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An Extension of the REA Framework to Support Balanced Scorecard Information Requirements

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ABSTRACT: In this paper, we propose extensions to the resource-event-agent (REA) framework to encompass the information requirements of the balanced scorecard and other management systems that incorporate nonfinancial measures. The REA conceptual accounting framework was designed to describe the information architecture related to an organization's economic activity (e.g., McCarthy 1982; Dunn et al. 2005). Geerts and McCarthy (2001b, 2002) extended the original REA to include value-chain level configurations, task-level configurations, and encompass a broader array of business economic phenomena. Yet, the REA framework remains closely tied to its accounting roots, with a focus on economic events and financial resources. A substantial number of organizations are adopting strategic management systems that include both financial and nonfinancial measures to overcome known limitations of systems based on traditional financial data alone (e.g., Said et al. 2003; Eccles et al. 2001; Ittner et al. 2003). We therefore examine whether the REA framework supports the information requirements of this broader domain and propose extensions to fill the gaps identified.

Keywords: REA framework; ontology; balanced scorecard; nonfinancial measures.

I. INTRODUCTION

The resource-event-agent (REA) framework was designed to provide a conceptual model of accounting systems in a database world (Dunn et al. 2005), and it remains closely tied to ''traditional accounting views of the enterprise'' (Geerts and McCarthy 2002, 5). Although the REA framework has an established heritage, it is currently limited in its ability to describe the broader range of economic and organizational activity related to strategic management, which increasingly emphasizes nonfinancial measures for internal management as well as external reporting (e.g., Kaplan and Norton 1992, 1996a, 1996b, 2000a, 2000b; IMA 1999; FASB 2001a, 2001b; Eccles et al. 2001; Lev 2001; Ittner et al. 2003). In this paper, we propose extensions to the REA framework to encompass the information requirements of the balanced scorecard and other management systems that incorporate nonfinancial measures.

The balanced scorecard is a prominent example of the trend toward broader use of nonfinancial measures, integrating both financial and nonfinancial measures in a strategic management control system that extends well beyond the traditional accounting view of

the enterprise. Over the last decade, the balanced scorecard has emerged as the most commonly accepted tool for developing, implementing, and monitoring the impact of management strategies. In their annual management tools survey, Bain & Company (2004) recently found that 72 percent of respondents use the balanced scorecard.

Despite the apparent popularity of balanced scorecard systems, many firms have struggled to integrate those information requirements into their enterprise systems. The need to integrate both financial and nonfinancial information across business processes complicates the design of balanced scorecard systems (e.g., Chenhall 2005; Olve et al. 2004; AICPA 2005; Angel and Rampersad 2005). In a 2001 survey by International Data Corporation and the Balanced Scorecard Collaborative, respondents from a broad range of industries stated that complex data sourcing remains the single biggest challenge to automating balanced scorecards, followed by the unavailability of the needed source data (Williams 2004). Consequently, only 17 percent of typical firms have successfully implemented systems that rely on a mix of both financial and nonfinancial measures, according to recent research by The Hackett Group (2004).

In this paper, we extend REA concepts to the broader enterprise domain to address the challenges of balanced scorecard systems initiatives by providing a sound ontology upon which to base the design of those systems. Ontologies offer an abstract and simplified, but complete representation of the underlying processes, and provide a consistent basis for understanding and communicating domain phenomena (Chandrasekaran et al. 1999; Weber 2003; Edgington et al. 2004). Thus, a sound ontology identifies the complex relationships among data and facilitates making the necessary data available.

The existing REA framework already supports a substantial portion of balanced scorecard information requirements, especially those information requirements related to traditional financial measures. It provides a model of enterprise activity that integrates information across business processes (Dunn et al. 2005; Romney and Steinbart 2006). We contribute to the design science literature by developing an extended REA framework to address broader strategic management requirements for accounting information systems. This extended REA framework provides useful documentation about the business activities that generate balanced scorecard measures and the causal relationships that underlie firm performance. It further provides an opportunity to use REA conventions to address the real problems that many firms encounter with balanced scorecard or similar systems initiatives.

We proceed as follows. In the next section, we review REA framework concepts and highlight the contributions of the REA framework to the design of accounting information systems. In the third section, we review the information requirements of the balanced scorecard and summarize balanced scorecard systems design issues. In the fourth section, we rigorously compare balanced scorecard information requirements against the REA framework and identify required extensions. In the fifth section, we propose extensions to the REA framework. We present concluding remarks in the final section.

II. THE RESOURCE-EVENT-AGENT (REA) FRAMEWORK

REA Background

McCarthy (1979, 1982) builds on Chen's (1976) entity-relationship concepts to create a generalized accounting framework applicable to integrated enterprise systems. McCarthy's (1979, 1982) REA model abandons debits, credits, and traditional account structures as artifacts associated with the mechanics of journals and ledgers in stand-alone bookkeeping systems. Instead, it characterizes accounting phenomena in terms of economic events and the associated enterprise resources and agents. Events are the activities that increase or decrease enterprise resources. Resources are defined as things of economic value that are

provided or consumed by an enterprise's activities and operations. Agents are the persons, organizations, or organizational units that control or participate in economic events.

McCarthy (1982, 569) further distinguishes between the declarative features, i.e., the resources, events, agents, and relationships among them, and the procedural features of the REA framework. The procedural features of the REA framework allow materializing conclusions, such as periodic financial reports, by deriving information, decomposing and combining events, and matching expenses to revenues at the macro level (McCarthy 1982).

McCarthy (1982, 561) presents the REA model as a general model of ''the stock-flow aspects of accounting object systems.'' Economic events reflect the increment (stock inflow) or decrement (stock outflow) of economic resources. Importantly, duality relationships link economic events that increment economic resources with the corresponding economic events that decrement economic resources, e.g., the purchase of inventory event is linked with the cash disbursement event that pays for the purchase. Thus, the REA model describes the causal relationships underlying accounting transactions.

REA as an Ontology

Since McCarthy's (1982) original research, there have been a number of extensions to the REA model to embrace more comprehensive descriptions of enterprise activity. Geerts and McCarthy (2001b, 2002) propose an extended REA framework as an enterprise domain ontology. They extend the original REA concepts to include ''a full accountability infrastructure for a firm'' (Geerts and McCarthy 2002, 5).

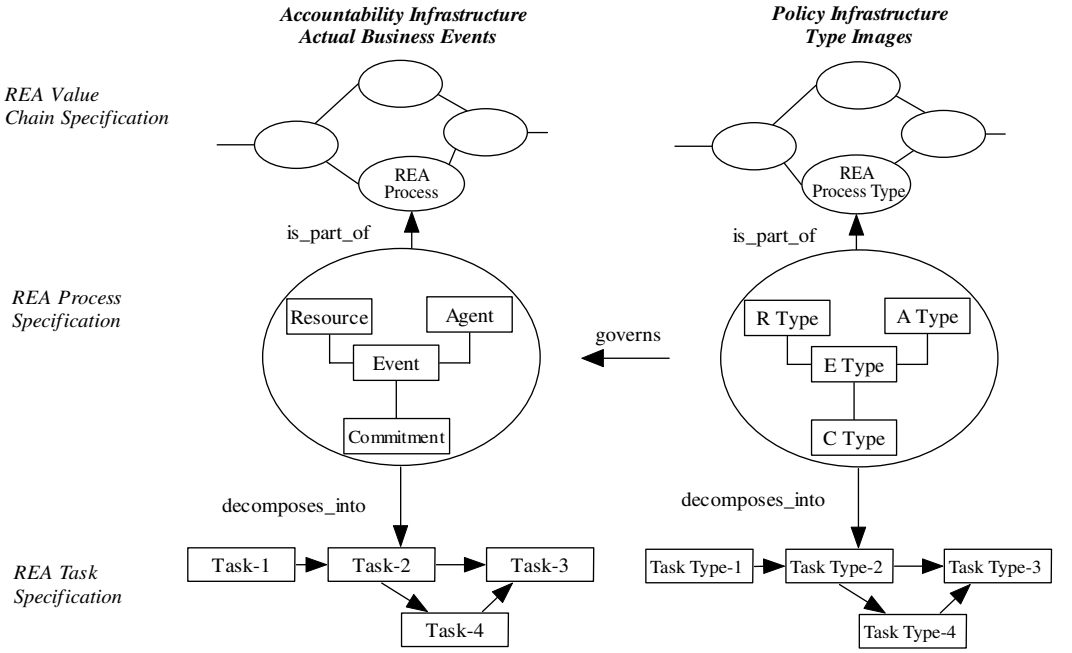
Ontologies play an important role in information-systems design. An ontology captures and represents domain knowledge in a generic way to provide a commonly agreed upon understanding of a domain (Gruber 1993; Wand and Wang 1996). An enterprise domain ontology identifies and defines the things of interest and the relationships among those things within the enterprise. It thus facilitates a more complete understanding of business process phenomena, and ensures semantic interoperability of the systems that support those processes. An enterprise domain ontology provides a conceptual model that supports knowledge sharing across a firm's functional borders and knowledge reuse across different systems implementations (Geerts and McCarthy 1999).

The REA ontology provides a top-down decomposition of the enterprise value chain as shown in Figure 1. It provides an accountability infrastructure depicting relationships among actual business events. At the top level (shown on the left side of Figure 1), the value-chain specification identifies the business processes—transaction cycles defined by the dualities of associated economic events—and the resource flows between processes. The ovals in the value-chain model represent individual processes and the lines indicate resource flows between processes. Value-chain processes are decomposed into the business process specification. At the business process level, each business process is described with models that closely resemble the original REA model. Process-level models are further decomposed into task-level models that specify the logical sequence of activities necessary to carry out the economic events defined at the higher levels.

Geerts and McCarthy (2002, 2003) further introduce abstraction relationships, such as ''typification,'' which links resource, event, and agent entities to knowledge-level groupings called type images. The type images create a policy infrastructure (shown on the right side of Figure 1) that ''conceptualizes what ''could be'' or ''should be'' within the context of a defined portfolio of firm resources and capabilities'' (Geerts and McCarthy 2002, 6).

Consider a manufacturing firm. The accountability infrastructure shown on the left side of Figure 1 then represents the firm's business processes, by which the firm acquires raw materials, converts the raw materials to finished goods, and sells those finished goods to

FIGURE 1
REA Levels and Type Images
(Adapted from Geerts and McCarthy 2002, Fig. 2)



customers. The policy infrastructure shown on the right side of Figure 1 represents the firm's control structure. For example, a bill of materials specifies the firm's plans for the raw material content of each finished good. The bill of materials therefore governs the flow of resources between the acquisition process, the conversion process, and the sales process.

To define further the policy infrastructure, Geerts and McCarthy (2002, 2005) distinguish among three variations of type images: standards, policies, and budgets. A standard represents an engineered specification, such as a recipe or bill of material. A policy implements organizational requirements and constraints, such as preventive internal controls like segregation of duties. A budget represents a target or goal for a specific time period, such as the number of units expected to be sold in the following quarter and the associated dollar value. The type image structure thus creates a firm-specific knowledge overlay to the operational level REA model.

The type image structure that Geerts and McCarthy (2002, 2005) describe is generally restricted to operational control and traditional budget planning. In the fifth section, we propose broader uses of type images to create a policy infrastructure to support the strategic performance measurement information requirements of balanced scorecard systems.

The Geerts and McCarthy (2002, 2003) REA ontology also includes extensions to the original REA framework at the process level. In particular, it introduces additional events that are not normally included in traditional accounting records but play important roles in commercial enterprise systems (Geerts and McCarthy 2001b, 2002). For example, commitment events, which represent agreements to engage in economic events in the future,

are not normally reflected in financial statements. Commitment events link to other commitment events in a ''reciprocal'' relationship corresponding to the duality relationships between economic events. Dunn et al. (2005) also describe instigation events that precede commitment events, such as customer inquiries about prices and product availability or sales calls, which occur prior to the customer order. Instigation events link to subsequent commitment events in a fulfillment relationship.

III. THE BALANCED SCORECARD INFORMATION REQUIREMENTS

Balanced Scorecard Overview

Kaplan and Norton (1992, 1996a, 1996b, 2000a, 2000b, 2001a, 2001b, 2004) present the balanced scorecard as an alternative to the exclusive use of financial measures to manage company performance. The balanced scorecard is now a well-known and widely used management tool. Reportedly, over 60 percent of Fortune 1000 companies used balanced scorecard systems by 2001 (Bourne 2002), and over 72 percent of firms surveyed by Bain & Company used them by 2004.

The balanced scorecard retains traditional financial measures to indicate profitability, growth, and shareholder value, but also includes the nonfinancial measures that drive the financial results. Managers typically use the balanced scorecard to look at their business from four perspectives: the *learning and growth perspective*, *internal business perspective*, *customer perspective*, and the *financial perspective*. A balanced scorecard system consists of objectives and corresponding performance measures for each of the four perspectives. The objectives and measures are linked together so that short-term actions support long-term strategic objectives (e.g., Kaplan and Norton 1996a).

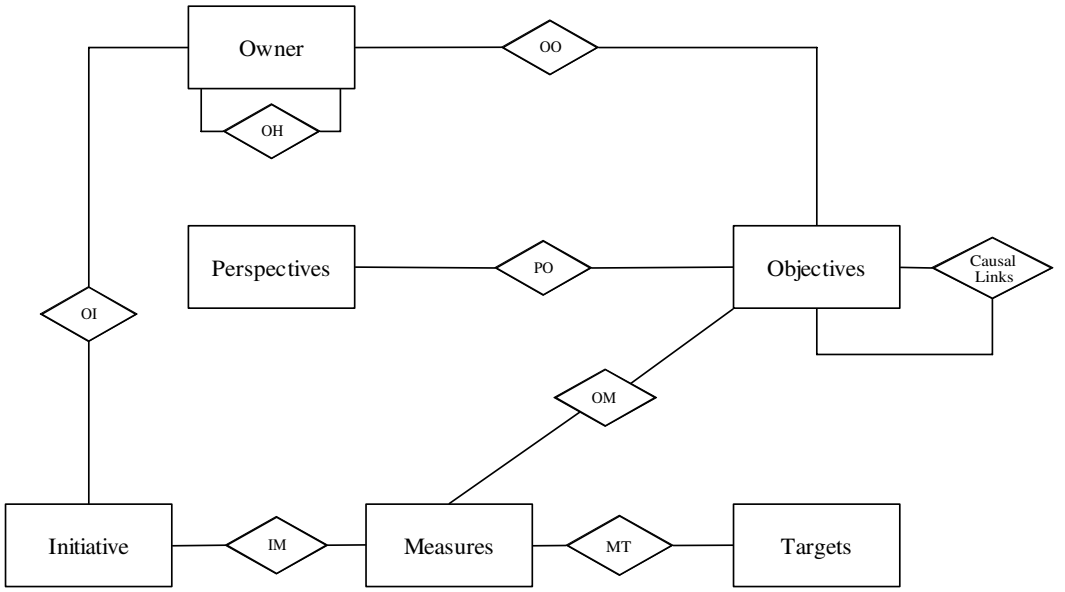
The balanced scorecard also incorporates other widely used management systems, such as shareholder value management systems, and activity-based costing (Kaplan and Norton 2001a). For example, balanced scorecard measures for the *financial perspective* can employ residual income measures, e.g., Stern Stewart & Company's EVA, which could then be decomposed into elemental measures of cost reduction, asset productivity, and revenue growth. Plus, activity-based costing can improve the quality of operational measures for the balanced scorecard *internal process perspective*.

The Balanced Scorecard Strategic Management System

To manage strategy with the balanced scorecard, enterprises express their strategy as an integrated set of objectives and measures that describe the long-term drivers of success, communicate those objectives throughout the organizational hierarchy, establish departmental and individual objectives that link to the overall strategic objectives, integrate the business and financial plans, and monitor the performance measures and the relationships to strategic goals (Kaplan and Norton 1996a, 1996b). Figure 2 presents a generic balanced scorecard data model that links balanced scorecard perspectives, strategic initiatives, performance objectives, and the corresponding financial and nonfinancial measures. The challenge is to make explicit links to integrate the nonfinancial measures with traditional financial measures. To implement balanced scorecards, firms need to tie the balanced scorecard strategic management structure shown in Figure 2 to the underlying business processes.

In 2000, the Balanced Scorecard Collaborative, a consulting organization founded by Kaplan and Norton in 1992 to support balanced scorecard usage, published functional standards for balanced scorecard systems. Those standards specify that balanced scorecard software should allow the description of perspectives, objectives, measures, targets, and strategic initiatives, and it should also allow users to establish specific cause-and-effect linkages among various objectives, associate measures with objectives, associate targets

FIGURE 2
Generic Balanced Scorecard Data Model[a]



[a] Adapted from Balanced Scorecard Institute example relational data model for the Balanced Scorecard.
Variable Definitions:

Owner	=	person or organizational unit accountable for balanced scorecard objectives;
Perspectives	=	balanced scorecard perspectives: financial, customer, internal process, and learning and growth;
Objectives	=	performance objectives set by the owner for each perspective; objectives are related to other objectives according to causal relationships;
Initiative	=	specific strategic initiative(s) designed to improve performance;
Measures	=	financial and nonfinancial measures related to specific objectives;
Targets	=	target values for specific measures for specific periods; and
Relationships (diamonds)	=	links between entities—identified with the first letters of the names of the participating entities.

with measures, and link strategic initiatives to one or more objectives. The standards do not, however, describe how the balanced scorecard software should be integrated into an organization's financial or enterprise systems. Those details are left to each organization to decide when implementing a balanced scorecard system.

We compared the generic balanced scorecard data model shown in Figure 2 against descriptions of balanced scorecard applications from several of the Balanced Scorecard Collaborative certified vendors, e.g., SAP, Peoplesoft, Microsoft, and SAS. Our impression is that the data model accurately represents the structure of the typical balanced scorecard software and is consistent with the functional standards. The model does not, however, link these objects to the underlying business processes, and those links can and should be extensive. Cascading balanced scorecard requirements throughout the firm, as recommended by Kaplan and Norton (2000b), requires that those objects apply to every business process as well as across processes. Thus, firms that implement the balanced scorecard are faced with a significant systems design task.

The REA framework, extended to support balanced scorecard information requirements, could provide an abstract, simplified, but complete representation of the underlying processes. Just as the current REA framework represents business activities for accounting information systems, an extended REA framework could also represent business activities for balanced scorecard systems. An extended REA could clearly identify how business activities affect each balanced scorecard objective and how those activities are interrelated. In other words, it could provide a conceptual model that facilitates balanced scorecard systems design.

IV. EVALUATING THE REA FRAMEWORK AGAINST BALANCED SCORECARD INFORMATION REQUIREMENTS

The REA Framework in a Strategic Management Context

Over time, the REA framework has been extended to encompass the array of enterprise operating activities. Geerts and McCarthy (1999, 93) recognize, however, that REA features need further amplification for ''accountability and policy-making purposes'' related to strategic management. Before we address further extensions to the REA framework to accommodate strategic management purposes, we first examine whether the current REA framework supports the range of economic and organizational activity related to strategic management and strategy implementation, as well as the specific information requirements of each balanced scorecard perspective.

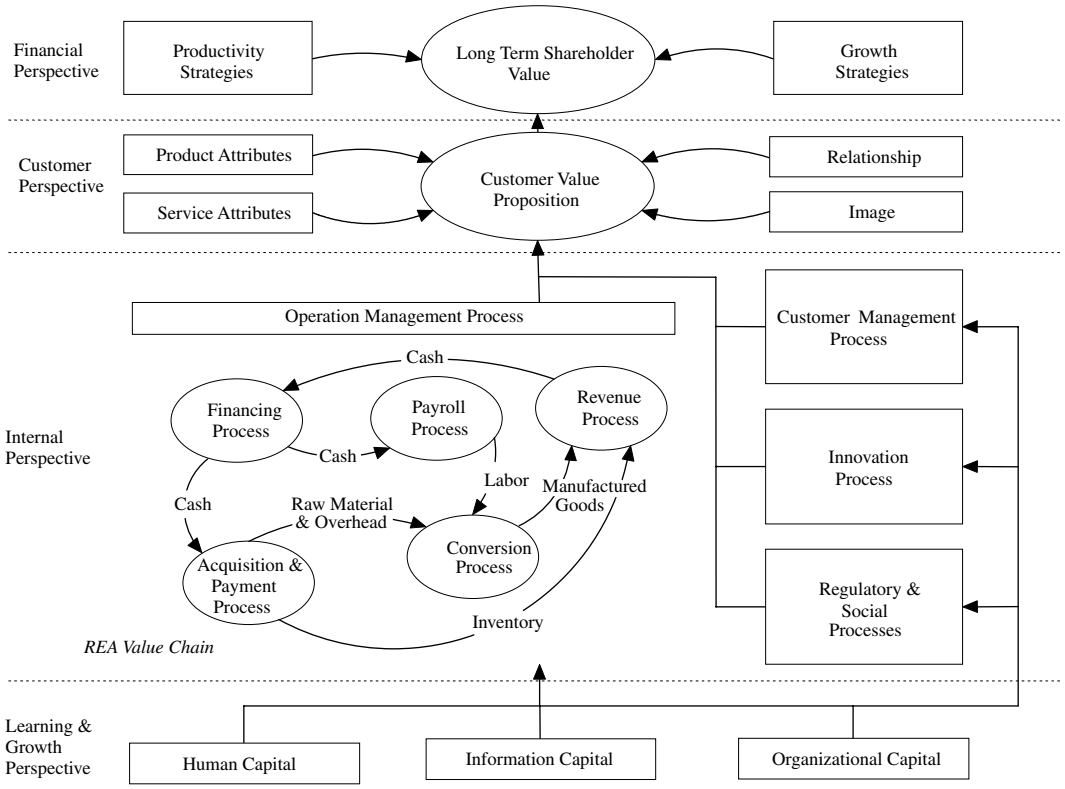
Figure 3 shows the REA value-chain structure within a balanced scorecard strategy map to highlight visually the relation between the REA structure and the balanced scorecard. As indicated by the placement of the REA value chain to represent the Operation Management Process in Figure 3, the REA value chain focuses on operational processes, e.g., the revenue and cash receipts process, and the acquisition and payment process (see Dunn et al. 2005 for a complete description of the REA value chain). Just as the balanced scorecard links operations management processes to the financial perspective, the REA framework supports financial reporting requirements through procedural elements that aggregate process-level data for financial statement summary reporting (McCarthy 1982). There is, however, little or no published material that applies the REA framework to other internal business processes, i.e., customer management, innovation, or regulatory and social processes, or the other balanced scorecard perspectives as we will explain below.

Table 1 lists generic balanced scorecard objectives and sample measures for all the perspectives based on Kaplan and Norton (2004). Using Table 1 to guide, we examined the REA framework against the information requirements of each balanced scorecard perspective. For each information requirement, we determined whether it is supported by the REA framework presented in existing accounting information-systems literature. In our review of existing accounting information-systems literature, we found REA models of the following processes: (1) sales/collection, (2) acquisition/payment (including acquisition of services, inventory, fixed assets, etc.), (3) conversion, (4) financing, and (5) human resources (e.g., McCarthy 1979, 1982; Geerts and McCarthy 2001b, 2002; Dunn et al. 2005; Romney and Steinbart 2006). We also noted examples related to long duration events, such as depreciation of fixed assets and consumption of services over time, and equity transactions (McCarthy 1982).

Balanced Scorecard Strategy Implementation and Management Processes

Before we address the information requirements of each balanced scorecard perspective, we examine whether the REA framework adequately supports strategy implementation and

FIGURE 3
REA Value Chain Embedded In Balanced Scorecard Strategy Map



management processes. The balanced scorecard requires a top-down approach to strategy implementation. Kaplan and Norton (1996a, 2001b) describe four processes for managing strategy: (1) *translating the vision*, (2) *communicating and linking*, (3) *business planning*, and (4) *feedback and learning*. Using these management control processes, organizations set goals, link reward to performance, and set performance targets. Then, they measure performance against those targets, evaluate performance, and adjust strategy as necessary. In other words, management makes plans and measures performance against those plans. Indeed, the ability to establish appropriate plans, effectively execute those plans, and measure results is crucial to managerial success (Drucker 2004).

The REA framework reflects enterprise economic activity but does not directly address the management activity related to control processes. The REA framework offers type images as the vehicle for modeling organizational policy, such as budgets, bills of material, or pricing policies (Geerts and McCarthy 2001b, 2003). The REA type image structure does not, however, describe the managerial processes and control structure necessary to plan, link, communicate, or learn from type-level information. For example, REA policy type images can apply internal controls, such as segregation of duties, to operational level economic activity (Geerts and McCarthy 2003), but the REA policy infrastructure does not

TABLE 1
Analysis of Balanced Scorecard Information Requirements Coverage in the Existing REA Framework (REA) or in the Proposed Extensions (EXT)

Perspectives/Objective Categories[a]	Sample Objectives/Measure Type	In REA Framework or Extension[b]	Description of Source of Information
Financial Perspective			
Productivity Strategy			
Improve cost structure	Reduce cash expense	REA	Resources, Events, Internal Agents all processes
Increase asset utilization	Invest to eliminate bottlenecks	REA	Resource acquisition events after determination of bottleneck locations
Growth Strategy			
Expand revenue opportunities	Sales growth; New sources of revenue	REA	Sales Process events, resources, agents and corresponding type entities
Enhance Customer Value	Improve profitability of existing customers	REA	Agent/Agent Type participating in Sales Process events
Customer Perspective			
Customer satisfaction	Percent satisfied	EXT	External information not directly related to economic events; proposed Evaluate event, see Figure 5 for example
Customer profitability	Percent unprofitable	REA	Customer/Customer Type and participation in Sales process events
Market share	Percent market share	EXT	External information not directly related to economic events; proposed Evaluate event
Account share	Percent account share	EXT	External information not directly related to economic events; proposed Evaluate event
Customer acquisition	Conversion rate	REA	Instigation events, Agent/Agent Type participating in Sales Process events
Customer retention	Customer lifetime value	REA	Agent/Agent Type participating in Sales Process events

(*continued on next page*)

TABLE 1 (continued)

Perspectives/Objective Categories[a]	Sample Objectives/Measure Type	In REA Framework or Extension[b]	Description of Source of Information
Customer Value Proposition			
Product/service attributes	Price, quality, availability, selection, functionality	EXT	Resource or Resource Type properties plus external competitor information; proposed Evaluate event
Relationship	Service, partnership	EXT	Agent and Agent Type properties plus external competitor information; proposed Evaluate event
Image	Brand image	EXT	External information not directly related to economic events; proposed Evaluate event
Internal Perspective			
Operations Management			
Develop supplier relations	Supplier ratings: quality, delivery, cost	REA	Agent/Agent Type properties
Produce goods and services	Cost per unit of output	REA	Conversion process
Distribute to customers	ABC costs of storage and delivery to customers	REA	Distribution process
Manage risk	Percent of capacity from existing and backlogged orders	REA	Sales Process Resources, Commitment Events, Reservation Relationships
Customer Management Process			
Customer selection	Target high-value customers	REA	Agent/Agent Type properties
Customer acquisition	Communicate value proposition	REA	Instigation Event and Agent/ Agent Type properties
Customer retention	Service excellence	REA	Agent/Agent Type properties
Customer growth	Customer education	REA	Instigation Event and Agent/Agent Type properties
Innovation Process			
Identify opportunities	Number of new projects	REA	Project/Project Type properties
Manage the portfolio of projects	Net present value of projects in pipeline	REA	Project/Project Type properties
Design and develop	Number of patents	REA	Resource/Resource Type properties
Launch	Number of new products launched	REA	Resource/Resource Type properties

(*continued on next page*)

TABLE 1 (continued)

Regulatory and Social Processes			
Environment	Energy consumption	REA	Conclusion materialization from stockflow relationships
Safety and Health	Incidence rates	REA	Agent/Agent Type property
Employment	Diversity	REA	Agent/Agent Type property
Community	Community investment	REA	Conclusion materialization from community investment agreement events
Learning and Growth Perspective			
Human capital	Strategic competencies: availability of skills, talent, knowledge	REA/EXT	Internal support processes that execute strategic initiatives; proposed Initiative event plus human capital resource; see Figure 6 for example
Information capital	Strategic information: availability of information systems, knowledge applications and infrastructure	EXT	Internal support processes that execute strategic initiatives; proposed Initiative event plus information capital resource
Organization capital	Culture, leadership, alignment, teamwork	EXT	Internal support processes that execute strategic initiatives; proposed Initiative event plus organizational capital resource

[a] Objectives and corresponding sample measures based on Kaplan and Norton (2004).
[b] REA indicates that example(s) available in prior REA research or reasonable extension to REA examples consistent with existing REA tenets. EXT indicates that extension proposed.

address how the internal control is established or who is responsible for monitoring its effectiveness.

Furthermore, the REA type image structure does not fully address causal linkages across perspectives or strategic initiatives that firms implement to improve performance. For example, a firm could create a strategic initiative to improve employee skills in certain job positions and couple that with technology to improve a critical business process. Thus, targets and measures for one or more learning and growth activity or activities should link to targets and measures for that critical business process to reflect management's expected cause-and-effect relationship. Geerts and McCarthy (2002, 2005) describe type images as providing policy-level extensions to REA economic activities. They define policy as ''a description of economic phenomena that could, should, or must occur'' (Geerts and McCarthy 2005, 4). Broadly interpreted, this definition could include the causal links across perspectives. However, Geerts and McCarthy (2005, 4) restrict the definition by providing an example of a policy definition: ''the price of any bottle of Channel No. 5 is $75.'' Thus, the current REA framework does not appear to envisage the sort of cross-process and cross-perspective links required to support a balanced scorecard initiative.

Financial Perspective Information Requirements

The *financial perspective* productivity and growth strategies support an overall goal of increasing long-term shareholder value. The REA framework represents an accounting system in which detailed data about economic transactions are stored in a disaggregated form and then aggregated to meet specific decision requirements (McCarthy 1982). McCarthy (1982) refers to the aggregation process as ''conclusion materialization.''

Since the balanced scorecard *financial perspective* generally includes traditional financial measures (Kaplan and Norton 1992), Table 1 shows that the REA framework clearly supports information requirements related to the financial perspective through the conclusion materialization process. For example, the total enterprise sales revenue is the sum of all sales events during the period less all sales return events during the period. This aggregated amount can be compared against similar aggregations in prior periods to measure sales growth. Similarly, information about sales events associated with new products or new customers can be aggregated to measure new sources of revenue.

Customer Perspective Information Requirements

The *customer perspective* addresses organizational performance from the view of the customer. *Customer perspective* objectives typically include customer satisfaction, customer profitability, customer acquisition, customer retention, market share, and account share (see Table 1). Within the REA framework, agents are defined as ''identifiable parties with discretionary power to use or dispose of economic resources'' (McCarthy 1982, 563). A customer is an external agent who participates in sales events (and corresponding cash receipt events) or pre-sales instigation and commitment events (Dunn et al. 2005). Thus, information about customer transactions can be aggregated to address customer acquisition, customer retention, and customer profitability objectives, since the required information can be captured when each customer participates in sales process events. For example, conversion rate, i.e., the number of customers participating in instigation events that subsequently participate in sales events, provides a measure of customer acquisition.

Customer satisfaction information, however, is not generally available at the time the customer participates in sales process events. Customer satisfaction represents a customer's perception of the sales process as well as the product(s) purchased, and customer satisfaction can be formed over time (e.g., Fournier and Mick 1999). Thus, customer satisfaction

often cannot be measured at the time of the sales event. Similarly, neither market share nor account share information is available at the time of the sales event. The market is a broader set that includes both the firm's customers and unknown customers of competing firms. Measuring customer satisfaction, market share, or account share therefore requires collecting and evaluating post-event information or external information unrelated to specific economic events. The traditional ''economic exchange'' orientation of the REA model does not lend itself to the collection of non-event information.

The *customer value proposition* ties process performance to customer objectives. Elements of the *customer value proposition* include (1) product attributes, such as price and quality, (2) relationship attributes, such as service and partnership, and (3) image attributes, such as brand image (see Table 1). Organizations affect customers' perceptions by changing processes and thereby changing the value proposition. For example, improving manufacturing quality can improve product quality, which affects customer satisfaction. Value propositions differentiate organizations from their competition (Kaplan and Norton 2001a), so value proposition objectives are measured relative to the other products and services in the marketplace. Measuring value proposition objectives against the competition again requires capturing external information unrelated to specific economic events and thus is not fully supported by the REA framework.

Internal Business Process Information Requirements

As shown in Table 1, the *internal business process perspective* includes operations management, customer management, innovation management, and regulatory and social processes. The *operations management process* includes most of the primary activities in Porter's (1985) value chain, and operations management measures are generally financial in nature, e.g., cost per unit of production output, and ABC costs of storage and delivery. The REA framework aligns closely with the balanced scorecard operations management processes (see Figure 3) and supports those information requirements.

The REA framework also appears to align closely with the *customer management process*, since that process seems ancillary to the sales process. The *customer management process* comprises the organization's activity to select and retain profitable customers. The information to support those measures could be collected during the instigation, commitment, and sales events comprising the REA sales process. For example, information about instigation events, e.g., sales calls, by customer type could be aggregated to provide information about efforts to attract and retain high-value customers. Hence, the existing REA framework is adequate with respect to the customer management process.

The *innovation process* allows organizations to ''build the franchise'' by developing new products and services and entering new markets (Kaplan and Norton 2001a). It is not clear whether the REA framework supports the *innovation process*, because Kaplan and Norton do not precisely define this process. Assuming that the *innovation management process* generally includes traditional research and development (R&D) activities, the REA framework likely supports most of the information requirements. We could not identify any existing REA research that describes R&D activity, but we envision it as similar to a conversion process. Instead of converting raw materials to finished goods, R&D activities develop new products from existing or prospective raw materials. For R&D activity, however, the knowledge of the scientists, engineers, and product development specialists represents important inputs. Under the existing REA framework, this knowledge would not be separately modeled; it is instead a characteristic of the agent. For balanced scorecard purposes, this knowledge could be better represented as a resource, albeit an intangible resource, as we describe in more detail later in this section with respect to learning and

growth information requirements. Notwithstanding this modeling difference, the information requirements for R&D projects seem conceptually similar to the information requirements for construction projects or production runs.

The *regulatory and social processes* represent corporate citizenship activities aimed at establishing effective relationships with governments and other external stakeholders (Kaplan and Norton 2001a). Again, we could not identify existing REA research that directly addresses the array of activities, e.g., solid waste disposal, safety programs, diversity programs, and community programs that Kaplan and Norton collect under this umbrella. Nonetheless, we believe that the REA framework can accommodate most environmental, safety and health, employment diversity, or community investment information requirements. For example, a stock inflow relationship between an energy acquisition event and the resource that consumes the energy could measure energy consumption. An employee type image with appropriate diversity categories could measure employment diversity. Community investment contracts and corresponding cash disbursements could measure the extent of community investment. An agent property, dynamically updated to reflect the number of incidents for an employee, could measure safety and health incident rates, and an employee incident type image could appropriately group incident types.

Learning and Growth Information Requirements

The balanced scorecard *learning and growth perspective* describes the infrastructure to support an organization's growth and improvement. The organization's intangible assets, e.g., human capital, information capital and organization capital improvements, and increases in those intangible assets drive business process improvements (see Figure 3). Thus, learning and growth measures relate to the availability of skills, availability of information systems, teamwork, etc., as shown in Table 1. Organizations typically affect learning and growth performance through knowledge exchanges rather than economic exchanges. For example, organizations increase skills through training and create alignment through communication (Kaplan and Norton 2004).

McCarthy (1982, 562) defines resources as generally equivalent to assets as defined by the Financial Accounting Standards Board (FASB). Under this definition, intangibles such as human capital would not be considered resources. Over time, however, the definition of resources has been broadened to include ''things of economic value (with or without physical substance) that are provided or consumed by an enterprise's activities and operations'' (Dunn et al. 2005). Thus, the REA framework appears to allow intangible assets, even though those assets might not meet the more restrictive FASB definition of assets.

Romney and Steinbart (2006, 632) describe an integrated model of the human resource management (HRM) and payroll cycles. Their model includes a training event that represents ''workshops, training programs, and other opportunities provided for employees to develop and maintain their skills.'' Also included are recruiting, interviewing, and hiring events that represent the activities performed to recruit and hire new employees with required skills. However, the activities shown in the Romney and Steinbart (2006) HRM model are not linked with strategic initiatives or performance in other business processes. The Romney and Steinbart (2006) HRM example is the only one we found that models the learning and growth activity shown in Table 1, although it provides a useful template for models of similar activities.

Summary

In summary, we conclude that the REA framework does support a substantial portion of balanced scorecard information requirements, especially those information requirements

related to traditional financial measures. The power of the REA framework lies in its ability to depict the causal events that give rise to accounting information. The existing REA framework is, however, generally restricted to a traditional accounting view of the firm's economic activities. Nevertheless, we argue that REA conventions can be applied to a broader view of enterprise activity to include both financial and nonfinancial measures and to represent a strategic structure that links performance across balanced scorecard perspectives. We therefore propose extensions to the REA framework to accommodate strategy management activity and additional information requirements of balanced scorecard systems.

V. PROPOSED EXTENSIONS TO THE REA FRAMEWORK

Process for Extending REA Framework

Our goal is to extend the REA framework to encompass the information requirements of balanced scorecard systems in a way that is consistent with REA theories and integrates with the existing REA framework. We first examine REA terminology and propose minor modifications to REA terms where necessary to encompass the concepts embodied in the balanced scorecard.

McCarthy (1982) originally defined resources as generally considered equivalent to assets in accounting terms. Dunn et al. (2005) define resources as things of economic value with or without substance that are provided or consumed by an enterprise's activities and operations. This definition is clearly broader, but still is insufficient to address some of the balanced scorecard concepts. Information has economic value, but it is not consumed by enterprise activities in the same sense that physical resources decrease in value as they are used. Romney and Steinbart (2006) define resources as things that have economic value to the organization, and we adopt this less restrictive definition. This broader definition encompasses the balanced scorecard concepts of human capital, information capital, and organizational capital that otherwise are not covered under more restrictive definitions in the existing REA framework.

McCarthy (1982) originally defined events to correspond closely to accounting transactions. Again, the evolution of the REA framework resulted in a broader definition. Both Dunn et al. (2005) and Romney and Steinbart (2006) define events similarly as business activities that need to be planned, controlled, or evaluated. Events thus include the commitment and instigation events that precede the economic events summarized in financial statements (see Dunn et al. [2005, 84] or Romney and Steinbart [2006, 624] for examples). We also include identifiable balanced scorecard management activities, e.g., setting targets, measuring performance, and evaluating performance against targets, within the broader definition of events. These management events are clearly business activities that need to be planned, controlled, and evaluated. They share features, such as duration, cost, and purpose, with other events.

McCarthy (1982) defined agents as persons or agencies that participate in economic events or are responsible for subordinates that participate in those events. Except for a broader definition of events, this definition has changed little. Romney and Steinbart (2006) describe agents as people or organizations that participate in events and about whom information is desired for planning, control, and evaluation purposes. We adopt this definition with one minor change. We define agents as people, organizations, or collections of people or organizations about whom information is desired for planning, control, and evaluation purposes. Using this broader definition, agents relevant to the balanced scorecard, including competitors, competitors' customers, and market participants in general can be modeled using REA.

Geerts and McCarthy (2002, 2005) describe type images and the associations between type images as creating a policy-level infrastructure, which specifies the economic phenomena that could, should, or must occur. Through a series of examples, they restrict the type image structure to issues of operational control and traditional budget planning. We suggest a broader interpretation of a policy-level infrastructure that incorporates strategic management structures, such as balanced scorecard perspectives, strategic initiatives, and strategic objectives as type images. These structures clearly specify the economic phenomena that should occur. Policy-level associations among these type images support causal linkages across balanced scorecard perspectives. Management events create and use these policy-level structures, which control the firm's economic activities, according to the firm's strategy.

Using these broader definitions of REA terms, we next describe extensions to the REA framework to address the structures required to support strategy implementation and the additional information requirements of the balanced scorecard customer and learning and growth perspectives.

Addressing Strategy Implementation and Management Processes

We extend the REA framework to reflect enterprise management activity by including the management planning and measurement processes as shown in Figure 4. We model two events: *set target* and *evaluate*, which are central to the process.

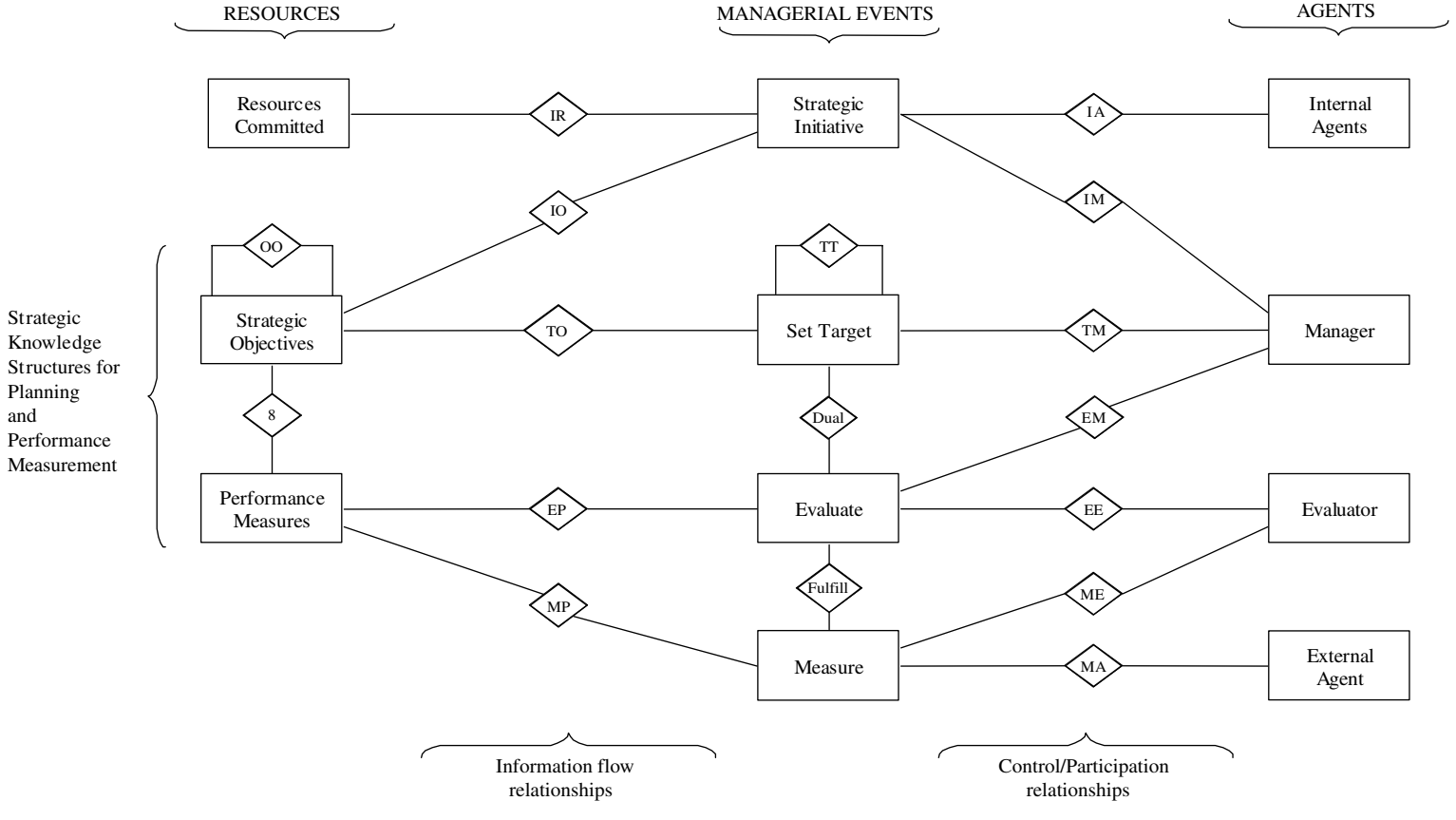
The *set target* event captures enterprise goal-setting activity, such as setting strategic objectives, budget levels, production schedules, and standard costs. Each *strategic objective* may be related to higher and lower level objectives. Thus, high level strategic planning is linked to lower level operational planning throughout the organization. The *set target* event supports strategic management by representing the managerial activities that establish strategic and operational plans and corresponding performance measures. The recursive *set target* events ''cascade high level measures to lower organizational measures'' and explicitly link measures to the organization's strategic objectives (Kaplan and Norton 1996b).

The *evaluate* event represents the activity necessary to provide feedback on strategic performance. The *evaluate* event includes the periodic activity necessary to appraise operational performance, financial performance, and performance relative to strategic initiatives. The *set target* and *evaluate* events are associated in a mutual relationship like the REA duality relationship. The *set target* event establishes policy that governs the firms economic activity, and the *evaluate* event compares the firm's economic activity to the policy. For each target-setting activity, there are one or more corresponding evaluation activities or activities. There is a control relationship between each *set target* and *evaluate* event and the responsible manager(s). There is a participation relationship between the *evaluate* event and the *evaluator*(s). Managers and evaluators are both internal agents in the REA vernacular. For each *evaluate* event, there can be one or more *measure* events, which include the activity necessary to gather post-event data, such as customer satisfaction, from outside the organization.

The *strategic objective* and *performance measure* entities represent knowledge structures (type images). Each *performance measure* relates to a *strategic objective*, and each *strategic objective* may relate to one or more other *strategic objectives* (the recursive relationship in Figure 4) to link objectives across balanced scorecard perspectives.

Strategic objectives further relate to the *strategic initiatives* that link organizational activities across balanced scorecard perspectives in a chain of cause-and-effect relationships. In a balanced scorecard system, strategic initiatives represent the planned actions of the

FIGURE 4
Managerial Planning and Measurement Process REA Extension



The relationships (diamonds) are identified with the first letters of the names of the participating entities, except for the duality relationship between *Set Target* and *Evaluate* events and the fulfillment relationship between *Evaluate* and *Measure* events. Recursive relationships are modeled as entities related to themselves (designated OO and TT in this example).

organization to achieve its strategic objectives. In Figure 4, a manager authorizes the *strategic initiative* event; internal agents, e.g., process owners, participate in the initiative, and resources are committed to the initiative. More complex initiatives could relate to one or more other events as additional resources are acquired, additional agents are hired, and so on.

The proposed knowledge structures support strategic goals and objectives and are consistent with the generic balanced scorecard data model shown in Figure 2. The proposed events represent managerial planning and measurement activity rather than economic activity. The proposed internal agents represent management and accounting roles rather than economic roles.

Addressing Customer Perspective Information Requirements

We next employ the strategic knowledge structures to support *customer perspective* information requirements. Figure 5 provides an example of how the managerial planning and measurement process links to the sales process. The *customer* (agent), *sale* (event), and *inventory* (resource) represent the traditional REA sales pattern without the corresponding cash receipt duality event. The *evaluator* (internal agent) and the *customer* (external agent) participate in the *measure* event to provide post-*sales* event customer satisfaction information. The *measure* event may relate to one or more *sales* events and imparts information inflow to the *performance measure* entity.

Each performance measure may relate to multiple sales to capture aggregate financial information about sales activity. Each performance measure may also relate to one or more inventory items and customer types to capture summary performance measure data for classes of inventory and customers. Once external information is collected and integrated with operational information, the evaluate event allows managers to compare performance to strategic objectives. This example shows how financial and nonfinancial measures can be linked across the balanced scorecard *internal business process* and *customer* perspectives.

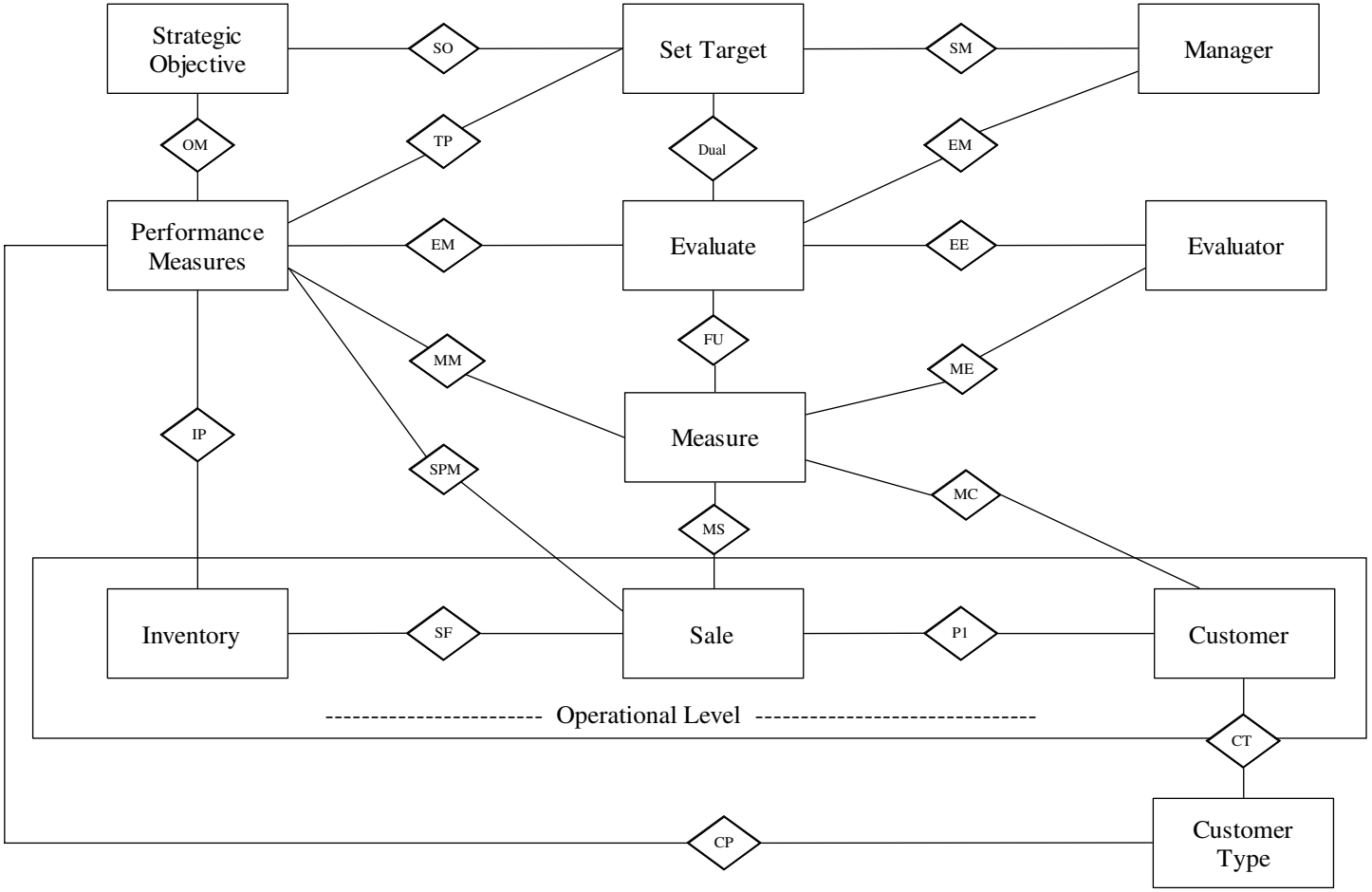
The same structure also allows measuring and evaluating other external *customer perspective* information, such as market share and account share data. The *measure* and *evaluate* events associate sales process data with corresponding sales data for the market and other market participants. The *measure* and *evaluate* events also represent managerial or administrative activity in support of other business processes, and information about the quantity or complexity of those events could therefore facilitate cost allocation in an activity-based costing environment. The structure could identify the cost of employees (agents) and related resources consumed in each evaluation event.

Addressing Learning and Growth Perspective Information Requirements

Finally, we extend the REA framework to include the learning and growth activities that organizations undertake to increase intangible assets. We borrow from existing REA conversion process examples where production orders initiate the use of labor and/or materials to produce finished goods. Much like production orders begin the conversion process, strategic initiatives launch the activities necessary to accomplish learning and growth objectives. For example, organizations establish comprehensive training programs to improve employee skills and thereby increase human capital.

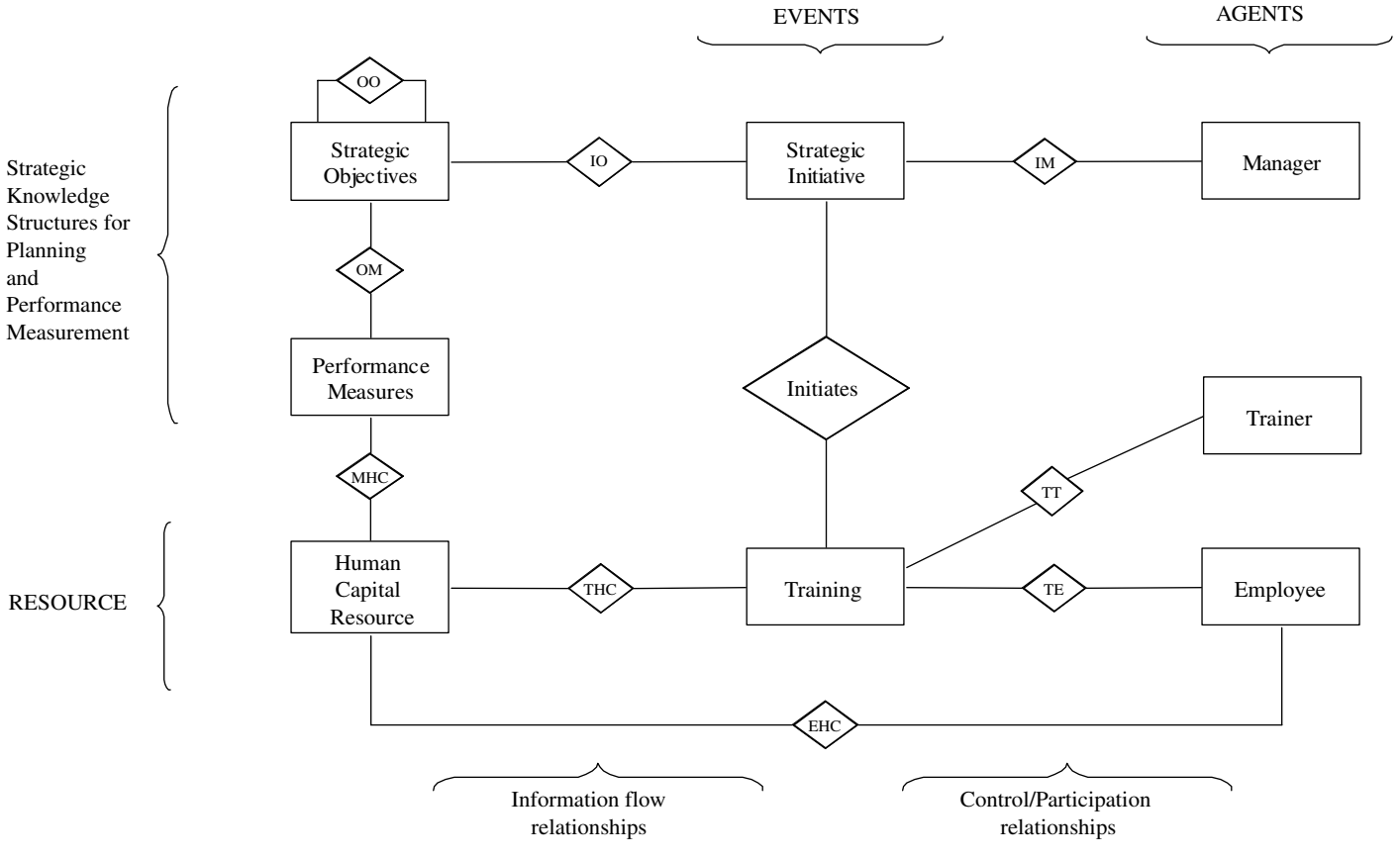
Figure 6 presents an example of a learning and growth process that addresses the human capital objective (see Table 1) with a corresponding performance measure reflecting a strategic employee competency, such as professional knowledge or skill. A *manager* (agent) introduces a *strategic initiative* (event) to improve those competencies and thereby improve

FIGURE 5
Example Linking the Managerial Planning and Measurement Process to the Sales Process



The relationships (diamonds) are identified with the first letters of the names of the participating entities except for the duality relationship (Dual) between *Set Target* and *Evaluate* events and the fulfillment relationship (FU) between *Evaluate* and *Measure* events.

FIGURE 6
Learning and Growth Process REA Example

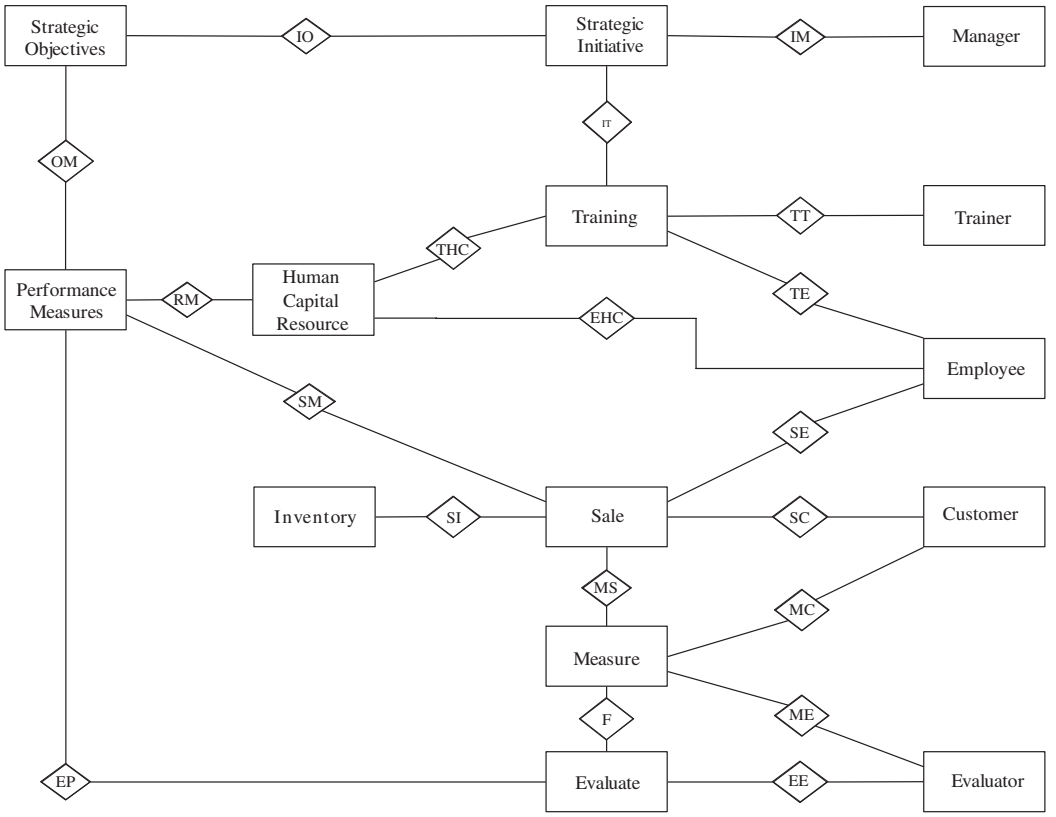


The relationships (diamonds) are identified with the first letters of the names of the participating entities except for the relationship (Initiates) between *Strategic Initiative* and *Training* events.

business process performance. The *strategic initiative* event relates to one or more *training* events that address elements of the competency. Similar to the HRM example in Romney and Steinbart (2006, 632), the *trainer* (agent) provides the training, and the *employee* (agent) receives the training. The *training* event thereby increases the intangible *human capital resource*. The relationship between the *employee* and *human capital resource* indicates which employees already possess certain skills or knowledge. The relationship between the *strategic initiative* and *strategic objectives* establishes the strategic purpose of the activities. The relationships between (1) the *strategic initiative* and *strategic objectives* and (2) *strategic objectives* and *performance measures* facilitate feedback on the effectiveness of the strategic initiative in achieving the associated objectives.

Figure 7 presents an example that integrates learning and growth processes with operating processes and corresponding measurement events. We combine the example shown in Figure 6 with the example shown in Figure 5, omitting the *Set Target* event. In this example, the *strategic initiative* involves training employees that participate in enterprise sales processes. The *training* event increases the *human capital resource*, which is then

FIGURE 7
REA Example Integrating Learning and Growth, Managerial Planning and Measurement, and the Sales Process



The relationships (diamonds) are identified with the first letters of the names of the participating entities.

applied to *sales* events as the trained *employee* participates in those events. The *performance measure* entity captures aggregate financial and nonfinancial information about both learning and growth and operations management processes. The example shows how leading measures, e.g., initiatives to increase the human capital resource, can be tied to lagging measures, e.g., financial outcomes of the sales process, across balanced scorecard perspectives.

We envision similar models of the acculturation activities that affect organizational capital and the systems configuration and deployment activities that affect information capital as shown in Table 1 (*Learning and Growth Perspective*). For example, a team-building initiative to address organizational capital objectives could result in several team-building exercises, and a knowledge management system initiative to address information capital objectives could result in various systems development events.

Balanced scorecard systems identify and track an organization's ''investment required in people and systems to generate and sustain growth'' (Kaplan and Norton 2001a, 90). These investments often reflect knowledge exchanges rather than economic exchanges. The human capital, information capital, and organization capital resources are complex and dynamic intangible constructs. They may have economic value, but unlike REA resources, they are not consumed by an enterprise's activities and operations. Our proposal extends the REA framework to support information requirements of such knowledge exchanges and intangible constructs. Although we employ somewhat broader definitions of REA terms and introduce new management events, we argue that our extensions remain consistent with basic REA concepts.

VI. CONCLUSION

The resource-event-agent (REA) framework represents a widely accepted conceptual accounting framework. Since McCarthy's (1982) original work on REA, a number of other researchers have extended the REA model. For example, the REA model was extended to manufacturing processes (Armitage 1985; Denna et al. 1994) and to include location information (Denna et al. 1993). Geerts and McCarthy (1999, 2001a, 2001b, 2002, 2003) extended the original REA model to include commitment transactions and type-level policy infrastructure. Notwithstanding these extensions, the REA framework remains closely tied to its accounting roots, with a focus on economic events and financial resources.

A substantial number of organizations are adopting strategic management systems that are comprehensive in that they include both financial and nonfinancial measures to overcome known limitations of systems based on traditional financial data alone (e.g., Said et al. 2003; Eccles et al. 2001; Ittner et al. 2003). These organizations require systems that support broader information requirements, which may not be supported by the existing REA framework. We, therefore, examine the REA framework against the more comprehensive requirements of contemporary accounting systems. By using a specific benchmark, i.e., the Balanced Scorecard, we can identify those components that are missing or must be better defined to provide a more complete REA enterprise ontology.

We selected the balanced scorecard as a prominent example of the trend toward broader use of nonfinancial measures for both internal management and external reporting. We also selected the balanced scorecard because it is well defined. Through several books and articles, Kaplan and Norton (1996b, 2000b, 2004) have clearly described the nature of balanced scorecard systems. While our analysis is based on the balanced scorecard, we believe that our conclusions also apply generally to any strategic performance measurement systems that rely on integrated nonfinancial measures.

We find that the existing REA framework supports a substantial portion of balanced scorecard information requirements, especially those information requirements related to traditional financial measures. However, the existing REA framework does not adequately support the strategic structure of a balanced scorecard system or the specific information requirements of the balanced scorecard customer and learning and growth perspectives. We therefore propose extensions to the REA framework to address broader strategic management requirements for accounting information systems. First, we propose to extend the REA framework to describe the management activity necessary to set targets and evaluate performance against those targets. Second, we propose extensions to include the information requirements of the balanced scorecard learning and growth perspective. We argue that activities to increase organizational intangible assets through learning and growth activities are conceptually similar to, although admittedly far less precise than, conversion processes that create tangible assets. The proposed extensions apply REA theory to broader strategic management control system domains.

Our work reaffirms the value of REA concepts. Organizations face significant challenges when implementing integrated enterprise systems or pursuing comprehensive strategic initiatives like the balanced scorecard. The success of such initiatives depends on how well the requirements are defined and communicated throughout the organization, and recent research indicates that less than 20 percent of balanced scorecard implementations achieve positive results (Angel and Rampersad 2005; The Hackett Group 2004; AICPA 2005). O'Leary (2004, 68) notes that REA is the ''generally accepted theoretical accounting enterprise model.'' As such, it provides a theoretical foundation for existing enterprise resource planning (ERP) systems and facilitates the understanding of the underlying ERP system (O'Leary 2004). We argue that, with our proposed extensions, the REA framework also serves as a theoretical foundation for strategic enterprise management systems based on the balanced scorecard.

Our work contributes to the body of design science research through which the REA concepts have evolved and continue to grow to meet changing accounting information-systems requirements. Our proposed extensions address limitations in the REA framework and serve to define a more complete enterprise domain ontology. Well-defined ontologies provide a common understanding of data and processes that exist within a problem domain and, therefore, facilitate the accurate communication between systems designers, developers, and end users that is critical to the successful implementation of enterprise systems (Linthicum 2004; Uschold et al. 1997). The extended REA framework should therefore interest organizations that are implementing balanced scorecard-like systems and the systems developers that assist them. The main strength of the extended REA framework presented in this paper is that the resulting system will tightly integrate traditional accounting (financial) and balanced scorecard (nonfinancial) measures in one system.

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