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Strategic management cycle: The underlying process building aligned linkage among operations practices

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A B S T R A C T

This study explores the mechanism of building an effective linkage among manufacturing practices that is a basic attribute of high performance manufacturing. High performance manufacturing companies are those that sustain high levels of performance over time. We propose a strategic management cycle, which explains how a firm establishes and maintains sustainable performance. We hypothesize and demonstrate how the cycle creates an effective linkage that integrates strategic activities and operational practices, which in turn yields high performance. We also argue and show how the first stage of the cycle, visionary planning, supported by the cross-functional culture, is a key to the high performance manufacturing company.

1. Introduction

The importance of high performance manufacturing practices, first observed in excellent Japanese manufacturing companies in the 1980s (Schonberger, 1982) is still strong in today's global competition. Global competition is noted by its standards of quality, cost, delivery and resource efficiency (Q, C, D and efficiency). Manufacturing processes are more important than ever because huge emerging markets such as Brazil, Russia, India and China (BRIC) countries require more cost-effective products. In addition, constraints on the availability of natural resources and CO_2 emissions are becoming stricter, requiring greater efficiency, adding increased demands on manufacturing performance.

It is often difficult to fully recognize the contributions of high performance manufacturing practices in meeting the increasing market demands, because to meet these demands, management must align these sets of practices rather than imitating individual practices of a benchmarked company. Well-aligned manufacturing practices, an effective linkage among practices, is the managerial outcome in high performing companies (Shroeder and Flynn, 2001). Global competition requires higher Q, C, D and resource efficiency. This implies, to be globally competitive, a company should build a more effective linkage among its practices. At the same time, the competitive pressures from the higher requirements of Q, C, D and the efficiency demand for not only operational excellence, but also the inclusion of technological innovations in products, including mature ones. It creates and increases the need for effective linkages among manufacturing practices. Recently, the demands on these innovative product and process performance attributes include energy usage and resources efficiency besides traditional Q, C and D criteria. Thus, the additional sources of competitive differentiation have been introduced. In other words, traditional Q, C and D performance should go hand in hand with the technological innovation to maintain or improve the company's competitive position over time. Especially in mature, advanced markets, the company needs to differentiate itself significantly to give customers a reason to replace existing products.

Technologically innovative developments tend to be more expensive in terms of cost and time. They demand a well focused and designed development strategy to satisfy the market's cost-effectiveness criterion. In addition, technological innovations must be aligned with competitive features and a fast ramp-up operational process. The linkage now required covers development strategy to operations. The linkage between business strategy and operations practices has been emphasized elsewhere (Wheelwright and Hayes, 1985). However, it can go too far. Christensen noted how a company is inclined to lose the flexibility to adapt to new technological changes, because of the close linkage among its specific technologies pursued with its current business processes and its underlying mindset (Christensen, 1997). Skinner called this inflexibility the 'millstone effect' (Skinner, 1978). Furthermore, Brenner and Tushman argued that a heavy commitment to a specific set of operational process practices decreases the likelihood of a firm's adoption of a radical innovation (Brenner and Tushman, 2003). Hannan and Freeman argued that the high level of reproducibility required to

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enhance reliability and accountability, which modern societies evaluate organizations on, requires structures with high levels of inertia (Hannan and Freeman, 1984). We propose that an effective linkage between technological development and operational processes is important in creating a high value because operational processes should assist in harvesting technological developments. For example, innovative technological equipment should operate in the environment it was designed for and with workers who are trained to operate it. Because a new product requires an appropriate set of processes to be manufactured, the problem is how to construct an effective linkage among the new product development, production processes and people that can sustain competitiveness over time. The capability to sustain and create effective linkages overtime is hard to build and sustain. Previous research reported some of the organizational arrangements that can achieve these linkages. The role of decentralization, as opposed to centralization, was noted by Duncan (Duncan, 1976). Adler et al. found that an individual worker's knowledge and conduct, created and sustained by training and trust to align their individual job activities with each other, will enable them to achieve their production goals (Adler et al., 1999). When necessary, the appropriate switching of organizational structures suitable for exploitation and exploration has been noted (Raisch, 2008). The establishment of two types of organizational units, one in charge of exploitation and the other exploration, under executives sharing the underlying missions of the units with the clear strategic goals of the company is required (O'Reilly and Tushman, 2004).

These studies, however, did not examine how the exploration process emerges in a company. This emerging process is part of a company's management process. Simon proposed that the firm starts to explore a new course of action when it recognizes the existing course fails to achieve the aspiration level or other potential opportunities that lift the aspiration level up (Simon, 1960). This proposition suggests the firm's behavior is basically rational and anticipatory, even though the capability to behave in those ways is bounded and the resulted behavior may not be optimal. Thus, we assume that the management cycle of Plan-Do-Check-Act (PDCA) as a rational approach is underlying the firm's behavior. We propose that a company acts based on the cycle and its competence to perform over time is determined by the effectiveness of the cycle that characterizes linkages among practices. We argue if the cycle goes well, practices can be aligned consistently to perform the objectives as planned. Exploitation and exploration will be coordinated under the cycle. In other words, the firm can manage exploitation and exploration through the cycle. High performers, we hypothesize, are distinguished by the capability to effectively develop and use the cycle.

In this study, we focus on an anticipatory planned behavior, shaped by a strategic management cycle, to achieve the exploitation and exploration processes over time. The emerging nature of these processes reflects the evolutionary or learning organization paradigm in POM (Hayes et al., 1988). As managers and employees go through these processes, they often change their mind-set and activities to effectively adapt to competitive and market changes. Thus, evolutionary processes are embedded in the strategic management cycle.

2. Literature review

2.1. Linkage revisited

The concept of practice linkages is built on how operations practices relate with each other, usually positively (Morita and Flynn, 1997; Shroeder and Flynn, 2001). In other words, when the company implements a practice effectively, other practices which match or fit these practices, should also be implemented effectively. A positive relationship between practices suggests there are technical and behavioral factors working in creating or sustaining the relationship. For example, the technical relationship works in such a way that well trained workers can maintain their machines or effectively implement statistical quality control and vice versa. The behavioral relationship means a worker is influenced directly by other workers' attitudes toward their job, positively and negatively. When the relationships are positive, a result is a virtuous cycle, or vicious cycle, depending on how they are aligned. A virtuous cycle drives continuous improvement, while a vicious one drives the decline of the company. Sometimes a negative relationship works in a balancing process. If a worker observes other workers' lazy attitudes, he or she may feel they will never work in that way. It generates an opposite force to the existing linkage, a negative linkage. This reverse or negative linkage can cause an improvement or decrease in the company's performance over time. The reverse relationship usually exists during a transitive phase, such as a turn-around from a poor situation or from a good one. An initiative spurred by a crisis, or arrogance or conflict can produce this type of reverse linkage.

Therefore, the emergence of linkages is a critical organizational phenomenon. Understanding them can yield more prescriptive statements for managers. Earlier research has reported that there often is a positive relationship between the extent of linkages among workers and levels of manufacturing performance (Morita and Flynn, 1997; Shroeder and Flynn, 2001).

Hypothesis 1. A positive relationship exists among practices and manufacturing performance.

2.2. Strategic management cycle: a critical driver of the levered linkage

2.2.1. Strategic management cycle

A levered linkage exists when there is a linkage between a plant's strategy and its operation floor. When they are properly aligned, the plant is more likely to achieve specific performance goals. While strategy is different from operations (Porter, 1996), the integration between them is critical (Miles and Snow, 1978). Even though a company is a mechanism to achieve strategies, objectives or goals, management processes address how to achieve them (Barnard, 1938; Ackoff and Emery, 1972). Therefore, a process must exist, which links the plant's strategy and operations floor.

The Plan-Do-Check-Act (PDCA) management process is based on a set of practices, which facilitates the effective implementation of goal seeking behaviors to achieve the plant's strategy and goals (Shewhart, 1939). The PDCA cycle is a problem solving process consisting of three sequential actions: decision making, implementation and evaluation. Thus, the PDCA process is an example of a process that establishes and utilizes a linkage between strategy and operations. The way to develop a strategic change may be different depending on a company' product and operations profile. While some research suggests that rational planning is practically implausible (Simon, 1956; Lindblom, 1959; Emery and Trist, 1965; March and Olsen, 1976; Mintzberg et al., 1998), planned thrusts or changes are indispensable because developing new products and process technologies cannot be done without acknowledging a lead time required between conception and finished products and implementation, respectively. The capability to conceive and implement planned behavior changes differs among plants. The uncertainty of this capability is noted in the gap between strategic planning and operations, which continues to be an important focus of management (Kaplan and Norton, 1996). When it comes to the continuity or enhancement of levered linkages, an effective linkage between strategy and operations, is not sufficient. This linkage is just one in a set of linkages that must exist if the plant is to maintain or improve its long-term success.

The strategic management cycle shown in Fig. 1, consists of four stages, each of which has an expected outcome. The first stage, Organization Vision Planning, is where a vision with clear goals, a long-term orientation and an organizational consensus or understanding are developed. The second stage, Strategy Formulation, is where the strategy is formulated so that necessary organizational attributes, such as acceptance of the strategy by the organization, ensure its consistency with the vision and goals, and build a sense of anticipation of what will be accomplished. Next, the third stage, Operation Practice, addresses the implementation of each practice to the level or strength appropriate for the strategy. Finally, the fourth stage, Organizational Performance, addresses the competitiveness, or performance of the plant.

In achieving its objectives, a plant moves sequentially through the steps in Fig. 1. The management process starts with generation and articulation of a vision and set of goals that reflect a set of values the company wants to pursue. The vision and goals are developed based on initial conditions, such as past performance, existing strengths and weaknesses, and forecasted environmental situations. The outcome of generating a vision and goals is an environment, defined as the extent of long-term orientation, clarity of the vision and goals and the level of organization consensus with them. The second stage of the cycle transforms the environment into a strategy that provides a framework for operational practices to achieve the vision and goals established in the first stage. As a result of the transformation, the strategy is more likely to be understood and accepted by the organization and be consistent with business objectives. The third stage is the depth of the implementation of the various operations practices. It converts the strategy into practices to implement the strategic plans. The outcome is the level, or strength of the practice in each activity. Finally, the final stage concerns the coordination and steering of the operational practices to achieve the goals by adjusting the company to current conditions. The outcome is a set of competitive performance measures that determine the plant's performance, such as sales and profits. The results are a function of the interaction between manufacturing practices and market conditions. The measures consist of quality, delivery, cost, and new product performances, etc. The values of these measures form the set of starting conditions for the next iteration of the process.

Fig. 1. Strategic management cycle.

The Strategic Management Cycle's success is a function of how strong each of the four stages in Fig. 1 is. The plant survives and grows when the management process creates and/or sustains an effective series of the sequential phases.

The concept of strategic management cycle is basically similar to the adaptive cycle Miles et al. proposed without explicit consideration of the transition from one cycle to next one over time (Miles and Snow, 1978). The adaptive cycle consists of three problems, the Entrepreneurial (Definition of an organizational domain), the Engineering (Creating of a system, which operationalizes management's solution to the entrepreneurial problem) and the Administrative problem (Reducing uncertainty within the organization and rationalizing and stabilizing those activities that solved problems faced by the entrepreneurial and engineering problems). These problems are the managerial agenda to adapt the company to environmental changes. These authors recognized four types of steering patterns of the cycle, the defender, the analyzer, the prospector, and the reactor. The prospector makes most innovative adaptation and the reactor is inconsistent in achieving solutions to the three problems. The reactor may be considered as a poor performer in the strategic management cycle framework.

Fig. 2 reveals the processes and practices driving the Strategic Management Cycle, identified in the corners of the figure. The cycle starts in the lower right hand corner of Fig. 2 with Organizational Vision, Goal Setting, and Infiltration. The first result is in the outcome of the Organizational Visionary Environment. The second

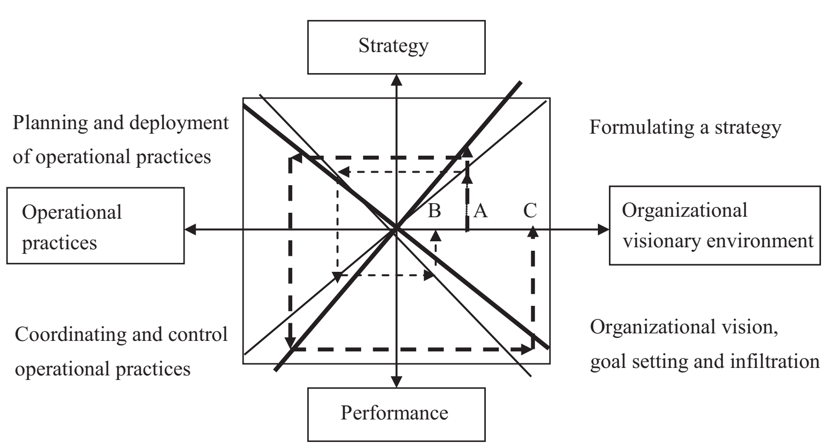

Fig. 2. Dynamic transition of the strategic management cycle.

stage, Strategy Formulation, found in the upper right hand corner of Fig. 2, is based on this environment and results in the Plant's Strategy (the top center of Fig. 2). The strategy triggers the Planning and Deployment of Operational Practices, found in the upper left hand corner of Fig. 2. This leads to the Operational Practice (the middle of the left hand axis). The strength of the Coordination and Control of these practices results in the plant's performance.

In Fig. 2, each quadrant has two dotted lines, a thick and a thin line, identifying different dynamic paths in the cycle. The thick line is an improving, or upward path, where the plant gets better as it progresses through the stages of the model. Conversely, the thin line is a decreasing, or downward path of the plant and its performance. As a result, two companies starting at the same level of the Organizational Visionary Environment, A, in one cycle will have different levels of C and B in this environment based on whether the plant has an upward (C) or downward (B) path. The lines indicate the difference of each plant's capabilities in the activities in each quadrant. A highly levered linkage plant, identified by the thin real line in Fig. 2, is located towards the four corners, because the four axes are balanced and their levels are high. When an average company follows an upward path, it will follow a spiral process as indicated by the thick lines. The shift to the thick dotted line is possible in any quadrant. For example, if a company improves the strategy formation, the practice level can be lifted up. Then, the heightened practice level adds more likely to higher performance.

The strategic management cycle underlies the plant's actions and behaviors. Each stage of the cycle is determined by the plant's strength in the prior stage, when a plant is strong in one stage, it will be strong in the next stage. In other words, the firm's dynamic behaviors are shaped by the strategic management cycle.

Hypothesis 2. There is a direct correlation between a plant's strength at one stage of the strategic management cycle and its strength of the next stage of strategic management cycle.

If the hypothesized relationship in Hypothesis 1 is found, it suggests that a plant's performance will be indicated by its score on each axis of the strategic management cycle in Fig. 2.

Hypothesis 3. There is a positive correlation between a plant's scores on the axes in Fig. 2 and its performance.

2.3. Integration of tacit knowledge and motivation

It is noted that not least of past researches indicates the rational planning behavior the strategic management cycle concept connotes is implausible. The incremental muddling through (Lindblom, 1959); the satisficing principle (March and Simon, 1958); and the five modes of strategic planning and implementation, the commander, change, collaborative, cultural, and crescive models (Bourgeois and Brodwin, 1984), are among them. Variations in planning behaviors come from two sources: (1) uncertainty from the lack and the asymmetry of information within the organization, and (2) diversified decision criteria (the difference of decision makers' goals). The former can be reduced by integrating available information and tacit knowledge or wisdom within the organization. The latter can be reduced by how much people within the organization are committed to the organization's vision and goals. The more committed they are, the weaker the unfavorable effect of diversified criteria. The cross-functional culture characterizes the degrees of the uncertainty and the goal congruence. When the culture is strong, the unfavorable effects of the two factors are reduced.

It has been noted that combining organizationally available information and tacit knowledge (wisdom) to reduce the uncertainty and fuzziness of the information is one of the most effective means to adjust to new unexpected situations (Jauch and Kraft, 1986). The cross-functional approach has been a controversial issue especially in the field of new product development (Imai et al., 1985; Cooper, 1994; Holland et al., 2000, Song and Montoya-Weiss, 2001). Though the cross-functional, or inter-functional, approach may not be directly related to new product development performance and the contingency theory proposes the degree of the integration required differs depending on the degree of uncertainty, (Lawrence and Lorsch, 1967), establishing an environment which includes cross-functional communications generally enhances the effectiveness of the new product development process (Souder et al., 1998; Keller, 2001). The issue is whether this approach is effective in integrating information and wisdom to create extra value and to create a commitment to plant goals. When this approach is effective, it is a positive culture.

We assume that an inter-functional culture is one of the important attributes in activating the strategic management cycle and developing the linkage among the activities necessary for achieving organizational goals. We explore into the effectiveness of an inter-functional culture, which many studies note can sustain an effective management cycle.

Hypothesis 4. An inter-functional culture is positively related to the effectiveness of the strategic management cycle, including the leverage linkages.

3. Methods

The data used in this study were collected from 2002 to 2004 in manufacturing plants in eight countries. They were Austria ($n=21$), Finland (30), Germany (41), Italy (27), Japan (35), South Korea (31), Sweden (24), and USA (29). Industries studied were Electronics (79), Machinery (79), and Transportation Components (automotive and truck) (80). Seventy nine factories had a reputation as world class plants, while 93 are randomly sampled and 66 are unidentified. The number of respondents of each factory is nineteen people, including plant manager ($n=1$), plant superintendent (1), plant accounting manager (1), human resource manager (1), information systems manager (1), production control manager (1), inventory manager (1), process engineer (1), quality manager (1), supervisor (4), and direct labor (5). Each respondent's questionnaire was specifically designed for the respondent's category. Besides numerical answers to questions such as sales, multiple persons were asked questions, using the 7 point Likert scale.

4. Analysis and results

4.1. Measurement of linkages

To test the nature of levered linkage between practices, we began by classifying the manufacturing practices into eight categories based on qualitative judgment and a factor analysis. These practices and categories are shown in Table 1. Though factor analysis results are not shown due to the limitation of pages, all practices in Table 1 satisfied the standards of reliability and validity tests with Cronbach's alpha of .60 and the factor analysis loadings of .55.

Table 2 compares the above and below average groups' average score on the eight practices, in each of which the eight countries, in the subgroups of plants that had an above average or below average values of the practices, Table 2 shows the difference between the scores of the above and below average groups is significant at .01, except for "External Involvement in

Table 1
Practice category and constituent practice.

Practice category	Constituent practice	Factor loading and Cronbach's alpha
Strategy: The extent to which the factory operates strategically	Formal strategic planning	877
	Manufacturing-business strategy linkage	886
	Anticipation of new technologies	842
		alpha = .828
Supply chain: The degree of implementing SCM effectively	Supply chain planning	.863
	Trust-based relationship with suppliers	.874
	Cooperation	.834
		alpha = .809
Facility efficiency: How efficiently the factory operates equipment and processes	Effective process implementation	.859
	Autonomous maintenance	.738
	Preventive maintenance	.848
	Maintenance support	.822
		alpha = .821
Efficient operation: How much the factory implements just-in-time operation	Daily schedule adherence	.671
	Just-in-time delivery by suppliers	.814
	Just-in-time link with customers	.783
	Synchronization of operations	.800
		alpha = .799
External involvement in quality improvement: How effectively the factory involves clients and suppliers	TQM link with customers	.759
	Supplier partnership	.920
	Supplier quality involvement	.916
		alpha = .831
Organizational quality improvement culture: What extent the factory's cultural preparedness to improve quality	Continuous improvement and learning	.853
	Customer focus	.654
	Customer involvement	.757
	Customer satisfaction	.733
	Organization-wide approach	.640
		alpha = .805
Quality improvement foundation: The degree of provision of environment to improve quality	Cleanliness and organization	.747
	Feedback	.853
	Process control	.867
		alpha = .760
Activation of floor: How interactive and cooperative the factory's floor	Commitment	.734
	Coordination of decision making	.762
	Suggestion-implementation and feedback	.818
	Multi-functional employees	.754
	Recruiting and selection	.753
	Shop-floor contact	.748
	Small group problem solving	.802
	Supervisory interaction facilitation	.751
		alpha = .899

Table 2
Comparison of above average and below average groups in the each country.

Practice category	Austria	Finland	Germany	Italy	Japan	South Korea	Sweden	USA
Strategy	6.04	5.71	5.69	5.49	5.72	5.74	5.55	5.52
	5.18	4.94	4.84	4.51	5.13	5.04	4.83	4.56
Supply chain	6.05	5.90	5.90	5.69	5.45	5.68	5.65	5.63
	5.47	5.49	5.24	5.24	4.94	5.17	5.14	5.15
Facility efficiency	5.64	5.17	5.23	4.95	5.33	5.47	4.91	5.17
	4.70	4.57	4.49	4.29	4.55	4.88	4.15	4.24
Efficient operation	4.89	5.06	4.82	4.99	5.12	5.36	4.72	5.21
	4.16	4.24	4.03	4.39	4.24	4.78	3.88	4.46
External involvement in quality improvement	5.36	5.57	5.29	5.40	5.13	5.29	5.20+	5.53
	4.80	5.13	4.65	4.79	4.66	4.92	4.93+	4.98
Organizational quality improvement culture	5.70	5.75	5.54	5.51	5.05	5.27	5.53	5.70
	5.25	5.34	5.04	5.12	4.63	4.94	5.12	5.24
Quality improvement foundation	6.01	5.20	5.63	5.42	5.50	5.60	5.24	5.80
	5.04	4.65	4.72	4.57	4.85	4.92	4.67	4.82
Activation of floor	5.64	5.39	5.60	5.13	5.31	5.48	5.64	5.66
	5.16	4.93	4.77	4.65	4.75	4.89	4.93	4.77

Note: The Top value in each box is for the above average group, and while the bottom value is for the below average group.

Quality Improvement" in Sweden. This supports the first hypothesis that there is a positive relationship between the practice levels in 63 of the 64 possible situations. This type of difference has been reported also by other researchers (Collins et al., 1996). (Table 3).

Table 4 shows the correlation coefficients of the practices in the plants classified as top, middle or bottom group by their value on each of the eight practices. The fewer number of statistically significant differences is because of the reduction of variance due to classifying the plants into the three groups noted above. For the top group, all the statistical significant correlations were positive. The middle group contains negative relationships and non-significant relationships more than either the top or bottom groups. This suggests that balancing forces and the isolating factors exist in the middle group. The reverse correlation between strategy and efficient operation is indicative of the inconsistent alignment of practices in this group. For example, though strategy related practices are well implemented, operational practices are poorly implemented. In addition, the number of statistically significant relationships between the practice categories in the middle group is lower than in either of the other two groups, 18 vs. 11 for both the high and low groups. The middle group's plants may struggle to increase their performance, because their efforts remain isolated or not aligned. Plants in this group may be expected to join the highest group someday by effectuating leverage to create a virtuous cycle of improvement; otherwise they may go down to the low group.

The low group's plants tend to remain poor performers. They appear to be in a trap, where one practice pulls down another. Given the nature of each group, we named the linkage types of the three groups in the order of practice level as levered (top), transitive (middle), and trapped (bottom) (Morita et al., 2001). We confirm these types of the linkage in new data with more countries and factories than in the original 2001 study. The results suggest a plant's main managerial agenda is to construct an effective linkage, i.e., to create each linkage as levered as possible.

Table 5 summarizes the practice categories and competitiveness of the three groups. Competitiveness is measured for each plant by using the first principal component of the factor analysis with the Varimax rotation on thirteen competitive measures that were perceptually evaluated by the plant manager on the Likert's scale from 1 (Worst) to 5 (Best). The thirteen competitive measures are unit cost of manufacturing, conformance to product specifications, on-time delivery performance, fast delivery, flexibility to change product mix, flexibility to change volume, inventory turnover, cycle time (from raw materials to delivery),

Table 3
Correlations among the eight practice categories.

Practice Category	1	2	3	4	5	6	7	8
1. Strategy	1.00	.536	.688	.394	.415	.336	.556	.519
2. Supply chain		1.00	.615	.494	.522	.624	.488	.699
3. Facility efficiency			1.00	.554	.444	.439	.671	.669
4. Efficient operation				1.00	.470	.353	.537	.482
5. External involvement in quality improvement					1.00	.701	.632	.531
6. Organizational quality improvement culture						1.00	.533	.649
7. Quality improvement foundation							1.00	.667
8. Activation of floor								1.00

Note: All correlation coefficients are significant at .1% significance level.

Table 4
Correlations practice categories of the three performance based groups.

Practice Category	1	2	3	4	5	6	7	8
1. Strategy**	1.00	.312 ns .250	.434 .286 .505	ns −.137 ns	ns ns ns	ns ns ns	.245 ns .204	.202 ns ns
2. Supply chain		1.00	.373 ns .355	ns ns ns	ns ns 295	.406 .487 .389	.203 −.278 ns	.484 .377 .541
3. Facility efficiency			1.00	.287 ns .211	ns −.325 .246	ns ns ns	.422 ns 355	.453 ns .436
4. Efficient operation				1.00	ns ns ns	ns ns ns	ns ns ns	ns ns ns
5. External involvement in quality improvement					1.00	.587 .539 .552	.278 ns .429	.259 ns .306
6. Organizational quality improvement culture						1.00	.372 ns .300	.488 .370 .516
7. Quality improvement foundation							1.00	.538 ns .418
8. Activation of floor								1.00

Note: ns implies for being not significant at 10% significance level.

** Each practice are presented by high, medium and low performance groups.

Table 5
Comparison of the practice categories and competitiveness of the three groups.

Practice category	The levered group	The transitive group	The trapped group
Strategy	5.81	5.25	4.75
Supply chain	5.82	5.44	5.14
Facility efficiency	5.35	4.87	4.34
Efficient operation	5.19	4.54	4.20
External involvement in quality improvement	5.44	5.07	4.75
Organizational quality improvement culture	5.54	5.25	5.02
Quality improvement foundation	5.70	5.13	4.61
Activation of floor	5.56	5.11	4.77
Competitiveness	.479	−.18	−.460

Note: The differences between the groups are all significant at .1% significance level.

Table 6
Factor loadings of the first principal component as comprehensive performance.

Scale	Constituent performance	Factor loading
Comprehensive performance	Unit cost of manufacturing	.542
	Conformance to product specifications	.549
	On time delivery performance	.635
	Fast delivery	.555
	Flexibility to change product mix	.619
	Flexibility to change volume	.648
	Inventory turnover	.562
	Cycle time (from raw materials to delivery)	.679
	Speed of new product introduction into the plant	.612
	Product capability and performance on time new product launch	.700
	Product innovativeness	.660
	Customer support and service	.521

Table 7
Operational practice scale and constituent practice categories.

Scale	Constituent scale	Factor loading and Cronbach's alpha
Operational practice implementation level	Supply chain	.806
	Facility efficiency	.796
	Efficient operation	.690
	External involvement in quality improvement	.775
	Organizational quality improvement culture	.780
	Quality improvement foundation	.822
	Activation of floor	.857
		alpha = .892

Table 8
Long-term orientation and constituent questionnaire.

Practice	Constituent questionnaire	Factor loading and Cronbach's alpha
Long-term orientation	We plan for the long-term, rather than optimizing short-term performance.	.804
	We believe that focusing on the distant future will lead to better overall performance than worrying about short-term goals.	.745
	Management outside of the plant is primarily concerned with short-range financial performance. (Reverse)	.701
		alpha = .612

speed of new product introduction into the plant (development lead time), product capability and performance, on-time new product launch, product innovativeness, and customer support/service. The first principal component explains 37.7% of the total variance. This component is interpreted as the comprehensive competence.

Factor loadings for components are presented in Table 6. The differences in the strength of the practices between the levered, transitive, and trapped groups are statistically significant at .10. The difference of the competitive measure's values between the levered group and the other two groups is clearly notified.

The results presented above support the first hypothesis that there is a positive relationship of the existence of linkages among operational practices and plant performance.

4.2. Measurement of strategic management cycle

The super-scales in Table 1, discussed under Measurement of Linkages above, are used to measure a plant's strategic management cycle. The result of the forming strategy stage is represented by the strategy in Table 1. The operational practice implementation level, the result of the operational practice implementation stage, consists of seven practice categories from the supply chain to the activation of floor in Table 1. The reliability and validity test results for the super-scale are found in Table 7. We use the total performance measure defined as the first principal component value of thirteen competitiveness measures.

To measure the visionary environment of the Strategic Management Cycle, we asked about the plant's long-term orientation. While companies have goals, and sometimes clear visions, Hayes et al. noted that a company with the highly levered linkage takes a long-term orientation in achieving them (Hayes et al., 1988). It takes time for resource commitments such as R&D, training, systems, and physical investment to yield their expected outcomes. Without a long-term perspective, it is difficult to make these types of resource allocation decisions consistently. We summarize the reliability and validity test results on the scale of the long-term orientation in Table 8.

The data set used to measure the relationship between the total manufacturing performance and the visionary environment is cross-sectional. Therefore, the transition from the fourth stage, i.e., from the total performance to the visionary environment is not exactly represented by the data. The transitional relationship therefore is an approximation. We assume the relationship is relatively stable over time.

Fig. 3 presents the correlation in each quadrant of the two axes making the quadrant. All correlation coefficients are significant at .1% significance level. These results appear to support the second hypothesis that there is a direct correlation between the strength of one stage of the strategic management cycle and the strength of the next stage, though the transitional relationship between the past performance and the visionary planning is relatively unstable. The companies appear to follow the cycle.

Companies were classified by their average value on the four axes into three groups: top, middle, and low. The cut-off values for the classification into these groups were the average (0) plus half sigma (standard deviation) and the average minus half sigma. The values are used to make each group as equal in size as possible. Table 9 compares each group's value on each axis and performance. The differences in Table 9 appear parallel to those presented in Fig. 2, indicating results for the third hypothesis, indicating the levered alignment exists between the stages of the cycle.

The coefficients reported in Fig. 3 are a measure of the relationship of the axes of the strategic management cycle. The values for the first and second stages (.212 and .318, respectively) are not as high as those for the third and fourth stages (.662 and .410, respectively) of the strategic management cycle shown in Fig. 1. In other words, when a plant establishes its organizational visionary environment based on its organization performance, and forms the strategy under that environment, management can make the biggest difference. That is, these stages appear to be the ones in which a plant can most powerfully develop the strategic management cycle, or a levered linkage.

It should be noted that in these quadrants a trap can be set even if the plant sustains its highly levered linkage. The plant may easily find itself in a vicious cycle in these quadrants, because the plant made a mistake due to its high variability in the transition between them. This may explain why high performance companies over a long time period have distinguished attributes related to these quadrants. For example, Collins argues that a long lasting high performance company seeks a set of values and clear strategic focus consistently over time (Collins, 2001). Also, this highlights the danger of a dependence limited to operational excellence only (Porter, 1996), which is a part of the cycle. Continuous excellence by a plant depends on the continuous high functioning of the strategic management cycle. On the other hand, the weak correlation between these quadrants suggests there is an opportunity for a turnaround. This would occur when an average plant shifts to the virtual cycle as exhibited by the thick lines in Fig. 2.

The high variability in the relationships between the top two quadrants, Visionary and Strategic planning (the fourth and first quadrants) of the strategic management cycle reported in Fig. 3, is notable. This suggests these action areas generally encompass the most difficult issues plants have to address. The areas are the initial stages of the strategic management cycle. Therefore Fig. 3 suggests that the actions at the front-end of the strategic management cycle, generating a vision and forming and following an appropriate strategy for a plant, have a higher rate of error than the other stages of the cycle.

The long term orientation has been considered as one important attribute to measure the goodness of the visionary planning. The

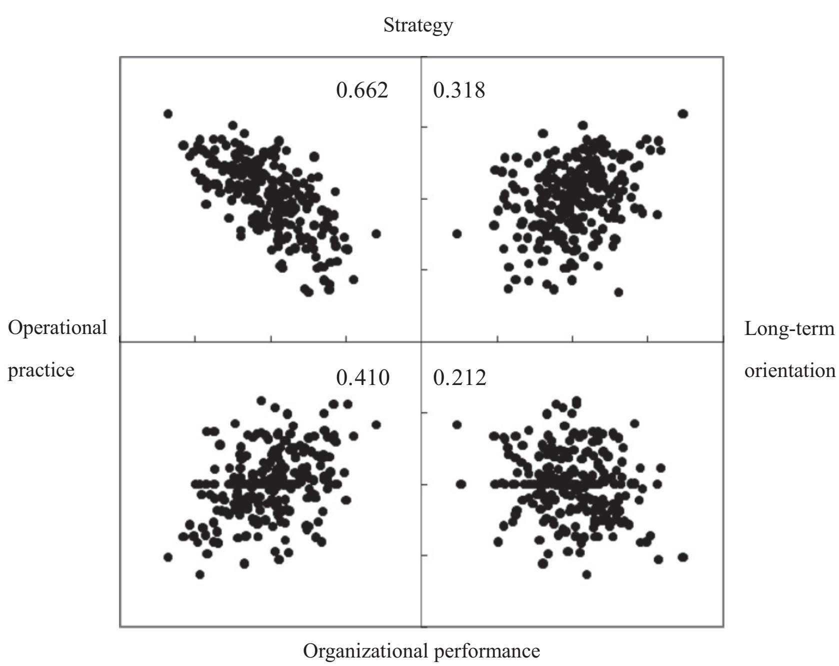

Fig. 3. Measured dynamic transition of the strategic management cycle.

Table 9
Comparison of the three groups.

Axis	Top group (72)	Middle group (83)	Low group (64)
Visionary environment	.730	−.025	−.568
Strategy	.881	.046	−.996
Operational practice	.858	−.031	−.876
Organizational performance	.712	.071	−.776

Note: The differences between the groups are all significant at .1% significance level. The figures in parentheses are the number of companies.

result shown in Fig. 3 suggests the attribute is not enough to assure stably good functioning of the strategic management cycle over time. The fuzziness or uncertainty attached to the visionary and strategic planning is regarded as one significant disturbance factor (Khurana and Rosenthal, 1998).

Next, we checked whether the inter-functional culture gives positive influences to functioning of the strategic management cycle. We divided the sample into two classes, high (above average) and low (below average) inter-functional group, by using a measurement scale of the inter-functional culture. Table 10 presents the reliability and validity test results for the scale. Table 11 compares the levels of the axes' values of the strategic management cycle of these two groups. All the differences are significant at .01%. It confirms Hypothesis 4.

That suggests that when a plant establishes and maintains a cross-functional culture, it can develop a high strategic management cycle.

4.3. Towards high performance manufacturing

Improving the effectiveness of the strategic management cycle is a key to the high performance manufacturing. Improvements should begin at the front-end stages of the cycle, setting up the visionary environment and formulating the strategy. The long term orientation with the cross-functional culture contributes to the stages. But just adopting the attributes is not enough. The cross-functional approach does not necessarily bring about the favorable effects on its own. (Keller, 2001) We will discuss how the high performance manufacturing can be realized based on our results.

4.4. Importance of front-end decisions

Establishing and maintaining the visionary environment and formulating strategy are made at the front-end of the company's strategic management process. With respect to these decisions, the concept of front-end loading is well known in the new product development (Wheelwright and Clark, 1992; Thomke and Fujimoto, 2000; Kim and Wilemon, 2002). Because front-end uncertainty is a significant source of problems in new product development and project management, front-end loading to reduce uncertainty is desirable (Khurana and Rosenthal, 1998). Delays in development, conflicting resource allocations because of unclear project priority, reworks, etc., all emerge due to this uncertainty. Uncertainty also occurs in the process deployment in plants. A poor visionary environment and poor strategy formulation that increases uncertainty make the cycle vulnerable to conflicting, erratic, and less consistent decisions, which leads to waste and ineffective behaviors.

Case studies

Two examples of the establishment and use of the Strategic Management Cycle were found during preliminary interview research conducted by the authors.

First case: the business unit of a Japanese electronics company transformed itself by introducing a new product development process for a new audiovisual appliance product. The transformation was triggered when the company president announced the factory would be closed if it remained uncompetitive. The goal was to make a competitive product in terms of quality (including serviceability), cost, and delivery.

The transformation began with the introduction of a front-end loaded development process that integrated R&D personnel into basic technology and device design, as well as manufacturing related functions. The new process generated a large volume of interaction, initially created some friction between parties. However, the processes facilitated the plant's communication culture and brought constructive interaction between floor people and development staffs. New product design ideas and improvements to existing processes originated on the plant floor. Today, when product engineers walk on the floor, there is a free exchange of ideas and opinions with workers. The plant manager described an episode, before introducing the new process. A worker gave a phone call telling him some strangers were walking around the floor. When he investigated this, he was told they were product engineers. This showed how isolated people on the floor and product engineers were from each other. The new front-end loading system made it easier for people to understand how important improvements were, and how to implement them effectively.

The final product design of this new product, including its internal circuit structure, from the first model to the latest model, is displayed in a room on the plant floor. By walking in and reviewing the display, workers can easily understand how the product design and configuration changed to adapt to customers' needs in terms of external design and compactness. The display also graphically shows how the number of parts has been reduced, helping contribute to a product that is half the size of the original product. Workers understand how their expanded roles contributed to the product's and plant's success.

This plant's new process for new product development embraces the core elements of the two quadrants, high uncertainty and complexity and the inability to have processes implemented and practiced effectively. However, by adopting new processes which integrated the implicit knowledge of the workers and coordinated their interdependent activities, the functioning of these quadrants improved, subsequently improving the plant's and firm's performance.

The company is now leading the Japanese market in this product

Second Case: a second Japanese electronics company that produces personal computers (PC) showed the benefits of linking plant personnel with the company's strategic goals and directions. In this case, the firm was not satisfied with its product's market

Table 10
Iner-functional culture scale and constituent practice categories.

Practice	Constituent scale	Factor loading and Cronbach's alpha
Inter-functional culture	Achievement of functional integration	.929
	Integration between functions	.920
	Leadership for functional integration	.899
	Organizational coordination of functional integration	.855
		alpha = .922

Note: Though we omit the explanation of the constituent scales' measurement here due to the limitation of pages, constituent scales are all passable by the reliability and validity tests with the cutoff values of alpha of .600 and factor loading of .550, respectively.

Table 11
Differences of the axes' values of the strategic management cycle.

Axis	High inter-functional group (1 1 9)	Low inter-functional group (1 1 7)
Visionary environment	.312	−.265
Strategy	.569	−.566
Operational practice	.496	−.490
Organizational performance	.245	−.237

Note: The differences between the groups are all significant at .1% significance level. The figures in parentheses are the number of companies.

share. The company introduced a JIT operation to the floor by inviting people from Toyota to help it become more cost competitive, an important focus in its niche. As a result, the floor space was reduced by close to 50%. However, the competitive situation did not improve. When asked if the result was satisfying, the plant manager said, "it is as expected. But we are not so excited about it, because making PCs itself does not provide satisfactory feeling to us." In the end, motivation in the plant did not change, it remained as low as it had been before.

Case summaries: the difference between the two cases is clear. The first company used an integrated approach which linked both wisdom and goals, while the second company tried to improve operations by importing an external knowledge. While the first company tried to improve the whole cycle, starting at the beginning of the cycle, the second company focused its attention only in the operational practice quadrant in figure 4. The difference in performance between the two firms was clear. The first firm became the number one in its market, while the second firm did not report the performance improvement it intended. The first company had developed the levered linkage, while the second had not.

4.5. Requirements for the long-term high performance manufacturing company

A key to a high performance manufacturing company is in the front-end of the strategic management cycle. This topic remains unexplored both academically and practically. Ill-structured is still an adverb often used to describe its characteristics. An effort to transform ill-structured decision-making into a structured one is desirable. The key benefit is systematizing the front-end loading process so that a routine, both formally and informally, with an appropriate level of structure, develops that ensures the leaders of the business, especially among units and functions, establish communication and interaction bonds with one another (Eisenhardt and Martin, 2000). Simple, experimental, and iterative processes that are effective for the high-velocity market appear to be contradictory under the structured decision-making, such as the PDCA cycle (Eisenhardt and Martin, 2000). But those processes should be implemented rapidly to be competitive. For example, more and earlier testing of prototypes is desirable in high-velocity markets (Eisenhardt and Tabrizi, 1995). It requires a speedy product development process that repeats the cycle from design to making at least more than one time within an allowable period under the competitive situation. In other words, product development time should be shorter. A formal front-end loading process potentially makes such experimental and iterative processes more likely in high-velocity markets (Morita and Ochiai, 2009). The front-end loading process can promote clarity and a common language that can be used to address the unstructured front-end of the cycle (Koen et al., 2001). It has been noted that the building of the total linkage from the front-end is Toyota's strategy of management (Amasaka, 2002).

4.6. Systematization of the front-end loading process

When the systematization of the front-end loading process is initiated, resistance is sometimes encountered from people involved in the process. Senior managers and functional managers, such as product development managers, who have severe time and resource constraints, can be reluctant to endorse the new process. They think the process is troublesome, time consuming, and probably inefficient for them, because they have to follow explicitly detailed, systematized procedures, while also creating additional uncertainties that take time to reduce. The process appears to slow decision making rather than improving it.

High performing Japanese manufacturing firms use a process that includes defining the values embedded in products or services, identifying and evaluating internally and externally available technologies, defining product configurations, evaluating and scheduling development projects, and designing and planning their supply chains (Morita and Ochiai, 2005). People from many functions, such as product R&D, process R&D, procurement, manufacturing, costing, and sales, are involved in the process to discuss, evaluate and understand what each function must do to accomplish the firm's goals. An important step in implementing the process is formatting the framework through which they discuss and make decisions.

The process is effective if it is applied initially to new product development. Most companies are not fully satisfied with their new product development processes. Eventually shortcomings in their existing new product development, including an unclear definition of the products value and the absence of linkages among functions, such as basic R&D and product development, etc., result in a lack of communication of tacit knowledge between functions, are discovered. To transform itself, an organization needs to be aware of these problems before it can promote an understanding of the importance of systematizing the processes used to clarify its vision and formulate its strategy.

Therefore, systematizing these processes enables a company to become more farsighted. This results in an enhanced capability to evaluate technology, processes, internal resource capabilities and allocation, and the business environment. The company can develop and improve the capability of mapping of necessary technologies and activities, including external alliance into the future (Wheelwright and Clark, 1992).

The results of this process include an increased learning capability in the front-end of the strategic management cycle. While standardization appears inappropriate in an area that is thought ill-structured, it is effective because the people who are involved in the front-end loading process are more capable in understanding not only what they know and do not know, but what the other parties do as well.

Many manufacturing firms demand devoted implementation of operations practices. They introduce many types of systems and scientific methods without hesitation, if they know other companies or competitors use them successfully. On the other hand, uncertainties at the front-end of the strategic management cycle are often left untapped, thus creating gaps between it and operations and manufacturing. The result is inefficiencies on the floor, in addition to the inefficiency of strategic activities upstream, such as new product development (Morita and Ochiai, 2005). Floor operations sometimes spend much time and effort compensating for the resulting weaknesses in its strategic activities, the front end of the strategic management cycle. Firms must pay more attention to the linkage between strategy and operations as business environments increase in uncertainty, because misalignment between strategic actions and operations increases. Little attention to these linkages results in high variability in the front-end stages as seen in Fig. 3. A more systematic approach, such as the levered linkages in the strategic management cycle, to these problems, can result in stable relationships between the quadrants.

5. Conclusions

This study revealed that a key to high performance manufacturing is in how well a manufacturing plant develops a levered linkage among its activities. The linkage exploits its resources and tacit knowledge to create products with greater and more attractive values to customers than their competitors do. Manufacturing practices and culture are important ingredients in developing this levered linkage. Alone, neither one cannot sustain the levered linkage over time.

The key to success in manufacturing is to drive the strategic management cycle effectively. To accomplish this, the company needs to be aware of its visionary environment and the formulating strategy, which are most problematic stages of the cycle. Thus, the integration of knowledge at the front-end of the strategic management cycle is a key to high performance manufacturing. This study indicates the development and use of an effective front-end loading mechanism is one of the most important issues managers must address.

Many companies that once had high levels of manufacturing performance and reputation find it easy to lose these attributes as markets become saturated and many other uncertainties emerge, as happened in the last decade. A key contribution of the strategic management cycle is to suggest that over time highly efficient manufacturing practices without strategy cannot lead to high performance. This was first noted almost 15 years ago by Porter (1996), when he reported that there is a significant difference between operational excellence and a true strategic position. Porter's observations were directed at Japanese manufacturing firms. The strategic management cycle can provide the necessary process to ensure that firms do not fall into the trap of pursuing operational excellence for its own sake.

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