crucial factors for the success of the company.

e) Strategic Objectives

- Increase profitability
- Improve market share
- Increase customer satisfaction and potential customers
- Improve product price, quality and delivery
- Improve operational processes
- Enhance employees' satisfaction and capability
- Sustain environmental and local community issues

f) Making Causal relationship among strategic objectives

After identifying critical strategic objectives, a Strategy or Success Map was outlined to indicate causal relationships among these strategic objectives. Kaplan and Norton have proposed the use of strategy maps in order to understand explicitly the causal relationships among strategic objectives or critical success factors and companies will have a better idea of how to achieve its potential competitive advantages.

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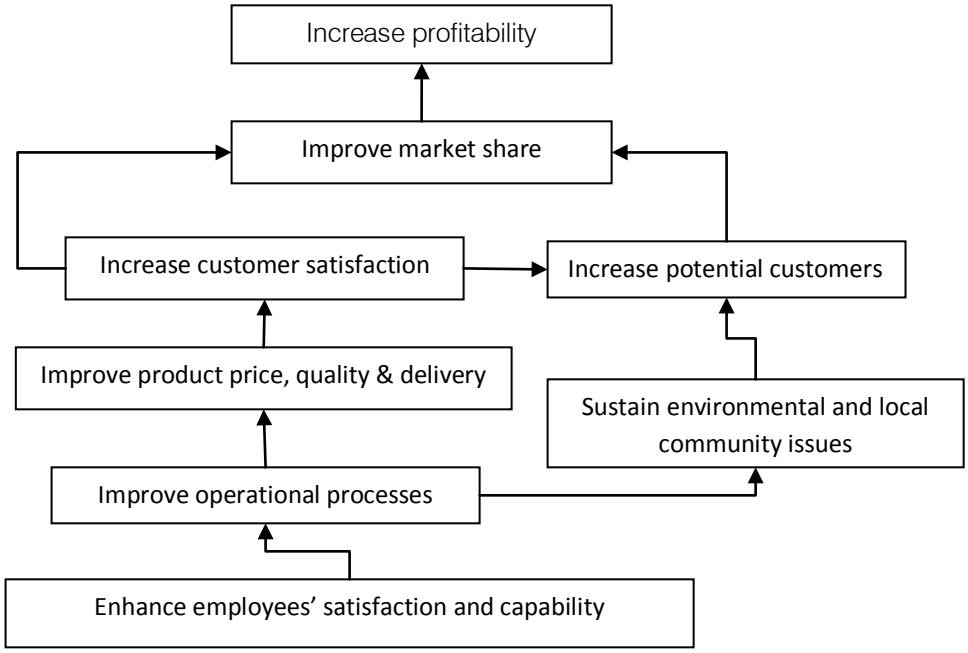

Figure 3 : Causal Relationship

g) Identifying all potential measures for strategic objectives

For outlined strategic objectives, all possible performance measures/indicators for non-financial objectives were identified (see table 3).

h) Identifying key performance indicators (kpis)

The purpose of this stage is to identify a few critical performance indicators which are vital for the success of companies in different perspectives. "KPIs tell you what to do to increase performance dramatically. KPIs represent a set of measures focusing on those aspects of organizational performance that are the most critical for the current and future success of the organization" (Parmenter, 2010). According to (Goodwin and Wright, 2000), this stage incorporates important actions such as identifying the criteria and alternatives; determining weight for each evaluating criterion; assigning values to each alternative (measure) against each evaluation criterion; computing the total utility value of each alternative; and ranking alternatives or selecting the best alternative as per their total utility values.

Six relevant evaluation criteria were identified to determine KPIs among above mentioned potential measures:

1. Alignment with strategic objectives (ASO)
2. Leading vs. lagging (LL)
3. Consistency and continuity (CC)
4. Focus on improvement (FI)
5. Simplicity and clarity (SC)
6. Accessibility (Ac)

In order to determine normalized weight for each criterion, AHP was applied. This is because AHP is preferable for comparison alternatives which are not greater than ten. In order to rank the above evaluation criteria or attributes, pairwise comparisons were performed as shown below;

Table 4 : Preference Matrix

Criteria	ASO	LL	CC	FI	SC	Ac
ASO	1	3	7	6	4	5
LL	1/3	1	5	4	2	3
CC	1/7	1/5	1	1/2	1/4	1/3
FI	1/6	1/4	2	1	1/3	1/2
SC	1/4	1/2	4	3	1	2
Ac	1/5	1/3	3	2	1/2	1
Sum	**293/140**	**317/60**	**22**	**33/2**	**97/12**	**71/6**

In order to determine a normalized matrix, each value in the column was divided by its corresponding column sum. The weight for each criterion (w_j) was found by calculating the average normalized value of each row. These results are obtained as below.

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Table 5 : Normalized Matrix

Criteria	ASO	LL	CC	FI	SC	Ac	Mean (w_j)
ASO	0.4778	0.5678	0.3182	0.3636	0.4948	0.4225	**0.4408**
LL	0.1593	0.1893	0.2273	0.2424	0.2474	0.2535	**0.2199**
CC	0.0683	0.0379	0.0455	0.0303	0.0309	0.0282	**0.0402**
FI	0.0796	0.0473	0.0909	0.0606	0.0412	0.0423	**0.0603**
SC	0.1195	0.0946	0.1818	0.1818	0.1237	0.1690	**0.1451**
Ac	0.0956	0.0631	0.1364	0.1212	0.0619	0.0845	**0.0938**

The consistency index, CI, was computed from above table and its value was obtained $CI = 0.0327$ (see Taylor III, 2006 for computation) and the random index $RI = 1.24$ (from standard table) for number of criteria $m = 6$. The degree of consistency for the pairwise comparisons was determined by calculating the ratio of CI to RI i.e $\frac{CI}{RI} = \frac{0.0327}{1.24} = 0.0263 < 0.10$. Hence the degree of inconsistency is acceptable.

Next, values to each potential measure were assigned against evaluation criterion using SMART approach. As mentioned before, the benefit of this technique is each alternative can be evaluated independently and it is particularly useful when new alternatives or criteria are added to the existing comparison and outdated ones are eliminated. This feature is very essential to add, modify and eliminate performance measures without affecting the value of previously existing performance measures. Based on these notions, committee members agreed to score each measure against each of the six criteria from best values to worst after thorough deliberations. The score values are ranging from 10 (worst relation between the criterion and the measure) to 100 (best relation between the criterion and the measure). And the cumulative values for each alternative were also computed using additive weighting method. Figure 4 and table 6 show the 46 potential measures were evaluated against the six parameters/criteria. Using this approach 19 KPIs were identified those scored not less than 80.

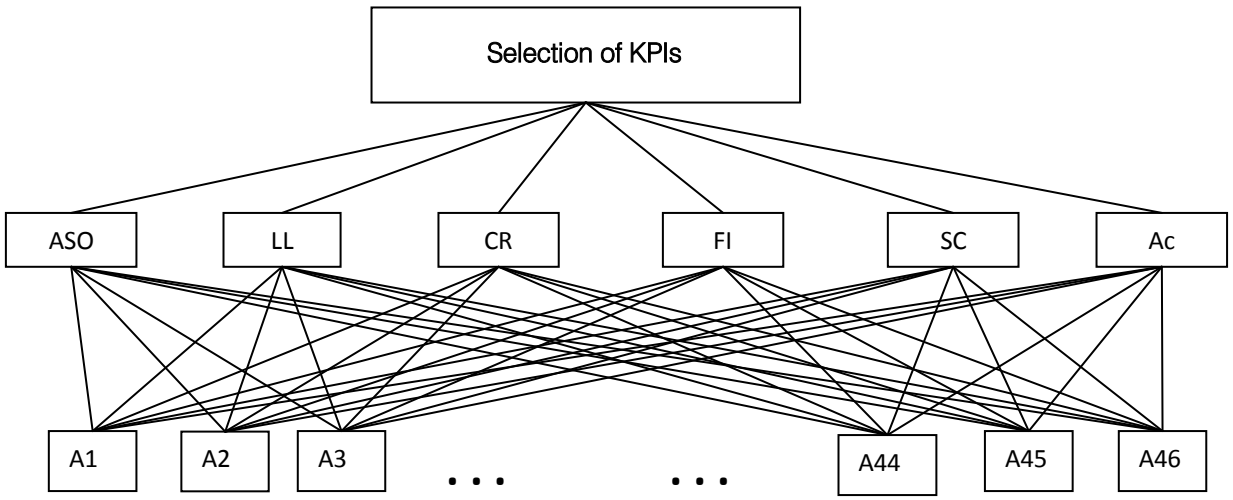

Figure 4 : MUAT frame work for selections of KPIs

After identifying these KPIs, targets were set for strategic objectives; formulae were determined for KPIs; frequency for reviewing, data sources and users for measures were identified.

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Table 6 : Scores and additive weighted values

Criterion	Wj	Alternative (potential performance measure)															
		A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	A13	A14	A15	A16
ASO	0.4408	100	70	60	90	50	90	40	100	100	70	90	70	75	100	95	75
LL	0.2199	50	80	85	20	60	80	50	60	60	50	80	80	90	90	100	30
CR	0.0402	30	75	90	30	10	70	40	60	70	60	90	40	30	85	80	40
FI	0.0603	40	80	80	10	30	60	20	80	70	50	80	20	20	70	20	60
SC	0.1451	90	20	10	100	100	90	80	70	90	60	70	20	80	80	70	80
Ac	0.0938	100	30	40	100	90	90	70	80	90	50	70	30	90	75	50	90
$X_i = \sum w_j a_{ij}$		81.13	62.00	58.78	69.77	60.40	85.20	49.62	82.17	85.81	60.67	82.43	56.98	75.31	90.15	83.14	64.93

Table 6 continued

Criterion	Wj	Alternative (potential performance measure)															
		A17	A18	A19	A20	A21	A22	A23	A24	A25	A26	A27	A28	A29	A30	A31	A32
ASO	0.4408	90	80	80	100	100	50	70	60	40	80	50	40	90	100	40	80
LL	0.2199	95	70	90	90	80	70	90	10	20	90	70	80	90	90	70	70
CR	0.0402	30	10	70	80	100	80	20	20	20	70	30	10	80	60	20	50
FI	0.0603	20	20	90	90	100	80	30	10	30	80	70	70	90	70	10	60
SC	0.1451	40	70	80	80	70	60	90	90	80	100	70	90	90	80	70	80
Ac	0.0938	30	60	70	80	60	60	90	80	80	100	60	100	80	60	70	60
$X_i = \sum w_j a_{ij}$		71.59	68.05	81.47	91.63	87.51	59.81	74.76	50.62	43.76	86.58	58.65	62.29	88.67	87.74	51.16	73.52

Table 6 continued

Criterion	Wj	Alternative (potential performance measure)														
		A32	A33	A34	A35	A36	A37	A38	A39	A40	A41	A42	A43	A44	A45	A46
ASO	0.4408	80	90	70	80	20	30	100	90	100	50	40	40	90	60	70
LL	0.2199	70	100	100	90	60	70	60	100	80	20	70	30	80	50	80
CR	0.0402	50	80	80	100	10	10	80	80	40	10	20	20	50	50	10
FI	0.0603	60	60	70	100	10	10	70	100	40	50	40	20	60	60	20
SC	0.1451	80	80	50	90	90	90	90	60	60	80	40	50	70	80	60
Ac	0.0938	60	50	70	80	90	90	90	80	80	90	30	40	80	90	40
$X_i = \sum w_j a_{ij}$		73.52	84.79	74.10	85.67	44.52	51.12	86.21	87.12	81.90	49.91	44.86	37.25	80.55	63.12	62.51

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V. Conclusions

At the time of designing performance measurement frameworks, one of the important challenges is determining key performance indicators (KPIs). MCPM framework should be designed by considering the needs of all critical stakeholders such as customers, shareholders, environment & local community, employees and suppliers as mentioned in performance prism principles. And then the strategic objectives should be outlined using the needs these important stakeholder. The causal relationships among these strategic objectives have to be shown with help of strategy map similar to concepts of BSC. The relevant performance measure evaluation criteria/attribute must be identified carefully in order to select KPIs among all potential candidate performance measures.

The findings of this article reveal organizations are contingently able to apply SMART and AHP to identify KPIs among all possible performance indicators at the time designing MCPM framework using the virtues of both. According to Contingency Management Theory, applying a single method can not be anticipated to undertake a significant change in all aspects. Contingency thinking avoids the classical "one best way" arguments and recognizes the need to understand situational differences and respond appropriately to them (Benowitz, 2001). A particular approach may be significant on certain aspects of business and deficient on other aspects. This paper has applied AHP to rank the six evaluation criteria and SMART to score the importance of each performance measure against each criterion in order to optimize their advantage. Therefore, AHP and SMART can be applied in collaboration for identifying KPIs rather than using them independently because organizations are able grasp the merits of these two well-recognized MADM methods. It has been also revealed the use of combined approaches of AHP and SMART are unexplored while selecting KPIs for development of MCPM.

VI. Research Limitations

The limitation for this article is that the values for comparison of criteria/attributes and the importance each alternative (performance indicator) were assigned subjectively after intense deliberation among performance measurement designing committee members. In order to minimize variations due to such subjective decisions, other suitable approaches of MADM such as fuzzy theories are recommended as future research direction.

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