FACTORS AFFECTING THE OUTCOMES OF PERFORMANCE MANAGEMENT SYSTEMS

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ABSTRACT

This paper proposes and tests a model to explain three critical outcomes of Performance Management Systems: information quality, effectiveness, and usefulness of the PMS to managerial decision-making. Drawing from Organizational Information Processing Theory (OIPT), we examined how those three outcomes may be influenced by factors that affect OIP requirements (industry, size, and geographic scope of operations) and by organizational and technological factors that affect OIP capabilities. Organizational factors included management's decision-making style and organizational structure. Technological factors included the types of technology used in the PMS (ERP; specialized tools such as EIS and DSS; and generic tools such as Excel, Access and Lotus Notes), and the degree of use of e-commerce and Internet technologies. We used stepwise regression to analyze data from a sample of 1,990 respondents in small, medium and large organizations, operating at regional, national, international and global levels across a broad range of the Dow Jones Global Industry Groups.

Keywords: Performance Management Systems, Organization Information Processing, Information Quality, Effectiveness, Usefulness.

INTRODUCTION

Organizations are investing ever-increasing amounts of resources into Performance Management Systems, but it is still not clear what they can expect in return, or how they might influence the likelihood of positive system outcomes. This study applies Information Processing Theory to develop and test a model of environmental, organizational and technological factors that are hypothesized to contribute to PMS outcomes. The empirical test of the model was conducted using a database with findings from a survey of 1,990 organizations.

The goal of the study is to explain three critical PMS outcomes: information quality, effectiveness, and usefulness of the Performance Management System to managerial decision-making. Drawing from the literature on Information Processing, we propose a model that examines how those three PMS outcomes may be influenced by a variety of factors that affect, on the one hand, an organization's information processing requirements and, on the other hand, its information processing capabilities.

The empirical test of the model explored three main environmental and organizational factors affecting information requirements: the nature of the industry, the size of the organization, and the geographic scope of its operations (ranging from regional to global). The empirical study also examined two sets of factors, organizational and technological, that affect the capability of the firm to process information. The organizational factors considered in the study were management's decision-making style (command and control vs.

collaborative), as well as organizational structure. Technological factors included the types of technology used in the PMS (ERP; specialized tools such as EIS and DSS; and generic tools such as Excel, Access and Lotus Notes), and the degree of use of e-commerce and Internet technologies.

The study used stepwise regression to analyze data from a sample of 1,990 respondents in accounting, finance, general management, information technology etc. The sample included small, medium and large organizations, operating at regional, national, international and global levels across a broad range of the Dow Jones Global Industry Groups.

The following sections summarize the relevance of the study, the model that was used to explore the factors influencing PMS outcomes, the research question and hypotheses inspired by the model, the methodology that was used to empirically test the model, the results obtained and their implications for research and practice.

RESEARCH QUESTION, MODEL AND HYPOTHESES

Performance Measurement Systems (PMS) enable organizations to plan, measure and control their performance, so that decisions, resources and activities can be better aligned with business strategies to achieve desired results and create shareholder value.

This study addresses the following research question: *"What factors, internal or external to the organization, explain the outcomes of Performance Management Systems?"*

In order to answer this question, we used the model shown in Figure 1 to examine the factors contributing to three types of PMS outcomes: usefulness, effectiveness and quality of information.
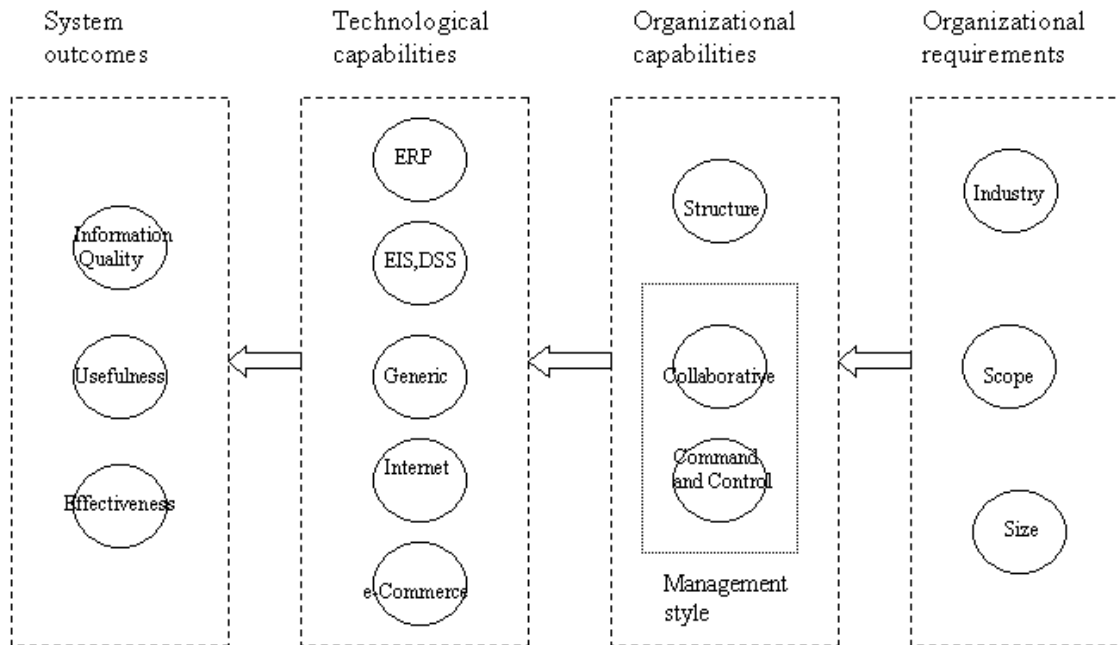

Figure 1. Factors contributing to PMS outcomes

Usefulness is defined in the literature as the degree to which a person believes that using a particular system would enhance performance [11]. Usefulness is related to the concept of voluntary IS "use" [2,3]. The actual usage of information systems is widely considered an important measure of IT success in organizations, and has been found to have a strong correlation with the perceived usefulness of a system by the user [8].

Effectiveness of a PMS is the degree to which the system delivers its intended results [9], i.e, helping organizations to plan, measure and control their performance, as described above.

Information Quality (IQ) is a multifaceted concept, with an entire stream of research just trying to define what it means. For the purposes of this study, we

used the widely accepted definition of IQ as "fitness for use." [1].

Various factors may contribute to PMS usefulness effectiveness and information quality. The factors identified in the model in Figure 1 were inspired by Organizational Information Processing Theory, or OIPT [4,5,6,7,10].

According to OIPT, organizations face different levels of uncertainty, i.e., "the difference between the amount of information available and the amount of information required to perform the task at the desired level of performance" [4]. This difference characterizes the information processing requirements of the task. The rightmost column in Figure 1 shows three factors that, according to OIPT, can be expected to influence the information processing requirements that a PMS must meet: industry, scope of operations, and size of the organization. Different industries vary in their velocity and predictability of change, and the resulting levels of uncertainty raise different levels of information requirements. Uncertainty, and therefore information requirements, can also be expected to increase as organizations expand in terms of their geographic scope of operations (regional, national, international, or global) and size (small, medium, large organizations).

OIPT proposes that organizations deal with these increased information processing requirements by trying to reduce the effects of uncertainty through buffering (e.g., extra inventory) or by increasing their information processing capabilities through structural mechanisms (e.g., lateral relations) and efforts to improve information flow (e.g., investments in IT and IS). The two middle columns in the model in Figure 1 represent those two ways of increasing information processing capabilities.

The column labeled "Organizational Capabilities" includes factors such as:

- structural arrangements to help enhance the organization's capabilities to process information;

- the degree to which management's decision making style affects information flow by making full use of two-way lateral and vertical communications (Collaborative styles) or by relying mostly on one-way vertical communications (Command and Control styles).

The column labeled "Technological Capabilities" includes factors such as:

- The types of technology used in the performance management system to generate and process information: Enterprise Resource Planning (ERP), specialized tools (EIS - Executive Information Systems, DSS- Decision Support Systems) or generic tools (Excel, Access, Lotus Notes);

- The level of use of e-commerce and Internet technologies to facilitate the flow of information.

Based on the OIPT-inspired model in Figure 1, this study therefore investigated the following hypotheses:

H1: The higher the level of uncertainty in an industry, the higher the likelihood that organizations will try to cope with these increased information processing requirements by improving their information processing capabilities through organizational adaptation (structure, management style) and technology (types of PMS technology, Internet, e-commerce).

H2: The broader their geographical scope of operations, the higher the likelihood that organizations will try to cope with these increased information processing requirements by improving their information processing capabilities through organizational adaptation (structure, management style) and technology (types of PMS technology, Internet, e-commerce).

H3: The larger their size, the higher the likelihood that organizations will try to cope with these increased information processing requirements by improving their information processing capabilities through organizational adaptation (structure, management style) and technology (types of PMS technology, Internet, e-commerce).

H4: Organizational and technological efforts to increase information processing capabilities are complementary, rather than mutually exclusive, so there is a positive relationship between organizational factors (structure, management style) and technology (types of PMS technology, Internet, e-commerce).

H5: There is a positive relationship between organizational factors that enhance information-processing capabilities (such as structures and management styles that facilitate information flow) and PMS outcomes (usefulness, effectiveness, and information quality).

H6: There is a positive relationship between technologies that enhance information-processing capabilities (types of PMS technology, Internet, e-commerce) and PMS outcomes (usefulness, effectiveness, and information quality).

H7: There are positive relationships among the various types of PMS outcomes (usefulness, effectiveness, and information quality).

METHODOLOGY

The empirical test of the hypotheses inspired by the model in Figure 1 was conducted using stepwise regression to analyze data obtained in a large survey (N= 1,990). The sample included small, medium and large organizations, operating at regional, national, international and global levels across a broad range of the Dow Jones Global Industry Groups. Respondents came from different functional areas, such as accounting, finance, general management, information technology etc.

The database used in this study came from a survey of performance measurement practices conducted

by the American Institute of Certified Public Accountants, Inc.

RESULTS

Descriptive Statistics

Table 1 shows the descriptive statistics for the three main PMS outcomes and the other variables in the model.

Usefulness of IT Tools was measured using a scale (Reliability: Cronbach's Alpha = 0.874) that included how useful IT in various performance measurement areas (analyzing and forecasting business results, plans and budgets, decision support), ranging from 1 to 5 (poor/ less than adequate/ adequate / more than adequate / excellent). The Usefulness scale ranged from 1 (poor) to 20 (Excellent), and the average value was 12.78.

Effectiveness was measured in a 1-5 scale, and the average value was 3.11 (5% not effective; 30% poor; 43% adequate; 18 % effective; 5% very effective).

Information Quality was measured in a 1-5 scale, and the average value was 2.97 (3% not effective; 18% poor; 56% adequate; 20 % effective; 3% very effective).

Table 1. Descriptive Statistics

Variable	N	$\overline{X}$	s
Usefulness of IT tools	1732	12.78	2.94
Effectiveness	1876	3.11	.92
Information Quality	1808	2.97	.79
Special tools (EIS, DSS)	1767	1.26	.44
ERP Systems	1767	1.28	.45
Generic Tools (Excel, Access, Notes)	1768	1.94	.23
e-Commerce	1847	1.54	.49
Internet	1840	2.65	1.14
Structure	1921	2.78	1.27
Collaborative	1923	1.54	.49
Command and Control	1923	1.31	.46
Scope	1925	2.37	1.16
Size	1898	1.67	.79
Industry	1923	4.60	3.27

Stepwise Regression Results and Hypothesis Testing

Table 2 shows the results of the stepwise regression used to test the hypotheses in the study (all Beta values significant at .0001). Figure 2 presents the relationships of the variables in the model, with the Beta values obtained for the relationships that were found to be significant at the .0001 level.

The overall results support the applicability of the OIPT-inspired model in Figure 1 to identify factors that help explain the outcomes of Performance Management Systems. Factors that affect organizational information processing (OIP) requirements were generally found to affect the organization's OIP capabilities, both in terms of organizational capabilities and technological capabilities (Hypotheses 1, 2 and 3). Organizational capabilities were found to be positively associated with technological capabilities, supporting the proposition that they are complementary, rather than mutually exclusive (Hypothesis 4). Organizational and technological capabilities were found to contribute to PMS outcomes (Hypotheses 5 and 6). Finally, as the model predicted, we found that PMS outcomes were related to each other (Hypothesis 7).

OIP Requirements and OIP Capabilities (Hypotheses 1, 2 and 3)

Our first three hypotheses concerned the three environmental and organizational factors used to capture the information processing requirements faced by the organizations in the sample: industry, organizational size and scope of geographical operations. Both Industry and Size affected Scope. As predicted, all three OIP requirement variables (Industry, Scope and Size) directly affected one particular aspect of OIP organizational capability (Structure). Size was the most important variable in explaining Structure, followed by Scope and then Industry. However, none of the three OIP Requirement variables (Industry, Size, Scope) were found to affect the other organizational OIP capability variable in the model, managerial decision-making style (Collaborative, Command and Control).

Two of the OIP Requirement variables, Scope and Size, were also found to have a direct impact on the other set of OIP capabilities, technological capabilities. Those technological capabilities included:

- the types of technology used in the performance management system to generate and process information: Enterprise Resource Planning (ERP), specialized tools (EIS - Executive Information Systems, DSS- Decision Support Systems) or generic tools (Excel, Access, Lotus Notes); and
- the level of use of e-commerce and Internet technologies to facilitate the flow of information. Scope was the most important variable to explain both ERP and Internet, explaining over 22% of the variation in ERP and 11% of the variation in Internet. Size and Scope also affected the use of specialized tools (EIS, DSS) and e-commerce.

Table 2. Regression Results

Dependent variable	Independent variables	Beta	$\overline{R}^2$	Significance
Usefulness of IT Tools	Information Quality Effectiveness Special tools (EIS, DSS)	.448 .074 .056	.25	.0001
Effectiveness	Information Quality Collaborative Internet	.519 .121 .110	.33	.0001
Information Quality	Special tools (EIS, DSS) Collaborative Internet Structure	.130 .097 .090 -.058	.04	.0001
Special tools (EIS, DSS)	Size Internet Scope Structure	.224 .117 -.069 .068	.08	.0001
ERP Systems	Scope Size Structure	.221 .094 .027	.07	.0001
e-Commerce	Internet Scope Size	.256 .115 .110	.11	.0001
Internet	Scope Collaborative Structure	.111 .091 .087	.03	.0001
Structure	Size Scope Industry	.361 .079 -.060	.16	.0001
Scope	Size Industry	.283 .111	.09	.0001

Turning now specifically to each of the first 3 hypotheses:

- Hypothesis 1 predicted that the higher the level of uncertainty in an industry, the higher the likelihood that organizations would try to cope with these increased information processing requirements by improving their information processing capabilities through organizational adaptation (structure, management style) and technology (types of PMS technology, Internet, e-commerce). As shown in Figure 2, we only found a significant (although weak) relationship between Industry and Structure. This may reflect the fact that the industry measures (based in the Dow Jones Global Industry Groups) did not fully capture the difference in the levels of

uncertainty in the industries represented in this study.

- As predicted in Hypothesis 2, a broader geographical scope of operations (representing an increase in OIP requirements) was found to be positively associated with both types of factors that increase OIP capabilities: technology (types of PMS technology, such as ERP, and EIS/DSS; Internet; e-commerce); and organizational adaptation (structure). The association between Scope and collaborative management style, however, was not significant.

- As predicted in Hypothesis 3, organizational Size (representing an increase in OIP requirements), was found to be positively associated with both types of factors that increase OIP capabilities: technology (particularly ERP, but also EIS/DSS, Internet and e-commerce); and organizational adaptation (Size explained over 36% of the variation in Structure). Once again, however, the association with Collaborative Management Style was not significant.
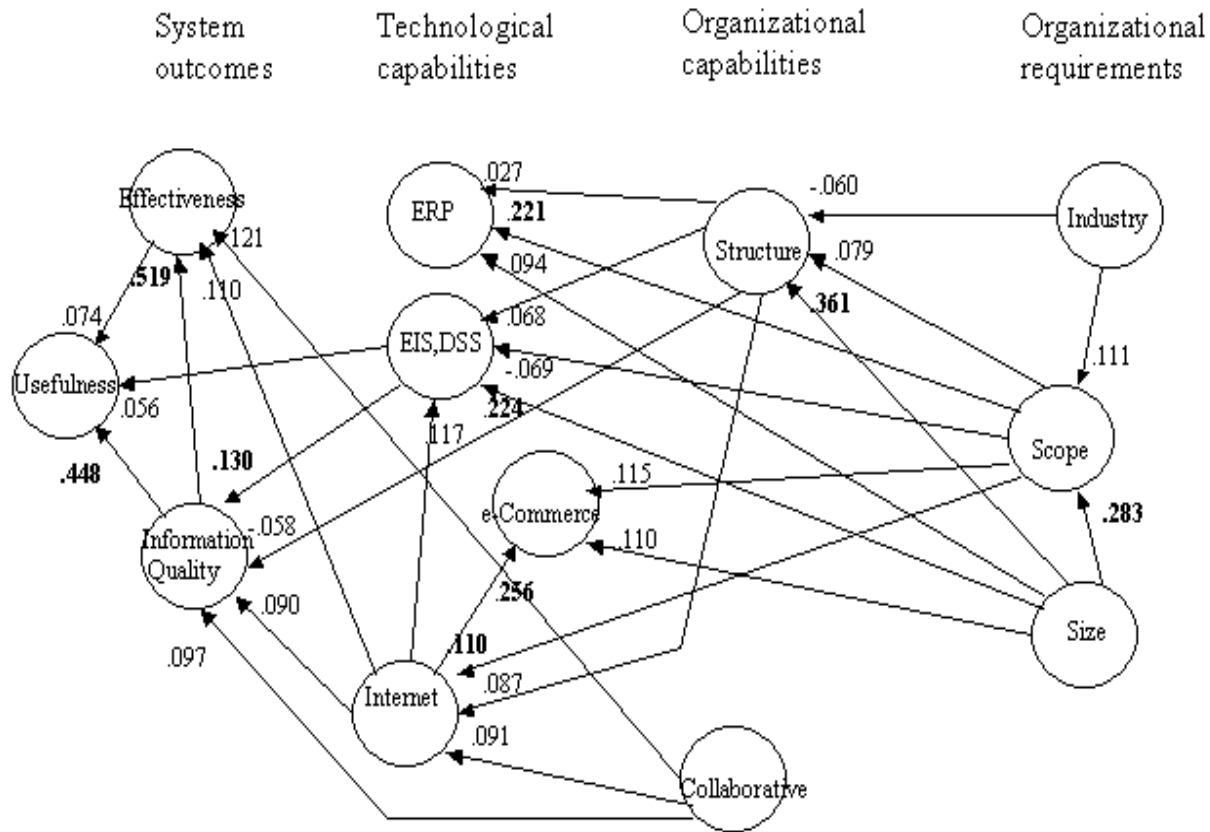

Figure 2. Regression results

OIP Capabilities: Organizational and Technological (Hypothesis 4)

Our OIPT-inspired model proposed that organizational and technological efforts to increase

information processing capabilities are complementary, rather than mutually exclusive. As predicted in Hypothesis 4, we found significant positive relationships between organizational factors (structure, management style) and technology (types of PMS technology, Internet, e-commerce). Structure directly affected the use of ERP,

EIS/DSS and Internet. The other organizational factor, Collaborative Management Style, was found to have a significant impact on only one of the technological factors (Internet). No significant relationship was found between the two organizational capabilities, Structure and Collaborative Management Style.

Organizational Capabilities and PMS Outcomes (Hypothesis 5)

According to Hypothesis 5, organizational factors that enhance information-processing capabilities (such as structures and management styles that facilitate information flow) were expected to have a direct impact on PMS outcomes (usefulness, effectiveness, and information quality), in addition to their indirect impact by affecting technological capabilities (Hypothesis 4).

Structure was found to have a direct impact on one of the PMS outcomes, Information Quality, suggesting that more complex structures may be negatively associated with Information Quality in Performance Management Systems.

Collaborative Management Style had significant direct impacts on two PMS outcomes, directly explaining 12% of the variation in Effectiveness and close to 10% of the variation in Information Quality.

The impact of both Structure and Collaborative Style on the third PMS outcome, Usefulness, was only indirect (through the impact of Effectiveness and Information Quality on Usefulness, as explained in the discussion of Hypothesis 7).

Technological Capabilities and PMS Outcomes (Hypothesis 6)

Hypothesis 6 predicted a positive relationship between PMS outcomes (usefulness, effectiveness, and information quality) and technologies that enhance information-processing capabilities, i.e. the types of technology used in the PMS (ERP and specialized tools such as EIS and DSS), and the level of use of Internet and e-commerce.

ERP was not found in this study to be directly related to PMS outcomes, but was related to other variables in the model such as Scope, Size and Structure. This lack of a direct impact on PMS outcomes may reflect the fact that ERPs are meant to support the coordination and integration of business activities, as well as information processing, and thus were not being used to directly and significantly support the performance management systems investigated in this study.

On the other hand, specialized tools like EIS and DSS were found to have a direct impact on two PMS outcomes: Information Quality (explaining 13% of the variation) and Usefulness (explaining close to 6% of the variation).

E-commerce was not found to affect directly any of the PMS outcomes, but was related to other variables in the model (particularly Internet, and also Size and Scope).

In contrast, the level of Internet use was found to influence PMS outcomes directly (explaining 11% of the variation in Effectiveness and 9% of the variation in Information Quality) and indirectly (through its relationship with the use of Specialized Tools such as EIS, DSS). The level of Internet use was also related to other variables in the model (Scope, Structure and Collaborative Management Style).

PMS Outcomes (Hypothesis 7)

As predicted in Hypothesis 7, we found positive relationships among the various types of PMS outcomes (usefulness, effectiveness, and information quality).

Information Quality was the most important factor in explaining both of the other PMS outcomes, Usefulness and Effectiveness (Information Quality explained close to 45% of the variation in the Usefulness, and over 51% of the variation in Effectiveness). The most important factors in explaining Information Quality (in the context of Performance Management Systems) were Specialized Tools (EIS, DSS), followed by Collaborative Management Style, Internet and Structure.

Effectiveness is positively related to the other PMS outcomes, Usefulness and Information Quality. The most important factors contributing to Effectiveness were Information Quality, Collaborative Management Style and Internet.

Usefulness was positively related to the other PMS outcomes, Information Quality and Effectiveness. The most important factors contributing to Usefulness were Information Quality, followed by Effectiveness and the use of Specialized Tools (EIS, DSS).

CONCLUSION

The overall purpose of this study was to test in a large sample whether a model based on traditional Organizational Information Processing Theory could be successfully applied to the particular case of Performance Management Systems. The results obtained lend support to the use of an OIPT-inspired model to explain PMS outcomes.

As expected, factors that affect OIP requirements (Industry, Scope of Operations, Organizational Size) were related to factors that increase OIP capabilities, including

organizational factors (Industry, Scope and Size were associated with Structure) and technological factors (both Scope and Size were associated with ERP, EIS/DSS, and e-Commerce; and Scope was associated with Internet).

We also found support for the proposition that organizational and technological efforts to increase OIP capabilities are not mutually exclusive, but complementary in nature (positive relationships between Structure and ERP, EIS/DSS and Internet; and positive relationships between collaborative management styles and Internet).

As predicted by the model, the three types of outcomes of Performance Management Systems considered in the study (Usefulness, Effectiveness and Information Quality) were related to each other. These outcomes were also directly influenced by the factors that affect the organization's capabilities to deal with increased OIP demands (including both technological and organizational processes). Usefulness is positively related to technology (the use of special tools such as EIS/DSS). Effectiveness is positively related to technological factors (Internet) and organizational factors (Collaborative Management Styles). Information Quality is positively related to technological factors (EIS/DSS, Internet), and Collaborative Management Styles, but negatively related to structural complexity.

However, it should be noted that the model should be further developed and tested. More research is needed to identify and test other variables that might further explain the outcomes of Performance Management Systems. Although we found many interesting relationships that were significant at the .0001 level, the variables in the model were only able to explain a significant amount of variance for Usefulness (25%), Effectiveness (33%) and Structure (16%). The factors that most contributed to Information Quality (itself a key variable to explain Usefulness) - such as Special tools (EIS, DSS), Collaborative Management Style, Internet and Structure - were significant at .001, but only explained 4% in the variation of Information Quality.

The modest scores respondents gave to PMS outcomes such as usefulness, effectiveness and information quality make it clear that the vast resources organizations invest in Performance Management Systems are not yielding proportional results. Our study suggests that Organizational Information Processing Theory can significantly contribute to extend our understanding of the dynamic underlying PMS outcomes. Further research on other factors that affect information processing requirements and capabilities should yield findings of high theoretical and practical significance to the improvement of Performance Management Systems.

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