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The Organization of New Service Development in the USA and UK

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ABSTRACT

We understand a great deal about the organization and management of new product development in the manufacturing sector, but we know relatively little about how applicable this research and practice is to the service sector. In this paper we introduce and test a framework for managing new product development in services. This framework is derived and tested by analyzing 108 service firms in a combined US and UK dataset, and then each national sub-sample separately. Our results generally support the predictive capability of the framework, and suggest that the development strategy, processes, organization and tools derived from manufacturing, specially those of concurrent engineering, are applicable to services. However, the framework better fits the US than UK data, which may question the notion of a 'best practice' applicable to different contexts.

Keywords: product development, services, concurrent engineering, simultaneous development

INTRODUCTION

We know a great deal about the organization and management of new product development in the manufacturing sectors, but we know comparatively little about how applicable this is to the service sector (Miles, 2000; Tidd *et al*, 2001;Tidd, 2002). In this paper we explore the extent to which a framework for organizing and managing new product development predicts variation in performance in service companies in the USA and UK. This framework was developed based on proven good practice in the manufacturing sectors, and adapted to encompass services as well as goods. A generic framework is potentially useful because large corporations increasingly offer and bundle products and services, e.g., field installation, after sale upgrades and add-ons, support, and maintenance (Chase and Garvin, 1989; Chase and Hayes, 1991). Large, high-tech companies employ as many people in service as manufacturing jobs. Moreover, the proportion of non-manufacturing jobs is growing as many industrial leaders are diversifying into services (Wise and Baumgartner, 1999).

The framework we propose is based on the principle of concurrent or simultaneous product development. Concurrency emerged as a paradigm for industrial product development because *simultaneous* contributions by disparate functions along the value-added chain proved faster and more effective than *serial* contributions (Takeuchi and Nonaka, 1986; Nevins and Whitney, 1989; Clark and Fujimoto, 1989; Stalk and Hout, 1990; Hartley, 1992; Susman and Dean, 1992; Clark and Wheelright, 1993; Gatenby, 1994; Ward *et al*., 1995; Gerwin and Susman, 1996; Zirger and Hartley, 1996; Fleischer and Liker, 1997; Liker *et al*., 1999). A framework of concurrency is needed in large service corporations as well as goods companies because functional differentiation occurs with growth in size and complexity, regardless of sector (Blau and Schoenheer, 1971; Blau *et al*., 1976), and inhibits enterprise integration (Tidd, 1993; 1995).

THEORETICAL FRAMEWORK

Concurrent Engineering practices may be summarized by five constructs using the mnemonic, SPOTS: Strategy, Process, Organization, Tools/Technology, and System. This framework is an enlargement of a composite model of CE effectiveness tested by analyzing 100 industrial corporations in the US (Hull *et al*., 1996; Collins and Hull, 2001; Liker *et al*., 1999) and validated during the course of conducting 16 industrial case studies of companies participating in a user group.[1] Each company in the group presented their methods of product development and helped shape the definition of CE best practices in terms of the SPOTS constructs.

Varied formulations of SPOTS constructs are commonly used in the literature on concurrent engineering (Zirger *et al*, 1990; Susman and Dean, 1992), organization design (Hage, 1980; Daft, 1995), and as building blocks in models for industrial improvement, such as the Lean Aerospace Initiative (Womack and Jones, 1996; Cusmano and Nobeoka, 1998; Henderson and Larco, 1999).

-- Insert Figure 1 Here --

Each of the SPOTS constructs plays a different role in performance improvement. *Strategy* provides focus; *process* provides control; *organization* provides coordination of people; tools provides transformation / transaction capabilities, and system provides integration. Each can be expressed on a continuum ranging from a mechanistic bureaucracy to an organic-professional organization (Burns and Stalker, 1961; Lawrence and Lorsch, 1967; Duncan, 1976; Daft, 1978; Mintzberg and Quinn, 1996; Hage, 1980; Hull and Hage, 1982; Hull, 1988; Damanpour, 1991; Susman and Dean, 1992; Leonard-Barton, 1992; Liker *et al*., 1999). The mechanistic form is best for cost efficiencies, the organic for innovative product differentiation.

[1] A Concurrent Engineering group, formed to exploit a CE database and transfer best practices, included: AT&T Bell Labs, Black & Decker, Chrysler, Eaton, Ford, GE, HP, Lockheed-Martin, Lucent Technologies, Motorola, Sun Microsystems, 3M, Unisys, US Army, Westinghouse, and Xerox.

But to simultaneously achieve both kinds of generic competitive advantage, cost and innovation, organic and mechanistic design elements need to be combined in an integrated system (Tidd and Bodley, 2001;Tidd *et al*, 2001). The need for combined organic and mechanistic practices is one reason why SPOTS constructs are defined below in ways that are relatively harmonious in terms of mechanistic and organic compatibility.

S--Strategy

The particular mode of strategy hypothesized as most congruent for concurrent systems is one of RRR (Rapid, Reiterative, Redevelopment). This approach to product differentiation accumulates numerous incremental innovations instead of striving for a risky radical (Dewar and Dutton, 1986; Mintzberg and Quinn, 1996). The RRR approach has enabled many companies to achieve greater cumulative novelty per unit of time than more radical approaches to innovation (Clark and Wheelright, 1993; Tidd and Fujimoto, 1995; Tidd, 1995). Short, repeat development cycles are hypothesized as making it easier for systems to maintain closely integrated relationships while making continual adjustments because multiple functions have opportunities for concurrent instead of serial input. The strategy of RRR is also hypothesized as improving performance because its focus on time compression and knowledge reuse provides a stimulus for both up and downstream functions to engage in frequent, constructive exchanges. Partly because the RRR approach entails conservatism and improvement, its strategic intent is to achieve both kinds of generic competitive advantage simultaneously, low cost and innovation.

Hypothesis 1

The greater the practice of a *strategy* of RRR,
The higher the level of performance improvement.

P--Process

Processes for controlling product development in a concurrent mode are more flexible and enabling than those of a coercive, mechanistic bureaucracy (Hull *et al*., 1996; Adler and Borys, 1996; Liker *et al*., 1999). Concurrent practices of product development involve external benchmarking, structured methods for translating customer needs into requirements/specifications, setting standards for project/product performance, and systematic reviews (McCabe, 1985; Melan, 1985; Garvin, 1995; Yearout, 1996; Tidd and Bodley, 2001;Tidd *et al*, 2001). By providing road maps and boundary conditions, cross-functional teams may be given more responsibility and stage gates less rigidly enforced in design reviews.

Product development controls are abetted by general methods of process improvement, such as mapping to identify ways activities are conducted, show wasted steps, and eliminate unnecessary hand-offs in product development as well as other kinds of activity mandated by ISO 9000 (Lovitt, 1996). Best processes are then documented as standards for helping to keep product development projects on track and continuously updated. This approach to control is in stark contrast to the rigid, mechanistic use of static manuals of standard procedure. One reason is because cross-functional teams are often involved in the creation, maintenance, and continual improvement of processes, thereby melding mechanistic and organic practices.

Hypothesis 2

The greater the practice of continuous process improvement in product development,
The higher the level of performance improvement.

O--Organization

A cornerstone of CE is an *organizational* concept, the simultaneous integration of work performed by functions along a value chain of product development and delivery. The notion of organic team structure enables people to cut across bureaucratic barriers due to size and structural differentiation (Hull *et al*., 1996). Concurrent product development involves multiple functions simultaneously at early steps of decision-making to maximize opportunities and preclude downstream problems, such as difficulties with manufacturability, marketability, and serviceability (Hartley, 1992; Susman and Dean, 1992). Early simultaneous influence exerted by downstream functions fosters continuing cross-functional communication patterns among diverse people to develop better products that are well thought-out from early stages, thereby avoiding costly late changes (Collins and Hull, 2001). Heterogeneous input typically results in better solutions to complex, dynamic problems. A spate of articles extol the virtues of cross-functional teaming (Hull, 1990; Meyer, 1994; Kahn, 1996), especially to the extent products are novel (Olson *et al*., 1995; Collins and Hull, 2001; Liker *et al*., 1999; Tidd and Bodley, 2001). One reason for its benefits, relative to serial approach where each specialists hands-off to another, is that the group exerts some degree of control over individual behaviors, thereby melding some of the equivalents of mechanistic design elements with organic ones (Takeuchi and Nonaka, 1986).

Hypothesis 3

The greater the level of cross-functional organization,
The higher the level of performance improvement.

T--Tools/Technology

Despite their intangibility, many service products are knowledge-based and/or are heavily dependent upon IT (Information Technology). Significant improvements in computers and software for storing and sharing information have increased capabilities for conceiving of new kinds of products as well as for managing development and delivery processes (Rayport and Sviokla, 1995). Tools that were once hard to change and difficult to distribute are now soft, flexible, and easily shared via electronic networks. IT is an enabler of continually updated processes and instant exchanges among cross-functional team members, regardless of distance. The mechanistic constraint of tools is thereby softened by the greater flexibility it permits in controls and increased frequency of communications.

IT tools are hypothesized as having a positive impact on system integration because of the speed and scope of data distribution. The lower cost of data transmittal and greater reliability are hypothesized as improving performance. However, data is not information. IT is presumed to be more effective to the extent that it supports mature processes and cross-functional organization (Mitchell and Zmud, 1999).

Hypothesis 4

The greater the implementation of Information Technology tools,
the higher the level of performance improvement.

<u>*System Integration*</u>

System integration is an emergent property involving mutual adjustment among multiple functions and adaptive practices that have become institutionalized (Thompson, 1967). An example is provided by industrial systems in which ongoing, complementary exchanges, such as DFM (Design for Manufacturability) is practiced by product design engineers concomitant with plant initiatives in FMS (Flexible Manufacturing Systems). Such a system is more capable because reciprocal integration enables design and manufacturing engineers to be mutually responsive to the needs of one another than serial integration (Liker *et al*., 1999). Systems characterized by concurrency are integrated by a number of such reciprocities, particularly those that align resources so as to rapidly respond to customer needs.

In terms of the framework presented herein, a concurrent system has a balance of deployment of the sets of practices in SPOT. Each of these constructs offers a particular kind of advantage, not only solo, but also in concert. For example, an industrial study found interaction effects among constructs defining concurrent practice (Hull *et al*., 1996). Synergy is lost if a single construct is overemphasized to the exclusion of others (Tidd, 1991; Tidd *et al*, 2001). Holistic thinking and robust knowledge enable concurrent systems to deliver customers products with a balanced portfolio of advantages, e.g., novelty and cost.

Hypothesis 5

The more integrated the product development system,
The higher the level of performance improvement.

Service Product Development Function

Concurrency as defined by the SPOTS framework is a product-focused managerial initiative largely derived from industrial methods. For example, a major New York bank created its product development department after benchmarking with industrial companies. The lesson learned was that the people who manage products are seldom able to dedicate enough focus on development. This case is consistent with studies showing that financial service companies with a formal process for product development were usually more successful (Cooper *et al*., 1994; Cooper and Edgett, 1996).

Hypothesis 6

The more formal the function of service product development,
the greater the adoption of concurrency as defined by the SPOTS framework, and
the higher the level of performance improvement in product development and service delivery

Concurrency vs. Process-Focused Managerial Interventions

The *product* focus of concurrency differentiates it from alternative interventions to improve service performance that are principally *process* focused. These include: (1) TQM (Total Quality Management), (2) ISO 9000 certification, and (3) BPR (Business Process Reengineering). Process approaches to performance improvement represent a viable alternative to product-focused strategies such as concurrency because service delivery is sometimes tantamount to the product itself. For example, a significant proportion of the value of a service product as perceived by the customer is likely to be affected by delivery processes when product generation and consumption are coterminous or extensive interpersonal exchanges are involved.

TQM provides a foundation for concurrency, which is one reason it requires evaluation as an alternative Concurrency differentiates itself from TQM by focusing on product per se and the improvement of a particular benchmark, cycle time the cost benefits associated with its reduction throughout the value chain and the opportunities of early to market. By contrast, TQM applications are broadly scattered. Its more general applicability may be one reason for its value to performance in services because they are highly diverse and involve considerable value beyond the design of the product itself. For such reasons, TQM has been increasing deployed in the service sector (McCabe, 1985; Garvin, 1988; Reichheld and Sasser, 1990; Graessel and Zeider, 1993; Yearout, 1996). Most recently, such major financial corporations as GE capital have adopted the 6 Sigma approach to quality improvement.

ISO 9000 has increasing found application in the service sector (Yearout, 1996). In some instances, its standards include product development processes. Because concurrency as defined by the SPOTS framework has a heavy emphasis on product development processes, there is potential overlap between the two initiatives.

BPR achieved considerable popularity during the 1990s (Hall and Wade, 1993; Davenport, 1995). Mapping processes in general sometimes included product development processes in particular. To this extent, BPR and concurrency have potential overlap. However, the adoption of BPR was has sometimes focused on operations and their automation by computer technology without including the people in the organization as part of the process. By contrast, the SPOTS framework is more broadly inclusive of strategic and organization practices as well as system integration.

Environmental Context

Environmental dynamism is a contingency presumed to stimulate the adoption of concurrent practices and/or alternative initiatives for improving performance (Atuahene-Gima and Ko, 2001;Tidd, 2001; Tidd *et al*, 2001). Many services businesses have been increasingly affected by so-called ‘hyper-competition’ (D'Aveni, 1994). Measures of environmental competitiveness and turbulence were found to be correlated with the adoption of concurrency as defined by the SPOTS framework in the USA data. These dynamics included increased technological complexity, faster rates of service product introduction, higher customization, globalization and demand for new and better services.

RESEARCH METHODS

Background

The feasibility of adapting industrial methods of concurrent engineering to service sector businesses was explored in the US using varied qualitative methods, informal and formal. Discussions were held for a year with a small group of executives from prominent service companies, e.g., American Express, Bell Atlantic, Chase Bank, etc. Two classes of MBA students were tasked with conducting 22 case studies that required adapting a 200-page industrial interview schedule into one that was appropriate for services. Many of the items had to be reconstructed at a more abstract, general level because of the intangibility and diversity of service products. Feedback on the initial attempts to make the principles of CE generic was obtained during two conferences/workshops on concurrency in services for 130 representatives from 75 companies in the New York during 1996-97. A parallel conference was held in London in 1997 for actual and prospective participants in the UK replication study. A user group of 10 service enterprises was formed in 1997 to apply principles of concurrency. Each company shared their product development processes with others in the group and ongoing experiences in implementing concurrency. Five of these companies were new to the research program resulting in a total of 27 cases studied from 18 corporations.[2] These case studies helped ground the formulation of hypotheses and the interpretation of statistical results.

Methods

US Sample. Participants in the survey were companies in the New York metropolitan area. Large companies were targeted because structural differentiation increases the need for integration provided by concurrent methods of product development. From a 1996 list of the

[2] American Insurance Group, American Express (3), Bankers Trust (2), Bell Atlantic (2), Bank of NY, Chase-Manhattan (4), Chubb Insurance, Citibank, GE Capital, Gemini Consulting, Jewish Charities, Mercedes-Benz, Merrill Lynch, Milliken (2), Morgan Stanley, New York Times (2), Paine Webber, and TIAA-CREF Insurance.

100 largest employers in Crain's New York Directory, 58 service companies were identified for mailing questionnaires to chief executives. Accounting/consulting, legal, manufacturing and universities were categories excluded from the list of 100. Smaller service businesses ranking in the top 25th percentile of their category, such as advertising, also received questionnaires to attempt to capture the diversity as well as size of enterprises within the region. Non-profits were included, but not pursued.

Approximately 120 questionnaires were mailed to potential key informants in service companies with whom contact had been made by phone or in person. The preferred respondent was someone in the service product development function. Alternatives included persons in business development, TQM (Total Quality Management), BPR (Business Process Reengineering), or Productivity Improvement. Members of professional societies, the American Society of Quality Control and the Association for Quality and Participation, were contacted for assistance in identifying appropriate respondents within target corporations.

Respondents from 70 businesses in 51 corporations returned questionnaires. These included 11 of the 12 largest publicly held corporations. Lines of business surveyed within a single corporation did not overlap, such as private banking and syndicated banking, which operate as separate companies for all practical purposes. All but 4 employed more than 500 people. The distribution of categories of the US service sector sample is attached as Appendix A-1. Approximately 34 percent were in financial services or insurance. The next largest category was health care. Most major categories in the service sector were represented except advertising. Some were not represented, such as broadcasting. With such exceptions, survey respondents appear to be reasonably representative of large service companies in the New York area and its diversity, especially in financial services.

UK sample. Respondents were drawn from a network of contacts of the School of

Management at Imperial College. Appropriate respondents were reached via constituents of Imperial College, both students and company representatives serving on various committees. A conference/workshop was held at Imperial College in 1997 to garner respondents among these constituents. Although the sample is one of convenience, the network of Imperial College includes links with the bulk of service companies in the greater London area. In total, 100 questionnaires were mailed, and after a reminder 38 usable questionnaires were returned.

The sample included 39 percent financial services or insurance. Most of the same kinds of business as in the USA were at least represented with the exception of construction and services rendered by divisions of industrial firms, such as financial credit groups. Although the size of the businesses represented is inexactly known, the average is lower than in the USA sample.

Measures

Framing the questions. The questionnaire focused on the development and delivery of service products. Respondents were asked to describe a typical service product to be used for the purposes of answering the questionnaire. An introduction to the questionnaire provided the following statements because the view of service as a product was not universally understood. Its purpose was to focus attention of the respondent on the development of a typical product with which they were familiar.

> Service products are something a customer pays for receiving even though it may be intangible (i.e., not a physical object. The service may be attached to a tangible product, e.g., warranty agreement, field repair, insurance, etc. However, a great many service products are intangible even though they may have a physical manifestation, e.g., bank check, an insurance policy, a charge card, etc. Often inter-personal experiences are critical to the delivery of service products, e.g., airline travel where the customer and employees are in relatively constant contact...

Factor analysis and scaling. Questionnaire items were factor analyzed (Varimax rotation) for the combined data. Scales based on these factors are shown in Appendix B. A factor loading is also shown for measures in both the US and UK sub-samples. All items within each of the SPOTS categories are summed. The Alpha coefficients are within acceptable ranges except for strategy in the UK data. A factor analysis of the scales within each of the SPOTS categories results in a single overall factor except in the instance of organization in the UK data. A unique analysis of the UK data is reported in a separate paper (Tidd and Hull, 2001).

Dependent Variable. Twelve questions were asked about product features, quality, time, cost, and service delivery. All 12 were significantly inter-correlated and are scaled in a single index of total performance improvement, Alpha= .90. The 12 items are also analyzed in three subscales corresponding to loadings in three factors in the combined data: product innovation & quality, time & cost in development and delivery, and service delivery. The three sub-scales load in a single factor.

Predictor Variables

Strategy is a matter of intent. Questions were asked on a range of options, from a focus on minor changes to existing service products, to a strategy of developing novel service products. An intermediate strategy, termed RRR (Rapid, Re-iterative, Redevelopment) was measured using two questions on intended focus during the past five years: making major changes to existing service products and making rapid changes to existing products. Their inter-correlation was .58 in the combined data, Alpha = .75.

Process is measured as the average of all 9 items from the page of the questionnaire dedicated to this topic, Alpha= .86. These items are unified by the themes of in-process design controls and continuous process improvement, e.g., benchmarking, Quality Function Deployment, process mapping, etc. The first set of 5 questions is specific to product development processes, e.g., setting performance criteria for development projects. The second set of 4 questions dealt with general process improvement initiatives, e.g., mapping processes to reduce non-value added activities. The product specific and general questions loaded in separate factors. As their inter-correlation was .62 in the combined data, all 9 items were averaged as a single scale. Deleting any item in the combined data or either sub-sample did not improve Alpha.

Organization was measured as the average of 12 items from a page of the questionnaire dedicated to this topic, Alpha=.87. The items are unified by the theme cross-functional integration. The first set of 8 questions dealt with the extent to which activities were organized as cross-functionally instead of within a hierarchy. The second set of 4 questions dealt with the extent of change in involving external organizations in the product development and delivery process, e.g., customers and suppliers. The first set of questions on cross-functional practices loaded in two factors, not one as in the US sub-sample. The three sub-scales load in a single factor that is more strongly correlated with the four performance measures than any one separately.

Tools/Technologies was measured as the sum of 9 items of the Information Technology page, Alpha=.72. These items were unified by the theme of the capabilities of computer information technology and its distribution internally and externally. The first 7 items dealt with the use of software for decision support and information management in general, as well as on project management in particular, e.g., common software. The last 2 items dealt with EDI (Electronic Data Interchange) with external customers and suppliers. The first set of questions loaded in two factors, not one as in the US sub-sample, and the external questions in its own factor. The first factor dealt with computer capabilities in general the second on their distribution. While this is a conceptually valid distinction, the strength of the correlations among these two factors was high and they are combined in a single scale and the Alpha was not increased by deleting any item in the combined data or either sub-sample. The three sub-scales load in a single factor that is more strongly correlated with the four performance measures than any one separately.

System Integration was measured as the sum of 9 statements contrasting concurrent vs. non-concurrent operations, Alpha=.87. These questions are unified by the theme of holistic thinking to balance and align competing interests along entire value chains over time. These statements were condensed from 13 graphs with accompanying text that were co-developed with participants in a CE user group to envision system maturity. The goal was to have a CE analog to the Carnegie Mellon system maturity model for software development. These questions were then correlated with performance outcomes in a follow-on survey of samples of employees in over 50 companies to validate their predictive capability (r=.51, Collins and Hull, 1999).

SPOTS index. All five SPOTS constructs are summarized in an index for comparing concurrency with other change initiatives. The five constructs load in the same factor in the combined, US, and UK data.

SPD (Service Product Development). A single item measures creation of a function for service product development, Do you have a job title for persons who are responsible for differentiating your service products from those of competitors? If yes, please specify. The most common job title specified was Vice-President or Director of Product Development.

Process focused Change Initiatives. Respondents were asked to rate the extent to which their company had adopted initiatives to improve the development and delivery of service products during the past 5 years. Options included: (1) TQM (Total Quality Management), (2) ISO 9000, and (3) BPR (Business Process Reengineering).

Environment change is measured by adding two standardized indexes on the same six items. One sums the extent to which changes in six items have resulted in greater competitiveness. The other counts the absolute change, regardless of direction, or turbulence.

<u>Three Studies</u>

Study I explores the extent to which the SPOTS framework transcends national boundaries by analyzing combined data from 70 USA with 38 UK service businesses. A dummy variable is used to assess the extent to which the USA and UK results are like and unlike.

Study II assesses the extent to which concurrent practices as defined by SPOTS are like and unlike in the two nations. Study II replicates the methods used in the combined analysis for the US and UK sub-samples for concurrency as defined by the SPOTS framework.

Study III analyzes the context within which concurrent methods of product development are deployed in the two nations. The product-focused concurrency strategy is compared with alternative process-focused interventions such as: TQM (Total Quality Management), ISO 9000 certification, and BPR (Business Process Reengineering). The impact of each of these interventions on performance is compared in the context of environmental changes, such as increased technical complexity, globalization, etc. However, conclusions from Study III are somewhat speculative because some of these contextual measures were added late to the questionnaires and are unavailable for total samples.

All three studies use a framework termed SPOTS (Strategy, Process, Organization, Tools, and System) to predict variation in performance improvements in service products development and delivery processes. Performance is analyzed as a total index and as three subscales: (1) innovation & quality, (2) time compression in development and cost reduction in development/delivery, signature indicators of CE effectiveness, and (3) service delivery. The first two factors roughly correspond to generic strategic alternatives, differentiation vs. cost (Porter, 1980). The third factor is conceptually important because it distinguishes service delivery process from product features. Delivery processes often comprise a significant proportion of value added by services, especially if interpersonal exchanges are involved (Gronroos, 1990; Reichheld and Sasser, 1990; Zeithaml *et al*., 1990; Lovelock, 1996; Storey and Easingwood, 1999).

Correlations and Descriptive Statistics

The performance sub-scales are significantly inter-correlated as shown in the first rows of Table 1 for relationships in the combined data. The inter-correlations among the performance indicators are stronger in US than UK sub-sample. Product innovation & quality has an insignificant negative correlation with time & cost in the UK sub-sample.

--Insert Table 1--

SPOTS constructs are significantly inter-correlated with one another in the combined data. SPOTS constructs are significantly inter-correlated with one another in the USA sub-sample. The correlation between process and organization is so strong in the combined and USA data that they are ether added together or entered separately in multiple regression analyses. In the UK sub-sample, these inter-correlations are all positive and statistically significant except for two, strategy with organization and tools/technology.

Each of the SPOTS constructs is significantly correlated with all performance indices in the combined sample. However, the correlation between tools/technology and service performance is weak. In the US sub-sample, SPOTS constructs are significantly correlated with all performance indices. In the UK sub-sample, the correlations of SPOTS constructs with performance are weaker, but statistically significant in all but two instances, tools/technology and system with time & cost.

The correlations of the dummy variable representing UK cases are consistently negative as shown in Table 1. A comparison of means show that these differences are significant for product innovation & quality, process, tools/technology, system and the SPOTS index. This result suggests that concurrent practices as measured by the SPOTS framework are less implemented in UK than the USA samples.

STUDY I: COMBINED ANALYSIS

Each of the SPOTS constructs explains statistically significant variance in one or more performance indicators in the combined sample. Approximately 30 percent of the variance is explained in time & cost and service delivery. . Over 40 percent of the variance is explained in total performance and innovation & quality. These results are generally supportive of the SPOTS framework as predictive of performance improvement in services.

Strategy. A strategy of RRR has at least weakly related to all four indicators of performance improvement in the combined data. However, the regression coefficient for service delivery was weak. Given that questions were only asked on strategies of product development and none explicitly on strategies of service delivery, this result is hardly surprising. This result supports Hypothesis 1, especially for product development.

--- Insert Table 2 Here ---

Process is combined with organization in an index to preclude problems of multicollinearity.[3] Process summed with organization, has a strong main effect on all performance indicators in the combined data as shown in the top row of Table 2. If process is entered without organization (not shown in Table), it explains significant variance in the overall performance index (.03), time & cost (.02), and service delivery (.03). With the exception of product innovation & quality, the results support Hypothesis 2.

Organization summed with process, as discussed above, has at least weak effects on 3 of 4 performance indicators in the combined data, innovation & quality being the exception. If organization is entered without process (not shown in Table), it explains significant variance in the overall performance index (.04), time & cost (.06), and service delivery (.03). With the exception of product innovation & quality, the results support Hypothesis 3.

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[3] The correlation of process and organization is .76 in the combined data, .82 in the US, and .59 in the UK. This high correlation in the US is probably due to covariance, not definitional dependence. Results of the US case studies show frequent co-variation in the revamping of processes and reorganization of product development groups.

Tools/Technology. In the combined data, Tools/technology has a significant effect on 3 of 4 performance indicators, service delivery being the exception. This result supports Hypothesis #4 although the coefficients are not as strong as for other constructs in the SPOTS framework.

System. In the combined sample, system has at least significantly weak relationships with all performance indicators. This result supports Hypothesis 5.

In summary, a strategy of RRR is particularly predictive of product innovation & quality and time & cost. Process and Organization are strongly predictive of time & cost and service delivery. Tools/technology has significant relationships with product innovation & quality and time & cost. System integration had significant effects on all performance indicators.

Nation as a category had no significant impact in any of the regression models shown in Table 2 despite several significant differences in means shown in Table 1. This suggests that differential implementation of practices measured by the constructs in the SPOTS framework explains significant differences in the two samples instead of unique cultural differences.

STUDY II: CONCURRENCY IN THE US AND UK

The regression coefficients for the USA and UK sub-samples are remarkably similar. However, the significance levels are somewhat lower in the UK data because of the small sample size. SPOTS explains less variance in the UK data except for service delivery. SPOTS constructs predict appreciable variance in the overall performance index in both nations, 45 percent in the USA and 38 in the UK. Of the sub-scales, the greatest variance is explained in innovation & quality, 51 percent and 38 percent respectively. Variance explained in time & cost is much greater in the USA data, 43 percent. In the UK data it is only 12 percent (but increases to 21 percent if organization is entered without process, not shown in Tables). Variance explained in service delivery is relatively low in the USA and UK data, 22 percent in both. In general, the SPOTS framework appears to predict performance improvement somewhat better in the USA than UK data except for service delivery.

Strategy is the only one of the SPOTS constructs with consistently stronger relationships in the UK than USA data. Moreover, strategy is correlated with service delivery in the UK but not the USA data. Interestingly, strategy is the only one of the SPOTS constructs that is not significantly lower in the UK than the USA.

Process summed with organization has similar relationships with performance in both sub-samples. If process is entered without organization in the USA data, it adds significant amounts of variance explained to the overall performance index (.03*) and service delivery (.02t). If process is entered without organization in the UK data, it adds significant amounts of variance explained to the overall performance index (.07*) and service delivery (.07*). The pattern of relationships for process is similar in the two nations, but possibly stronger in the UK than USA data.

Organization entered without process in the USA data adds significant amounts of variance explained to the overall performance index (.04*), time & cost (.03*), and service delivery (.05*). If organization is entered without process in the UK data, it adds significant amounts of variance explained to the overall performance index (.03t*), and time & cost (.12*). Organization is relatively more important than process in the USA data for predicting time & cost. It is more important in the UK data for predicting service delivery.

Tools/Technology has weak or insignificant effects in both nations. In the USA data, the strongest relationship is with product innovation & quality. In the UK data, the strongest relationship is with time & cost (mostly the former). However, this relationship in regression analysis may be spurious because its zero order correlation is not statistically significant. Its positive effect in regression analysis is partly due to the negative effect of tools/technology with which it is correlated (.64).

System has significantly positive effects in the US data with all performance indicators. In the UK data, the only strongly positive relationship of system integration is with product innovation & quality. By contrast, the relationship of system with time & cost is weakly negative.

STUDY III: CONTEXT OF CONCURRENCY

Study III examines additional variables to better understand the context within which concurrent methods of product development are deployed in the two nations. Statistically significant correlations are show by arrows in Figure 2 to relate environmental change, concurrency as defined by SPOTS, process-focused alternative, and performance. The top illustrates relationships in the USA data. The bottom is a mirror image in italics illustrating relationships in the UK data.

--See Figure 2---

Environmental change is not significantly different in the two nations and in both it is significantly correlated with concurrency as measured by the SPOTS index in both samples. However, the relationship is somewhat stronger in the USA than the UK, .35 vs. .29.

SPD (Service Product Development) as a function sharply differs in the two nations. Only in the USA did service companies apparently respond to environmental change by adopting concurrency as defined by SPOTS. Although a measure of SPD as a formal job was added late to both surveys, the contrast between the nations appears stark. 44 percent of companies in the USA sub-sample of 27 have a job title for product development. Only 7 percent, one service company in the UK sub-sample of 15 has such a title. Even though the number of available cases is small, the correlation of the service product development function in the USA data with both environmental change and an index of SPOTS is strong, .50 and .52 respectively. Moreover, the SPD function is significantly correlated with each of the SPOTS constructs and with every performance indicator as shown in Table 1. These results provide support for hypothesis #6 for the USA data.

Process-focused alternatives. The correlation between environmental change and process-focused initiatives is insignificant in the UDA data. By contrast, environmental change is strongly correlated with BPR in the UK data and more strongly so than for the SPOTS index, .52 vs. .29 respectively. Response to environmental change appears to be relatively more process-focused than product-focused in the UK in comparison with the USA data.

Performance. The impact of concurrency as measured by SPOTS relative to alternative process-focused initiatives was compared in multiple regression analysis. Results of these comparisons should be considered heuristically because SPOTS is an aggregated index of many practices while only a single item measures each of the alternative process initiatives. SPOTS has main effects in every equation for all samples when entered simultaneously with each process alternatives and controlling for environmental change. The only process-focused alternative to consistently explain additional variance was TQM for service delivery performance in all three samples as shown in Table 3. A weak positive relationship between ISO 9000 and service delivery was also observed in the UK data (P=.08, not show in Table 3). TQM also adds variance explained in the total performance index, which has five service delivery components, for the combined and USA samples.

--See Table 3—

TQM, and to a lesser extent ISO 9000, complement concurrency as measured by SPOTS in improving service delivery. The gap concurrency has in explaining service delivery performance suggests its limitations because of its product focus.

SUMMARY

The SPOTS framework, derived from Concurrent Engineering in industrial firms, appears to have applicability in the service sector in both nations. The SPOTS framework is a relatively robust, yet parsimonious framework for explaining why some service sector companies develop product features faster, cheaper, and better than others. The paradigm of concurrency in product development appears to have been more or less adopted in product development practice even though seldom is this specific term used.

The promise of concurrency is that it achieves multiple kinds of performance advantage simultaneously. SPOTS predicts multiple kinds of product advantages (innovations, quality, time compression and cost) in the USA data and to a lesser extent in the UK data. But SPOTS explains much less variance for service delivery in both nations, which suggests an important limitation.

Despite parallels, the UK data differ from the USA in several ways. These contrasts are summarized below:

1. All five of the SPOTS constructs load in a single factor in both samples. However, the positive correlation of the strategy with organization and tools is statistically insignificant in the UK data.
2. The strategy of RRR has a somewhat low Alpha coefficient (.59) for its two items in the UK: making major and rapid changes to existing products. This suggests that this combined focus is less common in the UK.[4]
3. In the UK, concurrent practices were deployed in a greater variety of patterns than in the USA as suggested by the larger number of factors, especially organization.
4. The inter-correlation between process and organization is lower in the UK data
5. The effects of process are generally similar in both regions, but the effects of organization are somewhat weaker in the UK data.
6. Tools/technology relationships with performance are weaker in the UK
7. System relationships are similar in both regions except for Time & cost in the UK data.
8. Inter-correlations among performance measures are weaker in the UK and load in 4 instead of 2 factors as in the USA, e.g., insignificantly negative correlation between product innovation & quality and time & cost.
9. Responses to environmental change in the UK are relatively more process than product focused.
10. Scores for SPOTS constructs are significantly lower in aggregate and for all components except strategy.
11. SPOTS explains less variance in performance indictors in the UK except for service delivery which is the same (Table 2) or greater (Table 3).
12. Concurrency as defined by SPOTS delivers less of its promise in the UK data to simultaneously achieve both kinds of generic performance advantages, innovation and cost

DISCUSSION AND CONCLUSION

Given that environmental dynamism in the two nations does not differ statistically, one may speculate on reasons for different responses. One possibility is that USA service companies are more focused on time compression, a kind of national obsession. This option is consistent with the weak relationships of time compression with other variables in the UK data. A related possibility is that UK service firms lagged in their initial adoption of concurrency, but are catching up. This option is consistent with the fact that environmental dynamism was significantly correlated with the adoption of a strategy of RRR in the UK and that this the only one of the SPOTS construct that was not significantly below the USA average. Adopting a concurrent focus might be a harbinger of more systemic changes in ways of doing business, as strategy is easier to change than structure.

An alternative line of speculation is that UK service companies pursue niche strategies and have adopted multiple kinds of systems to compete effectively in them (Tidd, 1993). Consistent with this line of reasoning is the many more factors for performance and practice observed in the UK data. For this reason, a follow-on analysis is reported in a separate paper that build-up the analysis from a uniquely UK perspective without forcing the concurrency paradigm as defined by SPOTS onto the data (Tidd and Hull, 2001).

Limitations of the study include difficulty in matching the two national samples in terms of type of service and size of establishment. Although the nature of the service rendered was not found to affect results in the USA data, the possibility remains that differences in business type between the two nations is a factor. As size is a strong predictor of structuring, difference might partly account for lesser coalescence of formal product development practices in the UK data. A single respondent reported answers about each enterprise. Respondents in the two nations could have interpreted the same questions differently. Measures of process alternatives were based on single items in comparison with the SPOTS index. Some measures were available for only portions of the samples.

Research opportunities including adding to product development paradigms measures that better predict delivery processes in services. A subset of Concurrent Engineering practices includes DFX (Design for Anything), which could include service delivery. Admittedly this may prove difficult because human variability affect many delivery processes. But the high value customers place on delivery process in many service contexts suggest an important opportunity for adding value both to theoretical understanding and practical applications.

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TABLE 1
CORRELATION COEFFICIENTS AND DESCRIPTIVE STATISTICS
Top= Combined Sample (N=108) ♦ Middle=US (N=70) ♦ *Bottom= UK (N=38)*

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
1. Performance Overall	**1.0**													
	1.0													
	1.0													
2. Innovation & Quality	**.71****	**1.0**												
	.81**	1.0												
	*.54***	*1.0*												
3. Time & Cost	**.77****	**.43****	**1.0**											
	.82**	.73**	1.0											
	*.61***	*-.13*	*1.0*											
4. Service Delivery	**.90****	**.49****	**.52****	**1.0**										
	.91**	.56**	.58**	1.0										
	*.87***	*.36**	*.36**	*1.0*										
5. Strategy of RRR	**.53****	**.53****	**.49****	**.39****	**1.0**									
	.53**	.60**	.56**	.38**	1.0									
	*.54***	*.40***	*.34**	*.39***	*1.0*									
6. Process	**.58****	**.51****	**.49****	**.48****	**.57****	**1.0**								
	.56**	.56**	.55**	.45**	.60**	1.0								
	*.64***	*.41***	*.36**	*.53***	*.50***	*1.0*								
7. Organization	**.62****	**.53****	**.58****	**.50****	**.54****	**.76****	**1.0**							
	.65**	.56**	.64**	.55**	.65**	.82**	1.0							
	*.52***	*.46***	*.43***	*.35**	*.25t*	*.59***	*1.0*							
8. Tools	**.41****	**.45****	**.38****	**.29****	**.30****	**.41****	**.39****	**1.0**						
	.37**	.45**	.42**	.26*	.34**	.38**	.34**	1.0						
	*.47***	*.40***												