A Multi-Method Approach to Building Causal Performance Maps from Expert Knowledge

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Abstract

This paper describes a multi-method approach to building the foundations of a causal performance measurement model. Such models have received considerable attention in the management accounting literature in recent years. Conventional models, such as the balanced scorecard commence with the strategic understanding of top management which is then translated into operational measures at lower levels. In contrast, this study proposes methods of performance mapping that draw on the knowledge of experts who control core operating tasks. Causal knowledge is elicited from individuals who through their experience and training have encoded relational or causal knowledge about complex systems; that is, they understand how things fit and work together, although they might not have articulated that knowledge. Because no single method for eliciting causal performance maps dominates the literature, the study triangulates three methods of deriving a map of causally linked key success factors (KSFs) – a computerized analysis, an ethnographic analysis and an interactive mapping by expert participants.

The study's primary contribution is the development and illustration of an approach to building performance models in management control settings where expert knowledge workers perform complex processes, the outcomes of which are difficult to quantify. The study's secondary contribution is the triangulation of multiple qualitative methods to enhance the validity of performance model development. This approach demonstrates (1) the use of cognitive mapping to extract tacit knowledge from employees in knowledge-intensive organizations; (2) the extensive array of performance relevant variables that arises from such mapping, and (3) the potential to use the resulting causal performance map as a comprehensive, articulated basis for developing a performance measurement system. The approach used in this study for developing a causal performance map is adaptable to management control of other knowledge-intensive organizations.

Key words: causal maps, knowledge workers, qualitative method, performance measurement

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1.0 Introduction

Performance measurement systems are an integral part of an organization's management control system (Hemmer, 1998; Otley and Fakiolas, 2000). Kaplan and Norton (1996) were among the first to articulate the link between performance measurement and the firm's production function. The distinguishing characteristic of the balanced scorecard (BSC) is that it represents a model of performance. It articulates the links between leading inputs (human and physical), processes, and lagging outcomes and focuses on the importance of managing these components to achieve the organization's strategic priorities. Others also have described similar models in the management accounting literature (Otley, 1999; Epstein et al., 2000; Ittner and Larcker, 2001). A key assumption in these performance measurement models is that the production process is known and can be modeled. It is also assumed that an organization's strategy can be articulated and communicated unambiguously throughout the organization. While research has examined implementations of BSCs (Malina and Selto, 2001; Kasurinen, 2002) and assessed the causal links between leading and lagging indicators (Rucci et al., 1998; Malina and Selto, 2004) it is silent on how key success factors (KSFs) and the relations among them are articulated.

The performance measurement models reported in practice appear to be the result of a) top-down imposition of desired KSFs and interrelations (e.g., Malina and Selto, 2001), b) interviews of top or divisional managers (e.g., Ambrosini and Bowman, 2002), and c) data-mining of existing archival sources (e.g., Porac, et al., 2002; Rucci, et al., 1998). Clearly, all are feasible methods to gather performance-relevant data, but all are somewhat flawed. Building a performance measurement model based solely on data currently available might create gaps in KSFs. Data mining relies on conveniently available data that might be unrelated to actual drivers of system performance or what should be but has not been measured. Top-down models might not reflect know-how, routines, and capabilities that really drive performance (e.g., Huff and Jenkins, 2002). Top management might understand the organization's intended strategy and policies but might be ignorant of or unwilling to discuss actual observed system behavior (e.g., Morecroft and Sterman, 1994; Forrester, 1994). An alternative approach is to build a performance model independent of current performance measurement practice, consisting of KSFs and their relationships with valued organizational outcomes. This method provides a more complete foundation for performance measurement by identifying all KSFs, some of which may not be currently captured by performance measurement protocols. Once KSFs are determined, then currently available performance measures can be compared with the identified KSFs. However the question of how to identify the KSFs and the relations among them remains unclear.

This paper describes a multi-method approach for the derivation of a performance model consisting of KSFs and their interrelations. We use this approach in a knowledge-based organization. In such organizations performance measurement problems can be particularly acute. Management control of organizations that compete based on knowledge is challenging as the knowledge crucial to value creation resides with experts (Albert and Bradley, 1997). Attempts to derive performance measurement models which reflect the firm's production function is problematic because knowledge of KSFs and the processes that drive organizational outcomes is expert knowledge located at core operating levels, not general knowledge known to top management (Forrester, 1994). We use three methods of cognitive mapping to capture the "map" of expert work. We allow the experts to explain what they do, the processes associated with their work, and the facets of their behavior that go unspoken in the organization. From this we learn about the relations between actions and outcomes and develop a causal performance map that represents experts' understanding of organizational performance. This paper reports on the first stage of a longitudinal study to develop and implement a performance-based management control system in a clinical program of a large, teaching hospital. A causal performance map is a prerequisite and serves as the building block for the design of the organization's performance measurement system.

The paper is structured as follows. The following section synthesizes the literature that forms the basis of the study. Next, three methods for eliciting causal maps are described. The research site, methodology, and the resulting causal performance maps are then described. Finally, the paper presents conclusions and future research extensions.

2.0 Literature review

The management accounting literature has a long tradition of advocating performance-based management control systems (e.g., Kaplan and Norton, 1996; Merchant, 1998; Simons, 2000). Recent years have seen examinations of the particular problems of implementing such systems in knowledge-based organizations (e.g., Widener, 2004). One basic problem is that the knowledge which is necessary to build systems in such organizations often resides in individuals. A related problem is extracting that knowledge for organizational use.

2.1 Converting the tacit knowledge of experts to explicit organizational knowledge

Knowledge-based organizations are dependent on the efficient management of human resources as this resource is the prime source of the organization's knowledge, capabilities, and systems. Because human resources are mobile and governed by self-interest, organizations seek to convert individuals' tacit or unobserved knowledge to explicit or organizational knowledge in order to build organizational capabilities (e.g. Nonaka, 1994; Nonaka and Takeuchi, 1995). Converting tacit knowledge to explicit knowledge is a daunting task because tacit knowledge is difficult to communicate. Those possessing it find difficulty in explaining the decision rules that guide their performance. The know-how is deeply embedded in the individual and is typically acquired through extensive training and on-the-job experience. Included in this tacit knowledge is knowledge that is relevant to the design of an effective performance measurement system (Forrester, 1994).

According to Ambrosini and Bowman (2001), tacitness of knowledge is a matter of degree. At one extreme, knowledge is deeply ingrained and totally unavailable. At the other extreme, knowledge can be easily communicated and shared. In the middle lies knowledge that has the potential to be articulated. By asking the right questions, this knowledge can be tapped and made available to the organization. The knowledge remains tacit because nobody has tried to articulate the knowledge, not even the holder of the knowledge. Articulating tacit knowledge through inquiry allows management to learn and thus improve their understanding of how their organizations achieve success (Ambrosini and Bowman, 2001). In knowledge-based organizations the tacit knowledge of experts is critical to understanding the inputs and processes associated with organizational success. The conversion of tacit knowledge to explicit knowledge provides the possibility to develop performance measurement systems that will be effective in coordinating, monitoring and measuring the work performed by experts. Creation of explicit knowledge from tacit knowledge enables top management to "learn" about the processes performed by experts so that factors critical to success can be identified and incorporated into the design of these systems. The imposition of a top-down performance measurement system without this knowledge has a propensity for failure (e.g. Huff and Jenkins, 2002; Forrester, 1994). In other words, in expert settings, converting tacit expert knowledge into explicit knowledge must be the first step in the design of an effective performance measurement system (Lorino and Tarondeau, 2002; Morecroft et al, 2002; Sanchez, 2001).

2.2 Capturing tacit knowledge to build a performance measurement system

The psychology, systems dynamics, and strategic management literatures use "mental data" from individuals to build formal cognitive maps. A cognitive map is a representation of an individual's personal knowledge and own work experience (Bougon et al., 1977). During the mapping process, individuals must explain what they do, revealing facets of their behavior that were previously tacit. The in-depth probing allows the knowledge that goes unspoken in the organization to be "mapped". Cognitive maps visualize knowledge and communicate the visualization to individuals, groups or organizations, thus converting tacit knowledge to explicit knowledge (Eden, 1992).

One type of cognitive map that captures judgments about the link between actions and outcomes is a causal map. Building a causal map is a means of converting individuals' tacit knowledge to a model of explicit KSFs and their interrelations. In causal maps, the nodes are the constructs the individual feels are important and the arrows show the relations among the constructs (Ambrosini and Bowman, 2001). A causal performance map can be viewed as a cognitive map of organizational success. Constructs and arrows represent the links among inputs, processes and valued outcomes. In this manner, cognitive mapping provides data to support the development of a performance measurement system. By tapping the knowledge of individuals within an organization, a causal performance map describes the constructs and relations among them. From this map it is then possible to define measures that are potential candidates for inclusion in a performance measurement system.

3.0 Map-Building Methods

Because no single method for eliciting causal performance maps dominates the literature, this study triangulates three methods of deriving a map of causally linked KSFs. The three methods are a computerized analysis, an ethnographic analysis and an interactive mapping by expert participants. A description of each method, along with associated strengths and weaknesses, are described below.

3.1 Map-building method 1: Computerized discovery of causal links

A major development for qualitative-method researchers is efficient and flexible qualitative database software.[1] This software serves two purposes. First, researchers use this software to create a database through systematic coding of qualitative data. (e.g., Jasinski and Huff, 2002). Second, qualitative researchers use the database software to analyze relations in the database of interview transcripts in much the same way as quantitative researchers use the SPSS or SAS software packages (e.g., Malina and Selto, 2001). Using this type of software for data analysis helps bridge the gap between the qualitative and quantitative research perspectives.

The researcher can use the software to create and test relational maps that aid in developing theoretical models and assessing the relative strength of the relations among the variables of the models. The use of the computer software to build a model of relations among qualitative data items reflects an attempt to achieve validity by establishing that the discovered relations are reliable and not purely subjective. Another researcher would be able to use the methods to develop the same model from the data. Interpretations of the model can vary, but that is also the case with quantitative research. Studies that utilize this model-building feature of qualitative data software include Malina and Selto (2001) and Friese (1999).

A disadvantage of computer-assisted data analysis is the potential to report causal links that only represent the query rules used for establishing the links (e.g., proximity of codes) rather than valid causal relations. Thus, additional, subjective evaluations of software-discovered links usually are necessary. This computer-assisted approach also can be incomplete if the coding scheme does not reflect all of the relevant underlying theory and field experience gained.

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[1] The term qualitative method is often used synonymously with field research and case research method. The proper distinction between qualitative method and other methods is by the nature of the data themselves. Qualitative method generally uses interview and observational data rather than quantities or quantified survey responses. See Ragin (1987) for a discussion of these alternative methods.

3.2 Map-building method 2: Ethnographic analysis of interview data

The second method for building causal maps reflects a traditional, ethnographic interpretation of interviews and interview context. This is perhaps the most frequently used method for analyzing qualitative data. Ethnographic interpretation allows the researcher to drive the creation of a causal map through his or her understanding of the context (from current and prior experience) and the use of the entire interview transcript to identify the causal relations. These relations might not be captured in software-discovered frequencies of association based on proximity of constructs. The use of the entire transcript provides a means of interpreting the perceived importance of the causal links from interviewees' comments. Use of the transcript data in this way can increase the likelihood that the ultimate map reflects reality rather than associations based on software-discovered proximity of themes. A disadvantage of ethnographic interpretation is the tendency to focus on confirming evidence. Psychology studies, for example, find that people place more weight on confirming evidence than on disconfirming facts and tend to ignore or forget information that does not follow their line of reasoning (Nisbett and Ross, 1980). Also, there is a risk of an incomplete analysis because of the cognitive complexity of the task.

3.3 Map-building method 3: Interactive mapping by expert participants

The third method can be described as a visibly aided, post-encoding sorting or construction task (e.g., Wattenmaker, 1992). It actively engages the expert participants in the map-building task by asking them to map causal relations among discrete themes or constructs extracted from their prior interviews. This method allows the experts to arrange construct cards according to their experiences of causality (Langfield-Smith, 1992; Daniels et al., 1995, 2002; Sirsi et al., 1996). This method is particularly advantageous for creating causal maps in early stages of investigating complex processes, when more objective data are either unavailable or pose an undue risk of dominating map building (Homer-Dixon, 1996). Care must be taken in determining the number of construct cards given to participants to successfully recall coded information. As much assistance as possible should be given to participants without leading them to predetermined results.

4.0 Research Method

To illustrate and integrate the three map-building methods for creating causal performance maps from knowledge experts, we look to a large public, teaching hospital. This setting was selected for several reasons. First, teaching hospitals represent the archetypical knowledge-based firm. Knowledge is dispersed and impacted in clinical programs where core operating tasks are performed and controlled by medical experts. Similar to other knowledge-based organizations, the medical-care production process is not well understood and organizational outcomes are difficult to measure quantitatively. These conditions create a management control environment where monitoring and measuring performance of core operating activities is particularly problematic. It is also a setting where tacit knowledge is at risk. Creating a causal map of performance provides a means of capturing this tacit knowledge and converting it to explicit organizational knowledge. This knowledge can then be used as the foundation for a performance measurement system. Second, public teaching hospitals have a weak performance management history, which presents an opportunity to demonstrate the value of documenting the tacit knowledge of clinical managers into KSFs and their interactions.[2]

The study is designed to develop causal performance maps using data from experts within a large teaching hospital. The data are collected using semi-structured interviews. Following Yin (2003) we use an interview protocol. The interview protocol is based on a generic performance model where inputs are converted into outputs through a transformation process. Figure 1 illustrates a simple performance model with outcomes classified as either effectiveness or efficiency outcomes. Effectiveness outcomes in hospitals, for example, include patient outcomes such as satisfaction and improvements in health status. Efficiency outcomes might include admission rates and financial budget performance (profit is not commonly used as an efficiency outcome measure in hospitals).

Figure 1

The model illustrated in figure 1 motivates the questions in the interview protocol (Table 1) but the questions do not constrain responses to fit this naïve model. Questions are designed to

[2]There is increasing pressure on health care organizations to adopt management control innovations implemented in other sectors of the economy (Capettini et al., 1998; Forgione, 1999; Handler et al., 2001; Steward and Lockamy, 2001) and yet little is known about the conditions that will facilitate their effective implementation in health care (Abernethy and Lillis, 2001).

elicit "stories of performance," because stories are vivid, contextual devices for relating personal knowledge and experience. By telling stories of how the organization functions and the factors leading to success, participants make explicit what might have remained tacit knowledge about goals, processes, performance, and outcomes (Ambrosini and Bowman, 2002; Boje, 1991).

Table 1

4.1 Data collection

The first contact in the field was the medical director of the hospital. He approved the research project and provided the resources needed to undertake the task. The medical director also provided the research team with background information concerning the history and the internal structure of the hospital and provided access to relevant archival data (e.g., budget reports and routine operating statistics). He identified four key participants for the study within one of the major clinical programs in the hospital.[3] The participants include the nurse managers of the two major wards of the clinical program, the medical director of a unit within the program, and the director of surgery within the program. All of the participants are directly involved in treating patients and have significant roles in resource management in the program. These respondents represent "experts"[4] in that they all are all highly trained professionals with significant, recognized expertise in their fields. They have supervisory responsibilities over the clinical program and perform both teaching and research functions. Table 2 includes personal statements from each of the participants concerning his or her role and responsibilities within the clinical program.

Table 2

We conducted two rounds of interviews. The objective of the first round of interviews was to elicit knowledge from the participants regarding desired performance outcomes, the drivers of those outcomes, the perceived causal interdependencies among performance drivers, and the causal time lags between enhancements in performance drivers and their effects. These

[3] The hospital is divided into clinical (e.g., obstetrics), clinical support (e.g. laboratory services), and non-clinical programs (e.g. administrative departments).

[4] It is difficult to use an external referent to obtain a definitive classification of an expert (Shanteau et al., 2002). Rather an expert is defined as someone displaying specialized skills and knowledge derived from training and experience (Shanteau & Stewart, 1992). All four participants in this study have many years of experience, extensive academic training, supplemented with on-the-job training.

interviews followed the interview protocol with the researchers using follow-up questions where necessary. The second round of interviews asked the experts to participate directly in building a causal performance map. All interviews lasted between one and two hours and were tape-recorded.[5]

This study uses the three complementary methods described earlier to analyze qualitative data collected from the interviews in order to create causal performance maps. All three methods start with performance stories collected in the first round of interviews. We then triangulate three methods of extracting the causal linkages within these performance stories. The first method relies on the computerized analysis of the coded transcripts from the first set of interviews. The second method reflects the traditional, ethnographic interpretation of first interviews and interview context. The third method uses the experts themselves to visually build causal performance maps with cards containing KSFs that have been extracted from their coded interview transcripts. In the first and second methods, we use the data to develop the causal performance map. In the third method, participants are involved in building and validating their own maps.

The goal of each method is to create one causal performance map for the clinical program. Several methods are used in the literature to consolidate maps. Bougon et al. (1977) use an average of individual maps and Langfield-Smith (1992) uses participant group discussion. Within each method used in this study, composite causal maps are created across individuals by using common constructs as "glue points" to combine the individual models (Clarke et al., 2000). Similarly, a composite, final causal performance map is created across methods. This approach insures that all elicited constructs and linkages are retained in the final map.

The following subsection describes the use of computer software to facilitate data coding and retrieval. Subsequent subsections describe the causal performance maps that result from each of the three methods.

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[5] We adhered to strict guidelines (required by our universities) to ensure that each participant was aware of the nature of the study. Each participant formally agreed to participate in the study and agreed that the interview could be tape-recorded. Disinterested contract typists transcribed the interviews verbatim. Participants had the opportunity to review the transcribed interviews. We corrected any factual errors.

4.2 Computer-assisted coding

The first step in analyzing interview data is the development of a coding scheme. The coding scheme used in this study is consistent with the interview protocol and reflects the underlying theoretical priors that form the foundation for the study. The coding scheme marks occurrences of discrete KSFs and performance driver themes in the data. However, we developed additional codes during the coding phase for variables unanticipated in the initial development of the interview protocol. The coding scheme is *not* designed to reflect causality or other associations between codes. This would have predetermined causal links; rather the coding scheme enables us to identify KSFs that can form elements of a causal performance map.

An advantage of using computer software for coding is that it helps to ensure that all data are coded and thus reduces the potential for researcher bias when selecting data for analysis. The use of the computer software for coding can reduce the occurrence and perception of data-selection and reporting bias. A further advantage of the computer-assisted approach to coding is the creation of an auditable and easily accessed qualitative database. Through the coding scheme, researchers express theoretical constructs and additional field knowledge they have gained. The data codes provide an index that enables researchers and others to retrieve all data relating to each code. For example, if one wanted all data relating to one of the dimensions of a construct of interest, say empowerment, it is trivially easy to retrieve all data associated with the appropriate code. Without the software, researchers must expend significant effort to search for all data relating to this particular dimension and inevitably run the risk of omissions caused by fatigue and available time. Without such an approach, those not directly involved with the data have no feasible way to replicate the qualitative analysis, and must rely entirely on the reputation of the researcher(s) and the rhetoric of the report to assess its validity.

Because all three map-building methods used in the study rely to a significant extent on the thematically coded interview data, establishing coding reliability is critical to the validity of all the analyses and findings.[6] This was accomplished by using the codes of two of the researchers. After coding the first interview, the two researchers discussed the suitability of the initial coding

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[6] The three methods relied on the initial code set in table 3 as a starting point. Method 1, which relies on computer-generated linkages between codes relies on this code set completely. Method 2 (ethnographic analysis of transcripts) and method 3 (interactive mapping by experts) are more flexible and adaptive, allowing departure from the specified code list. These methods are described in full in the ensuing subsections.

scheme and refined the set of codes (table 3).[7] The researchers then re-coded the first interview and coded the remaining interviews. Comparing the ratio of agreements and disagreements in coding all interviews by both researchers measures the degree of inter-rater reliability. An agreement occurs when both researchers use the same code for approximately the same section of text. A disagreement occurs when either the researchers did not code a section of text or they coded the section differently. Coding reliability averaged 83.2 percent, ranging from a low of 79 percent to a high of 88 percent. The average falls within the normally accepted range of at least 80 percent (Miles and Huberman, 1994). The two researchers discussed all disagreements and then agreed upon the final coding.

Table 3

4.3 Method 1: Computerized discovery of causal links

The first causal performance map derived in this study results from the relatively objective computerized analysis of thematic links in the coded interview transcripts, following the method described by Malina and Selto (2001). We use the database software to discover associations and possible causal relations among the coded sections of text from the interviews[8]. The software uses various proximity rules to count the number of associations between pairs of codes.[9] We then are able to infer possible causation among the elements of a map based on these frequencies <u>and</u> the subjective evaluation of the theoretical coherence of these links by the researchers. (Miles and Huberman, 1994). We set a quantitative threshold to identify a likely casual link in the map at seven associations, the mean number of all such occurrences, excluding zeros. Within this reduced set, we evaluate each observed linkage by reading the relevant transcript sections to subjectively assess whether the observed linkage is coherent or spurious. Only those links with at least seven coherent links are retained in the map. This constraint is an acceptance probability compromise of 50 percent, between including all observed, coherent links and setting a standard confidence interval about the mean (e.g., 95 percent).

[7] As recommended by Miles and Huberman (1994), the researchers found that definitions become sharper when two or more researchers code the same data set and discuss their initial difficulties.
[8] The software used in this case is Atlas.ti. However other commercial software such as QSR NVivo can be readily used for similar analysis.
[9] Proximity rules include coded quotations of one type *enclose, are enclosed by, overlap, are overlapped by, precede by one line,* or *follow by one line* coded quotations of another type.

These linked codes form the basis of the first version of the causal performance map, which is shown in figure 2. Figure 2 follows the basic framework of the naïve model but adds KSFs for each of the major components. Ovals represent the KSFs and arrows reflect causal links among the constructs based on the observed coherent associations. The total of 11 KSFs are distributed across the four categories with six KSFs in human and physical inputs, two KSFs in production processes, two KSFs in effectiveness outcomes and one KSF in efficiency outcomes. Traditional factors such as recruitment, retention, satisfaction, empowerment, training and teamwork appear in the human and physical inputs category. Patient care processes (e.g. quality of care) and patient flow (e.g. throughput) make up the production processes category. KSFs for effectiveness outcomes and efficiency outcomes are clinical outcomes and patient satisfaction, and department level financial outcomes, respectively. Figure 2 also includes external factors, which all respondents mentioned repeatedly. For example, the ability to recruit and train staff is directly dependent on availability of trained nursing and medical staff; economic and political factors influence the hospital's overall budget and hence influence ability to hire additional staff; bed shortages within the hospital and outside the hospital influence patient flow. For economy of presentation, the links among external factors and KSFs are not elaborated in this or subsequent models.

The causal performance map created by this method exhibits relations among KSFs within each category. For example, employee retention and training are linked, as are clinical outcomes and patient satisfaction. Between categories, human and physical inputs affect production processes and effectiveness outcomes while production processes affect effectiveness and efficiency outcomes. When taken as a whole, this causal performance map tells a credible story about how performance in this medical program is achieved.

Figure 2

Figure 2 reflects the most conservative map of causal links of those derived from this study because of the conservative quantitative threshold used. While figure 2 is not as rich descriptively as those that follow, it does build on the naïve model, identifying KSFs in this particular hospital setting. It tells a concise, coherent story about building physician and nursing capital, improving clinical processes, affecting patient outcomes, and influencing department-level financial outcomes. Method 1 and figure 2 demonstrate that the qualitative data support a “core map” and that the richer maps that follow are not purely subjective interpretations. Subsequent maps build on figure 2, although neither the researchers nor participants had access to this map during the development of maps using methods 2 and 3.

4.4 Method 2: Ethnographic analysis of interview data

To build the map ethnographically, three researchers, who did not participate in the development of the computer-assisted model or see it beforehand, used the basic code-and-retrieve program of *Atlas.ti* to collect all text attached to each thematic code. Inference of causality associated with these themes required reference back to the transcripts to ensure that extracted segments were not taken out of context and that all relevant text segments faithfully reflected the causal connections described by interviewees

KSFs (ovals) and causal linkages (arrows) for all four interviews were highly convergent among the three researchers. We resolved differences in terminology, linkages, or levels of aggregation by consensus. This process resulted in the development of a composite causal performance map for each of the four participants. These four maps were then combined into one overall causal performance map as shown in figure 3. The map created by method 2 reflects the most inclusive collection of KSFs and causal relations revealed by analysis of each interview. For example, if one participant’s map included training, empowerment, and communication, but others included only training and empowerment, figure 3 includes all three factors. Note that in some cases the constructs are combined into an oval. This occurred when we detected consistent patterns across participants in the linkage between a range of constructs. For example, all participants described one or more of the constructs employee empowerment, satisfaction and retention in terms of a reciprocal relation with teamwork, communication, networking or leadership, and none of the participants described relations among any of these that were inconsistent with such a reciprocal relation.

Figure 3

Figure 3 describes a more complex map that reflects our interpretations of the importance of expressed causal linkages beyond the more restrictive frequency of comment in method 1. Figure 3 includes nine additional KSFs that at least one interviewee expressed as important but did not generate sufficient frequency of comment to be captured in method 1. One of the nine additional

KSFs is unique to this map. Discharge planning is included in the production processes category in method 2 but not in methods 1 or 3, which follows. Finally, observe that figure 3 also identifies four additional external factors outside the span of control of the clinical program that influence performance.

Consistent with figure 2, figure 3 exhibits relations among KSFs within each category. Also consistent with figure 2, human and physical inputs affect production processes and effectiveness outcomes while production processes affect effectiveness and efficiency outcomes. Unique to this causal performance map is the bilateral relation between production processes and efficiency outcomes. The causal performance map generated using ethnographic analysis of interview data is consistent with the map generated by the computer-assisted method. Additional KSFs were identified and a recursive relation was found between two categories.

4.5 Method 3: Interactive mapping by expert participants

The third map-building method uses the participants to map causal relations among KSFs. To help participants organize their knowledge of performance by relevant features, we framed the task as modeling causality among the revealed KSFs (e.g., Attarwala and Basden, 1985; Luft and Shields, 1999; McEarlean et al., 1999). Thus, this method did not require participants to recall all previously stored or encoded information, a cognitive task that can be impeded by memory storage and retrieval processes (Spector and Davidsen, 2002). The constructs given to participants used the terminology of their individual interviews. Self-stick labels reflected each KSF, and self-stick arrows allowed for connections. We met with the participants individually for a second time, and undertook the following steps to extract the experts' knowledge for the links between the KSFs:

a. provided each participant with the set of self-stick labels developed from the transcript of his or her prior interview,
b. explained that these represented KSFs or activities based on their comments in the prior interview,
c. carefully defined each factor by using the specific comments and examples from their prior interview,
d. established mutual understanding that the specific comments reflected the theme on the self-stick label, and

e. requested their input on how these factors were inter-related (e.g., “We would like you to look at these factors or activities, see how they fit together – whether there are relationships among them – and position them in time sequence – whether there are some things that you do at one point in time that influence other factors later.”)

Each participant positioned the self-stick labels on a piece of paper and placed or drew arrows between them as appropriate to reflect their causal knowledge. At the same time, we tape-recorded the accompanying discussion to capture the rationale behind the relations discussed. Participants were able to revise their positioning of the labels and causal arrows as often as they wished during the interviews. Once the participants were satisfied that the map reflected their perceptions of the KSFs and the linkages among the KSFs, we firmly affixed the labels with tape. We made no attempt to finalize any map until the participant declared it finished and a good representation of the relationships among the KSFs.

We overlaid the individuals' maps into one causal performance map shown in figure 4. As in figure 3, figure 4 represents the most general inclusion of KSFs and relations obtained from participants. When the few mapping conflicts occurred, the majority judgment prevailed. In addition, individual constructs expressed in participants' own terminology were combined into one generic construct when definitions clearly matched.[10]

Figure 4

The level of complexity of figure 4 undoubtedly reflects the number of cues provided to the participants. Participants were provided with a set of cues (18 on average) reflecting the most commonly cited constructs in their own initial interviews. This deliberate research design judgment makes the task descriptive but also keeps the cognitive complexity of the task within reasonable bounds, although the maximum feasible number of cues for the task was not apparent. Participants were free to create additional self-stick labels beyond those provided by the research team, and three participants each added only one. Participants appeared to be comfortable working with the cues provided; whether they could have worked effectively with more cues is unknown.

[10] For example, in the construct lists given to participants, based on their terminology in initial interviews, terms such as patient outcomes and clinical outcomes were defined in the same way as “outcomes of a medical/clinical nature”.

Figure 4 adds several important features to the previous maps. One KSF that is unique to this causal performance map is admission rates. Even though it was not mentioned during the first-round interviews, participants created this KSF during the map-building process. Two additional bi-lateral causal relations were added in this map. When building the map, participants noted recursive relations between human and physical inputs and production processes and between human and physical inputs and efficiency outcomes. Participating in clinical trials affects employee training, communication, and peer reviews while efficiency outcomes affect the department's ability to recruit employees. Figure 4 introduces a feedback loop from outcomes back to inputs.

4.6 Triangulation of methods to prepare the clinical program's causal performance map

Each method of eliciting the program causal performance map yields important information and slightly different results. The computer-aided approach catalogues all frequent associations between pairs of KSFs. This approach, however, cannot capture the perceived intensity or importance of relations among factors beyond frequency of code associations. The ethnographic and participation methods, however, can reflect these important, although more subjective, assessments of causal links. At this early stage of causal performance map development, all information should be used. Therefore, we overlaid the maps from each of the three map-building methods to create a composite map from all the elicited KSFs and relations among them, using common constructs as "glue points" to orient the models (Clarke and Mackaness, 2001). Once again, we created the most general composite map, effectively layering figures 3 and 4 upon figure 2. Figure 5 displays this composite casual performance map, which reflects the full set of counted, inferred, and elicited KSFs and relations among them.

The causal maps – computer, ethnographic, or participant-interaction – are complementary. The computer assisted method created a map of causal links defined in objective terms by proximity and frequency. This map serves as an objective core. The ethnographic approach expanded the map to include more KSFs and recursive causal relations. The participant-interaction method again added a new KSF and two additional recursive causal relations. While this is not the same as cross-validation from independent data, the triangulation method uses three independent assessments of the causal relations reflected in the data. This triangulation method results in a more inclusive extraction and articulation of the causal linkages implicit in the participants' initial causal performance maps than any single approach. Triangulation enhances the possible descriptive validity of the map in figure 5. Figure 5 is a complex causal performance model that reflects the complicated nature of the clinical program studied here, which (like most business units) is a complex entity.

Figure 5

5.0 Conclusions and Future Research

5.1 Conclusions

We use interviews as a common source of mental data but triangulate three independent approaches to the analysis of the data to enhance the validity of the causal performance map. Most qualitative studies rely on one of several available methods, but a single qualitative method might not identify all of the organization's important performance factors and causal relations. This study triangulates the results of (1) computer-assisted mapping, (2) ethnographic mapping, and (3) interactive system mapping by participants. The integration of the three qualitative approaches leads to a causal map of system performance. To our knowledge, no previous study has triangulated methods as a means of validating the causal modeling of qualitative data.

None of the three methods used in this study, by itself, revealed the complexities of activities and their relations that are reflected in the composite causal performance map in figure 5. Each method added information and cross-validation to the mapping effort. The computer-assisted approach might offer comfort to more quantitatively oriented researchers that the ultimate map has a relatively objective core. A limitation of the computer analysis is that it uses an unweighted numerical threshold to identify the "core map" of possible causal links and does not consider expressed or perceived importance of causal relations beyond simple counting. Both the ethnographic mapping (using researchers' perceptions of causality) and the participant mapping (using participants' perceptions of causality) add this crucial qualitative, although more subjective, input. To ensure an objective core map, perhaps, at minimum, a computer-generated analysis should be used in addition to either the ethnographic or interactive method.

The study's primary contribution is the development and illustration of an approach to building performance management models in organizational settings where expert knowledge workers perform complex processes, the outcomes of which are difficult to quantify. There has been little research addressing the complexities of performance management in such settings.

Mechanisms for understanding the sources of value creation and the processes that drive organizational outcomes are a critical foundation for research in performance management in knowledge-based organizations. The approach presented here demonstrates (1) the use of cognitive mapping to extract tacit knowledge from employees in knowledge-intensive firms; (2) the extensive array of performance relevant variables that arises from such cognitive mapping, and (3) the potential to use the resulting causal performance map as a comprehensive, articulated basis for developing a set of performance measures. While this approach for developing a causal performance map is adaptable to other knowledge-intensive organizations, the potential contribution to the hospital sector alone is significant. This is a setting in which effective performance management of health care professionals is problematic as they often do not view organizational goals as consistent with the achievement of their own professional related goals. A performance measurement system could be an effective mechanism to achieve goal congruence in this setting but these systems often fail as they do not capture the processes and outcomes relevant to core knowledge workers.

This study presents a general qualitative approach to identifying a plausible and coherent causal performance map in a knowledge-intensive organization. Identifying this map is the first step in establishing an effective performance measurement system in these types of organizations. Developing the causal performance map enables management to learn about the activities and processes necessary to achieve a well functioning clinical program. It serves as a viable alternative in an organization with dispersed knowledge (e.g., Widener, 2003) to a top-down imposed performance measurement system or a data-driven system. However, Figure 5 is a highly complex map of performance drivers. It is unlikely to be feasible or desirable to implement a performance measurement system that includes performance measures for all of the KSFs identified in Figure 5. Sufficient data usually are not readily available and the use of excessive performance measurement can lead to information overload or selective focus on the most easily achievable measures (Feltham and Xie, 1994). The selection of critical KSFs needs to be performed with considerable care. A comprehensive performance model opens the way for top management to develop performance management protocols that effectively control key value drivers. This can be approached in several ways. First, *measurable* drivers are identifiable in the performance map (eg recruitment, patient flow). Existing data sources can be mined to test statistically the relative importance of these causal factors in driving outcomes. Second, *potentially measurable* drivers are identifiable. These factors are identified as key performance drivers, but are currently not measured within the organization (eg employee satisfaction). These are candidates for measurement depending on cost/benefit and feasibility assessment. Finally, key drivers that are not readily captured by conventional measurement protocols are also identifiable (eg empowerment). This prompts management to think beyond measurement as a means of achieving desired results. For example, people-focused measures might be desirable because of their salience or attention-directing qualities, but if the performance driver is empowerment then this might be best controlled by mechanisms other than measurement (e.g., Ouchi, 1977; Simons, 2000). One needs to resist the temptation to use whatever data are at hand. Data-driven development of a performance measurement system can ignore performance drivers, such as staff empowerment and satisfaction that are critical to success but are currently immeasurable. However, given an understanding of the relations among KSF within each major component, it might be possible to select a reliable proxy for the KSF related to that construct. For example, sick leave statistics (which are relatively easily obtained from an organization's HR system) might be used to reflect staff satisfaction.

5.2 Limitations

There are several potential limitations to the study. We use a limited number of experts to develop the causal performance map. It is thus possible that the map is not truly representative of the clinical program (or similar programs) but only reflects the views of the respondents selected. The model is built on qualitative data and may thus be subject to both interviewee and interviewer bias. We attempted to address these data limitations by adopting three alternative methods to extract the causal model, using multiple researchers, and testing for researcher bias (i.e., finding and eliminating inter-rater differences). We also collected data until we were satisfied that the "stories" from our set of experts were consistent. We were constantly on the lookout for disconfirming evidence. We recognize that the causal performance map might not be generalizable outside the clinical program in which it was developed. However, the objective of the research study was not to develop a generalizable map but rather to develop a method for extracting tacit knowledge from experts. We believe that the method used to generate the causal performance map is generalizable. Furthermore, we expect that all such maps are idiosyncratic to specific settings. It is possible, however, that the basic elements of the causal performance map are generalizable across clinical programs. Further research can be directed towards assessing if this is the case. This would enable the development of a more general "clinical" causal performance map for use in multiple programs within the hospital sector. The outcome of such research has the potential to make a significant contribution to the management of health care services.

5.3 Future research

The most obvious direction for future research is to design a performance measurement system using the causal performance map as the foundation. This represents the "hard" test for its validity. Three steps are required. First, it is necessary to identify suitable measures or proxies for each KSF in the causal performance map, thereby converting the causal performance map into a performance measurement system. Second, the statistical significance of the KSFs needs to be established. This will enable an identification of the most critical performance drivers among the array of KSFs. Third, top management needs to assess the costs and potential accuracy of on-going measurement of these KSFs. While there are costs associated with the design and implementation of a performance measurement system based on causal performance mapping, the process in itself ensures that the tacit knowledge impacted in core operating units is converted to explicit organizational knowledge. This is an important way the organization can build its organizational capabilities.

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TABLE 1

Interview Protocol

A. Record time, place, number and identity of interviewee (separate from taped interview)
B. Obtain signed consent form
C. Speak into recorder: This is the first interview number XXX
D. Ask the following questions in order:

1. Could you describe your current position and work at the hospital?
2. Does your unit have overall goals? Follow-up:
    a. Such as being the best or most efficient unit of its type?
    b. Such as fitting well into the overall network?
3. Can you describe what would be good performance outcomes for your unit?
4. If you could tell a story about how your unit can succeed, what would that story be like? Can you tell that story to us?
5. What factors are most important in determining whether your unit meets its goals, achieves good performance, or meets performance targets? Follow up, ask for examples:
    a. Investments in people? Improved personnel capabilities, competencies?
    b. Improvements in clinical technology or processes?
    c. Improvements in patient management and relations?
    d. Improvements in
        i. Clinical outcomes,
        ii. Efficiency
        iii. Control of costs
6. Are these factors linked in any way? Follow up:
    a. Does an improvement in one area lead to improvements in other areas?
    b. If so, what sort of time lags do you expect?
7. Do you think these factors can be measured?
8. If that were possible, would a combination of these measures help you manage your unit to reach its goals?

TABLE 2

Participant Qualifications

Participant	Qualifications (Condensed personal statements. The identities of the departments have been disguised to protect respondents' anonymity.)
1. Nurse manager 1:	I'm the Nurse Unit Manager of (X department). It's a 26-bed ward, which (has clinical and surgical components). I have a staffing of 32 EFT (*effective full time staff*). My role is to coordinate admissions and discharges and ensure that a safe level of care is delivered to all of those patients. I have been in charge of this ward 12 months. Before that I did surgery (in this clinical specialization) for 25 years, and was in charge of departments (within this specialization) for the last 13 years. Before my current assignment, I was at the University of Y lecturing at the School of Post Graduate Nursing.
2. Nurse manager 2:	I am the Nursing Manager of the (Y specialist sub-unit) and a 16-bed acute care unit, with a day procedure centre with a facility for six patients on a Monday to Friday basis. My role encompasses caring obviously for my staff, recruiting, retaining staff, control over a budget and a cost centre. Also overseeing things like education, certainly directives that come down from my Director of Nursing which have come from the Executive before that.
3. Unit medical director:	I'm Director of (Y specialist sub-unit) at the X medical center and a clinician with an interest in (specialization Y). All of my in-patient work is in the (specialization) service. I have administrative responsibilities for that service. I also have an outside practice. I have research interests in health services at the delivery of care and also in decision support and its relation to improving functional outcomes.
4. Director of surgery within department:	The work involved as Director is small; my main job is being employed as a surgeon. As director, I'm a liaison with the rest of the hospital and management, but management is a very small component of my role. Most of my time all year is spent doing surgery. I have been associated with this hospital in this role about six years.

TABLE 3

Qualitative Interview Codes (*descriptions*) and Frequencies

	Interviews				
CODES	1	2	3	4	Total
Clinical trials *(participation in new drug or new process testing sponsored by external parties*)	0	0	6	0	6
Clinical outcomes (*quality of medical outcomes*)	5	5	5	12	27
Communication (*quality, frequency, effectiveness of communication within and outside the unit*)	7	7	2	0	16
Department-level financial results (*financial outcomes for the unit*)	7	4	5	6	22
Department status (*level of prestige associated with the unit*)	0	0	4	4	8
Employee retention (*success in retaining qualified personnel*)	12	1	4	3	20
Employee satisfaction (*job, professional satisfaction*)	13	3	4	2	22
Empowerment (*influence, control, meeting personal vision*)	5	3	4	2	14
External funding of people, processes, technology (*funding from other providers*)	3	0	5	2	10
Hospital-level financial results (*financial outcomes for the entire hospital*)	1	0	1	7	9
Internal funding of people, processes, technology (*funding from hospital*)	6	1	4	8	19
Interviewee - Nurse Head of Department	1	1	0	0	2
Interviewee - Physician	0	0	1	1	2
Networking *(interactions with peers outside the unit*)	8	4	5	2	19
Patient care processes (*clinical processes affecting patient care*)	12	14	16	9	51
Patient flow (*rate and smoothness of patient flow through unit*)	16	2	8	13	39
Patient satisfaction (*quality of care and outcomes from patients' view*)	8	3	4	2	17
People constraints (*uncontrollable factors affecting people, e.g., nurse shortages*)	9	3	2	6	20
Performance reviews (*use of evaluations to motivate individuals, improve unit*)	3	0	3	2	8
Process constraints (*uncontrollable factors affecting clinical processes; e.g., nursing home bed shortages affecting discharge rate*)	3	5	1	14	23
Recruitment (*efforts and success of hiring qualified personnel*)	7	1	6	3	17
Teamwork (*internal teamwork)*	17	16	13	4	50
Technology *(information, medical technology used or desired*)	0	1	4	1	6
Training (*formal training programs, incorporation of best practices*)	12	9	11	14	46
Total code frequencies	155	83	118	117	473

FIGURE 1

Preliminary Conceptual Model

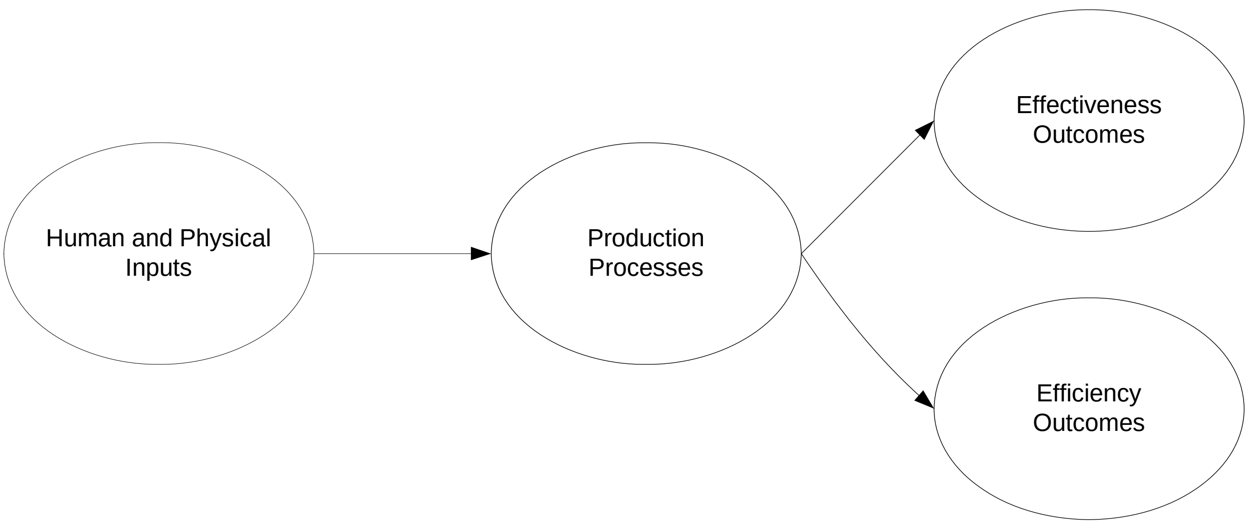


FIGURE 2

Method 1 Causal Performance Map

Computerized Discovery of Causal Links

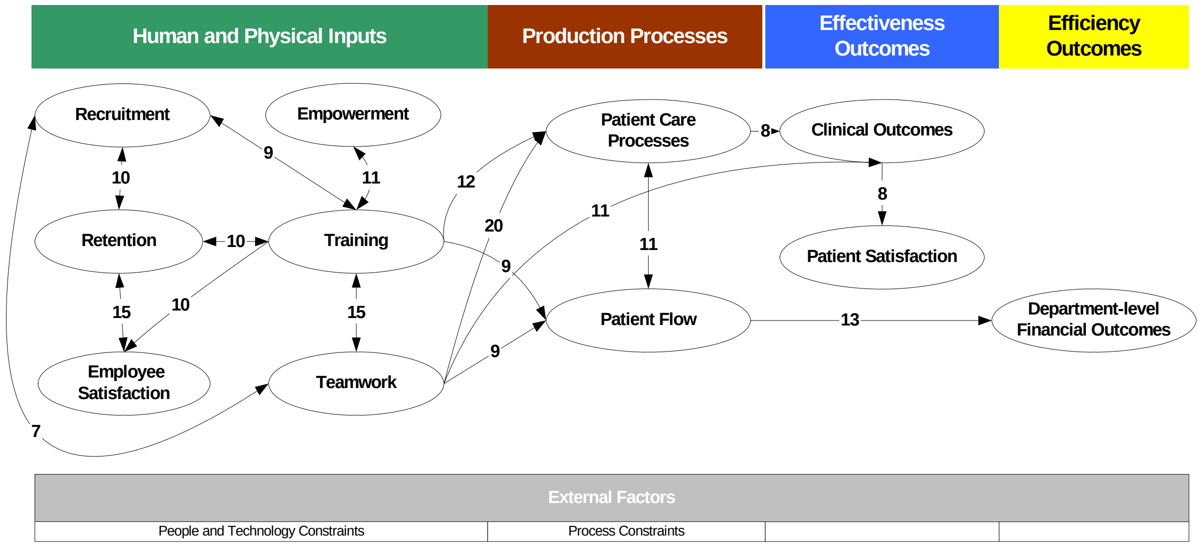
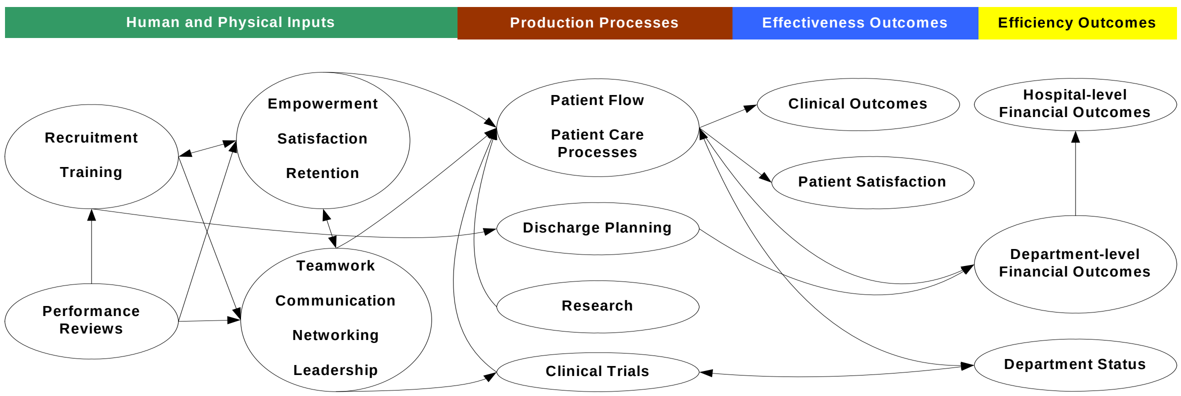


FIGURE 3

Method 2 Causal Performance Map

Ethnographic Analysis of Interview Data

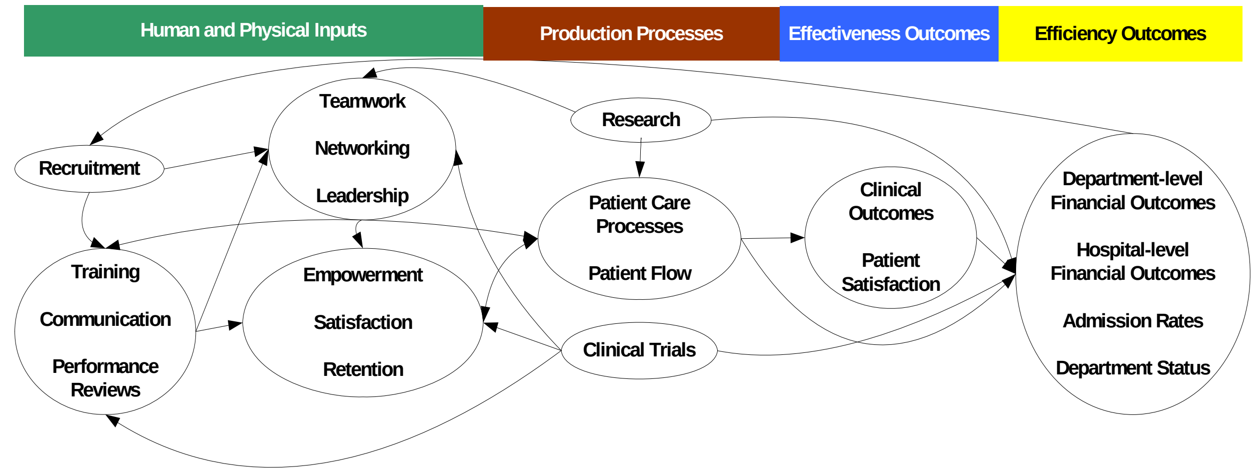


External Factors			
Technology, Nursing Shortage	Nursing Home Bed Shortage		
Budget, Hospital Leadership, Public Hospital Bureaucracy			

FIGURE 4

Method 3 Causal Performance Map

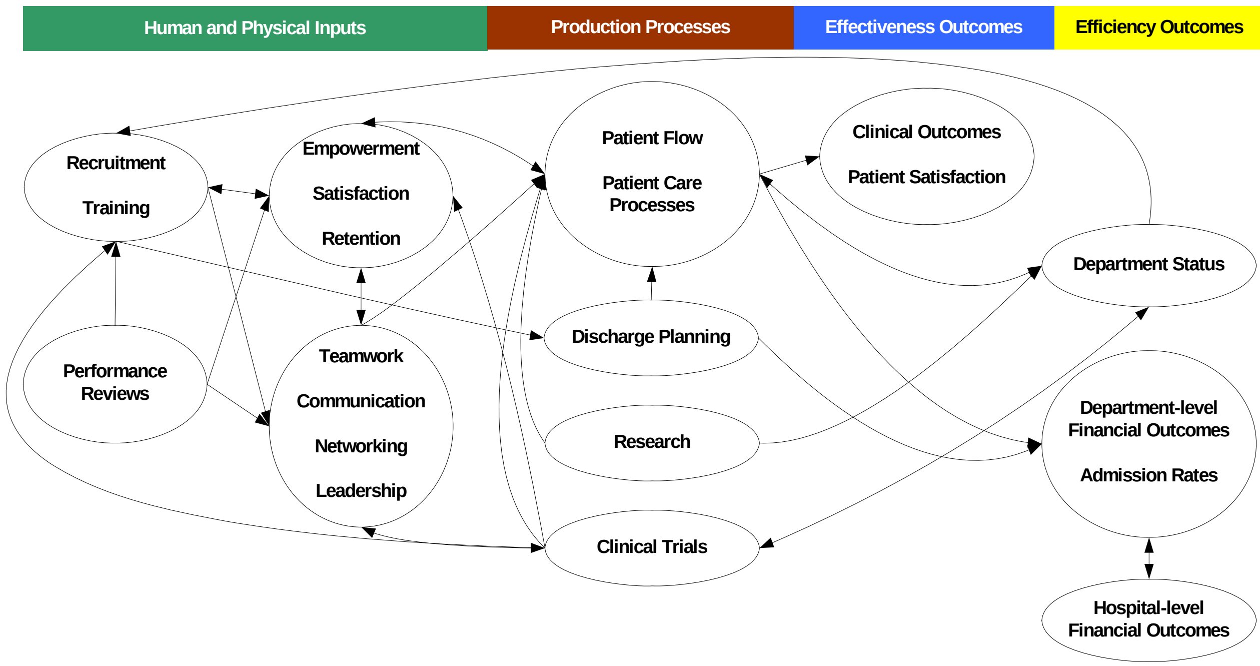
Interactive Mapping by Participants



External Factors			
Technology, Nursing Shortage	Nursing Home Bed Shortage		
Budget, Private Funding, Public Hospital Bureaucracy			

FIGURE 5

Triangulated Causal Performance Map



External Factors			
Technology, Nursing Shortage	Nursing Home Bed Shortage		
Budget, Hospital Leadership, Private Funding, Public Hospital Bureaucracy			