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Evolution in the strategic manufacturing planning process of organizations

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Abstract

This study examines how strategic manufacturing planning processes vary systematically with respect to planning characteristics, and how the planning process appears to evolve over time. Through an empirical evaluation of over 200 U.S. manufacturers, we document the existence of four strategic manufacturing planning groups. These groups vary with respect to the degrees of "rationality" and "adaptability" of planning. In addition, the strategic manufacturing planning history and level of planning maturity differs between these groups, providing evidence that the planning process changes and evolves over time from "non-rational adaptive" mode towards a more "rational adaptive" approach. Firms between these polar extremes appear to take different paths in their movement toward a "rational adaptive" mode, with some "focusing on rationality" first and others "focusing on adaptability" first. We also show that irrespective of the firm's environment, a greater degree of "rational adaptivity" is correlated with better planning outcomes and business performance. As such, it represents a "best practice" approach to strategic manufacturing planning. Insights created by this work not only make an important contribution to the manufacturing strategy literature, but can also be used by senior manufacturing managers to facilitate their progress towards more effective planning.

Keywords: Manufacturing strategy; Strategic planning; Empirical research

1. Introduction

Attention given to the manufacturing strategy by both academics and practitioners has been increasing since the time of Skinner's (1969) seminal work in this area. Although obviously intertwined, work in the area has generally been categorized as addressing the content, or "what", of the manufacturing strategy rather than the process, or "how" the decisions are made. The vast majority of published work has focused on the content. Dangayach and Deshmukh (2001), in their extensive review of the manufacturing strategy literature, found that 91% (237 out of 260) of the published studies in the area addressed content issues and only 9% (23 out of 260) addressed process issues. But as Dean and Sharfman (1993) observed with respect to organization-level planning, the "how", or strategic planning process, affects the "what", or the resulting strategy. Thus there have been numerous calls for more work focusing on understanding the strategic planning process within the manufacturing

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area, and we address this need in the study described here.

An important part of the planning process is in understanding how the ‘‘objectives, policies, and plans are formulated’’ (Garvin, 1993). How each firm conducts its strategic manufacturing planning (SMP) is captured, in part, by the ‘‘strategic planning system’’, which is the pattern of planning characteristics that organizes and coordinates the activities of those involved in the planning process (Lorange and Vancil, 1977; Lederer and Sethi, 1996). Even though the content and implementation of the strategy are important, the planning system itself does contribute to its success or failure. For instance,

> ‘‘Managers have the power to influence the success of strategic decisions, and thus the fortunes of their organizations, through the processes they use to make key decisions.’’ (Dean and Sharfman, 1993, p. 399).

This paper conducts an empirical evaluation of how SMP processes and system evolve over time, and thereby seeks to contribute to the development of ‘‘a body of literature on the manufacturing planning process’’ (Adam and Swamidass, 1989, p. 183). In addition, research reported in this paper should assist firms in better understanding and improving the performance of their SMP system and eventually the bottom-line profitability of their firms.

In the next section, the relevant literature is reviewed and propositions are developed. Section 3 describes methodology-related issues pertaining to data collection, operational measures, and pre-testing and validation of the instrument. The results are presented in Section 4, and discussed in Section 5 along with the contributions and limitations of this research. The final section offers concluding remarks.

2. Theory and proposition development

2.1. Manufacturing strategic planning

Research in the manufacturing strategy process area, which has largely been exploratory, has focused on both formulation and implementation (Dangayach and Deshmukh, 2001; Leong et al., 1990). The work focusing on formulation has tended to address two major areas: design and planning. Within the design area, research has been conducted both at a macro-level (Kim and Arnold, 1996), addressing agreement between the manufacturing strategy and the business or marketing strategies (i.e., Fine and Hax, 1985; Garvin, 1993; Hill, 1996; Jouffroy and Tarondeau, 1992; Menda and Dilts, 1997), and at a more detailed level (Kim and Arnold, 1996), focusing on what improvement programs should be pursued in support of certain competitive priorities. With respect to planning, a major stream of research includes case studies about the planning processes used by businesses to develop their manufacturing strategies (Blenkinsop and Duberley, 1992; Marucheck et al., 1990; Persson, 1991; Schroeder and Lahr, 1992; Voss, 1992). Finally, several tools have been reported to aid in the development of the manufacturing strategy (Crowe and Cheng, 1996; Platts and Gregory, 1990).

Less research has addressed specific characteristics of the SMP system. Marucheck et al. (1990) examined strategy formulation and implementation processes in six firms and observed several characteristics of the process. They observed that SMP tended to be top-down, done on a regular basis, and formal with respect to procedures and documentation. Anderson et al. (1991) also examined several process variables associated within strategic planning. Working with a larger sample of firms, they observed that manufacturing strategic planning was documented and was linked to the budgeting process. Mills et al. (1995) incorporated five different planning modes found in the strategic management literature (entrepreneurial, planning, ideological, adaptive and grass roots), that vary with respect to the degree of rationality and degree of emergence, in building a framework for designing the manufacturing strategy. Swamidass et al. (2001) examined planning with respect to whether it was top-down or an alternative to that approach. They proposed that alternatives exist to the traditional top-down approach including an emergent approach, adoption of improvement programs as a result of more bottom-up efforts, and one focusing on developing core competencies. Building on this research along with that found in the strategic management literature, Papke-Shields et al. (2002) examined in detail the planning characteristics of the manufacturing strategy formulation process. Finally, Lee (2002), in examining differences between the manufacturing strategy content and process in Japanese and Korean firms addressed several planning characteristics reflecting rational versus emergent approaches including flow and formality.

Several characteristics of planning approaches commonly discussed in the strategic management literature were identified in these studies. These include flow, formality, degree of documentation of the manufacturing strategy, an aspect of formality, frequency or intensity (identified by Lee, 2002; Marucheck et al., 1990; Mills et al., 1995; Swamidass et al., 2001)

Table 1
Planning characteristics

Construct	Domain	Prior conceptualizations
Rational characteristics		
Flow	Locus of authority for strategic planning	Dutton and Duncan (1987), Lorange (1980)
Formality	Extent to which the planning process is structured, through written procedures, schedules and other documents, and the extent of documentation resulting from the planning process	Anderson et al. (1991), Armstrong (1982), Camillus (1975), Das et al. (1991), Dutton and Duncan (1987), Grinyer et al. (1986), Kukalis (1991), Marucheck et al. (1990)
Comprehensiveness	Extent to which all possible strategic alternatives are identified and considered	Frederickson and Michell (1984)
Focus	Extent to which control or efficiency, usually seen as a tight link with budgets, rather than creativity is emphasized	Chakravarthy (1987), Lorange (1980)
Horizon	Length of time considered in strategic planning	Steiner (1979), Kukalis (1991)
Adaptive characteristics		
Intensity	Magnitude of resources committed to planning as evidenced by frequency and richness of meetings	Dutton and Duncan (1987)
Participation	Variety of individuals involved in strategic planning	Dutton and Duncan (1987), Dyson and Foster (1982), Hart (1992)

and the link of manufacturing strategy development to the budgeting process, referred to as the focus of the process (identified by Anderson et al., 1991). Other planning characteristics include comprehensiveness (Frederickson and Michell, 1984), degree of participation (Dutton and Duncan, 1987; Dyson and Foster, 1982; Hart, 1992), and the length of the planning horizon (Steiner, 1979; Kukalis, 1991). Table 1 shows the definitions and prior conceptualizations of these planning characteristics.

These planning characteristics reflect two schools of thought that have a long-standing recognition in the strategic management literature and have been considered polar extremes: "planning" or "rational" (synoptic formal) and "learning" or "emergent" (logical incrementalism) (Camillus, 1982; Fletcher and Harris, 2002; Frederickson and Michell, 1984; Quinn, 1983). A synoptic formal planning approach achieves rationality in the planning process through a more structured, controlled planning process that flows from the top, is comprehensive, is tightly linked to the budgeting process (control focus) and takes a long-term view (Das et al., 1991; Dutton and Duncan, 1987; Fletcher and Harris, 2002; Frederickson, 1984; Marucheck et al., 1990; Anderson et al., 1991). Those in the "learning" school assert that planning cannot be deliberately controlled, and should facilitate adaptation of the strategic plan through frequent interaction among a wide range of participants (Das et al., 1991; Dyson and Foster, 1982; Eisenhardt, 1989; Fletcher and Harris, 2002).

This distinction between a "rational" approach and an "adaptable" approach is seen with respect to the manufacturing strategy process. Several authors (e.g., Swink and Way, 1995; Dangayach and Deshmukh, 2001) have noted that the work addressing SMP has predominantly reflected a "mechanical" or rational approach (e.g. Hayes and Wheelwright, 1984; Fine and Hax, 1985; Skinner, 1969). However, consideration for a more adaptive approach has been suggested, given the need for businesses to address "dynamism of the future" (Miller and Hayslip, 1989). Following the lead of researchers in the strategic management and information systems fields (Fletcher and Harris, 2002; Glaister and Falshaw, 1999; Lederer and Sethi, 1996; Mintzberg, 1990a; Mintzberg, 1990b; Segars et al., 1998; Taylor, 1997), Papke-Shields et al. (2002) observed that these two aspects are not polar extremes. Instead, rational characteristics associated with the "planning" school and adaptive characteristics associated with the "learning" school appear to work together to yield a planning approach that is controlled in structure, yet adaptive through participation and intensity. Indeed, Segars et al. (1998) termed this as a "rational adaptive" approach and found that such an approach leads to greater planning effectiveness, which was also subsequently evidenced and confirmed in the manufacturing domain by Papke-Shields et al. (2002).

Although this is meaningful progress, several questions still remain. Are there systematic groupings or profiles of SMP approaches based on the rational and adaptive aspects in manufacturing firms? Also, knowing that the "rational adaptive" approach is the most effective, do these groupings reflect varying degrees of "rational" and "adaptive" approaches? Finally, given prior findings in strategic management about the effectiveness of different strategic planning approaches in differing environments, is the "rational adaptive" approach the most effective SMP approach regardless of the environment? While previous research indicates that rational–adaptive planning is desirable, it gives us very little insight into how firms get to that state. By bringing the analysis to the group level and observing how groups evolve, this study aims to provide more prescriptive insight into managerial interventions that can achieve desirable planning outcomes.

2.2. Existence of groups

Beginning with Mintzberg's identification of different strategic approaches (e.g., Mintzberg, 1978; Mintzberg and Waters, 1985), researchers have examined strategic planning processes in an attempt to identify different groupings or profiles. Pyburn (1983) identified three SISP profiles reflecting varying degrees of "rationality" and "adaptability". Later, Earl (1993) and then Grover and Segars (2005) each identified five SISP profiles representing varying levels of rationality and adaptability. Profiles similar to these have also been articulated in the manufacturing strategy literature. Hayes and Wheelwright (1984) identified four profiles of the development of manufacturing's strategic role, which reflect different aspects of rational and adaptive planning. More recently, Mills et al. (1995) discussed characteristics of five planning profiles from Mintzberg's work with respect to a framework to understand manufacturing strategy content and process. Based on such prior work, it is our contention that firms will exhibit combinations of rational and adaptive characteristics in a systematic (rather than random) manner. In other words, there will be stable combinations of rational and adaptive characteristics that can be used to explicitly identify specific SMP groups. This is critical for organizations as they seek to benchmark their planning systems and identify elements of effective SMP. It also forms the basis for our first proposition:

Proposition 1. *The strategic manufacturing planning characteristics in firms vary systematically and lead to the existence of different groups that reflect varying degrees of "rational adaptive" planning.*

2.3. Planning effectiveness

Although the effectiveness of strategic planning can be assessed in a variety of ways, few studies have addressed it in the manufacturing strategy literature, and they have done so in a relatively exploratory way. For example, Anderson et al. (1991) use the manufacturing manager's degree of satisfaction in assessing the success of the process. Again following the lead of researchers in the strategic management and information systems fields (King, 1983; Premkumar and King, 1991; Ramanujam and Venkatraman, 1987), Papke-Shields et al. (2002) examined the performance of SMP systems using multiple dimensions of a direct outcome of the planning process (see Table 2 for definitions and prior conceptualizations). These outcomes reflect desirable characteristics of the manufacturing strategy itself as well as other intangible benefits of engaging in SMP such as providing "a discipline forcing managers to look ahead periodically", requiring "rigorous communications about goals, strategic issues and resource allocations" and stimulating "longer term analyses than would otherwise be made" (Mills et al., 1995; Quinn, 1983). Using these direct outcomes, Papke-Shields et al. (2002) observed that a more "rational adaptive" approach led to greater planning effectiveness, and we would expect that SMP groups with varying degree of "rational adaptiveness" would reflect similar trends.

Proposition 2a. *The strategic manufacturing planning groups with a greater degree of "rational adaptive" planning would be associated with greater planning system success.*

Another measure of planning effectiveness could be enhanced organizational performance. Much of the prior research examining strategic planning at the organiza-

Table 2
Dimensions of planning system success

Construct	Domain	Prior conceptualizations
Strategy alignment	Congruence between the business and manufacturing strategy	Hayes and Wheelwright (1984), Hill (1996), Schroeder et al. (1986), Vickery et al. (1993), Segars et al. (1998)
Objective fulfillment	Degree of attainment of commonly accepted targets	Cameron and Whetten (1983), Raghunathan and Raghunathan (1994), Ramanujam and Venkatraman (1987)
Capability improvement	Degree of improvement in the capabilities of the planning systems	Cameron and Whetten (1983), Raghunathan and Raghunathan (1994), Ramanujam and Venkatraman (1987)

tional level has assessed the benefits of the planning system through business financial performance (e.g. Frederickson, 1984; Frederickson and Michell, 1984; Wood and Laforge, 1981). Although financial performance is downstream from functional strategic planning and may be affected by a myriad of other factors (King, 1983; Segars and Grover, 1998), it is expected to be affected by the success of the SMP process, the content of the resulting strategy, and how well the strategy is implemented. Since manufacturing strategy development processes may be tied to the strategic role of manufacturing in the firm (Swamidass et al., 2001), the impact of the planning process on business performance will also be further influenced by whether manufacturing's role in the organization is significant enough to influence overall business success. While these intervening factors of implementation and importance of manufacturing within the firm may differ from one organization to another, we would expect in general that more successful planning approaches would lead to enhanced business performance.

Proposition 2b. *Greater planning system success, associated with strategic manufacturing planning groups with a greater degree of ''rational adaptive'' planning, would be associated with greater business performance.*

2.4. Effect of environment

A common belief encountered in the strategic management literature is that the success of different planning approaches is contingent upon the environment in which they are used. For example, Frederickson (1984) observed that comprehensive decision-making was appropriate in stable environments but not in unstable environments. However, Eisenhardt (1989) observed that effective decision-making in ''high velocity'' environments did not lack structure and comprehensiveness, but that these planning characteristics were carried out in a different manner than that used in a more stable environment. This notion of combining aspects of rationality and adaptability is also seen in O'Reilly and Tushman's (2004) ''exploitative'' versus ''exploratory'' businesses, where ''ambidextrous organizations'' combine structured aspects to gain efficiency with more adaptable aspects to enhance responsiveness. As discussed previously, prior research has provided support for the effectiveness of a ''rational adaptive'' planning approach in a variety of environments, including ''high-velocity'' environments (Bourgeois and Eisenhardt, 1988; Glaister and Falshaw, 1999; Lederer and Sethi, 1996; Segars et al., 1998). Thus, although the more traditional belief is that the success of different approaches will vary across environments, there is support for a ''rational adaptive'' approach being more successful regardless of environment.

With respect to manufacturing strategy, the notion of a single best approach is found in the work on world-class manufacturing (WCM), which was first introduced by Hayes and Wheelwright (1984) and subsequently followed by other authors such as Flynn et al. (1999). Indeed, several characteristics associated with WCM relate to the SMP system including formal thrust of strategic planning, communication of strategy to all stakeholders, and long-range orientation (Dangayach and Deshmukh, 2001). Based on these prior findings, it is our contention that a ''rational adaptive'' SMP approach would be associated with enhanced performance across different environments.

Proposition 3. *The relationship between planning approach and performance will not vary, irrespective of the environment in which the manufacturing function operates.*

2.5. Changes in strategic manufacturing planning

Eisenhardt and Martin (2000), in studying dynamic capabilities (of which strategic planning is one) concluded that the existence of common features, or ''best practices'', has several implications for our current understanding of dynamic capabilities. One of these implications is equifinality companies may begin at different starting points and travel different paths in their development of a dynamic capability, but they will all eventually move towards the ''best practice''. With respect to SMP, this suggests that although firms may start at different places and take different paths, they will all eventually move to a more ''rational adaptive'' planning approach (see Fig. 1 for a schematic illustration). Such movement reflects organizational learning that is linked with knowledge acquisition. It requires changes in the way that work gets done, and represents a process that unfolds over time (Garvin, 1994).

An example of such an organizational learning in a manufacturing context is reflected in Hayes and Wheelwright's (1984) discussion of the four stages in the development of manufacturing's strategic role, where movement between stages involves ''progress along a broad range of fronts'' and is ''evolutionary''. Combining the ideas of a learning organization (Garvin, 1994) and movement toward best practices, along with our expectations about the existence of SMP groups, we expect the characteristics of the SMP process to evolve

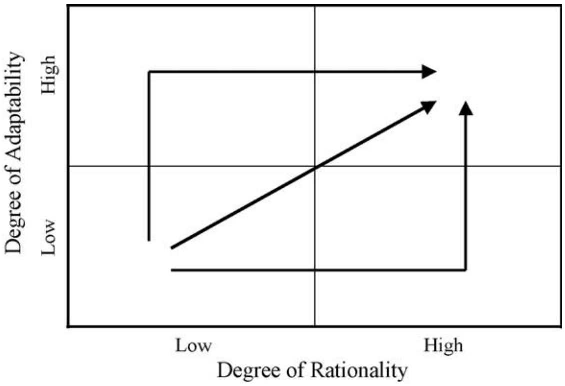

Fig. 1. Equifinality in strategic manufacturing planning approach changes.

with greater planning experience towards those of a more ''rational adaptive'' approach.

Proposition 4. *The systematic variation in strategic manufacturing planning approach is associated with varying levels of planning experience, with greater planning experience associated with a more ''rational adaptive'' approach.*

3. Methodology

3.1. Operational measures

Existing multi-item scales that have exhibited strong measurement properties in research addressing strategic manufacturing planning were used for all constructs associated with planning system characteristics, planning effectiveness, and business performance (Papke-Shields and Malhotra, 2001; Papke-Shields et al., 2002). A measure for environmental dynamism was developed based on prior research (the final survey instrument is included in Appendix A). Although the environment has been incorporated as a factor in strategic management research for some time, it has been largely ignored in research focusing on manufacturing strategy (Amoako-Gyampah and Boye, 2001; Ward et al., 1995). However, ''environmental uncertainty'' has been included in several studies including work by Swamidass and Newell (1987), Ward et al. (1995) and, more recently by Amoako-Gyampah and Boye (2001). As measured in these studies, the environment was captured as ''environmental dynamism'', which focused primarily on the rate of change and predictability of products demanded by customers. This seems appropriate given the importance of these factors to the content of the manufacturing strategy. Thus, building on work by Ward et al. (1995) and Amoako-Gyampah and Boye (2001), product dynamism was adapted from prior research and used to capture the environment within which manufacturing organizations operate.

Planning experience was assessed using two separate measures: the planning stage and the length of time the firm has been doing SMP. The planning stage was measured using a nominal variable adopted from research examining strategic information systems planning (Grover and Segars, 2005). This measure captures the firm's experience with SMP by capturing the experience of participating managers and the extent to which the planning approach is well defined. As is commonly found in studies of stages of growth (King and Teo, 1997), three stages were operationalized: a *preliminary stage* reflecting a planning process that is just beginning to be defined and has limited organizational and participant experience; an *evolving stage* where some organizational and participant experience exists, and planning is becoming more established yet is still being refined; and a *mature stage* where the planning process has become well defined through extensive organizational and participant experience.

In addition, an objective measure was used to assess how long the firms had been involved in SMP. Firms that have been conducting planning for longer are generally expected to have more mature planning. Although firms progress through the stages at different rates, whereby some firms quickly adjust their SMP approach while others may remain at a particular stage for long periods of time or even regress, the expectation is that greater experience will generally be associated with a longer planning history.

The survey instrument containing all the above-mentioned scales and performance measures was pre-tested with 16 vice presidents of manufacturing. All of the executives indicated that their firms conducted SMP and that they were actively involved in the process. In each case, the executive was interviewed in person after having completed the survey. Issues pertaining to the appropriateness of the dimensions of the planning system and their constituent items were discussed. Based on the feedback received from the first few executives interviewed, some items underwent refinement, but essentially no further changes were needed by the mid-point of this process. The preliminary assessment of the measures indicated a high degree of content validity and internal consistency.

3.2. Data collection

Data for this study is from a survey of manufacturing firms in the U.S. Sampling was done at the strategic business unit (SBU) level (division, subsidiary, or single product line) to address the level at which strategic planning in manufacturing is expected to occur. The targeted respondent is the highest-ranking manufacturing executive, which is often the vice president of manufacturing. Sampling was limited to medium to large manufacturing firms or SBU's (sales of $50 million or more) given prior findings that strategic planning differs between large and small firms (Lorange and Vancil, 1977; Marucheck et al., 1990). The sample of 681 firms was drawn from the *Harris Manufacturing Directory*, which has also been used in prior manufacturing strategy research (e.g. Safizadeh et al., 1996; Ward et al., 1994) and provided necessary information at the SBU level. Only organizations that listed a high-ranking manufacturing executive were included in an attempt to ensure that firms in the sample frame had at least some form of SMP.

From the surveys sent to the final sample, eight were returned as undeliverable and nine were dropped due to insufficient data. The final sample consisted of 202 business units, which represents a response rate of 30%. The respondent was one or two levels below the head of the firm in the vast majority of the cases, indicating that the vice president of manufacturing or equivalent was generally reached. The respondents represented a wide variety of manufacturing firms based on industry (SIC group), sales, product characteristics and process type (Table 3). No size (sales) or industry (SIC group) effects were observed in tests to evaluate differences in important variables (cluster membership via contingency table, planning variables and performance measures via ANOVAs) based on these characteristics. Finally, a check for non-response bias indicated that the respondents did not differ significantly from non-respondents with respect to SIC representation, sales, or number of employees.

To assess inter-rater agreement, respondents at approximately one-fourth of the firms were contacted and asked to provide the name of an individual considered equally knowledgeable about the planning process. A survey was then sent to that individual at 48 firms. Second responses were obtained from 45 firms, with the second respondents being executives of almost equal rank to the first (within 1 level) and having titles ranging from Manufacturing Manager to Vice President of Finance. Using these responses, a measure of inter-rater agreement (r_{WG}) was calculated for each variable (James et al., 1984, 1993). Although this measure has the disadvantage of no clear "standard", it has been used previously in empirical research such as this one. In all cases, consistency between respondents was present (r_{WG} values are indicated for each measure in Appendix A).

Table 3
Profile of survey respondents

	Characteristic	Frequency	Percentage
Sales (in $million)	50–100	45	22.9
	101–250	75	38.1
	251–500	26	13.2
	501–1000	30	15.2
	>1000	21	10.6
Number of employees	100–500	81	41.1
	501–1000	76	38.6
	1001–2000	28	14.2
	2001–3000	7	3.5
	>3000	5	2.5
Products[a]	Customized	41	19.8
	Standard, modified options	65	31.4
	Standard with modifications	43	20.8
	Standard, standard options	41	19.8
	Standard, no options	17	8.2
Processes[a]	Small batch	41	20.0
	Moderately large batch	31	15.1
	Batch	53	25.9
	Large batch	80	39.0

[a] From Safizadeh et al. (1996).

3.3. Measures validation and refinement

The measurement properties of the majority of scales (all planning characteristics, planning effectiveness and business performance) have been reported previously in the literature (Papke-Shields and Malhotra, 2001; Papke-Shields et al., 2002), although not all at the same time. To be consistent with this prior work, three measurement models were used. The first measurement model was for the theoretical network of planning characteristics constructs (formality, comprehensiveness, focus, horizon, flow, participation and intensity), the second measurement model was for the theoretical network of performance constructs (objective fulfillment, strategy alignment, capability improvement and business performance), and the final measurement model was for the product dynamism construct by itself. In all cases where changes were indicated, deletions were done only if they were theoretically justified (Anderson and Gerbing, 1988), and items were deleted one at a time and then the fit of the revised model assessed before further action.

The fit indices for the two theoretical networks of planning characteristics and performance constructs suggest that improvements could be made. As reported previously (Papke-Shields et al., 2002), four planning system characteristic items (C1, CR1, FL1 and P3) were dropped given evidence of cross loading, and dropping the items did not significantly affect content validity. Three items intended to measure strategy alignment (AL5–AL7) were also dropped since they were not appropriate in capturing the degree of alignment between business and manufacturing strategy (see Papke-Shields and Malhotra, 2001; Papke-Shields et al., 2002 for more details). The respecified measurement models indicated acceptable fit (planning system characteristics: normed $\chi^2 = 1.58$, CFI = 0.92, SRMR = 0.06; performance: normed $\chi^2 = 2.06$, CFI = 0.92, SRMR = 0.09; product dynamism: normed $\chi^2 = 2.25$, CFI = 0.95, SRMR = 0.12) given the sample size of 202 responses (Hu and Bentler, 1995; Hu and Bentler, 1999; Segars and Grover, 1993) (see Appendix A). Even though the product dynamism measure was newly developed as part of this research (unlike other constructs that were adapted from prior work), it showed acceptable measurement properties.

In prior research using the three measures of planning effectiveness, the correlation between them was extremely high (Papke-Shields et al., 2002). A similar result was previously observed with such measures in information systems research, where the covariation of the measures was best captured as a second-order factor (Segars et al., 1998). A second-order factor model for planning effectiveness was thus found to be appropriate (see Fig. A1 in Appendix A) in this study. Since there was no reason to expect different results depending on which dimension of planning system success was being assessed, these measures were collapsed into a single measure of planning system success, using the standardized factor loadings from the second-order factor model as weights.

Finally, unidimensionality and convergent validity were supported in the strong factor loadings for the items on each construct (see Papke-Shields et al., 2002; Papke-Shields and Malhotra, 2001) and the high composite reliability (reported in Appendix A). In addition, evidence of discriminant validity was found, whereby the average variance extracted for each construct was greater than the squared correlation between that construct and other constructs in all cases (see Table A1 in Appendix A). Given the strong measurement properties for all variables, a factor score was calculated for each construct using the factor loadings. All subsequent analysis was conducted using these factor scores, which represent a composite measure of constructs that are free from random sources of error.

4. Strategic manufacturing planning groups

Given the theoretical importance of the ‘‘rational’’ and ‘‘adaptive’’ aspects of planning, which are well established in the strategic management literature (e.g., Mintzberg, 1978, 1990a,b; Quinn, 1983; Grover and Segars, 2005), composite measures reflecting ‘‘rational’’ (flow, formality, comprehensiveness, focus and horizon) and ‘‘adaptive’’ (participation and intensity) characteristics were used in a cluster analysis to determine if different SMP profiles exist. And if so, whether they differ systematically based on the individual ‘‘rational’’ and ‘‘adaptive’’ aspects of planning. Given no theoretical reason for weighting the variables differently, the mean of the associated variables for each aspect was determined for each respondent.

Following the process outlined by Miller and Roth (1994) and Kathuria (2000), these composite variables were entered into two hierarchical clustering algorithms, Ward’s and centroid, to determine the appropriate number of groups, evaluating two-cluster to seven-cluster solutions. Based on the tightness of the clusters, as measured by root-mean-square standard deviation, R^2, and Pseudo-F, the four-cluster model appeared to provide the best fit, regardless of whether the Ward’s or centroid method was used. The results indicate that the clusters are sufficiently separated and that each cluster is relatively homogeneous (overall $R^2 = 0.76$). The presence of four unique and distinct clusters based on ‘‘rational’’ and ‘‘adaptive’’ dimensions of manufacturing planning system indicates that SMP systems indeed do vary systematically, which confirms our first proposition.

The four clusters are shown in Fig. 2 with respect to the degree of ‘‘rationality’’ and ‘‘adaptability’’ for each firm. The cluster centroids, as well as other variables of interest (which will be discussed later) are given in Table 4. Cluster 4 confirms the presence of a ‘‘rational adaptive’’ planning group. In addition there appears to be a group of firms that have ‘‘non-rational adaptive’’ planning systems (cluster 1). The remaining two groups lie between these two groups, but not merely along a linear continuum, and thus contain varying degrees of emphasis on either the rational or adaptive dimension.

The planning characteristics of each group were examined in greater detail through a series of ANOVA tests. This was done to determine if differences exist between the planning groups for each of the planning characteristics and if so, what those differences are.

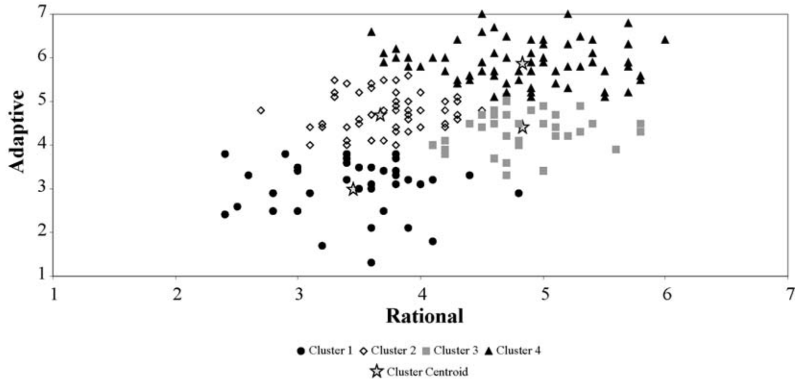

Fig. 2. Strategic manufacturing planning groups.

The variances across groups for each characteristic were not homogeneous, which is one of the requirements for ANOVA. Therefore, Welch's variance-weighted one-way ANOVA, which is robust to the assumption of equal within group variances, was used.

The results, which are also given in Table 4, indicate that cluster 1 is a ''non-rational adaptive'' planning group with respect to all planning characteristics except for planning flow. The planning flow is toward a top-down approach, which is normally associated with a ''rational'' approach. Cluster 2 differs from cluster 1 in that the two ''adaptive'' characteristics (participation and intensity) and planning focus are significantly higher than in cluster 1. Although formality, comprehensiveness and horizon are slightly higher and planning flow is slightly lower, the differences are not significant. Thus this cluster could be referred to as the ''focusing on adaptability'' group. The third cluster shows a significant increase in all of the ''rational'' characteristics except for planning flow, which shows no significant change from cluster 2. In addition the two ''adaptive'' characteristics (participation and intensity) show a decrease. Given these effects, this cluster could be labeled the ''focusing on rationality'' planning group. The final cluster is the ''rational adaptive'' cluster, with all planning characteristics except for

Table 4
Strategic manufacturing planning groups

Characteristic	Strategic manufacturing planning group[a]				F-value[b] (p = probability)
	Cluster 1 (non rational adaptive)	Cluster 2 (focusing on adaptability)	Cluster 3 (focusing on rationality)	Cluster 4 (rational adaptive)	
Centroid center[c]	3.4, 3.0	3.7, 4.7	4.8, 4.4	4.8, 5.9	
Group Size (n)	38	54	39	74	
Flow	4.9 AB	4.5 BC	5.1 A	4.3 C	$F = 4.97$
Formality	2.5 B	2.8 B	4.4 A	4.4 A	$F = 37.2$
Comprehensiveness	3.2 B	3.6 B	4.9 A	5.1 A	$F = 43.8$
Focus	3.6 C	4.6 B	5.3 A	5.7 A	$F = 32.2$
Horizon	2.9 B	3.2 B	4.4 A	4.9 A	$F = 35.3$
Participation	3.1 D	4.8 B	4.4 C	5.8 A	$F = 103.4$
Intensity	3.0 D	4.7 B	4.3 C	5.9 A	$F = 123.4$
Planning system success	4.1 C	5.0 B	5.1 B	5.6 A	$F = 37.2$, $p < 0.0001$
Business performance	4.6 B	4.9 AB	5.1 AB	5.3A	$F = 2.7$, $p = 0.0447$
Planning history	4.7 B	7.5 B	8.3 AB	12.0 A	$F = 5.5$, $p = 0.0012$

[a] Significant differences between strategic planning groups, indicated by different letters, based on standard ANOVA given similarity of Welch's to standard ANOVA.

[b] F- and p-values for overall significant difference test reported for Welch's variance-weighted ANOVA.

[c] Centroid given as rational and adaptive values, respectively.

planning flow having the highest levels relative to any other cluster. In the main, these results are supportive of Proposition 1.

The second set of propositions, addressing direct planning performance and downstream business performance, were tested following the same procedure as just described for the planning characteristics. Again, the variances across groups were not homogeneous, so Welch's variance-weighted one-way ANOVA was used to test for significant differences across SMP groups. Support for Proposition 2a is found in the significant differences between planning groups for planning system success (Table 4). Compared to all other groups, the ''rational adaptive'' group has significantly higher scores while the ''non-rational adaptive'' group has significantly lower scores compared to all other groups and the two ''focusing'' intermediate groups have similar planning effectiveness between the extremes. Support for Proposition 2b was seen in the significance of the regression of business performance on planning system success ($F = 35.12$, $p < 0.0001$, $R^2 = 0.15$). In addition, support was seen in the difference between planning groups, albeit not as strong as for the direct performance measure of planning system success (Table 4). The ''rational adaptive'' group has significantly higher business performance than the ''not rational adaptive'' group.

The third proposition, which posits that the performance of SMP groups will not vary across environments, was tested via a Chow test of structural change between subgroups (Greene, 1997). In this case, the relationship between SMP group and performance was examined for varying levels of product dynamism (the subgroups) to see if the relationship changed across environments. To do this the data was divided into three subgroups based on the level of product dynamism, and the middle group was dropped to increase the chance of detecting a difference if it exists (no support for P3) leaving low and high product dynamism subgroups. Before examining the relationship between planning group and performance across environments, the product dynamism subgroups were tested for equal variances using the Goldfeld–Quandt test, and support was found. For the Chow test, three separate estimated regression equations (regressing performance on SMP cluster) were obtained for the (1) low dynamism group, (2) high dynamism group, and (3) two groups combined. The results shown in Table 5 indicates that there is no difference in the ''SMP group-planning performance'' relationship across the two environmental groups, thus providing support for the proposition that these relationships do not vary across different levels of product dynamism.

The fourth and final proposition focuses on whether firms change with respect to their SMP processes as they gain more experience. This was assessed in several ways to provide as full and rich an understanding as possible. Specifically, the relationship between planning maturity group and planning approach group was evaluated, the planning maturity groups were examined for differences in degree of rationality and adaptability, and the history of SMP was evaluated across SMP groups. But before assessing the proposition, the assumption that greater planning maturity would be associated with a longer history of SMP was tested. The significant difference in planning history across the three maturity levels supported this assumption (please see Table 6).

The difference in maturity between the planning groups was evaluated via a contingency table (Table 7). The χ^2-test indicates that significant differences exist between the SMP groups with respect to the level of maturity ($\chi^2 = 73.5$, $p < 0.0001$). Specifically, the ''preliminary'' planners are most likely ''not rational adaptive'' in their approach while ''mature'' planners are more often ''rational adaptive''. This is also seen in the significant difference in degree of rationality and adaptability between ''preliminary'' and ''mature'' planners (Table 6). In the two intervening ''focusing'' groups (Table 7), there were only slightly more or less firms in the ''preliminary'' and ''mature'' categories than expected and the numbers of ''evolvers'' observed and expected were equal, indicating that companies in these groups are in the process of adjusting their SMP processes.

Further support for the fourth proposition is found in the significant difference in SMP history between the

Table 5
Chow test of effect of environment (product dynamism) on planning performance

Performance measure	Error sum of squares			Calculated F-value[a]
	Combined	Low dynamism	High dynamism	
Planning system success	1077.8	550.3	512.6	0.95
Business performance	2861.8	1455.3	1339.3	1.62

[a] Citical $F(2,135) \approx 4.79$ at 0.01 p-level.

Table 6
Planning differences across planning maturity levels

Characteristic	Planning maturity level			F-value (p = probability)
	Preliminary	Evolving	Mature	
SMP history	4.3 C	8.1 B	19.4 A	$F = 36.94, p < 0.0001$
Degree of rationality	3.7 C	4.5 B	4.8 A	$F = 45.34, p < 0.0001$
Degree of adaptability	3.9 B	5.1 A	5.2 A	$F = 40.39, p < 0.0001$

Table 7
Planning experience differences across strategic manufacturing planning groups

Planning experience	Strategic manufacturing planning group				Row total (%)
	Non rational adaptive	Focusing on adaptability	Focusing on rationality	Rational adaptive	
Preliminary	**30.0**[a]	**22.0**	**10.0**	**4.0**	66 (32.7)
	11.7	17.6	13.0	23.7	
Evolving	**4.0**	**26.0**	**20.0**	**52.0**	102 (50.5)
	17.7	27.4	20.3	37.0	
Mature	**1.0**	**6.0**	**9.0**	**18.0**	34 (16.8)
	6.0	9.0	6.6	12.5	
Column total (%)	35 (17.3)	54 (26.7)	39 (19.3)	74 (36.6)	202

[a] The bold value is the observed number, the other value is the expected value if no relationship existed between strategic manufacturing planning group and planning maturity stage.

planning groups. The length of time that firms had been conducting SMP ranged from 0 to 80 years with an average of 8.9 years, and differed significantly between the four groups in the expected direction (see Table 4). Thus more time spent in manufacturing planning does generally translate to higher planning maturity, which in turn is associated with more rational adaptive planning processes that are linked to higher planning effectiveness and, ultimately, business performance.

5. Discussion and contributions

5.1. Strategic manufacturing planning profiles

The results of this study provide valuable information with respect to the SMP process. First, the results that the SMP processes varied systematically rather than randomly with respect to the degree of ‘‘rational’’ and ‘‘adaptive’’ planning characteristics demonstrates that firms have discernibly different SMP profiles. Not only did the groups vary with respect to the planning process, but this variation was associated with differences in planning performance, with firms having ‘‘rational adaptive’’ planning outperforming those with ‘‘focusing’’ planning who in turn outperformed those with ‘‘not rational adaptive’’ planning. These differences in planning system success between the planning groups correspond to the differences observed in other studies (e.g. Bourgeois and Eisenhardt, 1988; Glaister and Falshaw, 1999; Segars et al., 1998).

In addition, a significant difference was found between the business performance of the ‘‘rational adaptive’’ and ‘‘not rational adaptive’’ groups. Even though the strength of this relationship was not as strong as that observed with the direct measure of planning system success, this outcome is not unexpected given that myriad other factors affect business performance. Indeed, when the effect of planning on business performance is evaluated as an indirect effect via planning systems success, the relationship is much stronger. Thus higher planning success leads to better business performance. This finding provides support for the importance of the SMP process to a firm's eventual success.

Finally, this study demonstrates that the relationship between SMP group and effectiveness is invariant across differing levels of product dynamism. While this finding contradicts the more traditional view that how you plan, as well as the outcome of that process, should differ depending on the environment, it supports the more current view that an approach combining elements of ‘‘rationality’’ and ‘‘adaptability’’ is desirable regardless of the environment–thus resulting in a ‘‘best practice’’. But how do firms combine these elements that were commonly considered polar extremes? It appears that organizations use the ‘‘adaptive’’ aspects to ensure that a variety of strategic issues are identified (given wider involvement) and adequately addressed (given more frequent review and evaluation) while using the ‘‘rational’’ aspects to provide structure (through established guidelines, more exhaustive alternative identification, and monitoring of outcomes against plans) as well as ensure that future consequences of decisions are evaluated (long enough look into the future). As mentioned previously, such an approach is also seen in the ‘‘ambidextrous organization’’ (O’Reilly and Tushman, 2004) where the ‘‘exploitative’’ aspect of the organization focuses on operations and efficiency via a formal, mechanistic structure while the ‘‘exploratory’’ aspect of the organization focuses on adaptability and response via a looser, more adaptive structure.

5.2. An evolutionary model of strategic manufacturing planning

But how do companies arrive at this ‘‘best practice’’? Are there changes in the planning systems that occur over time? And are these changes predictable? Combining the findings about differences between the SMP groups with the consistent findings about planning history (Table 4) and planning maturity (Tables 6 and 7), it appears that the approach for SMP does change over time from ‘‘not rational adaptive’’ towards ‘‘rational adaptive’’. All planning systems tend to evolve toward more effective planning systems, reflecting the evolutionist model of change, where there is a clear sense of the direction of change and the destination of change (Van Parijs, 1981). In other words, the change is not random, but instead moves toward an improved state, as is the case here.

Perhaps the findings in our study could best be understood by relating them to observations made by Greiner (1972), who in studying organizational growth over time, observed that such growth occurred in phases of evolution and times of revolution, where he defined evolution as ‘‘prolonged periods of growth where no major upheaval occurs’’ and revolution as ‘‘those periods of substantial turmoil’’ (p. 38). He concluded that ‘‘each phase is both an effect of the previous phase and a cause for the next phase’’ and that, ‘‘as a company progresses through developmental phases, each evolutionary period creates its own revolution’’.

Given our findings with respect to planning experience, Greiner’s observations could be translated as described here and depicted in Fig. 3. Organizations start out with ‘‘not rational adaptive’’ SMP. Such planning is most likely not planning at all but a series of ad hoc decisions, with no particular structure or vision guiding the process. In addition, having very few people involved and having it primarily driven from the top suggests that a high-level manufacturing manager is undertaking these initial efforts. This corresponds to Anderson et al.’s (1991) finding that the majority of manufacturing executives take the lead in developing the manufacturing strategy. They concluded that top-manufacturing executives ‘‘alone have the knowledge or strategic ‘‘savvy’’ to engage in strategic analysis and

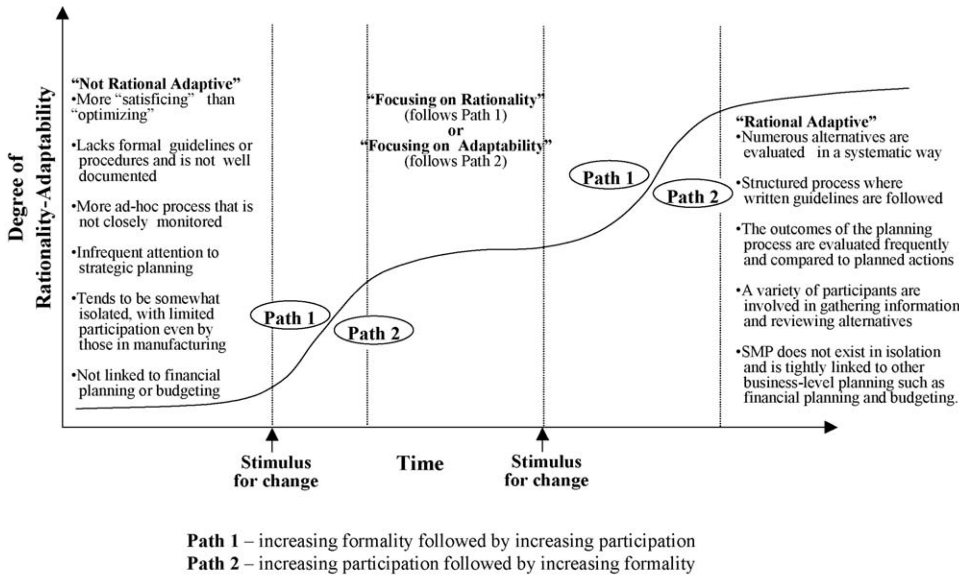

Fig. 3. Strategic manufacturing planning process evolution.

planning''. But this approach is not successful for long. There is a lack of coherent decisions within the manufacturing area because decisions are made independently and possibly without complete information. There is also a lack of alignment of the manufacturing strategy (as it exists) with the business strategy. Each of these has been observed as an impetus for addressing the manufacturing strategy process (Voss, 1990) and reflects a ''crisis'' situation that leads to changes in the SMP system.

5.3. Changing the strategic manufacturing planning system

But what types of changes occur? Firms may respond by attempting to take control of the planning process (e.g., Fine and Hax, 1985; Mills et al., 1995; Skinner, 1969) (path 1 in Fig. 3), or they may respond by increasing the attention given to the process through greater participation in the process (Mills et al., 1995) (path 2 in Fig. 3). Those firms attempting to take control (''focusing on rationality'' group) do so by creating a more structured planning process, the type described by the ''planning'' school. Policies and procedures are defined to guide the process so that the resources being devoted to it are used more effectively. Strategic manufacturing decisions are made after more thorough reviews of information rather than being a series of *ad hoc* decisions. And given the capital intensity of the manufacturing area, the planning process is more tightly linked to financial planning whereby implications of decisions are considered farther into the future. On the other hand, those hoping to increase attention to the manufacturing strategy process (''focusing on adaptability'' group) may do so by involving more people and having them interact more frequently to not only gain a ''buy-in'' from a broader constituency, but to also develop a more widely accepted and implementable strategy, as indicated by the ''learning'' school. However, this increased attention to the manufacturing strategy is not coupled with increased structure.

Once an organization has made such changes, it sees improvement in the outcomes of the planning process, and, thus, continues to plan in this way. However, both of these approaches represent a local equilibrium, each is an improvement over the ''not rational adaptive'' mode but neither is optimal. Those organizations originally ''focusing on rationality'' to gain control likely improve the efficiency of planning, but do so at the expense of not generating more ideas by involving others. The result may well be a process that is considered an exercise that produces stale plans that only partially represent the firm's interests. However, those ''focusing on adaptability'' through greater participation in and attention to the process may have enhanced the creativity and idea generation, but may lack the mechanisms needed to accurately capture and ultimately implement them (Grover and Segars, 2005).

Faced with such situations, organizations likely respond by making changes toward a ''rational adaptive'' approach. Those firms initially ''focusing on rationality'' recognize the benefits of involving more people, both within the manufacturing area and from other areas (Mills et al., 1995). And rather than continue with SMP as merely an ''exercise'', the companies begin to address the manufacturing strategy on a more continuous basis. Those firms initially ''focusing on adaptability'' recognize the need for structure to be able to evaluate and act upon the ideas being generated in a cohesive manner. Eisenhardt (1989) observed a similar situation where some degree of structure is necessary to avoid chaos in ''high velocity'' environments and to allow executives to make fast decisions. So irrespective of the evolutionary path and environment, firms arrive at a ''rational adaptive'' planning approach, where they experience some structure as well as constant reconciliation, which allows them to adapt as needed and enjoy the benefits of more successful planning.

5.4. Managerial interventions for planning changes

The evolution of strategic planning in manufacturing organizations is likely associated with learning, which can occur through experience or observations of what others have done. Although learning tends to occur over time, it need not be driven only by temporal considerations. It could be accelerated through management intervention. As Miller and Hayslip (1989) point out, ''these efforts to continuously improve the functioning of the company must themselves continuously improve and evolve''. Emshoff (1978) refers to the process of planning how to improve the planning process as ''meta-planning''. He explains the advantage of meta-planning in that it will ''enable organizations to define on-going programs to improve the effectiveness of their planning systems, eliminating much of the unproductive, but expensive, crisis-oriented change processes characteristic of many corporate planning systems'' (p. 1095). In other words, organizations can be more proactive in designing their SMP systems, and deliberately institutionalize elements of both rationality and adaptability early on in the planning cycle.

To accomplish such meta-planning, organizations must understand where they have been, where they are currently, and what factors led to their current state to gain insight into where they are going in the future and what can be done to facilitate or direct changes (Nolan, 1979). Hayes and Wheelwright (1984), in discussing their stages of manufacturing's strategic role, stress the importance of understanding (1) where your company lies on the continuum between no substantive role and being a source of competitive advantage and (2) what factors led to that position before embarking on making improvements. Similarly, an awareness of planning stages and associated characteristics can act as a catalyst to facilitate progress toward more effective planning. The changes described here may seem obvious to managers. But, as Greiner states:

> "at a more reflective level, I imagine some of these reactions are more hindsight than foresight. Those experienced managers who have been through a developmental sequence can empathize with it now, but how did they react in the middle of a stage of evolution or revolution?" (p. 44)

The process characteristics clearly define the identity of an improved planning approach and give direction for changes needed to enable progression through the stages to the desired state. Thus this meta-planning learning approach is a powerful tool in benchmarking and enabling progress in SMP, providing valuable assistance to practitioners. However, necessary changes may not be feasible in a given organization. The costs of changing the planning process and any related organizational structures may limit the ability to make the needed changes.

5.5. Implications for research

With respect to academia, this research has contributed to our knowledge of the strategic manufacturing process and opened the door to even further understanding. Specifically, our work demonstrates that companies differ systematically with respect to SMP and suggests that SMP systems evolve toward an end state of "rational adaptive" planning, which is the most effective approach. A valuable contribution for future research would be in seeking answers to a host of questions related to the factors that affect this process. For instance, do most organizations advance through the stages by making changes based on their past experience? Or are they learning from the experience of others? Are there specific actions that organizations take or are there conditions within organizations that enable them to advance more readily toward a rational adaptive approach? For example, does the attitude of the president or CEO toward manufacturing affect advances in the planning process? How does the strategic role of manufacturing in a company specifically affect the manufacturing strategy development processes (Swamidass et al., 2001)? Finally, why do some organizations focus on more rational aspects first while others focus on adaptive aspects? Is it linked to organizational culture or prior experience?

As is the case with all research, there are some limitations associated with this study that must be recognized. First, the list of planning process characteristics, although capturing the dimensions commonly identified in prior literature, may not be exhaustive. However, our work has put in place the building blocks for this endeavor by first learning more about the common characteristics of the strategic manufacturing process and how they evolve over time. Secondly, the data collected in this study is cross-sectional. To be able to draw definitive conclusions about the changes in strategic manufacturing process over time requires longitudinal data, which is another rich area for future research. Finally, this research did not address issues tied to implementation of the manufacturing strategy since the focus in this study was on manufacturing strategy development and understanding the benefits associated with such planning. We clearly recognize that even the best plans, if not properly implemented, will not lead to improvements in manufacturing performance or the ability of the manufacturing function to contribute to overall business success. Linkages between planning process, resulting decisions, implementation of those decisions, and business performance is an important avenue for future work. Hopefully our work has provided an important stepping-stone in that direction.

6. Conclusion

We have shown that consistent patterns of SMP exist, which in turn are related to planning success and ultimately business performance. It appears that these systematic differences with respect to the degree of "rationality" and "adaptability" also reflect changes in the SMP process over time. And although firms may start at different places with respect to SMP and may travel different paths in changes to their planning approach, they all appear to be moving toward a common form of SMP, the "best practice" of a rational adaptive approach.

Understanding "how" planning is done and what changes are needed to improve it is an important step toward an improved manufacturing strategy (the "what"). By using the results of this study and better understanding the association between planning experience and planning approach, organizations can identify where they currently fall with respect to the SMP groups and what changes are needed to enhance their planning. In other words, management can intervene to hasten the progress toward a more "rational adaptive" approach and more desirable planning outcomes, which when dovetailed with good implementation, can lead to business success.

Appendix A. Measurement of research constructs

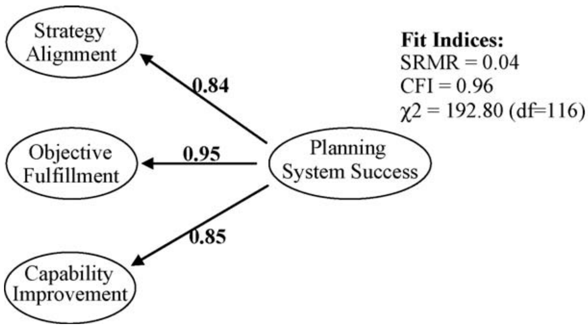

Fig. A1. Second-order factor model for planning system success.

Table A1
Discriminant validity of research constructs

Construct	Formality	Compre-hensiveness	Focus	Horizon	Flow	Participation	Intensity	Planning system success	Business performance	Product dynamism
Formality	**0.46**[a]	0.17[b]	0.16	0.14	0.00	0.08	0.14	0.14	0.01	0.00
Comprehensiveness		**0.51**	0.15	0.25	0.05	0.16	0.18	0.24	0.00	0.01
Focus			**0.51**	0.07	0.00	0.21	0.18	0.27	0.01	0.00
Horizon				**0.44**	0.07	0.11	0.15	0.40	0.04	0.00
Flow					**0.40**	0.11	0.03	0.06	0.00	0.00
Participation						**0.47**	0.29	0.45	0.03	0.00
Intensity							**0.57**	0.41	0.02	0.02
Planning system success								**0.68**	0.20	0.00
Business performance									**0.69**	0.00
Product dynamism										**0.36**

[a] Average variance extracted on diagonal.
[b] Squared correlations between constructs.

Planning system design characteristics: 7-point scales with endpoints "strongly disagree" and "strongly agree" in response to:

Formality (FR) (composite reliability = 0.77; r_{WG} = 0.63)

1. Policies and procedures greatly influence the process of SMP within our firm
2. Our process of strategic manufacturing planning is very structured
3. Written guidelines exist to structure SMP in our firm
4. The process and outputs of strategic manufacturing planning are formally documented

Comprehensiveness (C) (composite reliability = 0.81; r_{WG} = 0.70)

1. We attempt to be exhaustive in gathering information relevant for SMP[a]
2. Before a decision is made, each possible course of action is thoroughly evaluated
3. We attempt to determine optimal courses of action from identified alternatives
4. We will delay decisions until we are sure that all alternatives have been evaluated

(*Continued*)

Focus (CR) (composite reliability = 0.75; $r_{WG} = 0.66$)
1. In our SMP process we encourage control over creativity and idea generation[a]
2. Control systems are utilized to monitor variances between planning actions and outcomes
3. Our SMP is tightly integrated with the firm's financial planning routine
4. The manufacturing strategy process is tied to the annual budgeting process

Horizon (H) (composite reliability = 0.70; $r_{WG} = 0.64$)
1. The length of the planning horizon is short
2. In SMP, attempts are made to consider implications far into the future
3. Our planning horizon is fairly long, covering periods of 5 years or more

Flow (FL) (composite reliability = 0.71; $r_{WG} = 0.60$)
1. Strategic manufacturing planning is initiated at the highest levels[a]
2. The planning flow within our organization can be characterized as ''top-down''
3. Planning for manufacturing is initiated by requests/proposals from line managers
4. The extent of bottom-up initiation is high
5. The primary role of upper management is to endorse rather than formulate SMP

Participation (P) (composite reliability = 0.78; $r_{WG} = 0.70$)
1. Our process for SMP includes numerous participants
2. SMP is a relatively isolated organizational activity
3. The participation of specialists in SMP is high[a]
4. Line managers and staff are involved in the SMP process
5. The level of participation in SMP by diverse interests in the manufacturing function is high

Intensity (I) (composite reliability = 0.84; $r_{WG} = 0.63$)
1. We constantly evaluate and review strategic plans
2. We frequently adjust strategic plans to better adapt them to changing conditions
3. Strategic manufacturing planning is a continuous process
4. We frequently schedule face-to-face meetings to discuss strategic planning issues

Planning performance:

Objective fulfillment (OBJ) (composite reliability = 0.85; $r_{WG} = 0.82$) 7-point scales with endpoints ''entirely unfilled'' to ''entirely fulfilled'' in response to:
1. Enhancing management development
2. Predicting future trends
3. Short-term performance
4. Long-term performance
5. Evaluating alternatives based on more relevant information
6. Avoiding problem areas

Strategy alignment (AL) (composite reliability = 0.90; $r_{WG} = 0.87$) 7-point scales with endpoints ''entirely unfilled'' to ''entirely fulfilled'' in response to:
1. Understanding the strategic priorities of top-management
2. Adapting goals/objectives of manufacturing to the changing goals/objectives of the firm
3. Maintaining a mutual understanding with top-management on the role of the manufacturing function in supporting organizational strategy
4. Identifying manufacturing-related opportunities to support the strategic direction of the firm
5. Educating top management on the importance of manufacturing[b]
6. Adapting manufacturing technology to strategic change[b]
7. Assessing the strategic importance of new manufacturing technologies[b]

Capability improvement (CAP) (composite reliability = 0.92; $r_{WG} = 0.74$) 7-point scales with endpoints ''much deterioration'' to ''much improvement'' in response to:
1. Ability to anticipate surprises and crises
2. Flexibility to adapt to unanticipated changes
3. Ability to identify key problem areas
4. Ability to enhance the generation of new ideas
5. Ability to foster organizational learning
6. Ability to foster management control

(*Continued*)

Business performance (BP) (composite reliability = 0.90; r_{WG} = 0.91) 7-point scales with endpoints "much worse" and "much better" in comparison to major competitors in response to:

1. Sales growth
2. Earnings growth
3. Market share change
4. Return on investment

Product dynamism: Please indicate the extent to which you agree or disagree with the following statements as they pertain to the products offered by your firm. (composite reliability = 0.71; r_{WG} = 0.70)

1. The life cycle of products is relatively short
2. Customer requirements are fairly easy to predict
3. Demand is difficult to predict[c]
4. The rate at which products become obsolete is high
5. The rate of innovation of new products is high
6. Products change rapidly and/or unpredictably

Planning experience: Characterize your firm's experience with strategic manufacturing planning (r_{WG} = 0.66)

Preliminary Procedures and policies for conducting planning just beginning to emerge. Little formal strategic manufacturing planning experience among participating managers

Evolving Planning activities have been formally developed and tested. Some strategic manufacturing planning experience among participating managers. Process for planning still being refined.

Mature Long history of strategic manufacturing planning activities. Much strategic planning experience among participating managers. Well-developed policies and procedures for conducting planning in place

Length of strategic manufacturing planning experience

How long has your firm been involved in strategic manufacturing planning? — Years

[a] Item deleted during measure refinement as reported in Papke-Shields et al. (2002).

[b] Items deleted during measure refinement and validation as reported in Papke-Shields et al. (2002).

[c] Item is reverse-coded.

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