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Automatic replenishment: the relationship between resource commitment and program performance

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AUTOMATIC REPLENISHMENT: THE RELATIONSHIP BETWEEN RESOURCE COMMITMENT AND PROGRAM PERFORMANCE

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Some firms have adopted a new approach to order fulfillment, i.e., automatic inventory replenishment. With automatic replenishment programs (ARPs), sellers replenish or restock inventory based upon actual product usage and stock level information provided by buyers. This paper reports on a recent survey of logistics professionals regarding ARP involvement. In addition to providing a profile of current usage, the research also examines the relationship between investment in automatic replenishment-related resources and ARP performance. Firms making a greater commitment to ARP (in terms of resource allocation) reported enhanced day-to-day operational performance and greater success in the overall performance of the trading relationship.

INTRODUCTION

Inventory management, i.e., deciding what to stock, how much, and where, is one of the most difficult tasks businesses face. Traditionally, forecasts have driven production and distribution scheduling—usually with mixed results at best. Thus, high priority has been given to finding better ways to manage demand in order to overcome forecasting-related problems and improve service levels (Fisher et al. 1994). One of the solutions that offers great promise is demand-based replenishment, i.e., restocking or order fulfillment based upon actual point-of-sale data. While a variety of terms are used to describe such programs, e.g., continuous replenishment planning (CRP), vendor managed inventory (VMI), quick response (QR), and efficient consumer response (ECR), the umbrella term automatic replenishment programs will be

used to describe any inventory replenishment program that falls within the broad guidelines. Specifically, automatic replenishment describes an exchange relationship in which the seller replenishes or restocks inventory based upon actual product usage and stock level information provided by the buyer.

With potential for improved efficiency, enhanced profitability, and reduced costs, the programs have received extensive coverage in the popular press (Mathews 1994; Robins 1995; Casper 1996). Considerable rewards are believed to be associated with automatic replenishment programs. However, the programs are resource intensive in terms of implementation and maintenance.

Most published work relating to automatic replenishment has focused on case-studies and anecdotal accounts in the grocery industry (Fernie 1994; Whiteoak 1994). Only one empirical study was identified relating to automatic replenishment issues. Fiorito, May, and Straughn (1995) conducted a quick response survey among retailers. Thus, the current research was undertaken to assess the extent of involvement in automatic replenishment-type programs and to gauge their impact on business operations. Considering that extensive financial and managerial resources are required to support such programs, is there a "pay off" in terms of performance?

Automatic Inventory Replenishment

Automatic replenishment programs require close ties between trading partners, extensive exchange of information, and advanced technology support (Cottrill 1997; Keh and Park 1997). Product usage and stock level data are typically transmitted by a retailer via EDI or Internet to the distributor or manufacturer (Stratman 1997). Actual sales data, which are often transmitted several times per day, trigger replenishment quantities. When merchandise is ready for shipment, sellers often provide advance notification (Advance Ship Notices) electronically to buyers.

Responsibility for the replenishment decision may be assumed by the buyer or by the vendor. For example, with VMI systems, vendors receive withdrawal and current balance information from retailers and then replenish to a pre-determined inventory level. Vendors can arrange shipments, build loads, and cut purchase orders in such a manner that optimizes transportation and inventory planning. With CRP, the retailer (or purchaser) maintains more control over replenishment decisions. However, the decisions are still based upon actual sales data (Andel 1996).

Automatic replenishment programs have been credited with a wide range of benefits. For example, case studies have been reported profiling dramatic improvements including increased inventory turns and reduced out-of-stocks at store level. Such store-level improvements and increased sales must be balanced against the likelihood of increased inventory holdings at vendors' warehouses, at least during the initial implementation phase (Heard 1994). However, over time, point-of-sale data can be used to smooth-out the production cycle and bring vendor inventory levels down as well (Nannery 1994).

Automatic replenishment program implementation typically requires significant changes within an organization. Communication linkages and information system support are needed to connect the trading partners. Other operational changes that are likely to be required include a shift to smaller production runs in order to make more frequent, smaller shipments to retail customers. Also, with full implementation, traditional business roles are altered. For example, buying and merchandising roles no longer fit traditional patterns. Buyers no longer have to spend significant shares of their time and

effort on day-to-day re-ordering (Fiorito, May, and Straughn 1995). Finally, substantial commitment is required to support such programs. Resource commitment in a tangible sense (financial support) as well as intangible (managerial support) is critical to program success.

Resource-Based Theory

Many firms are focusing on the innovative utilization of logistical resources to create and add value for customers (Christopher 1993; Fuller, O'Conor, and Rawlinson 1993; Stank, Daugherty, and Ellinger 1998). However, despite recent logistical advances, further theoretical development on the strategic role of logistics remains a key priority (Mentzer and Kahn 1995; Stock 1996). Resource-Based Theory (RBT) of the Firm has significant potential for logistics research (Olavarrieta and Ellinger 1997), and provides the theoretical rationale for the current research.

Proponents of RBT suggest that the real origins of a firm's success are the organization's firm-specific or idiosyncratic resources. According to RBT, firms are bundles of resources (Wernerfelt 1984), which include all inputs that allow a firm to work and implement its strategies (Conner 1991). Firm resources can be tangible or intangible (Hall 1992), and they may be developed inside the firm or acquired in the market. Different classifications of resources have been offered in the literature (Barney 1991; Grant 1991; Amit and Schoemaker 1993; Bogaert, Maertens, and Van Cauwenbergh 1994; Brumagim 1994). The various classifications can be summarized as input factors, assets, and capabilities or competencies.

Input factors are generic resources that can be acquired in the market. For example, automatic replenishment program-related input factors include raw factors (e.g., barcoding equipment, warehouses, computers, and Point-of-Sale scanners) and raw skills (order picking skills, loading and unloading skills, driving skills, and computer-operating and programming skills). When transformed or applied, input factors become part of the firm's assets or capabilities/competencies, contributing directly to the output of the firm.

Assets are stocks of available factors that are owned or controlled by the firm (Dierickx and Cool 1989; Amit and Schoemaker 1993). Assets have the characteristic of being 'visible' resources (Bogaert, Maertens, and Van Cauwenbergh 1994). Examples of automatic replenishment program-related assets are Electronic Data Interchange operations, automatic forecasting and automatic replenishment computerized systems, satellite-based trucking communication technologies, and cross-docking operations.

Capabilities are complex bundles of skills, assets, and accumulated knowledge exercised through organizational processes, that enable firms to coordinate activities and make use of their resources (Schoemaker and Amit 1994; Day 1994; Schulze 1994). Wal-Mart's distribution system (Stalk, Evans and Shulman 1992; Day 1994), Hewlett-Packard's postponement dexterity (Feitzinger and Lee 1997), and Federal Express' reliance on information technology (Lappin 1996) are prominent examples of resource-based logistical capabilities. Examples of competencies related to automatic replenishment programs are organizational processes that facilitate pre-season planning with trading partners, joint planning and forecasting of replenishment/promotion, and the utilization of cross-functional teams.

A difference between assets and capabilities is that assets are related to 'having' while capabilities are related to 'doing', making them more invisible (Bogaert, Maertens, and Van Cauwenbergh 1994). Capabilities/competencies also differ from other firm resources in the sense

that they are enhanced by use (Nelson 1991). The more a capability is utilized, the more it can be refined and the more sophisticated and difficult it becomes to imitate. For example, researchers have emphasized the difficulty in attempting to copy firms' distribution systems (Lambert and Stock 1993). It is suggested that "...distribution can be designed as a unique offering not easily duplicated by competition," (Sterling 1985). Thus, the implementation of an automatic replenishment program can represent a commitment of resources designed to develop a distribution capability/competency that may differentiate the firm from its competitors.

Operationalization of Resource-Based Theory

Operationalization of RBT has proved problematic for researchers due to the inherent unobservability of many capabilities (Godfrey and Hill 1995). Accordingly, the majority of RBT-oriented studies have been conceptual rather than empirical. Attempts to operationalize RBT have involved either the utilization of proxy financial data to represent capabilities (e.g., Rumelt 1991; Markides and Williamson 1994) or the examination of associations between firms' competencies, their related activities, and performance (e.g., Snow and Hrebniak 1980; Hansen and Wenerfelt 1989; Sousa and Hambrick 1989; Conant, Mokwa, and Varadarajan 1990; Miller and Shamsie 1995). Examination of the association between investment in specific resources and performance can provide greater insight. Therefore, the current research focuses on the relationship between investment in automatic replenishment program-related resources and performance.

RESEARCH QUESTIONS

The Resource-Based Theory of the Firm suggests that the degree to which a firm commits resources to develop and facilitate automatic replenishment competency is positively associated with performance. However, the implementation of an automatic replenishment program is not purely a matter of financial commitment. The combination of tangible (financial) and intangible (managerial and temporal) resource commitment is particularly important to the successful development of an automatic replenishment competency.

An illustration of the benefits associated with commitment of both tangible and intangible resources to developing distribution competency is K-Mart's difficulty in matching Wal-Mart's logistical system despite continuous efforts to benchmark and copy it (Barney 1995). Wal-Mart's senior management's recognition of, and investment in, distribution and transportation as a strategic resource is cited as critical to its success (Walton and Huey 1992).

The current study seeks to provide a better understanding of the relationship between firms' commitment of resources to automatic replenishment programs and performance in achieving specific automatic replenishment-related goals, as well as on more global measures of performance such as profitability and the overall success of inter-firm relationships.

Research Question 1a:
Is the commitment of resources to automatic replenishment programs associated with the attainment of specific automatic replenishment-related performance goals?

Research Question 1b:
Is the commitment of resources to automatic replenishment programs associated with profitability?

Research Question 1c:
Is the commitment of resources to automatic replenishment programs associated with the overall success of inter-firm relationships?

RESEARCH METHODOLOGY

Based on a review of the literature and interviews with five logistics professionals, a survey of automatic replenishment practices was developed. The survey was pretested with six other persons: three logistics professionals, two consultants, and one academic researcher. The survey was modified with respect to their input. Two versions of the instrument were then developed: one for retailers and one for manufacturers.

Telephone calls were placed to a random sample of manufacturer and retailer members of the Council of Logistics Management, with the purpose of screening for involvement in automatic replenishment. Of the 762 total contacts, 247 (32.4%) were deemed ineligible because their firms were not using automatic replenishment or had yet to fully operationalize their system. Of the remaining 515 contacts, 282 agreed to participate. The other contacts either refused to participate (24), or failed to respond to multiple phone messages (209). Surveys were mailed to 282 individuals with reminder cards two weeks later.

A total of 104 surveys were returned of which six had excessive missing values, yielding 98 usable surveys. Of the 98 respondents, 75 were from manufacturing firms and 23 from retailing firms. The average annual sales volume and the average number of employees for respondent firms were $3.2 billion and 37,481 respectively. The respondent base represents a wide range of industries. The most highly represented industries were food and beverage (31.3%), electronics (12.2%), chemicals (9.2%), and apparel (8.2%). A demographic breakdown of the respondents is included in the Appendix.

Analysis of non-response bias was performed by comparing early versus late responses, as recommended by Armstrong and Overton (1977). The responses provided by the last quartile of respondents (those considered to be most similar to non-respondents) were compared to responses provided by the first three quartiles of respondents. The comparison of group mean responses to survey items revealed no significant differences (at $p < .05$) for the variables analyzed. Accordingly, non-response bias was not considered to be a problem.

RESULTS

The research findings provide a profile of automatic replenishment program involvement as well as respondents' perceptions of their firms' automatic replenishment program success to date. As shown in Table 1, the most common type of automatic replenishment program is vendor managed inventory (VMI). In addition, a high number of firms (nearly 37%) are involved in continuous replenishment programs (CRP). Other types of automatic replenishment had lower levels of involvement—supplier-managed inventory, quick response, jointly managed inventory, efficient consumer response, and distributor-managed inventory. However, these exploratory findings may be a function of the sample and are not necessarily generalizable.

Slightly over one-third of the respondents indicated that their firms are involved in more than one type of automatic replenishment program.

Automatic Replenishment Program Success

To examine how well automatic replenishment programs are performing, respondents were provided with a list of automatic replenishment-related goals and were asked to indicate how effective their firms have been in achieving them. The items on the list were initially developed based upon a review of the literature, and were later refined as a result of input received during initial interviews and the pre-test phase of the research. A total of 11 items were included; a 7-point scale was utilized (1 = not at all effective, 4

TABLE 1

INVOLVEMENT IN AUTOMATIC REPLENISHMENT PROGRAMS

Automatic Replenishment Program Type	Frequency*	Percent
Vendor-Managed Inventory	45	45.92
Continuous Replenishment	36	36.73
Supplier-Managed Inventory	16	16.33
Quick Response	12	12.24
Jointly-Managed Inventory	10	10.20
Efficient Consumer Response	9	9.16
Distributor-Managed Inventory	4	4.08
Other	18	18.37

* Multiple responses were possible

= somewhat effective, and 7 = extremely effective). Overall respondent means and standard deviations for the 11 items are shown in Table 2.

Automatic replenishment programs have been effective in achieving some of the more basic program-related goals. The respondents reported that their firms had been successful in terms of improving/increasing customer service levels (5.47), fewer stock-outs (5.33), improved reliability of deliveries (5.15), and faster inventory turns (4.93).

The respondents indicated that their firms have been moderately effective in achieving automatic replenishment objectives relating to program efficiencies as illustrated by their success in reducing over-stocks (4.78), inventory holdings (4.76), returns and refusals (4.62), handling (4.56), costs (4.50), and product damage (4.45).

The lowest level of program success is associated with reducing the need to discount product (3.96). Automatic replenishment attempts to exactly match supply and demand. However, even with careful monitoring, joint planning, and other processes aimed at exactly predicting demand, mismatches occur due to market conditions, changing consumer preferences etc.

Resource Commitment and Performance

The Resource-Based Theory of the Firm suggests that resource commitment and performance are positively related. Respondents were asked to indicate the extent of their firms' management commitment to automatic replenishment, the extent of their firms' resource commitment to automatic replenishment, and the extent to which thorough advance automatic replenishment program planning occurred within their firms. A 7-point scale with 1 = little, and 7 = substantial was utilized. Respondents' overall mean scores for all three items were relatively high, which is indicative of the considerable investment in resources that firms in the sample have made to implement automatic replenishment programs. Overall respondent means and standard

TABLE 2

EFFECTIVENESS IN ACHIEVING AUTOMATIC REPLENISHMENT RELATED GOALS

Goal	Mean*	Standard Deviation
Improved/increased customer service	5.47	1.31
Fewer stockouts	5.33	1.21
Improved reliability of deliveries	5.15	1.41
Faster inventory turns	4.93	1.47
Reduced overstocks	4.78	1.54
Reduced inventory holdings	4.76	1.64
Reduced returns and refusals	4.62	1.52
Reduced handling	4.56	1.47
Reduced costs	4.50	1.46
Reduced product damage	4.45	1.62
Reduction of discounting	3.96	1.60

* 7-point scale 1= not at all effective 7= extremely effective

deviations for the three resource commitment items are reported in Table 3.

To assess associations between resource commitment and performance, the three items were combined into a summary combination measure for resource commitment. Cronbach alpha for the three-item measure was .89 indicating a high level of reliability for the measure. Respondents' firms were classified as either high or low with respect to automatic replenishment program resource commitment based upon the summed score of responses to the three items (possible scores ranged from 3-21).

A split was made at the fiftieth percentile to form two groups. Thus, firms scoring 15 or more (on a 3 - 21 scale) were designated as high resource commitment firms, while the low resource commitment group consisted of firms scoring 14 or less on the summary combination measure for resource commitment. Results of t-tests performed to examine differences in means between the high and low resource commitment groups on specific automatic replenishment program related goals are presented in Table 4.

The results strongly suggest that performance on specific automatic replenishment related goals is positively associated with resource commitment. The high resource commitment group had significantly higher levels of achievement ($p = .05$) on specific automatic replenishment related goals than firms in the low resource commitment group on 10 out of the 11 items. In only one instance, reduced product damage, no significant difference was found between the high resource commitment and low resource commitment groups.

TABLE 3

COMMITMENT TO AUTOMATIC REPLENISHMENT PROGRAMS

Global Measure	Mean*	Standard Deviation
The extent of management commitment to Automatic Replenishment Programs	4.85	1.55
The extent of resource commitment to Automatic Replenishment Programs	5.25	1.36
The extent of thorough advance planning for Automatic Replenishment Programs	5.26	1.28

* 7-point scale 1= minor 7= substantial

TABLE 4

T-TESTS OF DIFFERENCES IN MEANS:
HIGH RESOURCE COMMITMENT VS. LOW RESOURCE COMMITMENT
IN ACHIEVING AUTOMATIC REPLENISHMENT RELATED GOALS

Goal	T-tests of differences in means* High resource commitment	Low resource commitment
Reduced costs	4.91**	3.94
Reduced inventory holdings	5.17**	4.22
Faster inventory turns	5.28**	4.47
Increased/Improved customer service	5.80**	5.02
Reduced handling	4.94**	4.02
Fewer stockouts	5.72**	4.75
Reduced product damage	4.74	4.11
Reduced returns and refusals	4.96**	4.16
Reduced overstocks	5.27**	4.03
Reduction of discounting	4.47**	3.36
Improved reliability of deliveries	5.58**	4.66
Summary Variable	56.60**	47.86

* 7-point scale 1= not at all effective 7= extremely effective
** Significantly different at 0.05

To assess the association between resource commitment and performance from an aggregate achievement perspective, a single summary variable was created by consolidating the 11 automatic replenishment program goal items. Not surprisingly, when a t-test was performed to compare means for the two groups, firms in the high resource commitment group (mean = 56.60 on an 11-77 scale) indicated significantly higher success in achieving automatic replenishment related goals than firms in the low resource commitment group (mean = 47.86).

Next, to examine associations between resource commitment and more global measures of performance, respondents were asked to consider their most important ARP relationship and to indicate how profitable it had been (7 point scale: 1 = highly unprofitable, 7 = highly profitable), and to rate the overall performance of the relationship (7 point scale: 1 = highly unsuccessful, 7 = highly successful). Overall sample means for profitability and for overall relationship performance were 4.85 and 5.18 respectively (standard deviations: 1.43 and 1.42). Once again, t-tests were performed to assess performance differences between the high and the low resource commitment groups. The results are shown in Table 5.

No significant difference was found between the two groups for ARP relationship profitability. Considering the financial and managerial commitment required to support automatic replenishment programs, this is not surprising. However, while profitability was not shown to be significantly higher with greater resource commitment, resource commitment was found to be related to relationship performance.

The high resource commitment group respondents rated the overall success of their most important ARP relationship significantly higher (mean = 5.50) than the low resource commitment group (mean = 4.70). Although a myriad of psycho-social factors, like trust and cooperation, may also influence the status of automatic replenishment program relationships, this finding can be regarded as a tentative indication of an association between resource commitment and more global measures of performance. Resource commitment in support of ARP's can be a building block—respondents in the high resource commitment group were

TABLE 5

T-TESTS OF DIFFERENCES IN MEANS: HIGH RESOURCE COMMITMENT VS. LOW RESOURCE COMMITMENT BY PROFITABILITY AND OVERALL RELATIONSHIP PERFORMANCE

Goal	T-tests of differences in means* High Resource Commitment	Low Resource Commitment
Profitability	4.92	4.72
Overall Relationship Performance	5.50**	4.70

* Individual items were measured on a 7-point scale with 1= not at all effective and 7= extremely effective, and then combined.

** Significantly different at 0.05

"happier" or believed that the trading relationships had been more successful.

DISCUSSION

Our examination of the resource commitment/performance relationship suggests a strong positive association between resource commitment and performance on automatic replenishment program-related goals. High resource commitment firms were significantly better performers than low resource commitment firms on ten of the eleven items as well as on the aggregate summary variable. However, results were mixed when relationships between resource commitment and more global measures of performance were assessed. While there was no significant difference between groups on relationship profitability, the high resource commitment group rated the performance of their most important ARP relationship as far more successful than respondents in the low resource commitment group. These findings strongly suggest that firms may enhance specific goal-related performance by committing resources to automatic replenishment programs. In addition, the findings offer evidence that resource commitment may also affect perceptions of overall relationship success.

Perhaps the most interesting finding to emerge from this research is the magnitude of the perceived performance differences between the high and low resource commitment groups on specific automatic replenishment-related goals. Once again, it should be noted that the respondents did not represent firms in various stages of automatic replenishment program implementation. Rather, all respondents were selected on the basis that they had implemented automatic replenishment programs. Prospective respondents who stated that their firms had not yet fully operationalized automatic replenishment programs were not deemed eligible to participate in the study. Thus, all respondent organizations in the sample had committed resources to operationalize automatic replenishment programs.

The results demonstrate consistently robust performance differences between respondents in the high and low resource commitment groups. Since all firms in the sample have already invested the considerable amount of time, money, and effort that is required to operationalize an automatic replenishment program, the magnitude of the differences is somewhat surprising. The findings suggest that firms who are prepared to commit additional resources to enhance their automatic replenishment programs may see even better performance. In sum, the current research indicates, as suggested by Resource-Based Theory, that firms may derive considerable performance benefits from focusing on the commitment of financial, managerial, and temporal resources to the development of an automatic replenishment competency.

Managerial Implications

Budget allocations within the firm are generally contentious and highly competitive. Everyone wants the same thing—a bigger share of the pie. The current research provides strong support for justifying budget allocations. Based on these findings, greater resource commitment (related to automatic replenishment programs in this instance) is related to enhanced performance. The firms that have committed greater resources are doing a better job operationally day-in and day-out. They indicated better customer service, fewer stock-outs, etc.

Differences were also noted on a higher or more strategic level. Resource commitment was not found to be related to higher profitability. Intuitively, this would be expected. It is unlikely that a firm can "spend more" to improve service and customer relations and simultaneously expect to improve profits. However, the firms making resource commitments to automatic

replenishment programs seem to be reaping benefits in terms of overall relationship performance. Such an assessment would seem to bode well for the future. Resource commitment is related to performance. Better performance can encourage long-term relationships and, eventually, influence firm profitability.

Future Research

This study offers empirical evidence to support the basic premises of Resource-Based Theory and the relationship between resource commitment and performance. The research setting involved one very specific firm application—involvement in automatic inventory replenishment programs. Future research should further explore the proposed relationship by testing in other domains. The tenets of RBT should be widely generalizable; however, further empirical testing is required.

The current research addressed the issue of resource commitment at a general level. No attempt was made to determine the prioritization of resource allocations or to identify the most important elements. For example, with automatic replenishment programs, an array of input factors ranging from barcoding equipment to order picking skills are commonly utilized. Are some input factors more important, i.e., should be funded first? Future research should explore this issue.

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APPENDIX

RESPONDENT BREAKDOWN BY INDUSTRY

Industry	Frequency	Percent
Food and Beverages	30	31.3
Electronics	12	12.2
Chemicals	9	9.2
Apparel	8	8.2
Miscellaneous Manufacturing	6	6.1
Pharmaceuticals	4	4.1
Medical Equipment	4	4.1
Health and Beauty Care	3	3.1
Transportation Equipment	3	3.1
Paper Products	2	2.0
Rubber	2	2.0
Fabricated Metals	2	2.0
Industrial and Commercial Machinery	2	2.0
Other	9	9.2

EMPLOYEES AND AUTOMATIC REPLENISHMENT

Total Number of Employees	Frequency	Percent
100,000 or more	3	3.1
10,000 to 99,999	19	19.4
1,000 to 9,999	34	34.8
100 to 999	21	21.5
less than 100	6	6.1

Maximum: 200,000
Minimum: 15
Mean: 37,481

EMPLOYEES AND AUTOMATIC REPLENISHMENT
(continued)

Employees Committed to Automatic Replenishment	Frequency	Percent
100 or more	9	9.2
75 to 99	6	6.1
50 to 74	5	5.1
25 to 49	7	7.1
less than 25	55	56.1

Maximum: 440
Minimum: 1
Mean: 39.43

RESPONDENT JOB TITLES

Title	Frequency	Percent
Manager (Miscellaneous)	17	17.3
Logistics Manager	15	15.3
Director of Logistics	12	12.2
Vice President Logistics	7	7.1
Distribution Manager	5	5.1
Director (Miscellaneous)	5	5.1
Director of Distribution	4	4.1
Vice President Distribution	3	3.1
Director of Transportation	3	3.1
Distribution Center Manager	3	3.1
Customer Service Manager	2	2.1
Other	11	11.2

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