Strategic Management of an Electronic Patient Record Project Using the Balanced Scorecard

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Effective performance measurement links goals to information. It is an integral part of the management process.[1, 2] Organizations have different approaches to providing their management teams with information, ranging from aggregating reports derived from operational systems to explicitly defining a set of key indicators about which data is collected and periodically distributed. Typically, in the latter approach, the emphasis is on standard financial and quality management data defined by corporate staff in those areas.[3] This provides large quantities of useful data, but fails to provide assistance to managers in thinking through their real information needs. Ironically, an excess of data overloads rather than enlightens managers. The scarce organizational resource is not information, it is organizational attention—the allocation of information processing capability to a defined issue or agenda.[4] Organizational attention is the fundamental constraint in achieving objectives.[5] What managers need is the right strategic information at the right time that can focus organizational attention on agendas linked to strategies.

The critical success factor (CSF) methodology addresses this shortcoming. CSFs are defined as the limited number of areas in which satisfactory results will ensure successful competitive performance. In the CSF methodology, management teams define industry CSFs, then corporate CSFs, and then CSFs for each subsystem of the organization, down to the individual manager level.[6]

The balanced scorecard methodology builds on the CSF concept of a limited, coherent set of performance measures related to strategic objectives, and adds the concept of balance among indicators. The balanced scorecard framework presents a management team with four different perspectives from

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which to choose performance indicators: a customer perspective, an internal perspective, a financial perspective, and an innovation perspective.[7, 8] The balanced scorecard does not require the top-down approach advocated in the CSF technique. In the balanced scorecard methodology, a management team at any level selects a limited set of performance indicators that are meaningful to them in each quadrant. The process of selecting and agreeing on measures forces the management team to define what is strategically important. Forcing the management team to choose measures from each perspective obliges it to consider objectives from every viewpoint, not just with the typical financial bias. Limiting the number of allowable measures in each perspective obliges managers to focus their strategic vision and to identify the handful of most critical indicators. Relationships between the measures encourage managers to form strategies that positively influence all quadrants or, where this is not possible, to explicitly choose the trade-offs they must make between different objectives. Understanding trends and the interrelationships between variables is particularly important when an action has one set of consequences locally and a very different set of consequences in another part of the system, or when obvious interventions produce nonobvious outcomes.[9] The balanced scorecard approach has been used in many industries including manufacturing,[10] finance,[11] construction,[12] and high technology.[8] The healthcare industry has started to adopt a similar concept, referred to as an instrument panel.[13, 14, 15] Another variation in health care is the report card—a comparative reporting system that allows healthcare purchasers and consumers to rank institutions.[16]

In their more recent work, Kaplan and Norton moved away from measurement system aspects toward the balanced scorecard as a strategic management system.[17] A properly constructed balanced scorecard should articulate the theory of the business unit, based on a series of cause–effect relationships derived from the strategy. This is similar to strategy activity system maps that examine the relationships between activities designed to deliver a business unit's strategic position.[18] The balanced scorecard becomes less of a diagnostic control system for flagging abnormal activities and more of an interactive control system for providing signals to the organization about management objectives, stimulating debate and activating organizational learning.[4]

Performance Management in an Information Technology Project

As information technology (IT) budgets have climbed exponentially, organizations have begun to pay much greater attention to understanding and maximizing business value from IT projects. IT leaders are managing the performance of their departments and are being managed with measurable indicators that are related to business strategy. This has led to a surge of interest in

IT performance measurement in various ways. Senior managers are beginning to focus on costs in all areas, from the data center to the total cost of ownership at the desktop level.[19] IT leaders are starting to use benchmarking, both internally to compare functions of similar business units, and externally to measure IT products and services against those of other organizations and industries. Institutions that have outsourced their information systems require the ability to ascertain whether predefined specific service levels are being achieved. Service level agreements might include well-defined performance metrics (availability, response time) as well as softer metrics such as knowledge transfer. There is also a large and growing body of research devoted to measuring use and diffusion of computer technologies.[20, 21, 22, 23] While these trends point to a broader acceptance of performance measurement and management within IT, none has given rise to a framework for ensuring that IT performance is measured and managed in a balanced, integrated way.

Electronic Patient Records

These broad IT industry trends are also influencing healthcare IT. Healthcare IT faces enormous challenges, from ensuring patient safety with Y2K compliant systems to realizing larger dreams of automated, paperless electronic patient records. An electronic patient record (EPR) system is a set of clinical information systems designed to store detailed, longitudinal information about patients nonredundantly at every stage of the clinical process.[24, 25] There are multiple and diverse challenges in implementing EPRs, including technology debates, vocabulary and messaging standards, confidentiality and security concerns, clinician use, and cultural acceptance of these systems.

There is a large body of literature devoted specifically to evaluations of healthcare information systems in general, and EPRs in particular.[26, 27, 28, 29] Much of this work is devoted to understanding the changes that automation will bring to clinical processes and the factors that influence clinician acceptance of technology-enabled change. Again, this work provides very valuable insight into specific aspects of an EPR implementation, but does not advance a broader, unifying framework for analyzing the success of an EPR project holistically.

Objectives and Hypothesis

In this work, we hypothesized that the balanced scorecard methodology would provide an effective framework for management teams, both to formulate their strategic information needs and to manage implementation of an EPR.

The objectives of our work were to develop a performance management system, based on the balanced scorecard, that helps healthcare IT managers evaluate an EPR project; and to use the framework to evaluate a pilot EPR implementation.

Method

Over the past four years, Sunnybrook and Woman's College Health Sciences Centre (Sunnybrook), an academic health sciences centre in Ontario, Canada, has been developing an EPR. Multiple hospital information systems send data to and receive data from the clinical data repository, using HL7 messaging standards. The Sunnybrook EPR is being developed in phases. Data that have so far been incorporated into the EPR include patient demographics, encounter details, laboratory results, radiology reports, discharge summaries and operative reports, and orders for laboratory tests, radiology exams, and diets.

During this same period of time, Sunnybrook also developed prototype decision support systems in five different clinical areas based on the balanced scorecard methodology.[30] The balanced scorecard projects were well received by the clinical management teams. Managers found that the balanced scorecards helped their teams develop a common understanding of their goals and strategies. The iterative development process kept important issues (as defined by the management teams) on their agendas, facilitating discussion about strategic direction and potential action plans. It also elicited ongoing discussion about the relative importance of different indicators, programs, and disciplines, and about the mechanisms for interpreting and using the data. Most importantly, the process ensured that the system being developed was shaped by management needs.

A Balanced Scorecard for an EPR Pilot Project

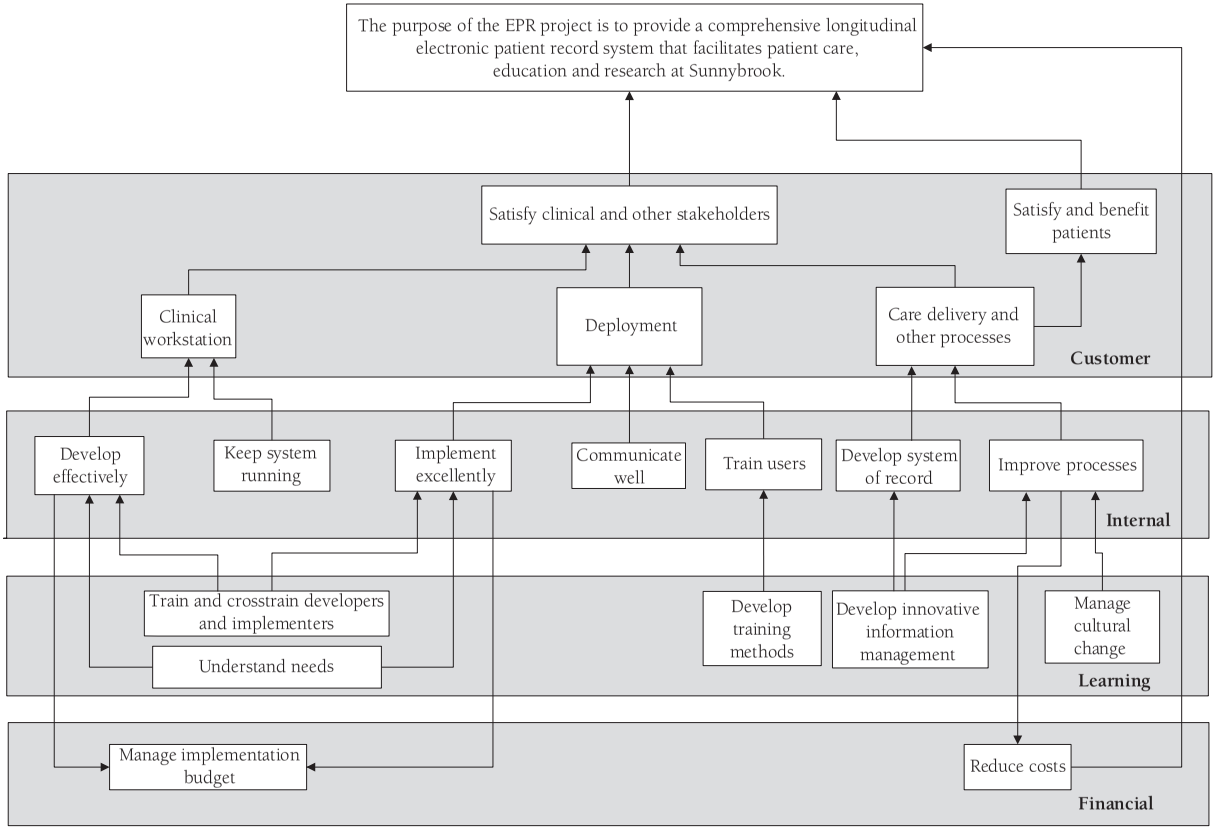
Using the same well-defined and proven development methodology, we developed a balanced scorecard for the EPR project, as shown in Figure 1.

Early in the process, the project management team generated potential ideas for the EPR balanced scorecard. We used a consensus building group process to come to agreement on the initial indicators and their cause–effect relationships. We intend to develop the system iteratively using a spiral development process.[31] Progressively more complete versions of the balanced scorecard prototype will be built over time.

The cause–effect relationships of the EPR objectives developed by the project management team are outlined in the following. (Phrases in italics refer to objectives indicated in Figure 1.)

The purpose of the EPR is to provide a comprehensive, longitudinal electronic patient record system that facilitates patient care, education, and research at Sunnybrook. For the first phase of the project, which incorporated clinical display of laboratory and radiology results only, we amended the purpose statement to read "The purpose of the EPR pilot is to demonstrate the acceptability of the clinical display and its deployment processes."

Figure 1. The EPR Project Balanced Scorecard



Customer Perspective. The primary customer objectives of the project were to *satisfy and benefit patients* and *satisfy users of the system.* Satisfaction of users was divided into satisfaction with the *clinical workstation,* with the *deployment,* and with improved *care delivery and other processes.*

Internal Perspective. Internal objectives that must be accomplished in order to achieve objectives in the customer quadrant were as follows:

Satisfaction with the *clinical workstation* depends on *effective development* and on *keeping the system running.*
Satisfaction with the *deployment* depends on *excellent implementation, good communication* and effective *training.*
Satisfaction with *care delivery and other processes* depends on *improvements to the care delivery and other processes* due to the new system.

Innovation. Effective *development* and *implementation* depend on *understanding user needs* and on *well-trained, crosstrained staff*. Other innovation measures include *innovations in training* methods and *innovative information management.*

Financial. In the private sector balanced scorecards discussed by Kaplan and Norton, financial perspectives, especially profit objectives, tend to be paramount. We have found that this is not true of public sector balanced scorecards, in which financial measures tend to be viewed as constraints. In this case, the financial objective of the project was to deliver the project *on time and on budget* and to contribute to *reducing the cost of care*.

The essence of the balance for this scorecard was to implement an EPR system that satisfies the needs of users at reasonable cost and to reduce costs while optimizing patient satisfaction and quality of care.

Performance Measurement Results

We developed measures for each objective using a combination of surveys, focus groups, observations, and quantitative analyses.

Customer Perspective. We evaluated *patient benefit* subjectively, by observation. We noted a quick turnaround of treatment when a nurse retrieved a critical prothrombin time in the presence of the physician, who then prescribed Coumadin without delay. One physician reported that the reverse chronological display of results by modality (rather than having to search for results within each encounter, as had been the case in the previous patient care system) had helped him more easily understand the data trend and had prevented a return trip to the hospital for a patient.

We measured *user satisfaction* by triangulating a survey of pilot users, a focus group, and observation data. The survey instrument consisted of an end-user satisfaction rating instrument developed by Doll and Torkzadeh.[32] The tool used five-point Likert scaled questions to measure attitudes towards

the implementation of the EPR, organized into six major themes: content, format, accuracy, ease of use, timeliness, and system use. The survey also included open-ended questions that assessed changes caused by the balanced scorecard system and elicited suggestions for improving the system. One hundred user surveys were distributed to all users on the two pilot units; twenty were returned.

The second component of user satisfaction measure was a focus group. The research team selected a group of users from the two pilot units. A minority of the focus group participants had participated in the surveys. The focus group was partially structured with an interview guide that correlated with the survey factors. Sample questions were designed to be open-ended, singular, nondichotomous and clear. The focus group was audiotaped and coded by two investigators. Representative focus group statements were paired with associated survey findings.

Results indicated that users were generally satisfied with *clinical workstation* system content (77 percent), format (81 percent), and ease of use (60 percent). In particular, the clinical display functionality for identification of new and critical results was highly valued. Users were satisfied with *deployment* and communication about the pilot and expressed a preference for the new EPR system over the old patient care system. Despite this preference, only 31 percent of users indicated that they consistently use the new system. Most indicated that they would continue to use the old patient care system until the new system had equivalent clinical ordering functionality.

We correlated these findings with the third component of the triangulation, unit observations. Two sets of observations indicate that clinical display was used to retrieve results on the pilot units about 25 percent of the time. The current patient care system was used 75 percent of the time. The main reasons for clinicians using the current patient care system were that order entry was available on the old system, but not on the new one at present; no training had been received to date; and passwords were forgotten. Users on this unit also made the point that they check blood work or radiology examinations once per day. This caused us to reconsider our definition of "use" and made us question whether the project management team's initial expectations of use had been unrealistic. As many others have found, satisfaction with the technology and its deployment does not automatically translate into system use.

We measured training satisfaction with a post-training questionnaire. Users were very satisfied with almost all aspects of training, especially the interactivity of the classes using multiple linked clinical workstations. This was one of the innovations that the team implemented for this project. Trainees commented on the large volume of training material that had to be covered in the four-hour training session.

Internal Perspective. We attempted to understand effectiveness of *development* from aggregate data derived from our change control logs. The majority

of problems were with lab results (30 percent) and ADT messages (30 percent). Twenty percent of problems were critical and had to be solved prior to the system going live.

To gauge *"Keep system running,"* we tabulated downtimes since the start of the pilot. Over a period of three months, the system was down for a scheduled twenty-five hours and fifteen minutes (including time allocated to upgrading backup software and network software). There were two hours of unscheduled downtime, during which the system was unable to receive ADT messages.

Implementation effectiveness was measured from onsite clinical support staff logs. Sixty percent of calls were for training support; 22 percent were application problems. Each problem was referred back to the development team for resolution. Less than 5 percent of calls related to the network, indicating that the network connection between clinical workstations and the clinical data repository is stable.

To measure *communication effectiveness,* we tabulated communication events, including four publications in the campus newspaper, five specific meetings with operations directors or patient care managers, two campus wide consultations, and numerous informal communications. Users expressed satisfaction in the pilot survey with the communications strategy and felt that they had been kept informed.

Since the system was a direct replacement for existing functionality, the team knew that there would be minimal change to existing *clinical processes.* One process that did change was password issuance to improve timeliness of the request for access, and the electronic signature of the confidentiality undertaking. From an administrative perspective, this was a modest process improvement.

Innovation Perspective. We related effectiveness at meeting *user needs* with effectiveness of the clinical display specification process. Approximately 50 percent of changes in the development change control logs required a change in specification. The main reasons for the incorrect specifications were inexperience with product functionality and unexpected interactions between ancillary systems and the clinical data repository behavior.

Financial Perspective. From a financial perspective, we were *within budget,* but overran our development time estimate by 25 percent. We did not expect to have any impact on the *cost of patient care* at this early stage of the full EPR project.

Discussion

The EPR balanced scorecard model and evaluation results have been disseminated to and discussed with various teams, with different effects. At the development team level, there was discussion about the number of change control items and the development process. This has led to a continuous quality improvement exercise to improve the specification and testing methodologies.

The team also discussed the meaning of the data, and what a good definition of development excellence might be.

At the project management level, the team validated the EPR balanced scorecard model. The cause–effect relationships do reveal the project strategy. The team validated the finding that users might be satisfied with the software itself and the implementation, but not find sufficient improvement to their processes to warrant their switching to the new system. This had been discussed early in the project as the most serious risk to clinician acceptance of the system. The team reviewed the deployment strategy and discussed changes to the strategy that were necessary to account for this finding. Some of the implications included the possibility of mandating use, additional refresher training at later project stages, and mitigation of organizational risk as the old, noncompliant patient care system degraded.

The balanced scorecard brought about a synthesis of data from multiple sources, which led to exploration of the relationships between objectives, particularly at a process level. For example, discussions about the onsite clinical support log led to debate about the effectiveness of the handoff of development problems to the development team. Discussion about system downtimes led to the realization that users were for the most part unaware that messages were not being received into the clinical data repository. This led to debate about the definition and boundaries of the "system" in a best of breed, multisystem integrated environment, and about whether user satisfaction had in fact been affected by downtimes.

At the senior EPR steering committee, the model and data were reviewed. There were discussions about deployment strategy, organizational risks if users did not use the new system, and Y2K implications of system nonuse. This team also reviewed the "keep system running" goal in depth, and discussed the system uptime target, its definition, and planning steps that the project would undertake to improve uptime as users become more dependent on the new system.

The evaluation demonstrated the first part of the hypothesis: The balanced scorecard provided the EPR management teams with an effective tool to formulate its performance management information needs. The balanced scorecard helped the EPR project team to communicate its priorities, both downward to the development team level and upward to the steering committee level. The balanced scorecard information helped managers evaluate the success of the project, and helped identify areas where the implementation strategy was not succeeding. Discussions about the diffusion of the project and about the meaning of system uptime challenged existing mental models in these areas that were based on the old patient care system, and caused the teams to reframe these problems in different ways—an example of "double loop learning."[33] The balanced scorecard helped the teams build a shared vision of success and fostered a systems approach to the project, characteristics of a learning organization.[9]

Conclusions

Management teams need a framework for understanding and managing performance in an integrated way. The balanced scorecard was an effective methodology for helping the EPR management teams to define their objectives, associated performance indicators, and the cause–effect relationships between them. Providing indicator data within this framework helped management teams to filter information and to focus on improving performance in strategically important areas. We conclude that the balanced scorecard framework is a powerful tool for enabling strategic management of an electronic patient record project.

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