Investigating the Information Processing Capacities of Organizational Controls

A Computational Modeling Perspective

Chris P. Long, Sim B. Sitkin, Laura B. Cardinal, Richard M. Burton

McDonough School of Business, Georgetown University, Washington DC 20007, cpl32@georgetown.edu
Fuqua School of Business, Duke University, Durham, NC 27708, sim.sitkin@duke.edu
C. T. Bauer College of Business, University of Houston, Houston, TX 77204, lbcardinal@bauer.uh.edu
Fuqua School of Business, Duke University, Durham, NC 27708, rmb2@mail.duke.edu

Abstract

In this study, we use a series of computational models to develop an information processing perspective on organizational control use. We evaluate and compare the information processing capabilities of various formal and informal control configurations under different information uncertainty conditions. Results of this study suggest that a wide range of formal controls can be used to direct subordinates who perform interdependent tasks while a more narrow range of informal controls are most effective for directing subordinates who perform complex tasks. Results of this study provide a basis for formalizing an information processing perspective on organizational control implementation that differs but is complementary to the current emphasis on agency in organizational control research.

Theory

Building from the precepts of information processing theory [7], the information processing perspective on organizational control use that we seek to develop in this paper builds from the general proposition that controls serve as key mechanisms that managers can use to direct task information to their subordinates. Specifically, this perspective evaluates how managers use controls to both decrease their subordinates' task-related uncertainty and to increase the ability of those subordinates to achieve prescribed production standards [9].

The controls we describe are distinguished by the portion of the production process to which they are applied: the inputs, processes and outputs of organizational production tasks. Managers use *input controls* to direct how material and human elements of their production processes are qualified, chosen, and prepared through selection, training, and/or socialization (e.g., Van Maanen and Schein 1979). Managers use *process controls* such as production rules and behavioral norms to ensure that individuals perform actions in a specific manner. Managers also use *output controls* when they prescribe and monitor quality and/or quantity outcome standards (e.g., customer satisfaction levels, production schedules) [e.g., 7].

According to information processing theory, controls serve as mechanisms through which managers can exchange important task information with their subordinates [4]. Managers use controls to both gather information about their subordinates' capacities to achieve production standards *and* direct task information to their subordinates in ways that guide those subordinates to more effectively fulfill their task responsibilities. This perspective conceptualizes the focus of managers' efforts to prepare, direct, and review their subordinates' production activities as ways of enhancing those subordinates' capacities to understand task-related issues and improve their ability to achieve desired task outcomes [2, 7].

Overall, the information processing perspective seeks to identify which configurations of controls best enable managers to deliver needed task information to their subordinates under specific information uncertainty conditions. To accommodate information uncertainty demands, we argue that managers must first decide when they will exchange information with their subordinates by examining which controls provide the best "fit" under various task complexity and task interdependence conditions.

***Task Complexity* –**Research suggests that more complex tasks both require and stimulate increased information exchange because individuals who work on complex tasks often must rely on information that others provide them [10]. While information exchanges in these units can lead to higher performance, Galbraith [22] argues that the capacity of organizations to facilitate the processing of information related to complex tasks is key to realizing these gains.

***Task Interdependence* –** Task interdependence describes an attribute of multiple tasks where changes in one task affects the state of and, thereby, elicits adjustments in other tasks. Increasing levels of task interdependence can increase information uncertainty because it forces subordinates both to rely on the potentially uncertain inputs of others to complete their focal production tasks and to attempt to coordinate with others on the completion of their task objectives [8]. The more interdependent particular tasks are, the more information that individuals must exchange to adapt, adjust and achieve highly effective levels of mutual understanding [2].

***Information "Richness"* –** We also argue that managers must decide what type of information they will exchange with subordinates by evaluating the "richness" or quality of the information that they seek to exchange. The media that managers choose for the transmission of information comprises a key component of this dynamic. Often these media choices are determined, at least in part, by the control context within which the individual resides [7]. Managers who operate within organizations that rely on *formal controls* generally exchange information of low to moderate richness and direct subordinate tasks using codified rules, standard operating procedures, and written memoranda. In contrast, managers who rely on *informal controls* tend to exchange information of a much higher richness and use more informal means such as face-to-face discussions and cultural artifacts direct their subordinates' work activities [1].

Study Design

Contributing to the development of the information processing perspective on organizational control use rests on correctly identifying what controls managers need to apply to effectively direct information flows in their units and address their subordinates' information uncertainty problems. Due to the complex nature of these relationships, we have chosen to develop and employ a series of computational models to evaluate the efficacy of various control configurations under differing levels of task complexity and task interdependence . Using our approach we seek to understand which control configurations provide the best "fit" with a range of information processing demands.

For our study, we chose the commercial software version 2.2 of the Vite'Project (also VITE') discrete event, agent-based computational modeling platform. Within the parameters specified by the modeler, boundedly-rational computational agents stochastically perform tasks and make decisions while communicating and coordinating their work on projects containing other boundedly-rational computational agents. We selected the VITE' program for this study because it operationalizes the information processing view of organizations within the decision-making and communication properties that agents in the platform possess. Our study thus, builds on a growing body of scholarly work that has developed and employed this platform in organizational research [5, 6].[i]

Consistent with recent presentations of simulation research [e.g., 10], we employ VITE' as a laboratory for examining and comparing the information processing capacities of various organizational control configurations [6]. We developed a 2 x 2 x 2 x 7 study design to examine how 7 control configurations (single input control, single process control, single output control, combined input/process control, combined process/output control, combined input/output control, combined input/process/output control) can be used to facilitate efficient information processing under two task complexity conditions (high/low), two task interdependence conditions (high/low), and two control formalization conditions (formal/informal).[ii] We used *overall* project cost (in thousands of "Vite' " dollars) as the performance measure for various control combinations examined in this study.

We conducted ANOVAs for each of our four task uncertainty conditions. Within each condition, we compared the cost of producing 100 production units when agents operate within one of 14 control conditions (seven formal and seven informal control configurations). Relatively greater information processing efficiencies were obtained when a particular control configuration enabled agents to produce 100 production units at a significantly lower production cost than alternative control configurations. We then used post-hoc analyses to obtain the most effective control configurations within each information uncertainty condition.

Results

Our analysis identifies what control configurations are best in different uncertainty conditions. [iii]

Low Task Interdependence/Low Task Complexity. Overall, the results we obtain suggest that a broad range of formal and informal task control configurations provide managers with the means to effectively direct information processing when both task complexity and task interdependence are low.

High Task Interdependence/Low Task Complexity. As task interdependence rises and task complexity remains low, we observe that configurations of formal input, process, input/process, process/output, input/output, and input/process/output controls provide managers with equivalently effective mechanisms to direct their subordinates' activities.

Low Task Interdependence/High Task Complexity. If task complexity is high and task interdependence is low, configurations of informal input or input/process controls appear to provide the most effective means of directing organizational information processing efforts.

High Task Interdependence/High Task Complexity. If task complexity is high and task interdependence is high, our results suggest that informal input controls provide managers with the most effective means of directing organizational information processing.

Discussion

The findings we obtain from this study enable us to make several contributions to organizational research. First, we highlight the role that controls play in helping organizations direct the use of task-related information. Second, we explore the capacity of various configurations of controls to accommodate a range of different information processing demands. Our research, thus, provides the basis for understanding how and why managers integrate and address information processing concerns within their overall control portfolio.

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[i] Descriptions of the core components of VITE' can be obtained from the corresponding author
[ii] Descriptions of the specific manipulations we applied in VITE' can be obtained from the corresponding author
[iii] Statistical results can be obtained from the corresponding author.