Exceptions and organizational learning in BPM

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Abstract:

This paper describes a study investigating the way that business performance management (BPM) systems, characterized by performance dashboards, "traffic light" indicators, and "exceptions", enable performance and process improvement. Though BPM systems are new, they represent a new face of management-by-exception (MBE), and idea almost as old as management science itself. There has long been considerable debate in the literature as to whether management-by-exception is an effective method, particularly as to whether it allows "double-loop" organizational learning. To understand the rise (and reported success) of BPM, it is important to determine how, if at all, management-by-exception leads to organizational learning. This study examines the literature on MBE and develops a typology of exceptions. It uses the ideas of Simons (1990, 1991, 1994) on diagnostic and interactive management control systems to argue for multiple paths from exceptions to organizational learning, showing that both "single-loop" and "double-loop" learning are possible with MBE. The paper concludes with research questions guiding the design of an empirical study currently being pilot tested.

1. Objective of this study

Recent practice in the field of business intelligence has seen a paradigm shift from BI as an information gathering, storage, and dissemination tool (Luhn 1958; Gilad & Gilad 1986) to a tool to "help organizations optimize business performance by encouraging process effectiveness as well as efficient use of financial, human, and material resources" (Golfarelli et al. 2004). The new paradigm, called business performance management (BPM), is focused on aiding users throughout a business in the performance of their tasks by "providing the right data to the right people at the right time to optimize decisions and accelerate results" (Eckerson 2006) typically on a process-by-process basis. In contrast to classical BI, which focused on collecting a large data warehouse and providing sophisticated tools for professional analysts to query it, BPM's target customers are ordinary knowledge workers and managers with widely varying levels of authority and technical savvy. Each user receives a customized interface, usually called a "dashboard", that provides a selection of data relevant to his or her responsibilities, updated in real-time or "right-time". These interfaces use alerts or graphical cues to signal anomalies and exceptions, and ideally provide tools to analyze and act on the exceptions through the same software system.

Though BPM systems are new, and different from other information systems in fundamental ways, the idea of management-by-exception (MBE) is almost as old as management science itself. Dekker and Woods (1999) trace the idea back to Frederick Taylor (1911) and even beyond. Management-by-exception is a way of reducing information overload and freeing managers to focus their limited time and attention where it is most needed. BPM is implemented with the goal

of improving the performance of processes; however, there is considerable debate in the literature as to whether management-by-exception is an effective method for achieving improvement of routines and processes – otherwise known as organizational learning (Argyris 1982, Strong & Miller 1995, Dekker & Woods 1999). To understand the rise (and reported success) of BPM, it is important to determine how, if at all, management-by-exception in BPM systems can lead to organizational learning. The primary goal of this paper is to discover the ways in which learning is produced in a MBE paradigm, thus laying the groundwork for future studies that explore the boundaries and nuances of this process.

In researching management-by-exception, it quickly becomes apparent that scholars writing about the topic hold a variety of different ideas about what exceptions are and what managers do with them. For example, some perspectives view exceptions as errors or problems that reside in systems or processes, and are objectively measurable, while other perspectives hold that exceptions are events defined by a need or possibility for intervention in a process, and thus depend upon the attitudes and situations of the people who perceive them. Some descriptions focus on the causes of exceptions while others focus on the way they are to be solved. Some question whether exceptions are characterized by quantitative criteria (e.g. thresholds) or by qualitative criteria such as "actionability". While most equate exceptions with problems or potential problems, some suggest that they may be beneficial, injecting cooperation or flexibility into processes. Some challenge the notion that the occurrence of an exception is a binary variable, arguing that exceptions might be better represented as a continuous measure of seriousness or as a probability of a problem occurring. A secondary goal of this paper, then, is to establish a working definition of an exception.

The research questions to be addressed are thus: (1) What is an exception, and what are the types of exceptions? (2) How can management-by-exception lead to organizational learning, and what factors affect this process?

In Section 2 of this paper, a literature review brings to light a variety of perspectives on management-by-exception and its link to organizational learning, including the ideas of Simons (1990, 1991, 1994) on management control systems, which applied here may help to resolve some of the disagreements between other literature. As we review the literature, we present a definition and typology of exceptions. Section 3 links exceptions to IS and develops theoretical propositions. Pilot testing is under way, so Section 4 (research design) is truncated, and Section 5 (results) and Section 6 (conclusions and implications) are unfinished.

2. Literature review and theory development

2.1. Exceptions

The term "exception" as used in management differs somewhat from the dictionary definition "a case to which a rule does not apply" (Merriam-Webster 2008). Instead, it refers to items under supervision that are deemed worthy of a manager's attention by some filtering criterion. Taylor (1911) argued that all matters under a manager's supervision should be reviewed by an assistant and that those "exceptions to past standards or averages" should be pointed out, both good and bad, to give the manager "in a few minutes a full view of the progress which is being made, or the reverse, and leaving him free to consider the broader lines of policy." The management-by-exception paradigm has at its heart the goal of utilizing managers' time well; they should not

have to be involved with the normal work of subordinates or be overloaded with reports of normal operating conditions, but rather have their attention focused where it is needed.

Information systems scholars have identified the difficulties in programming computer systems to identify the exceptions that require attention. Ricketts & Nelson (1987) tried to find out how managers viewing a budget variance report would choose cases to investigate further, and found that no simple prediction based on "noticeability" worked; subjects were not using percent thresholds, dollar thresholds, or a percent-times-dollar threshold, and in fact, different subjects used very different heuristics for selecting cases to investigate. Some were suspicious of small variances that seemed unrealistically close to targets, while others chose to examine all variances on large budgets because these budgets seemed important. They found that theories for predicting *noticeable* differences were insufficient to predict *actionable* differences. Not every deviation from expected or desired outcomes requires a manager's intervention.

For some scholars, the distinguishing characteristic of an exception is that it is actionable – there is some action that a manager can take that has a possibility of improving the outcome. Dekker and Woods (1999) use the word "anomalies" to describe deviations or disruptions in processes, and reserve the term "exceptions" to describe the problematic anomalies that other agents cannot satisfactorily handle. They describe the difficult choices managers must make about intervening when they aren't sure that an anomaly is an exception. Intervening early, without waiting for evidence that a situation is out of hand, may show a lack of faith in subordinates, but intervening late may make problem resolution difficult. They point out that, while anomalies can be identified with certainty by good measurement, exceptions (by their definition) are rarely clear,

and should be viewed probabilistically.

Management-by-exception applies not only to the supervision of people but also to the management of machines or of processes. Strong and Miller (1995) define exceptions in computer-based information processes as "cases that computer systems cannot process correctly without manual intervention". They suggest that some exceptions are flaws in the technology or process that should be eliminated with a TQM-like approach, but that others are points in a process where human intervention is legitimate and helpful. Rather than designing processes with a goal of full automation, designing them to incorporate human judgment at key points is a good way to add flexibility and intelligence to the system. By viewing exceptions as events that may be *designed*, this work stands out from other treatments of the topic.

Most conceptualizations of exceptions assume them to be objectively real, and thus measurable by machine, but some conceptualizations place them partly or wholly in the eye of the beholder. Montazemi and Conrath (1986) found that experienced managers selected cases for further investigation when their causal assumptions were violated, for example when variables believed to be correlated were seen to move in opposite directions. These cases stood out as exceptional even though the important quantitative indicators were all within acceptable levels. Many of these managers did not know *why* they found the cases exceptional, but they knew they perceived problems and that the cases were worthy of further attention. Mental models, also known as cognitive maps, conceptual frameworks, and schemas, may be important to identifying some kinds of exceptions.

2.1.1. Synthesis: definition and typology of exceptions

A definition of exceptions that incorporates many of the ideas of other theorists is: *Exceptions are relevant occasions that afford attention to, and intervention in, a process under an agent's supervision*. That exceptions are *relevant* means that their existence is not independent of the needs of humans from the process. This distinguishes exceptions from anomalies (deviations from norms or expectations) that are neither noticeable nor actionable; but it does not follow Dekker & Woods (1999) in excluding all anomalies. It admits as exceptions those process anomalies that are meaningful and relevant to the manager. That exceptions are *occasions*, rather than thoughts or perceptions of the manager, indicates that they are real events and may be perceptible to other agents, including machines. That exceptions *afford* managerial *attention* requires that they be perceptible; that they *afford intervention* requires that some action be available to the manager that has a nonzero probability of producing a better outcome than non-intervention. The term intervention may refer to actions such as observation and inquiry, so the definition of exceptions even includes suspected anomalies or problems that, upon investigation, turn out to be nonexistent.

A synthesis of the literature on exceptions identifies three distinct types of occurrences that fit the definition given above. I refer to these as deviations, escalations, and enigmas. *Deviations* are differences between measurable, process-related variables and the norms or expectations managers compare them to. Interval variables imbue deviations with direction and degree, either of which may be important in their interpretation. Non-quantifiable measures may also experience deviations, for example, a failure to acquire a certain customer, or an unexpected mention by the press. *Escalations* are situations in which an agent experiences a need or desire

for the cooperation or assistance of another agent in performing his or her (or its) responsibility. These situations may be discovered by the focal agent, such as when a knowledge worker requests information from an expert, or may be discovered the "needed" party, as when a manager discovers that a subordinate has made a mistake. These are occasions that call for interpersonal intervention: asking, telling, helping, training, debating, collaborating, sharing, or some other cooperative action. *Enigmas* are mysteries, puzzles, or ambiguous clues that suggest the possible existence of valuable knowledge to be uncovered. Exceptions in this category are not clear deviations from well-understood variables, nor are they problems that *need* to be solved, yet like the other types of exceptions they afford attention and action if discovered.

2.2. Exceptions and organizational learning

This study seeks to connect exceptions to process and performance change; mechanisms for such change are provided by the literature on organizational learning. Organizations "learn" by encoding the lessons from their experience as new routines (Levitt & March 1988). Because organizations are oriented toward targets (goals, aspirations, benchmarks, and the like), deviation from these targets has a strong effect on learning – actions that precede the successful accomplishment of a target may be incorporated into standard processes, while actions that precede a signal of failure may be "unlearned" and used less often thereafter. Given this mechanism, it is clear that the way targets are set has a strong effect on learning outcomes.

When exceptions interrupt normal work, they disrupt the rhythm of everyday routines and cause teams to switch to conscious thinking about their actions and decisions. This can have a strong effect on organizational learning as it creates a window of receptiveness in which new routines

can be learned, as well as a motivation to search for new routines (Zellmer-Bruhn 2003). Many BPM technologies, such as exception-triggered email alerts and mobile alerts in real-time, are designed to do exactly that: interrupt a manager and draw attention to an unfolding situation for which a resolution must be found . Interruptions and exceptions, however, can themselves become routine and lose their potential to stimulate learning (Gasser 1986).

When an exception raises concern about a subordinate's ability to handle a problem, intervention and knowledge sharing called for. There are a variety of ways managers can intervene in a process, from a deep intervention, taking total control, to a slight intervention in which the manager merely observes, perhaps asking or answering questions. Dekker and Woods (1999) discuss the challenges of intervention in the work of subordinates, which include difficult choices of when and how to intervene, in the context of air traffic control. They make two observations that indicate a potential for learning through intervention exists. First, management-by-exception requires that knowledge be distributed, that subordinates have different knowledge about their tasks than managers have. Second, because an immediate transfer of total control from a subordinate to a manager is unusual and likely to be harmful, management-by-exception is better seen as a form of cooperation between knowledge workers, with all that that implies for knowledge-sharing and learning.

2.2.1. Synthesis: learning from deviations, escalations, and enigmas

Several mechanisms for organizational learning are found in that literature, and we find that the different types of exceptions each afford organizational learning in their own ways. Levitt and March (1988) indicate that two of the mechanisms for organizational learning are (1)

modification of routines in response to feedback on action, and (2) the dissemination of other agents' already-learned knowledge. *Deviations*, when discovered, enable feedback-based learning. Favorable deviations from targets reinforce the actions and strategies that preceded them, increasing the likelihood that such actions will be incorporated into organizational routines and repeated, while undesirable deviations from targets have the opposite effect. If differing outcomes on a variable do not have favorable or unfavorable connotations, no such learning should occur; on the other hand, if a variable is charged with value but is not clearly causally related to a manager's options for action, superstitious learning or wrong learning may be possible (Levitt & March 1988).

In contrast, *escalations* facilitate Levitt's and March's second mechanism. They stimulate interaction between agents with different sets of knowledge, and thus pose opportunities for the dissemination and synthesis of knowledge already learned. While it is possible for a manager or expert to take a problem over completely, in which case little knowledge is shared, escalations are usually more cooperative in nature. One-way knowledge sharing, as when a supervisor teaches a worker how to solve a problem, or two-way knowledge sharing, as in a debate or brainstorm, are both possible. Escalations may also involve more than two people.

Enigmas are linked to organizational learning by a mechanism like that described by Zellmer-Bruhn (2003) in her study of interruptions. Enigmas pique the curiosity of their discoverers. The curiosity reaction disrupts the enactment of routine work and triggers a switch to conscious information processing, creating two conditions conducive to learning: (1) a temporary period of receptiveness to ideas, and (2) a motivation to search for new and different ideas. Enigmas do not

necessarily lead to learning, and indeed may often be ignored. Whether they are exploited for organizational benefit likely depends on the attitudes (e.g. curiosity) and characteristics (e.g. analytical skills) of the people who face them, as well as the culture and practicalities of their work context.

2.3. Learning, and control, from the same system

The argument of Argyris (1982) poses a major challenge to management-by-exception when he argues that it is only capable of producing one of two important types of organizational learning. This type, called single-loop learning, is the identification and correction of errors in a process given a set of assumptions, rules, objectives, and values. Management-by-exception is a managerial control system that applies these givens in order to measure performance, discover errors, and fix them. The other important type of learning is double-loop learning, the questioning and improvement of the assumptions, rules, objectives, and values. Argyris argues that management-by-exception creates several cognitive, political, and practical obstacles to double-loop learning, because the information systems needed to measure and identify exception cases by their nature rely on consistent assumptions and objectives. In order to use deviations from targets as a fair and unbiased criterion for performance evaluation, the targets and data sources must be held constant, precluding the questioning of these fundamentals.

Simons (1990, 1991, 1994) made a similar observation, but showed that, depending on a managers' orientation toward and information system, either single-loop or double-loop learning can be achieved.

He argued that information systems grouped under the term management control systems

("formalized routines and procedures that use information to maintain or alter patterns in organizational activity") were used by managers for multiple purposes: monitoring, learning, signalling, constraint, surveillance, motivation, and others (Simons 1990). Control systems are used to enforce rules, plans, and objectives (strategies) as well as to challenge and reformulate them. The forms of these information systems (including systems for planning, budgeting, cost control, competitor analysis, performance evaluation, resource allocation, etc.) are fairly similar across organizations, but they can drive different types of learning by the manner of their use.

Two distinct managerial orientations toward control systems are evident: *diagnostic* and *interactive*. Diagnostic systems are programmed in a formalized process by top managers, perhaps annually, and used to communicate and enforce the firm's performance goals from the top down. Managers expect subordinates to make decisions to carry out the plans, and do not pay attention to these systems unless subordinates are incapable of managing them according to the program. Interactive systems, on the other hand, are systems that managers use to regularly and personally involve themselves in aspects of the business. A system is interactive when: (1) information generated by the system is a regular and important agenda item for top management; (2) the system demands frequent attention from operating managers at all levels of the organization; (3) data are discussed in face-to-face meetings of superiors, subordinates, and peers; and (4) use of the system relies on continual challenge and debate of underlying assumptions, data, and plans (Simons 1991).

By making certain systems diagnostic, managers ensure that performance anomalies are corrected promptly and consistently, especially in those areas of critical importance to the bottom

line. By making other systems interactive, managers encourage experimentation, discussion and challenge of underlying models, and double-loop learning in areas that may be important to the future of a business. Simons argued that systems are typically used diagnostically when they correspond to critical success factors for organizations (and different systems are used diagnostically in different types of businesses), while systems are used interactively when they relate to key uncertainties that are important to a manager's vision of the organization's future.

3. Information systems support for learning from exceptions

Information systems, such as BPM dashboards, can enable and enhance learning from exceptions in several ways, some of which are unique to the three exception types. BPM systems are quite sophisticated at measuring variables called key performance indicators (KPIs), comparing them to targets, and alerting managers to minor and major deviations as they occur. New data-collection paradigms like the real-time enterprise ensure that more deviations are detected, and are detected closer in time to the factors that may have caused them, than was possible with older technologies like weekly or monthly reporting. The selection of metrics to be used as KPIs determines what kind of learning is possible; expert practitioners recognize this when they prescribe that metrics must be valid measures of performance and must be affected by the actions a user can take, for valid, non-superstitious learning from feedback (Eckerson 2006).

Information systems can also enhance cooperation and communication, which are essential to learning from escalations. Systems could also help with the discovery of need for intervention, as managers can use dashboards to monitor employees' ongoing performance and signal potential problems. Dekker and Woods (1999) observed that early interventions by managers could be

low-impact interventions such as observation and questioning, while later interventions required taking significant control over exception situations. Systems that could predict the timing and criticality of developing problems, they believed, would allow managers to better choose the time and depth of intervention. They also saw a need for systems that enabled the gradual transfer of control, by stages, rather than forcing a switch from total process control by a worker to total control by a supervisor.

Enigmas are clues to the potential for learning, and information systems are important to detecting the clues as well as to analyzing and deciphering them. The clues are often previously-unseen patterns in data, which lead to search for the mechanisms that cause them. Thus, new and different data sources help to uncover them, as do new ways of showing the data. Visual displays and graphics can be powerful tools for revealing patterns in extremely large, otherwise overwhelming databases (Tufte, 2001). Enigmas usually have to be discovered by humans with the aid of such analytical tools, but systems that automatically flag them are not inconceivable. One interesting possibility is the computerization of maps of cause-effect relationships based on users' mental models. A system might look through the databases for cases that don't make sense with a user's assumptions, and flag these as enigmas. Table 1 summarizes the three types of exceptions, the ways they can lead to learning, and the way information systems may facilitate the process.

Table 1. Types of exceptions

	Definition	Avenue to learning	How IS can facilitate
Deviations	Differences between measurable, process-related variables and the norms or expectations managers compare them to.	Feedback. Favorable deviations reinforce the activities thought to have caused them; unfavorable deviations have the opposite effect.	Measure and collect meaningful data; draw attention to deviations; highlight their degree and directionality; provide data in real-time.
Escalations	Situations in which an agent experiences a need or desire for the cooperation or assistance of another agent in performing his or her (or its) responsibility.	Knowledge sharing. By bringing people together, escalations enable the transfer and synthesis of their different sets of knowledge.	Facilitate monitoring and communication; predict future exceptions so that concerned parties can be prepared; enable cooperative intervention by degrees.
Enigmas	Mysteries, puzzles, or ambiguous clues that suggest the possible existence of valuable knowledge to be uncovered.	Inspire search for explanation. Create a temporary receptiveness to new ideas and theories, as well as the impetus for search.	Provide lots of data; add new data sources and forms regularly; offer tools for visualization and pattern detection; enable multi-dimensional exploration of data; highlight oddities with cause-effect schemas.

3.1. Diagnostic vs. interactive orientation

The way an organization uses its information systems, which may be manifested in organizational culture or perhaps a top manager's attitudes, may bias the ways exceptions are turned into organizational learning. In particular, systems used diagnostically bias the enforcement of performance objectives, plans, and values, while systems used interactively bias experimentation, inquiry, and challenges to these givens. When a deviation is encountered in a diagnostic information system, for example, it causes the positive or negative reinforcement of routines that preceded it, because managers are strongly motivated to achieve target levels of all KPIs. When a system is interactive, however, the same deviation may be seen as an occasion to re-evaluate the target, or an opportunity to test out a new tactic for resolving it. An escalation in a diagnostic system may require a manager to respond and teach an employee how to solve a problem, but an escalation in an interactive system may stimulate a lively cross-level discussion and brainstorm. Enigmas are likely ignored in a diagnostic system but their discovery may be socially rewarded in the context of an interactive system.

We believe that the diagnostic or interactive character of an information system's usage context may be manifested either as features of the technology or as organizational behaviors. Table 2 shows the types of software features and organizational behaviors we expect to witness when each type of exception is seen in either a diagnostic or an interactive usage.

Table 2. Expected management-by-exception IS behaviors and software features

	Diagnostic orientation	**Interactive**
Deviations		
Features		
	Dashboard indicators signal whether measures are "good" or "bad" by the use of graphic conventions	Dashboard displays use non-value-laden data such as historical data, time-series, or trends for most performance indicators.
	Dashboard systems alert users when data falls "out of bounds" by sending e-mail or text message alerts.	Dashboard systems allow users the freedom to program and adjust KPI targets, benchmarks, alerts, and/or displays.
Behaviors		
	Dashboard users believe that KPIs (data) indicate how *well* a person, process, or group is performing.	Dashboard data are perceived as provide clues or "symptoms" to help users understand "what's really going on."
	User attention is mainly focused on the problem data that fails to meet targets.	Users pay attention to all indicators that differ from expectations, whether good or bad.
	Targets and benchmarks are not changed or negotiated once they are set.	Targets and standards may change.
	Measures that deviate from a target or benchmark are problems and, action is taken quickly when these occur.	Deviations enter into analysis and discussion; remedial action is not triggered in a knee-jerk way in response to deviations.
	Incentives for managers and employees (e.g. bonuses, commissions, rewards) are based on data measures of performance.	Data are unlikely to be seen as unequivocal measures of performance, so incentives are not likely to be based on KPIs.
Escalations		
Features		
	Dashboard software allows managers to evaluate employees' performance with KPIs, "traffic lights", and alerts.	Dashboard software includes features that support collaborative work between professionals.
Behaviors		
	In meetings, managers use dashboard data to focus and motivate action.	Managers and subordinates study dashboard data with back-and-forth discussion.
	When a manager contacts a subordinate about dashboard data, it is usually to investigate a performance problem.	Ad-hoc discussions of dashboard data often occur when users go to one another for expertise, more info, or opinions and analysis.
Enigmas		
Features		
	n/a	Charts, graphs, and other data visualization tools help users discover patterns in the data.
	n/a	Dashboard software offers powerful ways for users to get more data for analysis, such as drill-down to data tables, or the ability to make database queries.
Behaviors		
	n/a	Dashboard users investigate unexpected patterns in the data when they notice them.
	n/a	The data is ambiguous; users do not know, before analysis, what different levels of the indicators mean and what to do about them.

Based on Simons's arguments about diagnostic and interactive control systems, a reading of the organizational learning literature, and our understanding of the roles exceptions play in learning, we have some expectations about the types of performance change and improvement likely to occur when systems are used either diagnostically or interactively. Organizations that use their systems with a diagnostic orientation are most likely to support incremental, quantitative improvement on established measures of performance. In other words, single-loop learning is stimulated as managers work hard to achieve predetermined targets and react quickly to unfavorable deviations. Information systems used interactively are more likely to drive innovation, experimentation, and double-loop learning. This type of learning is much more likely to produce qualitative changes to processes, including changes to the structure, complexity, and goals of the processes as well as changes in the responsibilities of project participants and to the process's importance to the organization. Over time, double-loop learning should also produce quantitative performance improvement, but likely with more variance in performance change than results from single-loop learning. Presented as propositions, our expectations are as follows:

> *P1: A management-by-exception information system used diagnostically is likely to positively affect quantitative performance on established measures. This performance improvement is likely to be incremental, with low variance.*
>
> *P2: A management-by-exception information system used interactively is likely to affect qualitative changes in processes or tasks, such as any of the following:*
>
> - *changes to task/process structure and methods*
> - *changes in complexity of task or process*
> - *changes in goal(s) of the task/process*

- *changes in organizational importance of the task/process*
- *changes to roles and responsibilities of participants*

With an interactive orientation, quantitative performance changes are likely to be more variable, less incremental, than when systems are used diagnostically.

Figure 1, below, illustrates the propositions graphically. The two control orientations (each consisting of a set of information behaviors and attitudes toward information) instigate different types of organizational learning, which in turn affect different aspects of processes.

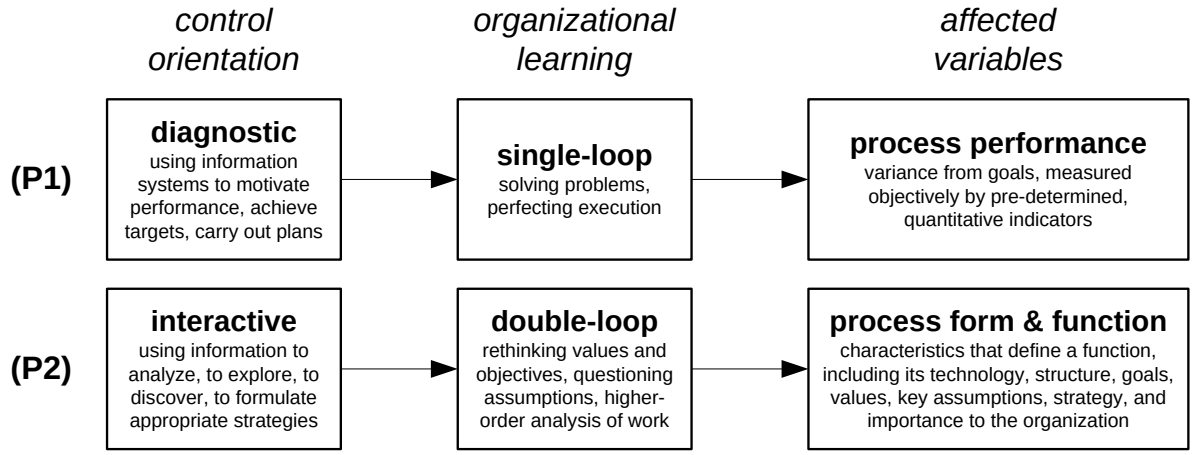

Figure 1: Control orientations, learning mechanisms, and outcomes

4. Researching the propositions in a BPM context

4.1. Research questions

Our investigation seeks, firstly, to test our ideas about how learning *can* result from management-by-exception, but also to determine *whether* it is occurring in BPM today, and *how*.

A study is being conducted to look for evidence of exception management in action, to determine whether the distinctions (three types of exceptions, two managerial orientations) are real, and also to determine which of them are being leveraged for advantage by typical firms. Research questions are as follows:

1. Does beneficial organizational learning (i.e. process or performance improvement) occur for these BPM system users?
2. If so, are "incremental, quantitative performance improvement" (from P1) and "qualitative changes in processes or tasks" (from P2) distinct and independent forms of learning?
3. If so, are both observed in the experience of BPM users, or do they primarily experience only one of the types?
4. Are "diagnostic" and "interactive" distinct modes of BPM system usage? Are they independent, or are they opposites?
5. If so, are both encountered in a survey of BPM users, or is BPM primarily used in only one of these two ways?
6. If yes to #3 and #5, are our expectations upheld? Do systems used diagnostically lead to steady performance improvement, and systems used interactively lead to more qualitative and variable improvements?

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