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### Managing for Flexibility: A Manufacturing Perspective

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## Managing for Flexibility: A Manufacturing Perspective

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**MANAGING FOR FLEXIBILITY: A MANUFACTURING PERSPECTIVE****Ravi Kathuria**

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## **MANAGING FOR FLEXIBILITY: A MANUFACTURING PERSPECTIVE**

### **ABSTRACT**

This paper investigates managerial practices that are conducive to the management of flexibility. Using data from manufacturing plants in the United States, this paper identifies managerial practices that manufacturing managers strongly demonstrate in plants that place a high emphasis on flexibility. The results indicate that managers who pursue flexibility, emphatically engage in team building, employee empowerment, and other relationship oriented practices that generate enthusiasm among employees. These practices seemingly motivate workers to deal with the uncertainty and changes, in the form of product mix, customer delivery schedule, capacity adjustments, etc., that characterize manufacturing flexibility. Furthermore, workers are entrusted with the traditional responsibilities of manufacturing managers, such as monitoring, problem solving, etc.

**Keywords:** Manufacturing Flexibility, Managerial Practices.

## **INTRODUCTION**

Manufacturing flexibility can be a critical source of competitive advantage yet it is one of the most difficult goals to achieve (Upton, 1994; Gupta & Somers, 1996). Gustavsson (1988) recognized the difficulty in achieving manufacturing flexibility early on and suggested that it should not be treated as a commodity that could be bought off-the-shelf and put directly to use; it should rather be planned and managed carefully. Realizing the importance of management of flexibility, companies are becoming increasingly anxious to build supporting infrastructure at the plant level that would help them accomplish flexibility (Upton, 1995). Manufacturing flexibility may manifest in the ability of a manufacturing plant to introduce new designs or new products into production quickly, adjust capacity rapidly, customize products, handle changes in the product mix quickly, and handle variations in customer delivery schedule (Wood, Ritzman & Sharma, 1990; Nemetz, 1990; Boyer, Leong, Ward & Krajewski, 1997; Suarez, Cusumano & Fine, 1996).

The difficulty in accomplishing flexibility may, in part, be due to a lack of ‘applied focus’ on the managerial aspects of flexibility (Gerwin, 1993). Despite the shifting emphasis of competition toward flexibility (Beckman, 1990; Ferdows & De Meyer, 1990), there are hardly any guidelines as to what kind of infrastructure facilitates the management of flexibility. Lack of research on the administrative aspects of flexibility leads us to the following question: Should manufacturing managers still manage work as they did when the manufacturing priorities were to improve labor productivity and to run plant at peak efficiency? Or should they be more flexible in their approach as companies increasingly emphasize manufacturing flexibility? This paper attempts to answer the above question by investigating managerial practices that manufacturing managers *strongly demonstrate* in the wake of a *high emphasis* on flexibility.

## **BACKGROUND AND THE RESEARCH QUESTION**

Manufacturing flexibility has long been recognized as a competitive priority (Fine & Hax, 1985; Hayes & Wheelwright, 1984; Skinner, 1978, 1985). Despite an upsurge in the research focusing on flexibility (see Suarez et al., 1996; and Gupta & Somers, 1996 for recent literature reviews), few studies have investigated specific managerial practices that could facilitate accomplishment of the so-called 'difficult' goal of achieving flexibility at the plant level. Some studies do address issues such as worker training and delegation. For example, Fisher, Jain, and MacDuffie (1994) observe the reason why organizations fail to achieve flexibility is not because they do not have the right technology but because they either fail to impart worker training or do not understand its importance. Gupta and Somers (1996) reached the same conclusion in that the best way to increase flexibility is to invest in worker training in addition to technology and organizational systems.

In a study of thirty-one plants in the printed circuit board industry, Suarez et al. (1996) confirmed the need for better and broader skills for achieving 'mix' flexibility. They found that increasing workers' authority and coordination would help increase flexibility in the form of 'mix,' 'new-product', and 'volume' flexibility. Elango and Meinhart (1994), and Levary (1992) argued to promote team work for manufacturing organizations vying to be flexible. Walton and Susman (1987) noted that employees made decisions after consultation with one another in the plants that implemented Advanced Manufacturing Technologies (AMTs). Levary (1992) also observed manufacturing workers, that try to be responsive to changes (emphasizing flexibility), were increasingly involved in the decision-making process.

Upton (1995), in a study involving fifty-two uncoated paper plants, observed that work force management was a strong determinant of flexibility. Examining the impact of management

on achieving flexibility, Upton observed: “One clear conclusion .... is that *managerial emphasis on a number of factors is strongly related to flexibility*. This implies that the capabilities necessary for competitive performance can wither or never be built through not recognizing and underlining their importance. However, the capabilities that support flexibility can also be *cultured - by encouraging and emphasizing their importance to the operators in the plant*” (1995, pp. 222-223, emphasis ours). The managerial emphasis was measured using operators perception of the degree of importance given to ‘uniformity and efficiency’ as opposed to ‘quick changeovers.’

From the above discussion, it is clear that certain managerial practices seem more relevant for situations characterized by a high emphasis on flexibility. To identify appropriate management practices for the accomplishment of flexibility, we pose the following research question:

***Research Question:** What kind of managerial practices do manufacturing managers strongly demonstrate when the emphasis is high on flexibility?*

## **RESEARCH METHOD AND DATA ANALYSIS**

### **Sample and Data Collection**

The data used in the study were collected from four employees at two different levels of each company - the manufacturing manager and three subordinates. A preliminary sample of 158 manufacturing plants agreed to participate, of which 99 returned usable sets of questionnaires. The subordinates were used for determining the managerial practices of their manufacturing managers who were responsible for getting the work done in accordance with the priorities of the

plant. The data from the manufacturing managers were collected for assessing a plant's emphasis on flexibility.

In terms of the sample mix, 15% of the participating companies are in fabricated metal, 9% in machinery except electrical and computers, 11% in electrical machinery and electrical goods, 7% in transportation and aerospace, 20% in consumer nondurable, and 38% are miscellaneous including chemical, pharmaceutical, and packaging industry. The distribution of the participating plants characterizes the type of industries in the original sample, as well as, the US industry population, in general.

The frequency analyses of the background variables - job tenure, organizational tenure, education, and age of manufacturing managers - reflect a fairly uniform distribution. Among the background variables, job tenure averaged 5.11 years (s.d. = 4.53), organizational tenure averaged 12.43 years (s.d. = 9.07), and age of manufacturing managers in the sample averaged 42.40 (s.d. = 9.29). Regarding the education of manufacturing managers, 54 respondents (57%) had a bachelor's degree or higher.

### **Operationalization and Validation of Measures**

The variables were operationalized using multi-item instruments. Multiple methodologies, including reliability analysis, factor analysis, and ANOVA, were used to validate the scales.

#### **Manufacturing Flexibility**

In this paper, we assess a plant's emphasis on flexibility as perceived by its manufacturing manager. The emphasis on flexibility was measured using five items. Manufacturing managers rated these items on a five-point Likert scale with values ranging from 1 - 'Not at all Important' to 5- 'Extremely Important.' The items, namely *introducing new designs or new products into production quickly*, *adjusting capacity rapidly within a short period*, and *customizing product to*



*customer specifications, handling changes in the product mix quickly, handling variations in customer delivery schedule*, have been taken from Ritzman, Safizadeh, Wood, and Sharma (1993), Wood et al. (1990), and Nemetz (1990).

Factor analysis was conducted to assess the number of dimensions these items would load on. The five items loaded on a single factor with an eigenvalue of 2.145. The items represent the following flexibility types - new product, volume, mix or changeover, delivery time, and modification - proposed by Suarez et al. (1996) and Boyer et al. (1997). The reliability estimate of the five-item scale is 0.6577, which is above the minimum threshold for newly developed scales (Nunnally, 1978).

### **Managerial Practices**

To ensure generalizability of the model to a wide variety of manufacturing settings, we selected generic managerial practices applicable to all types of managers and organizations. The behavioral approach that emphasizes what managers actually do on the job was considered most appropriate for this purpose. Since Yukl's (1989) behavioral approach to work force management is characterized as "state-of-the-art in terms of recency and comprehensiveness..., and its basic purpose is to be used across different organizational situational contingencies..." (Hunt, 1991, p. 153), we decided to use it in this study.

The managerial practices listed in Yukl's taxonomy are likely to occur when a manager interacts with subordinates, superiors, peers, or even outsiders; and the relative importance of these practices is expected to vary across situations (Yukl, 1989, 1994). These practices are: (i) Relationship oriented practices that include networking, team building, supporting, mentoring, inspiring, recognizing, and rewarding; (ii) Participative leadership and delegation practices, such

as consulting, and delegating; and (iii) Work oriented practices, namely planning, clarifying, problem solving, monitoring, and informing. These practices are defined in Table 1.

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Take in Table 1

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Measures for these managerial practices were obtained from Yukl (1990). The fourteen practices are operationalized using a total of seventy items. Cronbach's alpha coefficients for the fourteen practices in the questionnaire were computed, and the internal consistency was found to be very high for all scales (Cronbach's alphas 0.82 to 0.93). Before averaging responses of multiple subordinates for a manager on each work force management practice, level of agreement among subordinates was assessed, as suggested by Yukl, Wall, and Lepsinger (1990), using a one-way analysis of variance (ANOVA) on each scale score for 99 plants. The F-tests were highly significant ( $p < 0.001$ ) for each of the fourteen scales, except for monitoring ( $p < 0.01$ ) and planning ( $p < 0.05$ ). A significant F-test implies that the variation among managers is much greater than the variation among individual respondents reporting to these managers.

It is, therefore, considered appropriate to aggregate responses of subordinates to reflect constructs at a higher level (Georgopoulos, 1986; Dansereau, Jr. & Alutto, 1990). For each of the fourteen work force management practices, scores were computed by averaging across items, and then across respondents to produce a single score for each manufacturing manager.

## **RESULTS AND DISCUSSION**

Table 2 shows the means, standard deviations, and correlations between variables. All pairs of managerial practices are positively and significantly correlated. Managerial practices that are positively and significantly ( $p \leq 0.05$ ) correlated with the emphasis on flexibility include team building, mentoring, inspiring, recognizing, and planning. These correlations imply that manufacturing managers, who are employed in plants with a relatively high emphasis on flexibility, tend to strongly demonstrate the above practices.

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Take in Table 2

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T-tests were conducted (Table 3) to ascertain if the managerial practices were significantly different in plants with a high emphasis on flexibility compared to those with a low emphasis. From the sample we extracted two groups based on their emphasis on flexibility. The first group includes plants that rank in the top-third on the emphasis on flexibility, and the second group includes plants that rank in the bottom-third. As seen in Table 3, team building, mentoring, inspiring, recognizing, and planning are emphasized more by manufacturing managers in plants that place a high emphasis on flexibility. On the other hand, managers in plants with a low emphasis on flexibility do not strongly demonstrate these practices. These differences are significant at  $p < 0.05$ . The two groups of managers also differ, though moderately ( $p < 0.10$ ), on supportive and delegating practices. For all other practices including networking, rewarding, consulting, informing, monitoring, problem solving, and clarifying, the differences are not significant.

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Take in Table 3

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The results indicate that the relationship oriented practices - team building, supportive, mentoring, inspiring, and recognizing - seem to play an important role in manufacturing settings characterized by a high emphasis on flexibility. It appears as though uncertainty caused by possible variations in delivery schedule, volume, and product mix can be best handled by encouraging cooperation and teamwork among employees (team building), using influence techniques to generate enthusiasm among employees (inspiring), praising and recognizing

effective performance (recognizing), by being friendly and considerate (supportive), and offering employees advice on how to advance career (mentoring).

Regarding the participative leadership (consulting) and delegating practices, it appears that changes in the product mix, customer delivery schedule, and the volume are best handled by empowering employees to handle these changes. As regards consulting, managers in both settings - low as well as high emphasis on flexibility - seem to use it evenly.

As one would expect, four of the five work oriented practices - problem solving, clarifying, monitoring, and informing - played no significant role in facilitating the management of flexibility. A nonsignificant difference for each of the four practices confirms the need for workers' active involvement (lesser or no involvement of manufacturing managers) in formal problem-solving activities; task assignments and setting performance objectives; monitoring their own machines, equipment, and processes; and seeking the necessary information when the emphasis is high on flexibility. This finding is also consistent with the notion of self-managing teams when the environment is characterized by flexibility - variability in the form of inputs, outputs, and the processes. Managers, however, place a greater emphasis on planning, that includes the determination of long term strategic objectives, when the situation is characterized by uncertainty and variability in product mix, delivery schedule, and production volume.

## **CONCLUSIONS AND IMPLICATIONS**

### **Conclusions**

This study shows that managers strongly demonstrate certain managerial practices when the emphasis is high on flexibility than when the emphasis is low, in order to encounter the uncertainty underlying flexibility. The results provide empirical evidence to the contentions of

some early researchers including Elango and Meinhart (1994), Hall (1983), Levary (1992), Walton and Susman (1987), among others. This study is a comprehensive evaluation of fourteen managerial practices for managing flexibility. It fills a void in the manufacturing literature by examining managerial practices that facilitate the management of flexibility. The knowledge of these pertinent managerial practices, that managers increasingly engage-in when the emphasis is high on flexibility, would facilitate accomplishment of the so-called difficult goal of managing flexibility.

When the emphasis is high on flexibility, team building, inspiring, recognizing, supportive, mentoring, and delegating practices seem more useful in getting the underlying tasks done effectively. These practices, shown in Figure 1, seemingly encourage employees to deal with the uncertainty and changes, in the form of product mix, customer delivery schedule, capacity adjustments, etc., that characterize a high emphasis on flexibility. Furthermore, planning plays a significant role when a company wants to promote the ability to handle variations associated with a high emphasis on flexibility.

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Take in Figure 1

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The study also unearthed that most of the work oriented practices - problem solving, clarifying, monitoring, and informing - are not used strongly by managers when the situation is characterized by a high emphasis on flexibility. Managers seem to empower self-managing employee teams to seek information necessary to carry out their work, to monitor the progress and quality of their own work, and to fix problems as they arise. Furthermore, all managers seem to consult with their employees before making any decisions that affect employees, regardless of the emphasis on flexibility. Offering monetary rewards to individual employees is not what managers

engage-in when pursuing flexibility. In most cases, offering tangible rewards may also be outside the purview of manufacturing managers.

The general findings of this study are consistent with the underlying logic of the contingency theories of leadership. Some noteworthy theories, among others, are the path-goal theory of leadership (House, 1971), the leadership substitutes theory (Kerr & Jermier, 1978), the multiple linkage model (Yukl, 1989), and the least preferred coworker contingency model (Fiedler, 1964). These theories are supportive of the notion that different leader traits, skills, and behaviors have differential usefulness in different situations. The present study is an affirmation of these situational leadership approaches in manufacturing settings characterized by a varying degree of emphasis on flexibility.

### **Implications for Practitioners**

The identification of managerial practices that managers increasingly use when the emphasis is high on manufacturing flexibility can help the practicing managers in the following ways. First, the findings of the study can be used to apprise manufacturing managers of the ‘right’ type of managerial practices for managing manufacturing flexibility. Demonstrating the right managerial practices would facilitate accomplishment of the so-called difficult goal of accomplishing flexibility at the plant level. The manufacturing managers faced with a high emphasis on flexibility in their plants should fervently use the relationship oriented practices to motivate their employees to effectively deal with the uncertainty that characterizes manufacturing flexibility.

The traditional responsibilities of manufacturing managers, such as problem solving, monitoring, etc., were perhaps appropriate when the focus was on efficiency and cost control in an environment of few standard products. In plants vying to be flexible, workers should rather be

entrusted with these responsibilities. In such situations, manufacturing managers should encourage employees to work in self-managing teams that seek necessary information to carry out their work, are self-monitoring, and empowered to fix problems as they arise. Managers should serve as coaches, mentors and motivators when the manufacturing plants intend to introduce new products frequently, make frequent changes in product designs as desired by their customers, develop capabilities to accommodate changes in the volume and delivery schedules, and make capacity adjustments rapidly.

Second, the findings of this study can help assess training needs for manufacturing managers in plants that emphasize flexibility. The training needs can be identified by comparing the inherent behavior profiles of manufacturing managers with the one appropriate for a high emphasis on flexibility. For example, managers in manufacturing settings with a high emphasis on flexibility seem to strongly demonstrate the relationship oriented practices and empower employees that, in turn, encourages employee involvement, and helps with managing the uncertainty in the forms of output, input, process sequence, etc. Having determined the gap - the practices that a manager needs to work on to effectively carry out the tasks underlying flexibility - the manager may use one of the available management games and simulations (cf., Keys & Wolfe, 1990; Tannenbaum & Yukl, 1992) to increase his/her score on the requisite practices.

### **Directions for Future Research**

The ideas presented in this paper provide a good starting point for further theoretical as well as empirical research in flexibility and human resources. Given that flexibility is a multidimensional construct, future research should develop a more comprehensive measure of flexibility, and examine the appropriateness of managerial practices for pursuing different dimensions of

flexibility. Building and examining such hypotheses will further help delineate the relationship between managerial styles and the management of flexibility. Future research may also benefit from extending this research to other competitive priorities, such as delivery, quality, and cost, and examining the task-managerial practice congruence for each priority.



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**TABLE 1**  
**Yukl's Definitions of Managerial Practices**

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**Relationship Oriented Practices:**

**NETWORKING:** Socializing informally, developing contacts with people who are a source of information and support, and maintaining contacts through periodic interaction, including visits, telephone calls, correspondence, and attendance at meetings and social events.

**MANAGING CONFLICT AND TEAM BUILDING:** Facilitating the constructive resolution of conflict, and encouraging cooperation, teamwork, and identification with the work unit.

**SUPPORTING:** Acting friendly and considerate, being patient and helpful, showing sympathy and support when someone is upset or anxious, listening to complaints and problems, looking out for someone's interests.

**DEVELOPING AND MENTORING:** Providing coaching and helpful career advice, and doing things to facilitate a person's skill acquisition, professional development, and career advancement.

**MOTIVATING AND INSPIRING:** Using influence techniques that appeal to emotion or logic to generate enthusiasm for the work, commitment to task objectives, and compliance with requests for cooperation, assistance, support, or resources; setting an example of appropriate behavior.

**RECOGNIZING:** Providing praise and recognition for effective performance, significant achievements, and special contributions; expressing appreciation for someone's contributions and special efforts.

**REWARDING:** Providing or recommending tangible rewards such as a pay increase or promotion for effective performance, significant achievements, and demonstrated competence.

**Participative Leadership and Delegation:**

**CONSULTING:** Checking with people before making changes that affect them, encouraging suggestions for improvement, inviting participation in decision making, incorporating the ideas and suggestions of others in decisions.

**DELEGATING:** Allowing subordinates to have substantial responsibility and discretion in carrying out work activities, handling problems, and making important decisions.

**Work Oriented Practices:**

**PLANNING AND ORGANIZING:** Determining long-term objectives and strategies, allocating resources according to priorities, determining how to use personnel and resources to accomplish a task efficiently, and determining how to improve coordination, productivity, and the effectiveness of the organizational unit.

**PROBLEM SOLVING:** Identifying work-related problems, analyzing problems in a timely but systematic manner to identify causes and find solutions, and acting decisively to implement solutions to resolve important problems or crises.

**CLARIFYING ROLES AND OBJECTIVES:** Assigning tasks, providing direction in how to do the work, and communicating a clear understanding of job responsibilities, task objectives, deadlines, and performance expectations.

**INFORMING:** Disseminating relevant information about decisions, plans, and activities to people that need it to do their work, providing written materials and documents, and answering requests for technical information.

**MONITORING:** Gathering information about work activities and external conditions affecting the work, checking on the progress and quality of the work, evaluating the performance of individuals and the organizational unit, analyzing trends, and forecasting external events.

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(Adapted from Yukl, 1994; p.69)

Table 2

**Descriptive Statistics**

Variable	Mean	S.D.	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Informing	3.17	0.48	.60	.66	.70	.45	.59	.55	.62	.47	.48	.50	.72	.63	.46	.03 <sup>n</sup>
2. Planning	2.99	0.45		.65	.51	.62	.69	.59	.55	.33	.37	.45	.72	.54	.32	.23
3. Clarifying	3.17	0.49			.72	.58	.65	.64	.59	.37	.59	.52	.79	.65	.43	.12 <sup>n</sup>
4. Consulting	3.17	0.59				.47	.61	.63	.69	.40	.62	.52	.71	.72	.42	.08 <sup>n</sup>
5. Monitoring	3.08	0.46					.71	.53	.58	.49	.45	.40	.64	.56	.22	.06 <sup>n</sup>
6. Prob. Solving	3.16	0.49						.70	.74	.43	.50	.44	.76	.68	.43	.06 <sup>n</sup>
7. Supporting	3.31	0.51							.73	.38	.58	.46	.65	.71	.38	.14 <sup>n</sup>
8. Team Building	3.27	0.58								.52	.64	.55	.72	.71	.48	.21
9. Networking	2.65	0.76									.46	.51	.57	.50	.52	.02 <sup>n</sup>
10. Delegating	3.22	0.62										.51	.56	.54	.45	.10 <sup>n</sup>
11. Mentoring	2.51	0.65											.66	.60	.58	.25
12. Inspiring	3.03	0.56												.71	.50	.20
13. Recognizing	3.08	0.59													.47	.18
14. Rewarding	2.58	0.82														-.00 <sup>n</sup>
15. Flexibility	3.75	0.64														1.00

All correlation coefficients are significant at  $p < .05$  unless specified otherwise.

n = not significant at  $p < .05$ .

Table 3

**Difference in Managerial Practices for Plants with High/Low Emphasis on Flexibility**

Variables	High Emphasis		Low Emphasis		Difference	
	Average	S.D.	Average	S.D.	T	Sig. T
<b><u>Relationship Oriented Practices</u></b>						
Networking	2.69	0.72	2.67	0.66	0.15	0.442
<b>Team Building</b>	<b>3.33</b>	<b>0.51</b>	<b>2.99</b>	<b>0.67</b>	<b>2.10</b>	<b>0.020</b>
<b>Supportive</b>	<b>3.34</b>	<b>0.52</b>	<b>3.14</b>	<b>0.52</b>	<b>1.43</b>	<b>0.079</b>
<b>Mentoring</b>	<b>2.75</b>	<b>0.66</b>	<b>2.28</b>	<b>0.62</b>	<b>2.74</b>	<b>0.004</b>
<b>Inspiring</b>	<b>3.13</b>	<b>0.56</b>	<b>2.84</b>	<b>0.54</b>	<b>1.96</b>	<b>0.027</b>
<b>Recognizing</b>	<b>3.23</b>	<b>0.52</b>	<b>2.91</b>	<b>0.58</b>	<b>2.17</b>	<b>0.017</b>
Rewarding	2.72	0.80	2.62	0.77	0.49	0.313
<b><u>Participative Leadership and Delegation</u></b>						
Consulting	3.23	0.56	3.05	0.70	1.01	0.157
<b>Delegating</b>	<b>3.34</b>	<b>0.48</b>	<b>3.14</b>	<b>0.65</b>	<b>1.35</b>	<b>0.092</b>
<b><u>Work Oriented Practices</u></b>						
Informing	3.12	0.46	3.05	0.53	0.49	0.311
<b>Planning</b>	<b>3.08</b>	<b>0.43</b>	<b>2.83</b>	<b>0.42</b>	<b>2.22</b>	<b>0.015</b>
Monitoring	3.10	0.45	2.97	0.45	1.01	0.159
Problem Solving	3.18	0.50	3.09	0.46	0.69	0.245
Clarifying	3.23	0.49	3.12	0.48	0.92	0.181

The high emphasis sample includes only plants that rank in the top-third on the emphasis on Flexibility, and the low emphasis sample includes only plants that rank in the bottom-third.

The average scores for managerial practices **in bold**, in the two samples, are significantly different at  $p < 0.10$ .

**Figure 1. Relative Importance of Managerial Practices for Managing Manufacturing Flexibility**

