

INFORMATION TECHNOLOGY (IT) APPROPRIATENESS: THE CONTINGENCY THEORY OF "FIT" AND IT IMPLEMENTATION IN SMALL AND MEDIUM ENTERPRISES¹

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ABSTRACT

There is little doubt that advanced information and communication technologies (IT) are changing the way businesses operate and conduct commerce. As the advent of a more secure Internet and new transmission standards makes it easier and cheaper for businesses to conduct inter-organizational commerce, it is incumbent upon SME managers to assess whether implementing new technologies such as Electronic Data Interchange (EDI) over the Internet, XML or web-based e-commerce is the "right thing to do" for their organizations. The key question implicit in this decision is addressed in this paper: "Under what conditions should businesses consider themselves likely candidates for (new) IT implementation?" Using the structural contingency theory of "fit" as a foundation for this research, this paper reports the development of the notion of "IT appropriateness" and its determinants. This is followed by an analysis of the relationship between IT appropriateness factors and accrued benefits from IT implementation. Data collected from a survey of small businesses revealed that there are four critical factors that must be assessed by businesses to determine if they are likely candidates for IT (for this study, the particular technology in question was EDI) implementation. These factors are the **internal/external business & technological environment, organizational readiness and trading partner support, financial impact and workflow productivity**. The resulting factors are conceptually consistent with the notions established in the systems perspective to the structural contingency theory of fit. The results of this exploratory study demonstrate that IT appropriateness is a robust and valid construct and is a good mechanism for understanding the factors of **organization-technology fit** that impact organizational performance in terms.

INTRODUCTION

In a study of drivers of IT adoption in 188 small retail businesses, Lee and Runge (21) found that owner's perceived relative advantage and firm's willingness to innovate may have an impact on potential IT adoption in small businesses. In the same vein, Mirchandani and Motwani (28) studied electronic commerce (EC) adoption in small businesses and found that the following factors discriminate between adopters and non-adopters: enthusiasm of the top manager/CEO toward EC, compatibility of EC with work of the company, relative advantage perceived from EC, and knowledge of employees

about technology. In an earlier study, Magal and Lewis (23) investigated factors that affect IT success in small business. In a survey of 150 small businesses, Magal and Lewis (23) found that respondent's awareness of IT and attitude toward IT are critical factors in their use of new information technologies. Further they found that IT use in small businesses is predominantly focused on generating business efficiencies (op. cit). In their design framework, Lee and Feng (22) emphasize the importance of considering and incorporating contextual factors relating to legal, technological, and organizational issues in the design of inter-organizational systems such as EDI. A consistent theme in these and other studies about IT implementation in small firms is the critical importance of contextual and organizational variables in engendering a relative advantage through improved firm performance (5, 16, 19, 32).

Although researchers have identified drivers for IT adoption and implementation success in small firms, many questions that tie IT fit with contextual and structural variables and firm performance are not fully understood. For example, what kinds of organizational, contextual, and other factors influence IT success in small businesses? What makes one firm more innovative compared with other firms? For example, there is some evidence to indicate that organizational size is just one important factor in making a firm innovate and adopt new IT (46). Other than size, which factors should small firms evaluate to find the right fit between IT choices for the organization in order to boost firm performance? When implementing new information technologies, is there a significant relationship between contextual and structural factors on the one hand and organizational performance on the other?

RESEARCH OBJECTIVE

Given the previous discussion, the overarching objective of this research is to conduct an exploratory study to identify the contingent factors that can be considered by a candidate firm to evaluate information technologies for adoption in terms of its potential "fit" or "appropriateness" and its ability to influence benefits accrued to the organization. The rest of the paper is organized as follows. The next section describes the theoretical foundations of this research, with particular emphasis on the notion of fit described in terms of IT appropriateness. This is followed by a description of the research method utilized for this study. The subsequent section provides an analysis of data and a discussion of results. The paper concludes with a discussion of the implications of the results for practice and research and

inherent limitations of the study.

CONCEPTUAL BACKGROUND AND RESEARCH QUESTIONS

The Contingency Theory of "Fit"

The notion of fit in IS research has followed two basic strands, the first targets the group level of performance and the second focuses at the individual level of performance. The former approach is based on Van de Ven and Drazin (44) work and is applicable at the group level. Zigurs and Buckland (47) proposed a theory of task-technology fit (TTF) in the context of group support systems (GSS) effectiveness and found empirical support for this theory (48). The second research strand regarding the notion of fit is targeted at the individual user level in an IS evaluation context. Goodhue (12) proposes a task-technology fit (TTF) perspective wherein it is posited that a higher task technology fit will result in better user performance on tasks and that users can successfully evaluate task-technology fit. Based on this theory, Goodhue and Thompson (13) have empirically shown that task-technology fit has a direct impact on individual performance.

However, the two TTF approaches discussed above are not appropriate for the research problem under study reported here. Zigurs' TTF is focused on the GSS domain, uses the notion of fit to propose ideal profiles, and ties the task-technology relationship to a criterion variable, group performance. Goodhue's TTF is focused on user performance and user evaluation of IT and does not use structural contingency theory of fit as its basis. It is safe to say that from an organizational context, task-technology fit and task performance has little consequence. More important is the business value (efficiency and/or effectiveness) derived when there is a "good" or "poor" fit between organizational or structural and contextual constructs on the one hand and organizational performance on the other.

Consequently, the present research introduces a third strand of research for investigating fit that focuses on the organizational level as compared to the group or individual performance level. In doing so, it is necessary to start with Van de Ven and Drazin's summary of the structural contingency theory of fit, wherein, fit is broadly described in terms of "congruence, internal consistency of multiple contingencies, structural, and performance constructs." The concept of "fit" in contingency theory is well documented in various areas of organizational behavior research. The interested reader is referred to the works of Van de Ven and Drazin (44) and Drazin and Van de Ven (6) for an excellent review of the concept of fit in structural contingency theory.

According to Van de Ven and Drazin (44), the key thread common to all scholarly research in this area is that an organizational outcome is the consequence of a "fit" or match between two or more factors. There are three ways to define and test the concept of fit: Selection, Interaction, and the Systems approach (44). Due to its relevance to this study, we focus on their description of the systems approach. Under the systems approach, "fit is a feasible set of equally effective, internally consistent patterns of organization and context and structure" (44, p. 335). Furthermore, they argue that "organization design can only advance if we address, in simultaneous manner, the many contingencies, structural alternatives, and performance criteria inherent to organizational life" (44, p. 347).

IT Appropriateness

Based on the previous discussion, it is clear that the

concept of fit has broad utility to various areas of theory development wherein "organizational performance is a function of match, congruence, intersection, or union of two or more factors" (44, p. 361). Fit as matching in this research context implies that there is a match between two theoretically related variables without reference to a criterion variable (47, p. 322). Thus, consistent with the systems approach for defining and assessing "fit," in the context of the present research study, we describe the notion of *Information Technology (IT) Appropriateness* as consisting of the *conditions* under which a business should consider itself a likely candidate for (new) IT implementation. Thus, appropriateness is an issue of determining the "readiness" of a firm for new IT implementation. It goes to the question of "fit" between current business conditions faced by a candidate firm and the nature of IT being considered for adoption/implementation and its potential impact on organizational performance.

The IT: Electronic Data Interchange (EDI) Implementation

The IT studied in this research is Electronic Data Interchange or EDI implementation in small and medium-sized enterprises (SMEs). One of the reasons for choosing EDI as the IT construct in this study is its continuing critical importance in the future of global commerce, and particularly its use by small and medium-sized firms. In addition, according to most projections, Electronic Data Interchange (EDI) as a technology for enabling B2B commerce is still "alive and kicking." For example, IDC (IDC.com, 1/2004) forecasts that EDI will continue to be "a mainstay for communication between companies and that the volume of commerce conducted over EDI will grow an average of 7.7% per year through 2007." Notwithstanding the growth of Internet commerce via enabling technologies such as extranets, web-based ordering, web services, EDI (or some form of EDI such as EDI/XML) clearly continues to be the mainstay of global business-to-business commerce at this time.

Research Questions

In view of the notion of fit as match between organization, context and structure, and the previously stated research objective, this paper reports on the investigation of two key research questions.

- Under what conditions should businesses consider themselves likely candidates for new IT implementation? Addressing this question will provide a better understanding of the structure and characteristics of IT appropriateness.
- What is the relationship of these factors on organizational performance in terms of accrued benefits? This question addresses the notion expressed earlier from the contingency theory of fit that suggests that there needs to be a match between organizational and contextual factors on firm performance.

RESEARCH METHOD

The study utilized a survey to elicit responses from 353 EDI-capable businesses located in a Midwestern state in the USA. The survey questions were designed on the basis of past literature and a case study conducted by the author on the impact of Electronic Data Interchange (EDI) adoption and integration on small and medium sized enterprises (SME). A pilot case study was also done while developing the survey to ensure the

completeness and validity of the items included in the survey. Further, initial testing of the readability and clarity of the survey questions was done by circulating the survey to a panel of three experts in survey design. Many survey items were revised, reformulated, simplified, and reformatted to make them easy to read and understand.

Instrumentation

The notion of "IT appropriateness" was operationalized based on critical conditions and considerations that influence the IT adoption and integration decision reported in various research studies described earlier and especially from observations regarding EDI implementation made by Senn (1992), the EDI World Institute (10), Cragg and King (5), Arunachalam (1), Iacovou et al. (16), and the diffusion theory-based results reported by Premkumar et al. (32, 33). Respondents were asked to rate 18 potential attributes of IT appropriateness on an "importance" scale. Respondents were asked the following question: "Under what *conditions* should businesses like yours consider themselves likely candidates for EDI implementation? Please respond to this question by rating the importance of each circumstance listed below." Respondents rated question items on a 3-point Likert-type scale with verbal labels for each point. Respondents checked "1" if they felt that an attribute was "not at all important," "2" when it was "somewhat important" and "3" when it was "very important."

IT Benefits Realized by Responding Firms

Organizational performance was measured by assessing the impact of EDI on the firm in terms of relative benefits realized by SMEs through its adoption and integration. The items to measure relative benefits were identified from a priori research reported by Pfeiffer (31), Swatman and Swatman (40, 41), and Iacovou et al. (16). For convenience and readability of the survey instrument, the benefits from EDI implementation were initially categorized into indirect and direct benefits. Responding firms were asked to assess the impact of EDI implementation on their organization by indicating the extent to which each listed benefit had been obtained by the firm. Thus, responding firms rated the extent to which various benefits were obtained by their enterprise. The exact phrasing of the question was as follows. "Please evaluate the impact of EDI implementation in your organization by indicating the extent to which each of the following benefits has been obtained by your enterprise. Select a response by assessing the change observed in the listed EDI benefit." This was assessed on a 5-point Likert-type scale with verbal labels ranging from a score of 1, "substantially deteriorated (or decreased)," to 3 or "no change," to 5, "substantially improved (or increased)." Thus checking a "5" would indicate that a firm had obtained a substantial improvement (or increase) in a specified benefit because of EDI implementation, whereas checking a "1" would indicate that a firm had observed a substantial deterioration (or decrease) in a specified benefit item.

Data Collection

The survey was mailed to 353 EDI-capable SMEs in a Midwestern state in the USA. Nearly half of these companies were identified from the EDI World 1998 directory and the remaining were located by approaching EDI hub companies and government organizations in the area. Anonymity was promised in return for completed surveys. Various measures to reduce non-response rates were also undertaken. In order to boost

response rates, nearly 418 follow-up phone calls were made. Approximately 338 companies were called once, 79 called twice, and one was called thrice. The first follow-up was done after two weeks of the initial survey mailings. After the first follow-up a total of 59 completed survey responses were received giving a response rate of 16.7%. Based on the first follow-up phone call, businesses that had expressly indicated an interest in participating were identified and called the second time around. These efforts culminated in an effective response rate of 24.3%, that is, 86 useful responses. The possibility of a high non-response rate is a major problem with questionnaires (37). However, it is worth noting that, McDaniel and Gates (25) report that higher response rates are a means to reducing nonresponse bias. They also report that "...of all the studies that have looked for differences between nonrespondents and respondents (or early or later respondents) of mail surveys, none has been reported that found meaningful, practical differences between respondents and the entire sample or between early respondents and respondents as a whole" (25, p. 233, emphasis added).

RESULTS AND DISCUSSION

Sample Profile

Respondent Position and Firm Sector. An equal number (43) of individuals responding on behalf of the surveyed-firms belonged to the non-technical managerial or administrative ranks as those from the information systems branch. Of the 86 respondents a majority were from the manufacturing (57%) and wholesale trade (27%) sector making up nearly 84% of the sample. The remaining firms were either in the retail trade sector (7%) or in the services and other sectors (9%).

Organizational Size. Nearly 49% of the responding firms have less than 100 full-time employees with 36% having less than 50 employees. Organizations with more than 100 employees but less than 500 made up 36% of the sample. Using the SBA (Small Business Administration) criteria for organizational size would put all sampled firms into the "small business" category (Siropolis, 1997). More than half (52%) of the firms in the sample employ fewer than 5 part-time employees while the rest are well distributed across the other categories. A significant proportion (20%) of the sampled organizations employ between 5 and 10 employees while nearly 12% (10 firms) employ more than 50 employees. The remaining sampled firms are evenly distributed between the 11 to 20 and 21 to 50 categories. A large number (nearly 70%) of responding firms had gross sales over \$1 million in 1997 with more than half (47%) generating over \$10 million in sales. The remaining firms were evenly split between \$10,000 and \$1 million in gross sales. Nearly a dozen firms (14%) did not reveal their sales numbers by marking "don't know."

Perceived IT Appropriateness

Descriptive statistical analysis of the various "IT appropriateness" attributes or items produced the results tabulated in Table 1 below. It is apparent from the mean ratings and standard deviations that each listed attribute is "somewhat important" to "very important" with the exception of the last three, "inventory carrying and servicing costs are high," "cost of out-of-stock items is high or unacceptable," and "trading partners are concentrated." However, even these three considerations have average importance scores that indicate that they are important to respondents, albeit to a lesser degree than

the others. As expected, the most important test for appropriateness of EDI technology is whether a major customer wants the firm to implement it. Interestingly, this is closely followed by tests that can appropriately be categorized as

"internal/external environmental conditions" such as "fundamental way of doing business in our industry is changing," "trading partner support and cooperation is available" and "management is enthusiastic and supportive."

TABLE 1
IT Appropriateness: Descriptive Statistics

	N	Mean	Standard
A major customer or supplier wants you to implement EDI	83	2.84	.45
Fundamental way of doing business in our industry is changing	81	2.58	.61
Trading partner support and cooperation is available	82	2.57	.61
Relationship with trading partners	80	2.44	.69
Management is enthusiastic and supportive	83	2.40	.64
Customer service expectations are high	82	2.34	.71
Current state of computerization of your business is conducive to EDI implementation	82	2.34	.74
Financial resources are available	82	2.32	.73
Volume or frequency of orders and other business transactions are high	82	2.30	.70
Current internal systems are easily adaptable to EDI	81	2.28	.69
Increasing use of EDI in your business sector	82	2.27	.70
Tracking of specific sales or shipments or manufacturer's orders is essential	84	2.23	.83
Loss of time due to paper flow is substantial	83	2.22	.72
Management of paper flow consumes excessive personnel or financial resources	83	2.19	.74
Internal organizational situation is amenable	82	2.00	.67
Inventory carrying and servicing costs are high	80	1.94	.75
Cost of out-of-stock items is high or unacceptable	82	1.85	.82
Trading partners are concentrated	82	1.76	.68

The Structure of IT Appropriateness

The IT appropriateness rating scales were further analyzed using the principal components statistical technique with varimax rotation and Kaiser normalization. This exploratory factor analysis was used to identify any underlying factors that constitute the "IT appropriateness" construct and can adequately represent the sample data. The factor analysis rotation converged in 9 iterations and distinct four-factor structure was found, explaining nearly 61.3% of the sample variance. Nunnally (1978) recommends a 0.5 threshold to achieve an adequate level of reliability for each factor in exploratory work. Nearly all the "IT appropriateness" items had a loading greater than 0.5 on the factor to which they were attributed. Of the 18 total items, only two were below the 0.5 threshold, with values of 0.48 and 0.46 respectively. The communalities for the four factors ranged between 0.53 to 0.79 with two exceptions at 0.42 and 0.36. These results provide additional support for the validity of the latent factor structure and indicate that the four factors account for a large percentage of the sample variance of each variable. In addition to the above, the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity both confirm that the factor model is appropriate. The Kaiser-Meyer-Olkin measure of sampling adequacy statistic is 0.82 indicating that the partial correlations among sample variables are small. Bartlett's test of sphericity test produced a Chi-square statistic of 673 (p-value=.000) indicating that the factor model is appropriate i.e., the hypothesis that the correlation matrix is an identity matrix is soundly rejected. Further, each of the four factors has at least three items loading on them except factor 4 which includes two items (as shown in Table 2). This is in line with the recommendation of some authors such as Thurstone (42) and Kim (20, p. 68) that in judging the value of a factor

analysis it is "more crucial to have at least three variables per factor" than achieving a higher ratio of the number of variables to the number of underlying factors.

Based on the statistical analysis described above and conceptual congruence, the four distinct factors that determine **IT appropriateness** for the surveyed firms can be defined as follows.

1. The **first factor** relates to the *internal/external business & technological environment* variables that impact an organization. For example, if the nature of the business situation in which a firm operates is such that there is an increasing use of EDI in its industrial sector and that internal systems and business processes are adaptable to EDI, then a firm is a good candidate for EDI implementation.
2. The **second factor** relates to the potential *organizational readiness and trading partner support* available to the candidate firm. For example, availability of financial resources and trading partner support and co-operation are two examples of the variables that make up this factor and could impact successful IT implementation and in consequence firm performance.
3. The **third factor** relates to the potential for positive *financial impact* of implementing a technology like EDI. For example, when inventory carrying and servicing costs are high and the volume or frequency of orders and other business transactions is high, a firm could generate substantial savings by using inter-organizational systems such as EDI.
4. The **fourth factor** relates to the potential of implementing information technologies that can achieve enhanced *workflow productivity* for the organization. This factor emphasizes the potential ability of information technologies such as EDI to substantially reduce the time and resources

spent on creating and managing the flow of business documents. This factor coupled with the previous factor

addresses the benefits accrued from improved organizational efficiencies due to IT implementation.

TABLE 2
Factor Loading for IT (EDI) Appropriateness Factors
(Cross-loadings between factors below 0.25 are not shown)

Tests for IT Appropriateness:	Factor			
	1	2	3	4
Increasing use of EDI in your business sector	.68			
Customer service expectations are high	.66			
Fundamental way of doing business in your industry is changing (e.g., Just-in-time, Quick Retailing)	.62	.38	.33	
Current internal systems are easily adaptable to EDI	.61	.28		.32
Management is enthusiastic and supportive	.53	.44	.45	
Trading partners are concentrated	.53			
Current state of computerization of your business is conducive to EDI implementation	.48	.41	.36	
A major customer or supplier wants you to implement EDI	.46	.44		
Trading partner support and cooperation are available		.81		
Financial resources are available		.68	.43	
Internal organizational situation (work flow procedures and employees) is amenable		.64		.42
Relationship with trading partners (e.g., potential to forge stronger alliances to create barriers to entry)	.47	.62		
Cost of out-of-stock items is high or unacceptable			.79	
Volume or frequency of orders and other business transactions are high	.34		.67	
Inventory carrying and servicing costs are high		.42	.63	
Tracking of specific sales or shipments or manufacturer's orders is essential	.29		.62	
Loss of time due to paper flow is substantial				.85
Management of paper flow consumes excessive personnel or financial resources	.237	.249	.180	.83
Eigenvalues	3.4	3.3	2.9	2.8
% of Total Variance Explained (Cumulative)	18.2	34.4	50.2	61.3
Cronbach's Alpha	.84	.77	.75	.87
Mean Inter-item Correlation	2.35	2.33	2.07	2.20

The four factors, internet/external business and technological environment, organizational readiness and trading partner support, financial impact of technology, and workflow productivity are clearly robust and could potentially be applicable to any information technology implementation in the small firm context. Essentially, these four dimensions of IT Appropriateness represent a particular mix of contextual, organizational and structural factors that describe organization-technology fit.

Relationship between Benefits and Appropriateness Factors

As suggested earlier based on the contingency theory of fit, the evaluation of organization-technology fit can be further enriched by answering the question: "Is there a relationship between appropriateness factors and organizational performance measured in terms of relative benefits accrued?" In order to investigate this relationship, the step-wise regression analysis technique was employed. The descriptive statistics of individual benefit items are displayed in Table 3. Each one of the benefits listed is significantly different from the middle scale value of 3.00 ("no change") when a one-sample t-test was applied at the 95% confidence level. In other words, on the average, survey-

respondents reported achieving a small but statistically significant positive change in each of the listed benefits due to the implementation of EDI in their organization. It should be noted that "inventory levels" and "transaction costs" are reverse-coded and therefore a deterioration (or decrease) in them has a positive influence on realized benefits from EDI implementation. Also as shown in Table 3, the mean scores for all the individual "benefits" items clearly support this conclusion.

Each appropriateness factor identified in the previous section of the paper was used as an independent variable and an overall benefit score was used as the dependent variable in this analysis. An overall benefit score was calculated by simply summing the individual item scores. The overall regression model (N=75; F= 2.552) was significant at the 95% confidence level (p-value=0.046). The standardized coefficients for each of the factors were -0.031, 0.253, 0.161, and 0.184 respectively with the constant being 27.177. This result confirms the proposition that IT appropriateness is a valid and robust construct and is a useful predictor for successful new IT implementation measured in terms of realized benefits.

TABLE 3
Change in Accrued IT Benefits--Descriptive Statistics (N=78)

Potential IT Benefits Realized	Mean	Standard
Quality of Information	3.83	.93
Relationship with Trading Partners	3.83	.80
Customer Service	3.61	.80
Ability to Compete	3.59	.70
Operational Efficiency	3.55	.89
Cash Flows	3.33	.70
Transaction Costs (reverse coded)	2.69	1.04
Inventory Levels (reverse coded)	2.76	.51

These results are consistent with the contingency theory of "fit" in that there is clear and significant evidence of a relationship between organizational, contextual, and structural factors implicit in the four dimensions of IT appropriateness dimensions and performance factors ("benefits accrued"). From this statistical conclusion, an initial theory of organization-IT fit can be stated. Rephrasing Van de Ven and Drazin (44), positive firm performance due to new IT implementation will result if there is match between IT appropriateness factors that describe the small firm business context, technological context and internal organizational conditions.

SUMMARY AND CONCLUSIONS

This paper has addressed the issue of organization-technology fit by asking the question: "when and under what conditions is an organization a candidate for advanced information technologies such as EDI?" To study this question, the structural contingency theory of fit was used to develop the notion of IT appropriateness and the relationship of its factors with indicators of organizational performance. A survey of SMEs based on a pilot case study and *a priori* research revealed that there are four distinct factors that impact the readiness of organizations for IT implementation and have a direct influence on accrued benefits of IT implementation.

Limitations of the Study

As with most research endeavors, this research has some potential limitations. Since the research method used for this study is nonexperimental in nature, only one IT, i.e., EDI, is included in the investigation, and the sample size is limited, the results are not necessarily generalizable to all small firms and information technologies. However, results could be applicable to the demographics of small firms represented by the sample and to some extent to other inter-organizational information technologies that are similar to EDI. Finally, even though all efforts were taken to reduce nonresponse bias and other errors, inferences, conclusions, recommendations from this type of research strategy are generally supported with lesser confidence than true experimental research (37).

Implications for Practice

This study has attempted to clarify the notion and structure of IT appropriateness. SME owners/managers attempting to determine the appropriateness of new IT for their organization must understand the significance and potential contingent impact of the various factors described by this study on

organizational performance. By doing this kind of evaluation, SME owners/managers can truly realize the full potential of new information technologies.

Implications for Research

In terms of research implications, the notion of "IT appropriateness," as expressed by the underlying factor model, can be used in other studies relating to IT diffusion and/or impact within organization, possibly as a moderating variable. Further, IT appropriateness measured in terms of some appropriate mix of its determinants can potentially be considered as an important predictor of (new) IT adoption and integration and organizational performance. Using other examples of inter-organizational systems and other advanced information technologies, further research also needs to be conducted to evaluate how the IT appropriateness factors impact organizational performance and what kinds of contingencies would change these relationships. Finally, this research also provides an initial basis for a new theory of organization-technology fit at the organizational performance level that could complement the prevalent theories of task-technology fit at the individual and group performance level.

FOOTNOTE

An earlier analysis of the data included in this paper was presented at the International Decisions Science Institute conference in Chihuahua, Mexico, July 8-11, 2001.

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