Scorecard Approach to Benchmarking Organizational Safety Culture in Construction

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Abstract: This paper promotes adopting the balanced scorecard tool to benchmark organizational safety culture in construction. It argues that this tool has the potential to provide a medium to translate the organization's safety policy into a clear set of goals across four perspectives: *management, operational, customer, and learning*. These goals are then further translated into a system of performance measures that could effectively communicate a powerful strategic focus on safety to the entire organization. Four perspectives have been developed to represent all stakeholders, thereby ensuring that a holistic view of safety is used for strategic reflection and implementation. The paper argues that by selecting and evaluating the appropriate measures, in each perspective, requirements can be identified, and actions to the identified goals can be aligned and facilitated. The proposed balanced scorecard approach should therefore enable construction organizations to pursue incremental safety performance improvements. Work-in-progress is briefly reported to give insight into the potential applicability of this approach.

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Introduction

Work accidents are the result of a sequence of events. They arise from different causes that can generally be classified as physical incidents posing hazardous situations and behavioral incidents caused by unsafe acts (Kartam 1997). Construction organizations are becoming more aware that controlling physical aspects and technical hazards are not the only ways to reduce accidents. Attention must also be given to managerial, organizational, and human factors. However, these organizations lack the insight for the development of effective performance measures and metrics needed to achieve a comprehensive safety management system. Moreover, such measures and metrics are needed to test and reveal the viability of strategies without which a clear direction for improvement would be highly difficult to achieve. Smith et al. (1998) state that the basis for acceptable safety performance is an established and robust safety management system that provides the means for controlling and monitoring performance.

Safety Measures

To date, most safety performance measurement systems have been preoccupied with the negative consequence of site accidents rather than proactive prevention strategies. The most common construction safety measures for identifying these failures have been the use of accident rates, lost time injury frequency rates, and workers compensation statistics. Such measures are now almost universally regarded as being unsuccessful in providing meaningful measures of safety performance (Trethewy et al. 1999). This is due to their reactive nature—they only record accidents after they have occurred. It is also because of this those incidents or near-misses that have the potential to cause injury can go unrecognized. Furthermore, using accident statistics can encourage under-reporting of accidents, as workers may not report an accident for fear of being reprimanded for compromising the safety performance of the workplace.

Although accident statistics are widely used throughout the construction industry, Laitinen et al. (1999) state that it is almost impossible to use accidents as a safety indicator for a single building construction site. This is because of random variation where many sites will have no accidents, and it is not possible to determine whether these sites with zero accidents are safer than sites with, for example, four or five accidents. Glendon and Mckenna (1995) identify a number of reasons why accident data, or similar outcome data, are poor measures of safety performance. The main problems are that such data are insufficiently sensitive, of dubious accuracy, retrospective, and ignore risk exposure. The use of workers compensation statistics such as Experience Modification Rate (EMR) was also criticized for being sensitive to factors unrelated to safety. Hinze et al. (1995) outline scenarios whereby changing some variables that are unrelated to safety performance, such as labor cost or company size, the EMR value was drastically altered, regardless of lack of change in actual accidents.

To overcome the disadvantages of adopting reactive measures, it has been suggested to use behavioral observation measures (Peterson 1998; Laitinen et al. 1999). These measures are based on random samples of workers behavior, which is then evaluated to be safe or unsafe (Tarrants 1980). The advantage of using a behavioral observation method in measuring safety performance is that it does not just focus on noncompliant behavior but also acknowledges safe behavior. However, this method is not without its drawbacks. One of its major disadvantages is that no allow-

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ance is made for the severity of the safety breach. This could mean that a site could still end up with a high safety score but could have had a number of serious safety breaches at the same time. If using this to compare with other sites, a site with a few serious safety breaches could score higher than a site with more safety breaches but of a less serious nature.

In addition to the above drawbacks, current performance measures offer too little in reflecting the management commitment and corporate culture within which safety is supposed to permeate all levels of the organization. Moreover, the traditional assumption that safety is the sole responsibility of the contractor (Hinze and Wiegand 1992) is no longer valid, especially after the introduction of the Construction, Design, and Management (CDM) regulations in many developing countries. The fundamental principle on which these regulations are based is that all project participants (client, architects, designers, subcontractors, etc.) who contribute to safety on a project are to be included in considering safety issues systematically, stage by stage, from the outset of the project (Baxendale and Jones 2000). For example, once a decision is taken to commission a project, the client, together with the designer, must apply the CDM regulations by appointing a planning supervisor who must ensure that all design work has been considered from a safety perspective. The planning supervisor is also responsible for assessing the safety competence of principal contractors and for observing their performance. As can be seen, these regulations bring safety, on an obligatory basis, into the planning and design of construction work (Baxendale and Jones 2000). Accordingly, project participants are drawn into the sphere of responsibility for safety-plan implementation, thus changing the safety norms (Langford et al. 2000). As such, performance measures need to reflect the safety aspects of these work phases too.

In view of the preceding review, it is clear that a much wider perspective is required, one which allows organizations to swerve away from only considering accident-related statistics. There is also a need to focus on the means by which such accidents are prevented, i.e., adopting a much broader stance that accommodates focusing on the determinants of a positive safety climate and integrates these within the achievement of a zero-accident culture. This paper attempts to develop safety performance measures and metrics in the context of

1. assessing safety performance objectively as well as subjectively, where a mix of quantitative and qualitative performance measures is adopted. This is to enable organizations to regularly evaluate safety performance and identify areas of potential improvement.
2. distinguishing between metrics at the operational and managerial (strategic) levels. Using a classification based on these two levels, each metric can be assigned to a level where it would be most appropriate.
3. using leading performance measures such as measurements of safety climate to capture the perception, inter alia, of both management and workers. Budworth (1997) refers to the practice of measuring safety climate as taking the *safety temperature* of an organization.

In the following sections, the paper gives an introduction to the concept of safety culture and climate and then presents an argument for adopting a scorecard approach to benchmark construction safety performance through which the above three requirements are met. The paper also suggests using a measurement approach that is based on a combination of questionnaire, focus groups, behavioral observations, and situational audits.

Safety Culture and Climate

The term ''safety culture'' first made its appearance in the 1987 OECD Nuclear Agency report (INSAG 1988) on the 1986 Chernobyl disaster. Gaining international popularity over the last decade, this term is loosely used to describe the corporate atmosphere or culture in which safety is understood to be, and is accepted as, the number one priority (Cullen 1990). Numerous definitions of safety culture abound in the academic safety literature, with all of them identifying it as being fundamental to an organization's ability to manage safety-related aspects of its operations (Glendon and Stanton 2000). The author takes the view that safety culture is a subfacet of organizational culture, which affects workers' attitudes and behavior in relation to an organization's on-going safety performance. This view is in line with the definition of the ''organizational culture''—a concept often used to describe shared corporate values that affect and influence members' attitudes and behaviors. Cooper (2000) argues that defining the *product* of safety culture is very important to clarify what a safety culture should look like in an organization. He adds that this also could help to determine the functional strategies required to developing this *product*, and it could provide an outcome measure to assess the degree to which organizations might or might not possess a ''good'' safety culture. This outcome has been severely lacking in construction.

Although Blockley (1995) advocates that the construction industry would be better characterized as one with a poor safety culture and that attempts to improve the safety record will not be fully effective until the safety culture is improved; progress over the last decade on defining and measuring the safety culture concept in construction appears to have been somewhat slow. Confusion between the ''culture'' and ''climate'' terms might have contributed to such a slow progress. Although these two terms have been used interchangeably due to the relationship and some overlap between them, climate refers only to the people's perception of the value of safety in the work environment. According to Cooper and Philips (1994), safety climate is concerned with the shared perceptions and beliefs that managers and workers hold regarding safety in the workplace (i.e., safety climate is, to some degree, dependent on the prevalent safety culture). It can be, therefore, argued that safety climate is largely a product of safety culture, and the two terms should not be viewed as alternatives.

Safety culture is concerned with the determinants of the ability to manage safety (top-down organizational attribute approach); whereas, safety climate is concerned with the workers' perception of the role safety plays in the workplace (bottom-up perceptual approach). The top-down approach includes observable measures such as management commitment, participation and accountability, procedures and policies, communication, etc. On the other hand, the bottom-up approach includes a different set of observable measures such as workers' constructive involvement, proactive reporting, individual attitude, group behavior, working relationships with supervisor and co-workers, etc. This dual perspective of safety should be adequate to comprehensively assess and benchmark safety performance. A number of previous studies in construction have, either directly or indirectly, addressed some elements of the safety culture and climate concepts. However, these studies are relatively few compared to the many that have focused on safety performance records, type and rate of accidents, and associated cost and lost time (Mohamed 2000).

Benchmarking in Construction

Benchmarking is described by McNair and Leibfried (1992) as ''an external focus on internal activities, functions, or operations

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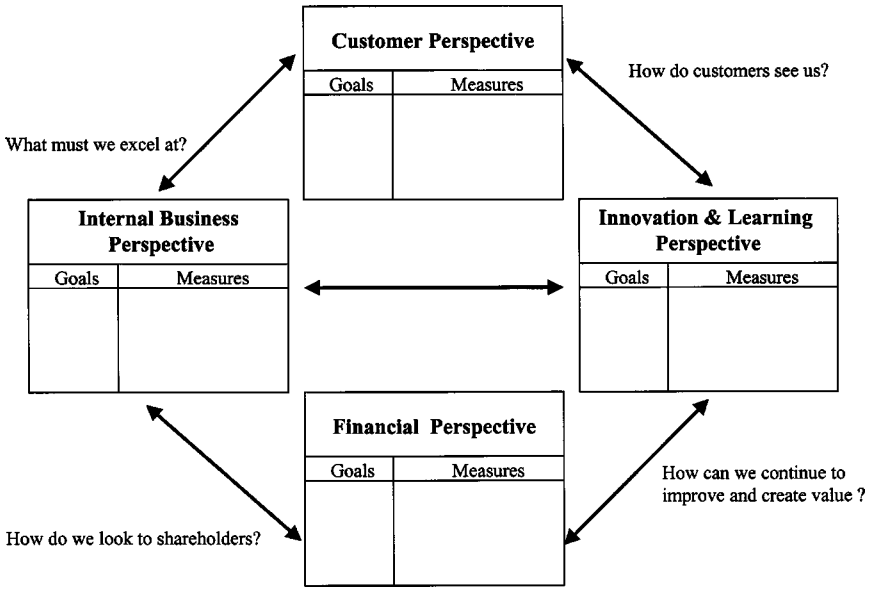

Fig. 1. Original balanced scorecard (adapted from Kaplan and Norton 1992)

in order to achieve continuous improvement.'' For a successful benchmarking exercise, measurement needs to focus attention on what is to be accomplished and compels organizations to concentrate time, resources, and energy on achievement of objectives. Measurement should simply provide feedback on progress toward objectives. If results differ from objectives, organizations can analyze the gaps in performance and make adjustments. During the 1990s, there has been considerable interest in the application of the benchmarking concept in construction. This interest is reflected in the reported literature, where benchmarking is addressed in the context of project duration (Walker 1994), project and organizational performance (Mohamed and Tilley 1997), and the use of information technology (IT) (Stewart and Mohamed 2001). In benchmarking, care must be taken to concentrate on meaningful measures that are (1) understandable (can be expressed in clear terms to avoid misinterpretation or vagueness); (2) attainable (can be met with reasonable effort); (3) valid (can capture and reflect the main features of the process/aspect to be measured); and most importantly (4) client-focused. The measures should also be incorporated in a performance measurement framework that provides more than a group of isolated and eventually conflicting measures and strategies. This could be achieved by utilizing the strategic management tool, known as the Balanced Scorecard (BSC).

Balanced Scorecard

The BSC was first introduced by Kaplan and Norton (1992) to allow managers to look at their business performance from four important perspectives: *financial, customer, internal business, and innovation and learning*. The BSC attempts to integrate all the interests of key stakeholders; i.e., owners, customers, employees, etc., on a scorecard. The term ''balanced'' in the name reflects the balance provided between short- and long-term objectives, between lagging and leading indicators, and between external and internal performance perspectives. The diverse interests and measures are categorized in the above-mentioned four perspectives of the scorecard (Fig. 1). As can be seen, the BSC (in a slightly modified format) can be an ideal tool for construction organizations to assess and measure their safety culture. Rather than giving a measure of only the accident statistics that a construction site might have, the BSC attempts to give a holistic and value-based balanced report. Although there is no definitive empirical evidence to show that adopting the BSC actually leads to superior performance, anecdotal evidence suggests that the BSC is increasing in popularity in a variety of applications (Balanced Scorecard Collaborative 2000). Its application in construction, however, is rather limited (Stewart and Mohamed 2000). The BSC framework developed in this paper focuses solely on measuring organizational safety culture.

Measuring Safety Culture

To effectively develop a safety balanced scorecard that can meet its potential in measuring safety culture, the four traditional perspectives, defined by Kaplan and Norton (1992), should be put in a different light. The result still shows four perspectives but with slightly different names and content to meet the nature of the task. (Fig. 2).

Management Perspective

Despite notions that culture cannot easily be created or engineered (Schein 1990), in practice, the creation or enhancement of a safety culture is dependent upon the deliberate manipulation of various organizational management characteristics and activities thought to impact upon safety management practices. Management's commitment and involvement in safety is the factor of most importance for a satisfactory safety level (Jaselskis et al. 1996). Therefore, this strategic perspective reflects the following: *What must management excel at to achieve a zero-accident culture*?

A focus on this perspective should lead to measures that would likely relate to such elements as management safety policy, commitment, accountability, and leadership. Using these elements in the BSC results in a number of criteria reflecting management control activities such as directing, leading, planning, and co-coordinating. The process of deciding which measures of these

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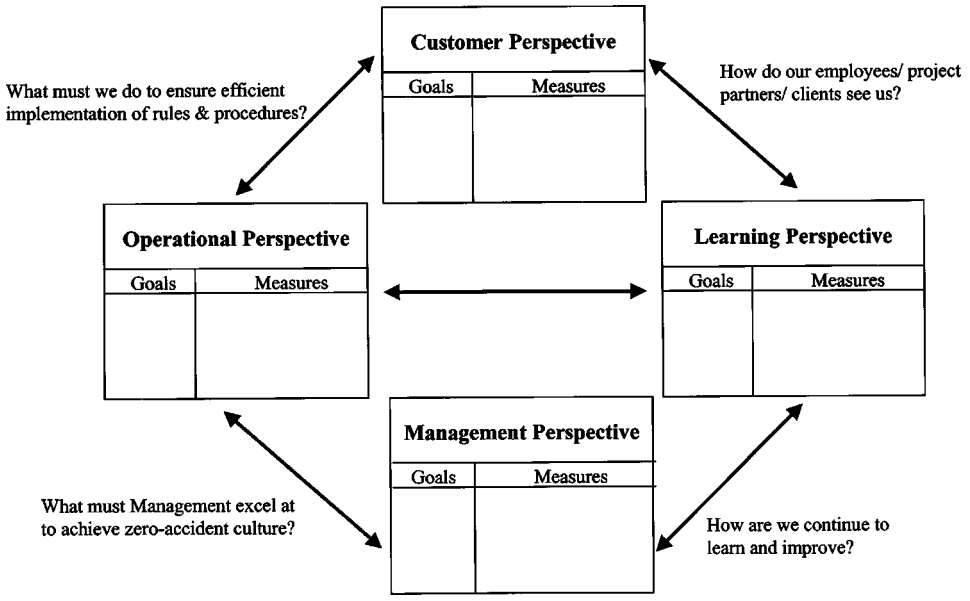

Fig. 2. Safety management balanced scorecard

criteria to adopt is a valuable one because it forces management to be very explicit about their safety-related management control activities and the relationship between them. Structuring this perspective according to a number of management control activities would also provide a focus on the goals of different activities necessary to accomplish the overall objective (i.e., achieving a zero-accident culture).

To reflect this perspective and to avoid developing an incoherent measurement system, it is crucial to incorporate measures that emanate from the organization's safety policy. As Keegan et al. (1989) argue, the process of deciding what to measure must start with looking to the organization's business strategy, defining the objectives, and then determining how it could be translated into divisional goals and individual management activities.

Operational Perspective

Although the BSC is a strategic rather than a diagnostic information system (Simons 1995), Kaplan and Norton (1996) take the view that it is primarily a mechanism for strategy implementation, not for strategy formulation. To account for the latter viewpoint, this perspective poses the question, *What must we do to ensure efficient implementation of safety rules and procedures*? The main objective in this operational perspective is to enhance the integrity of the safety management system through addressing operational activities such as having and maintaining safer workplaces, improving working relationships, being proactive in reporting and detecting hazards, etc. Despite the fact that some of these activities may not always be measurable or conductive to quantification, they affect the achievement of the goals stipulated in the management perspective, similar to how internal business processes determine the success of a business. As can be seen, this perspective is concerned with implementing action plans (means to the ends stipulated in safety rules and procedures).

Customer Perspective

The shift in philosophy that takes place when safety management's viewpoint is embedded within the BSC framework is that the customer perspective is expanded to include the employees, project partners, as well as clients. Stated another way, the customer perspective advocated herein should incorporate measures to capture how internal as well as external customers perceive the endeavors to achieve a zero-accident culture, as being promoted by the organization. Ideally, these measures should show all those involved how the safety culture is performing and foster incentives to work together (employees, project partners, and clients). As safety management's customer is viewed in three dimensions, it is important to focus on each. Employees are the first dimension, as they are the source of achieving safety goals. This dimension reflects the following: *How do our employees perceive the role safety plays on site, and how do they view our efforts*? The second dimension deals with project partners where measures should reflect, *How do our project partners see us dealing with safety in addressing specific project objectives*? Finally, the third dimension concerns clients where it would be important for the organization to reflect on, *Compared to competing organizations, how do our clients see us in the context of safety?*

Learning Perspective

If the measuring process remains static, then its potential to affect a positive outcome for the organization is limited. Market, technology, project, client, and other factors will often lead to changes in the type of information that needs to be collected to evaluate safety performance. Therefore, this strategic perspective reflects the following: *How are we to continue to learn and improve*? The focus herein is on the future as opposed to current safety performance levels. This perspective adds a dynamic element to the measurement framework. It recognizes that organizations must continually learn and improve to achieve better safety performance levels. It is in this perspective, that organizations should incorporate human resource management measures, thereby recognizing that people are true drivers of learning and improvement. This provides the rationale for investments in developing individuals' skills and capabilities, information systems, and enhanced organizational procedures (motivation, empowerment, etc.).

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Performance Measures

Although the BSC is undoubtedly valuable, its adoption is often constrained by the fact that it is simply a framework. It suggests some areas in which measures of performance might be useful, but provides little guidance on how the appropriate measures can be identified, introduced, and ultimately used to manage performance. Therefore, performance measures that can relate to a perspective must be linked to the goals of this particular perspective. Developing such measures and linking them to goals is challenging but essential to ensure the effectiveness of the BSC approach. Another important facet of the BSC framework is that the measures represent a chain of cause and effect. Therefore, the proposed BSC should be viewed as a set of hypotheses about cause and effect relationships that affect safety performance. For example, the decision to commit extra resources (management perspective) for training employees to identify site hazards (learning perspective) should lead to minimized the number or severity of hazard-related incidents (operational perspective), which should reduce the number of near-misses, leading to improved employee and client perceptions (customer perspective). It is worth pointing out that other cause-and-effect relationships, in the BSC, do not have to follow the order of this particular causality chain.

Given the overall framework of BSC application for measuring safety culture, performance measures can be developed that fit into each perspective. In practice, an organization should concentrate on a short list of measures that best capture and communicate the goals of each perspective. Also, organizations need to select only measures that are more suitable to the nature of their business. To measure training, for example, an organization may decide to keep a record of the number of hours spent by individuals on training (hours/employee); whereas, another organization might be more interested in the level of competency related to the training. Once the measures are established, necessary information is then obtained, and the key linkages among the measures are identified. Proposed goals and measures in each perspective are briefly described next.

Management Perspective

As mentioned earlier, this perspective is concerned with the overall strategic objective of achieving a zero-accident culture and should represent a top-down driven strategy on safety as part of an organization's overall strategy for business. As such, goals in this perspective should reflect business, procurement, human resource management, and finance strategies. This multitude of strategies, in combination or alone, influences safety performance levels, be it voluntarily or involuntarily. Therefore, it is essential that there is coherence between these strategies, so that employees receive a consistent message on safety as a strategic issue. Typical goals would include accident elimination, reduction of the number of incidents, improved productivity (as a result of less accident-related disruption to work), enhanced business image, accident-related cost reduction (compensation, insurance claims, etc.), highly competent workers (via a diligent recruitment policy and effective training programes), and more safety-aware subcontractors (via a rigorous evaluation and selection process). Having quite diverse goals is necessary to provide valid benchmark standards through the assessment of a wide range of management issues across a number of processes (Fuller 1997). Once these goals are identified and agreed upon, a set of measures should be developed and put in place to give insight into current practice and the progress rate toward meeting performance targets.

Traditional lagging performance measures (e.g., accident and incident statistics) still have an important role to play in this perspective; however, these measures are merely one part of a whole. An additional set of proactive measures is much needed to reflect the effectiveness of management activities (commitment, proactiveness, leadership, etc.) as related to the goals identified previously. In the first instance, such proactive measures may seem unfamiliar to the industry due to their focus on behaviors, attitudes, and situations. Although understandable, there are a variety of well-tested instruments (quantitative and qualitative data collection tools) that can be used to measure the psychological, behavioral, and situational aspects of safety culture. These are briefly presented next.

To measure management commitment, for example, a series of questions that measure people's commitment along various dimensions of safety have been successfully used to survey individuals within organizations (Guldenmund 1998). There are also alternative measures for capturing the psychological aspects, which include group interviews and discussion groups (Johnson 1992; Buchan 1999). The behavioral aspects of safety culture can be examined via peer observations, self-report measures, and/or outcome measures (Cooper et al. 1994). Other behavioral measures that encompass leadership behaviors are also well documented (Komaki 1998). The situational aspects of safety culture tend to be reflected in an organization's policies, operating procedures, management systems, control systems, communication flows, and workflow systems (Thompson and Luthans 1990). As such, this wide range of cultural influences should be measured via audits of safety management systems (Glendon and McKenna 1995). Details of all these instruments are beyond the scope of this paper, but the premise is that these developed instruments, in the safety and organizational culture literature, would serve as thoughtful background for the application of the BSC to measure organizational safety in construction.

Operational Perspective

Rules and procedures are the core component of safety management systems. A successful safety management system program is based upon the premise that safety is both a management responsibility and a line function. Although top management helps formulate safety policy, its actual success depends upon the ability of site management and supervisory personnel to insure that rules and policies are adhered to during daily operations (Agrilla 1999). Consequently, this perspective is concerned with the efficient implementation of safety rules and procedures on site. It also encompasses the ability to address specific project objectives in relation to safety, appraisal of physical work environment, and workers' constructive involvement. One of the greatest strengths of the BSC is the salience that it gives operators, as they become more aware of the linkage between policy, procedures and performance targets. This, in turn, would help them identify opportunities for meaningful safety performance improvements outside the realm of compliance.

Goals in this perspective include higher degree of compliance, higher level of workforce proactiveness, more efficient site layout planning, efficient communication/feedback systems, safer workplaces, and better worker/supervisor relationships. Considering these goals, measures would likely relate to elements such as process improvement, frequency of suggestions to improve safety, safety meetings, plan reviews, extent of accident analysis tasks, ratio of recommended/completed remedial actions, degree of employee empowerment, and constructive involvement.

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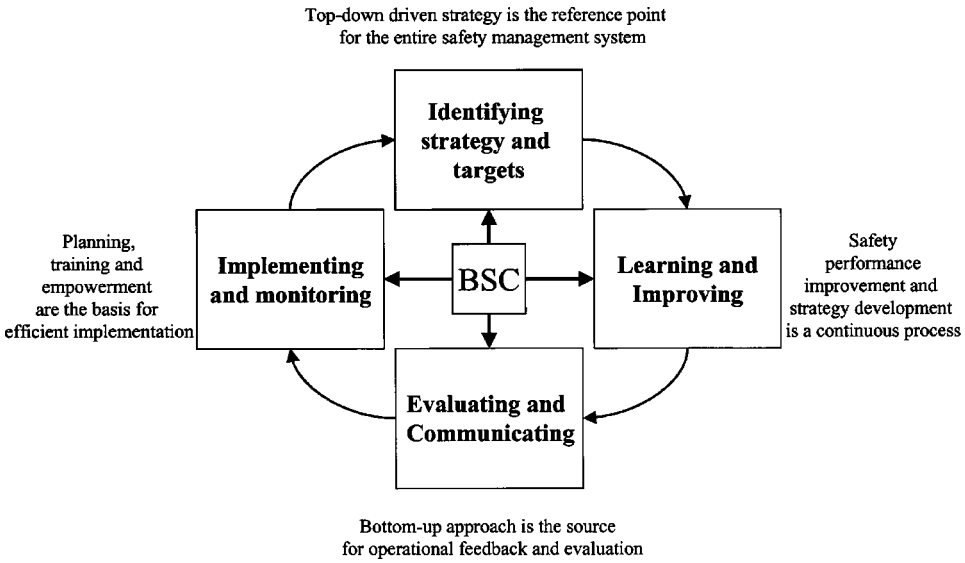

Fig. 3. Safety management system for strategic and operational implementation

Customer Perspective

Safety culture within the organization must be a philosophy, not just a set of guiding rules and procedures. Ideally, evaluating safety culture should be a two-way process, in which feedback from employees and clients are obtained on both the goals and measures being used to measure its attainment. This comprehensive role can be clearly seen in Fig. 3, which demonstrates the role of the BSC as the ''king pin'' of the safety management system. The customer perspective represents the product of the safety culture. It can be used to assess how employees and external parties perceive safety on construction sites as a product of the prevailing organizational safety culture, thus setting an important indicator of the extent to which individuals are actually implementing the safety management system. This, in turn, would indicate whether additional opportunities are present for improving safety performance and enhancing safety culture.

Goals in this perspective should mainly focus on safety climate on sites. Descriptive measures would be chosen to capture client as well as employees' opinions reflecting their perception of, and attitudes toward, safety within an organizational atmosphere at a given point in time. These will include several standard measures such as customer satisfaction, standard of communication, employee attitude, and response to management. Ojanen et al. (1988) argue that the only way to measure safety climate is by surveys. The reader is referred to the Flin et al. (2000) study where contemporary safety climate surveys and measures were critically reviewed in an attempt to establish a common set of organizational, managerial, and human factors that are being regularly included in measures of safety climate.

Learning Perspective

The BSC will often identify gaps between the targets and existing performance. By using it to identify strategic initiatives and related measures, these gaps can then be addressed and closed by initiatives such as managers and workers training and development. This perspective addresses the increasingly important issue of learning and improvement. Strategy, goals, and measures should not be set in stone; the process of strategy development and performance improvement should be an evolving one, as shown in Fig. 3. Measures should focus on such issues as encouraging bottom-up information flow and feedback, enhancing skills through education and training, improving supervisor/worker relationships, aligning incentive and reward schemes that are related to superior safe behavior, and empowering workers, etc. Such measures should facilitate a periodic review of performance and progress made in meeting strategic objectives. Based on this review, programs should be designed to target identified problems. For example, research has shown that a safety behavior modification program can be used successfully in giving feedback to employees about their performance, thus increasing safe behavior (Cooper et al. 1994). Causal relationships between measures should also be validated at defined intervals. The outcome of the review may necessitate the modification of action plans and revision of the scorecard.

Work in Progress

To gain some insight into the potential applicability of the BSC in measuring organizational safety culture, a dialogue with five construction project managers with safety management responsibilities in large contracting organizations was undertaken. The managers represented five different building and construction organizations operating in the state of Queensland, Australia. The dialogue was loosely structured in the form of a question and response survey asking to what extent the organization had considered developing a system like the proposed BSC. Each manager was asked to identify up to six major goals and associated measures per perspective that might form the basis for an effective BSC with the potential to reveal whether safety performance, in their respective organizations, is improving over time. It is unfortunate that most of the nominated measures are passive in nature, reflecting the industry's reluctance to take on a more leading rather than lagging approach to measurement. Nevertheless, nominated goals and measures were collected and managers were then individually asked to answer the following question for each of the measures: ''What is the degree of certainty you have that a change in the performance measure value would reflect a meaningful and relevant change in the organization's safety performance level?'' Using the collective response to this question as a

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Table 1. Suggested Goals and Associated Performance Measures

Perspective	Suggested goals	Basis of suggested performance measures	Qualitative	Quantitative
Management	Eliminate accidents	Number of accidents		√
	Reduce incidents	Number of incidents		√
	Improve productivity	Degree of performance reliability	√	
	Lead by example (management commitment)	Extent of management involvement to improve safety	√	
	Reduce accident-related cost	Dollars saved on accidents reduced		√
	Emphasize subcontractors' safety-awareness	Number of safety issues ''pushed'' down to subcontractors		√
Learning	Continue to improve safety performance level	Number of safety initiatives		√
	Build highly competent workforce	Extent of ability to transfer learning into workplace	√	
	Empower workforce	Extent of workforce proactive involvement to improve safety	√	
	Establish an effective strategic feedback system	Number of safety audits/reviews		√
	Provide adequate training to new recruits	Number of hours of competency/induction training		√
Operational	Establish and maintain a safe workplace	Score of compliance/noncompliance to safety requirements		√
	Establish an operational feedback system	Score and/or number of safety audits/focus groups/reviews		√
	Implement an efficient follow-up system	Recommended/implemented remedial actions ratio		√
	Carry out more effective site layout planning	Number of incidents due to poor safety integration into planning		
	Create a better working environment	Degree of satisfaction with current working relationships, safe behaviors and attitude towards safety	√	
Customer	Ensure client satisfaction	Client satisfaction rating	√	
	Instigate employee satisfaction	Number of complaints/grievances/legal suits		√
	Exceed project partners expectations	Extent of meeting/exceeding their expectations	√	
	Enhance workforce morale	Extent of recognizing and rewarding individuals with excellent safe performance	√	

guide, and restricting the number of measures per perspective to six, only 20 measures were selected. Table 1 shows the selected performance measures. Generally, managers' feedback suggests that both tangible and intangible benefits could be gained by implementing the proposed BSC. This strongly supports the potential value of the proposed approach.

This exercise was then followed up with another one aimed at seeking the opinions of major contractors and subcontractors in Australia regarding their willingness to introduce the proposed BSC to measure organizational safety culture and the perception of its strengths and weaknesses. Another important aim of the survey was to solicit participation from organizations nationwide. It is believed that such participation is needed to facilitate the development of a more robust set of measures for each perspective. This, in turn, should lead to inviting willing organizations to implement the BSC, with the view to create their own baseline measures against which future improvements (or otherwise) would be detected. The measures, listed in Table 1, were used in a survey to examine their dependency on, or sensitivity to, the size of the organization. Survey findings indicate that the majority of respondents (mainly project and safety managers) are more interested in operational and learning perspectives. This might be attributed to the diversity of both organizational size and strategic goals. Only large organizations showed interest in the management perspective. Respondents, however, were concerned about three issues: (1) the total number of measures suggesting their restriction to no more than three per perspective; (2) the way suggested measures can be operationalized; and (3) the possibility of not having the data for some of these measures.

Kaplan and Norton (1996) suggest that the use of correlation analysis to test the expected relationships in the BSC. Accordingly, a follow-on survey targeting building and construction organizations operating in Australia was conducted to provide additional information related to the use of selected measures and to examine the intercorrelation among them. The findings are based on the experiences of 62 organizations, with the majority of respondents being construction managers with 2–16 years of safety management responsibilities. Survey results show that the extent of management involvement to improve safety is positively related to the ability to identify safety hazards; it is also positively related to the number of safety reviews. Similarly, the higher the number of safety initiatives is related to a lower number of incidents due to poor safety integration in planning, higher client satisfaction rating, and greater savings due to reduction in the number of accidents. All of these results were statistically significant. Fig. 4 illustrates a snapshot of the results of correlation among a selection of performance measures across the four perspectives.

Although a correlation test does not allow making statements about cause and effect, results of the regression analysis are consistent with the body of safety management literature. It is worth emphasizing that these results tested only the relationship among performance measures and not the BSC itself. This is because the BSC, in practice, should be organization-specific. Nevertheless, the regression results provide support for applying the BSC as a tool for measuring the organizational safety culture.

In response to the above concerns, research attempts are underway to enable translating the proposed measures onto a consistent scale, thus allowing each participating organization to aggregate all information into a final figure that can be used to evaluate the organizational safety culture. This should make the proposed BSC more attractive for implementation by construction organizations. This is in line with Wood's (1990) statement that ''Management is likely to accept any valid performance measure if it embodies the corporate agenda and if the operating units and top executives get the help they need on the issues.''

Also, to examine the cause-and-effect relationships between select performance measures and across perspectives, system dynamics modeling techniques have been utilized to build a dynamic comprehensive simulation model. The developed model is currently being used to analyze the severity of various safety-related managerial issues from the perspective of strategic man-

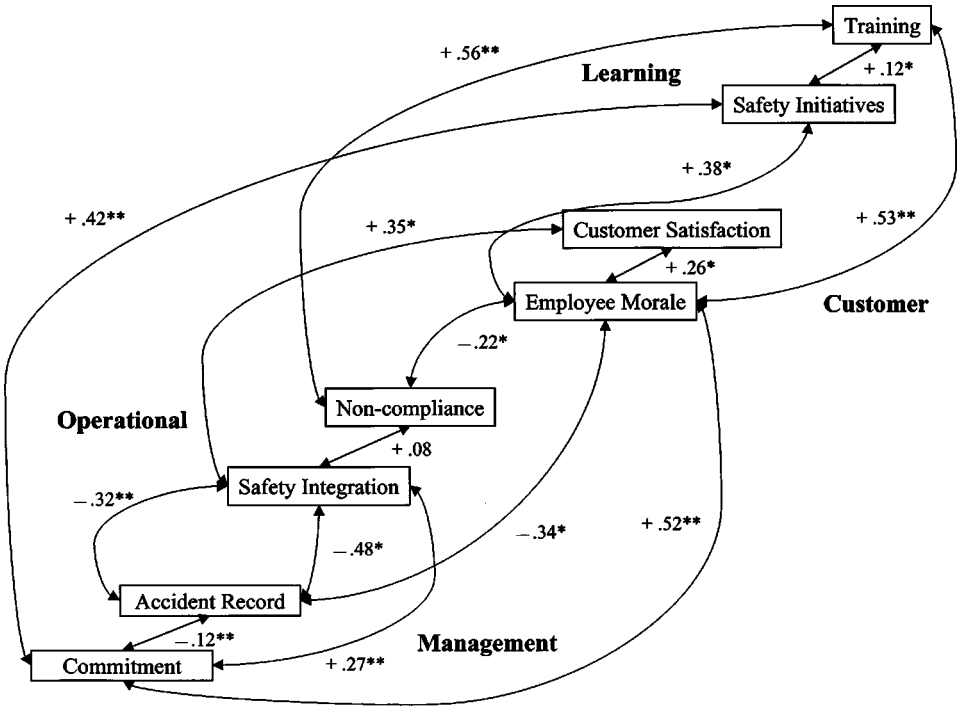

Fig. 4. Correlation results *p-value<0.05, **p-value<0.01 (one-tailed set)

agement decisions. Subsequent empirical research will be reported in future publications.

Concluding Remarks

From a practical standpoint the balanced scorecard is a proven management framework that provides a means of identifying links between strategic objectives and concrete measurements throughout an organization. This framework enables targets to be set and means of achieving them to be articulated. This paper advocated that this framework (with slight modifications) offers a tangible focal point for the complex process of getting an entire construction organization to proactively manage safety. It offers the advantage of providing a mix of objective and subjective safety performance measures and adding value by making both relevant and balanced information available to all stakeholders. Organizations need, though, to select only a handful of measures that reflect their policy and line of business, without leading to ''information overload.''

It is also important to note that the fundamental premise of the proposed approach is that current results in all perspectives need to be displayed and reviewed on a regular basis in order to obtain an appropriate overview of an organization's safety performance. Management should, therefore, set targets and assign responsibility for particular goals. Periodic reviews will hold individuals accountable and ensure action. Because the BSC presents measures that management and employees can influence directly by their actions, this approach to performance measurement is expected to encourage behavioral changes aimed at achieving a zero-accident culture. Finally, the proposed BSC is expected to create an environment that is conducive to learning organizations by testing and providing feedback on hypotheses regarding cause-and-effect relationships. All together, it should lead to a measuring and benchmarking organizational safety culture.

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