



Manager's Degree of JIT Involvement, Locus of Control and Managerial Performance

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ABSTRACT

The competitive global environment has lead many firms into adopting practices that focus on eliminating inefficiencies across the enterprise and its supply chain. The Just-in-Time philosophy is one such practice, however, research has predominantly focused on its technical features and on organisational variables, with surprising little research at the individual level. This paper examines JIT at an individual level and argues that the manager's locus of control orientation would interact with their degree of JIT involvement to affect managerial performance. The results of a survey of 60 managers employing JIT, demonstrate that an increased degree of JIT involvement leads to a more positive effect on managerial performance for internal locus of control managers than for external locus of control managers.

Keywords – just-in-time (JIT); locus of control; degree of JIT involvement; managerial performance

INTRODUCTION

The adoption of Just-in-time (JIT) systems for many firms has been the result of the manufacturing function being elevated to a position of strategic importance and a source of competitive advantage (Kalagnanam & Lindsay 1998). The apparent benefits of JIT stem from the reduction/elimination of many non-value adding activities. However the adoption of JIT does not automatically increase profits due to the direct and indirect costs associated with implementation (Balakrishnan et al. 1996). Groebner & Merz (1994, p.26) asserted, 'as with any new management process, JIT's effectiveness is dependent on how the technique is implemented'.

Previous research analysing the impact of JIT on performance is equivocal, with some researchers reporting performance improvements with the implementation of JIT systems (Flynn et al. 1995; Callen et al. 2000) and others finding no improvements (Balakrishnan et al. 1996; Kendall & Steen 1998; Clarke & Mia 1993). Several researchers have demonstrated that contingency variables play an important role in determining the success or otherwise of the JIT philosophy. This research has shown that organisational variables such as structure and culture (Sohal et al. 1993; Selto et al. 1995; Kalagnanam & Lindsay 1998), infrastructure (Flynn et al., 1995), intensity of market competition (Chong & Rundas 1999), and performance-related information (Mia 2000) are important variables in determining the successful adoption of JIT.

However, little attention has been placed on examining individual behavioural considerations within a JIT environment. This is surprising given the significant changes the JIT approach creates in the work place (Peters & Austin 1995). The introduction of JIT can induce job-related stress, which can have a detrimental effect on individual performance in terms of long-term productivity, work quality and decision making (Inman & Brandon 1992; Peters & Austin 1995; Godard 2001).

The need to go beyond the technical and uncover the behavioural aspects of JIT adoption was recognised by Power & Sohal (2000b p.933) who noted the importance of balancing ‘people involvement’ against an understanding of what this change in involvement means to the individuals concerned and the organisation itself. The consequence of a lean production system under JIT makes employee involvement and behaviour management crucial, as exposed inefficiencies and problems need to be corrected to ensure customer orders are delivered on time. Indeed, Godard (2001) asserted that the benefits of higher empowerment, task involvement and belongingness may be diminished due to workers being overwhelmed and becoming stressed. Watson & Bauml (1967) argue that individuals will perform better in situations where actual environmental locus of control and the individual’s preferred locus of control are congruent. The inherent differences in control within a JIT and non-JIT system have implications for the involvement and behaviour management of all staff. The purpose of this study is to examine the interaction between degree of JIT involvement and locus of control affecting managerial performance. Empirical evidence is presented which suggests that the association between the degree of JIT involvement and managerial performance is influenced significantly by whether a manager has an internal or external locus of control.

BACKGROUND AND RELEVANT LITERATURE

JIT Philosophy

The JIT manufacturing philosophy is a contemporary management practice that is used to control the production flow through a multistage environment (Langfield-Smith et al. 1998, p.20.11). The JIT philosophy emphasises demand-driven production (a pull rather than a push system), reduced or eliminated inventory, set-up time reduction, high-quality (zero defects), manufacturing cells, continuous improvement, multi-skilled workers and employee empowerment (Bhimani & Bromwich 1991; Sohal et al. 1993; Crusoe et al., 1999; Horngren et al. 2000). These aspects of JIT production are concerned with the elimination of activities that do not add value to the product being manufactured (Bhimani & Bromwich 1991; Kendall & Steen 1998). Overall the JIT system allows a business to become more responsive to customer requirements through the elimination of all inefficiencies in all aspects of an enterprise and its supply chain (Kendall & Steen 1998).

Although JIT has many benefits, Balakrishnan et al. (1996) pointed out that adopting JIT production does not automatically increase profit because the benefits from JIT adoption may be offset by its many direct and indirect costs. Significant training and implementation costs, increased dependence on suppliers, higher risk of plant shut-down, development of a flexible cross-trained workforce and cost and availability of normally required computer-aided design and drafting software are some of the costs associated with JIT implementation (Crusoe et al. 1999). Research has also indicated that the

many changes and imperatives that JIT brings about can have profound effects on employees such as higher stress levels (Klein 1989; Inman & Brandon 1992; Godard 2001). Thus, the adoption of JIT needs to be managed in an appropriate manner to reap the benefits.

JIT and Performance

The increase in global competition has lead organisations to consider adopting practices such as JIT to establish or maintain a competitive advantage. Thus research on the impact of JIT on performance is important in establishing whether the adoption of JIT reaps the alleged benefits espoused. A review of research in this area reveals that the impact of JIT on performance is unclear. Balakrishnan et al. (1996) argued that JIT adoption would increase a firm's return on assets (ROA) through an increase in a firm's competitive advantage, lowering inventory levels and a decrease in asset base due to the freeing-up of both capital and physical assets. On average, the researchers did not find a significant ROA response to JIT adoption. Clarke & Mia (1993) studied the extent of JIT adoption and found that of the 35 respondent firms in their study that used JIT, only approximately one-half reported improvements in some performance measures. These findings are similar to Kendall and Steen (1998) who concluded from a comparison of JIT and non-JIT firms that JIT as an overall production process did not appear to improve efficiency significantly. However, Flynn et al. (1995) observed performance improvements in firms adopting JIT. Further Callen et al. (2000) when comparing JIT and non-JIT firms on a number of criteria found that JIT firms achieved greater productivity, higher profits and lower total and variable costs than their non-JIT counterparts.

Other research has demonstrated that contingency variables play an important role in determining the success or otherwise of the JIT philosophy. Flynn et al. (1995) established that infrastructure practices such as information feedback, management support and workforce management improved JIT performance. Kalagnanam & Lindsay (1998) found that JIT firms utilising an organic model of management showed higher performance than firms using a mechanistic organisational structure. Other factors which have been shown to affect the success of JIT include organisational culture, corporate strategy, degree of intensity of market competition and the provision of performance related information (Sohal et al. 1993; Chong & Rundus 1999; Mia 2000).

Although the contingency approach has been criticised for underspecifying complex relationships (Drazin & Van de Ven 1985; Van de Ven & Drazin 1985), it is a useful approach in gaining an understanding of when and how benefits are obtained from a system and in explaining conflicting research results (Brownell, 1981; Frucot and Shearon, 1991; Otley et al. 1994; Flynn et al. 1995; Selto et al. 1995; Kalagnanam and Lindsay 1998). Selto et al. (1995 p. 665) argued that 'the adoption of new manufacturing practices such as Just-in-time (JIT) and total quality management (TQC) is only

the first step to improving manufacturing performance. Even more crucial is the fit between manufacturing practices and organisational design, structure and process'.

Studying various contingency constructs, Selto et al. (1995) discovered that a misfit between worker empowerment required by JIT practices and existing authoritarian management helped explain the detrimental effect on workgroup performance. Research conducted by Sohal et al. (1993) found that the main issues to be addressed when implementing JIT relate to human resource development and management, not production methods and techniques. The technical aspects of JIT will be of little impact if they are implemented without due attention being paid to human variables (Power & Sohal 1997).

Research to date has been limited to the impact of organisational design, structure and process variables on organisational performance. However, personal and intrapersonal variables and their possible association with features advocated under JIT appear not to have been considered. Given the very different working environmental conditions promoted under a JIT system compared with a traditional system, an understanding of manager behaviour and performance is crucial if firms are to gain full advantage of the benefits espoused under a JIT system. The link between managerial performance and organisational performance has been documented (Brownell & Merchant 1990).

Managers and supervisors have greater levels of responsibility and are more likely to be held accountable for organisational effectiveness within a JIT environment (Groebner & Merz 1994; Peters & Austin 1995). It has also been suggested that JIT can induce job-related stress, which can have a detrimental effect on individual performance in terms of long-term productivity, work quality and decision making (Inman & Brandon 1992; Peters & Austin 1995). Power & Sohal (1997) argue that a greater understanding at the individual level will enable the development of models to predict more accurately the organisational conditions which facilitate successful implementation and operation of JIT. Ashton et al. (1995) state that the consideration of people's behaviour and the meaning they attach to systems and processes can alter and shape the organisation. They suggest that this, in part, explains the perceived gap between theory and practice, especially with respect to new manufacturing technologies.

The importance of understanding the impact of behavioural aspects on management systems is evident from the abundance of research focusing on such considerations. Personality variables such as locus of control, tolerance for ambiguity and authoritarianism have been found to be important variables in the examination of the success of management practices (Vroom 1960; Mitchell et al. 1975; Abdel-Halim & Rowland 1976; Brownell 1981, 1982b; Chenhall 1986; Licata et al., 1986; Chenhall &

Brownell 1988; Mia 1989; Frucot & Shearon 1991; Harrison 1992, 1993; Otley et al. 1994; Selto et al, 1995). However, the relevance of personality variables to the successful adoption of contemporary practices, such as JIT, is uncertain due to the limited research in this area. This exposes a weakness in our understanding of how to properly manage resources and processes within such an environment.

Degree of JIT Involvement and Locus of Control

One of the expectations and working environment changes promoted under JIT is employee empowerment (Bhimani & Bromwich 1991; Sohal et al. 1993; Rayburn, 1996; Langfield-Smith et al. 1998; Crusoe et al. 1999, Horngren et al. 2000). Theoretically, empowerment of employees gives the people near the coalface who know the production system intimately the capacity to solve problems and improve the production processes.

Power & Sohal (2000a) argue that JIT companies can be expected to be characterised by a participative management style. 'Stating that JIT requires and facilitates greater levels of employee involvement that will be critical to success (or otherwise) oversimplifies the profound nature of these changes...' (Power & Sohal, 2000b p.933). For the companies involved in Power & Sohal's (2000a) study, employee involvement was found to be a critical element in the successful operation of JIT. This finding is in line with Selto et al. (1995) who argued that workgroup performance was impeded because of a conflict between an authoritarian management style and employee empowerment. The appropriate extent and management of employee involvement within a JIT environment could be the key to successful JIT adoption. An important personality variable that has been shown to impact on performance in participative settings is locus of control.

Locus of control is one of the most studied variables in psychology and the other social sciences (Rotter 1990 p.489). This is not surprising considering its applicability across a wide range of situations (Joe 1971; Brownell 1981, 1982b). Lefcourt (1966 p.207) defined locus of control in the following manner:

As a general principle, internal control refers to the perceptions of positive and/or negative events as being a consequence of ones own actions and thereby under personal control; external control refers to the perception of positive and/or negative events as being unrelated to ones own behaviours in certain situations and therefore beyond personal control.

Watson & Bauml (1967) suggested that individuals perform most efficiently in situations where actual environmental locus of control and the individuals' preferred locus of control are congruent.

Thus, a congruent situation occurs for internal individuals when they possess control, whereas congruency exists for external individuals when control is determined by chance.

The call for empowerment within a JIT environment necessitates the need to manage the extent of involvement and control, given that the locus of control orientation of managers could determine the success of such empowerment. Indeed, the conflict between the authoritarian management and empowerment in Selto et al.'s (1995) study could in part be explained by the personalities of the subjects involved. Mitchell et al. (1975), utilising a questionnaire, found that internal locus of control 'superiors' were generally more considerate and less directive than external locus of control 'superiors'. In a laboratory experiment, Licata et al. (1986) also found that internal 'superiors' were more willing to allow subordinates greater participation than external managers. Runyan (in Mitchell et al. 1975) argued that internal locus of control individuals show greater work involvement and prefer a participative style of management compared to external locus of control individuals who would appear frustrated under a similar style. Studies by Brownell (1981, 1982b), Mia (1989) and Otley et al. (1994) examining a budget scenario show that subordinate managers performed better and were more job satisfied when their locus of control matched that of the environment when examining a budget scenario. Thus, the extent of involvement needs to be balanced with the locus of control orientation of the managers concerned.

In establishing the locus of control hypothesis, Rotter (1966) intended the construct to be broad allowing its application to a variety of behavioural situations (Rotter 1990). It is argued that the basic locus of control congruency premise, as put forward by Watson and Bauml (1967) will hold under a JIT scenario. An underlying phenomenon of the basic locus of control congruency thesis is the perception of control or influence (Rotter & Mulry 1965). The JIT environment encourages efficiency, timing and quality of production within a demand-driven production system. The level of control or influence exercised by managers and employees within the plants to deal with the production flow would determine the locus of control nature of the environment. If managers perceive they are responsible for dealing with and managing the demands, distortions and process improvement efforts at the plant then the source of control over performance is internal. Thus, characterizing this high degree of involvement as an internally controlled situation, congruence will only exist for individuals who are internal on the locus on control dimension. Internals are hypothesised to perform better in this situation than under a low involvement situation. Under a low involvement condition where internals perceive they have no influence or control on changing the process or on 'fixing' problems that may arise to ensure production flow is on schedule could feel frustrated thus lowering performance. Alternatively, an externally controlled situation would be characterized, as one in which there was a low degree of JIT involvement. In this situation congruence will occur for individuals who

are external on the locus of control dimension, and they are hypothesized to perform better under this condition than under high involvement situations. Externally controlled individuals perceive that events are outside their control and would appear frustrated if required to deal with changes or distortions to structured work practices to enable deadlines to be met.

HYPOTHESIS

It is argued that there is an interaction between degree of JIT involvement and locus of control affecting managerial performance. More specifically, internals are expected to perform better when given a high degree of JIT involvement whereas externals are expected to perform better when given a low degree of JIT involvement. The hypothesis is presented in the null form as follows:

H_0 : There will be no significant interaction between degree of JIT involvement and locus of control affecting managerial performance.

RESEARCH METHOD

A mail survey was used to collect data for the study. Survey methodology was chosen for its usual advantages such as greater external validity, limiting interviewer bias and the probability of gaining a larger sample to reduce sampling error. The other benefit of utilising this methodology was to allow a sample to be drawn from a cross section of manufacturing plants employing JIT. Previous research on JIT has been predominantly one-site case studies (Scott et al. 1992; Groebner & Merz 1994; Mullarkey et al. 1995). Increasing the number of plants also assists in obtaining a greater variation in the variables of interest.

Firstly, for the purpose of this study the level of analysis chosen was managers and supervisors within a plant. Callen et al. (2000) justifies the examination at plant level rather than firm level because a multi-plant firm will not necessarily adopt JIT in all or even most of its plants. Secondly, the sample was restricted to manufacturing plants to increase homogeneity within the sample, without losing variation among the firms. Thirdly, the sampling was limited to Australia thus limiting any cross section differences due to general market conditions and culture. Further plants had to be autonomous thus allowing some control over decision making. Lastly, to minimise any size effect plants were required to have at least 50 employees. The minimum of 50 employees criterion was also used by Callen et al. 2000.

Identification of JIT Plants

Given that there was no available database identifying plants across Australia that utilised JIT, the plants were identified by the following four means.

1. Industry bodies were contacted.
2. ¹ This method revealed 13 plants utilising the JIT philosophy.
3. Thirteen academics across Australia with relevant JIT research experience were contacted. Pursuing this line of inquiry resulted in the identification of an additional three plants.
4. Word searches were conducted on the Australasian Business Intelligence (ABIX) database using the search strings “just-in-time” and “JIT” as a free text search. This resulted in the identification of 10 plants using JIT manufacturing.²
5. The managers of plants contacted were asked if any of their other Australian plants also used JIT. This led to a further three plants.

The plant manager or equivalent of each identified plant was contacted. Contact details were obtained from *The Business Who's Who of Australia* and *Kompass Australia*. The contact was made for two reasons. The first was to ensure that those plants participating were global JIT users and, secondly, to request participation. It was necessary to ensure prior to sending the questionnaires that the plants were global JIT users because, if one plant uses only one component of JIT while another plant adopts a global implementation of JIT, putting both in the same group would induce heterogeneity within the sample (Callen et al. 2000). To determine the existence of global JIT adoption a modified version of a method developed by Callen et al. (2000) that employed a checklist of 17 JIT techniques was utilised. The plant managers were asked to indicate which of the 17 JIT techniques were adopted at their plant. If the plant manager could confirm that nine out of the 17 techniques were used, the plant was classified as a JIT adopter. This is in line with Callen et al. (2000) and addresses criticism of past research, where organisations that used one JIT practice were compared with others that used 10 (White 1993). Thirteen plants fulfilled the criteria and the plant manager agreed to allow their personnel to participate. The average number of JIT practices used by the plants was 12 with a range between 9 and 16. Table 1 lists the JIT practices and the number of plants that used each practice.

[take in Table 1]

The manufacturing processes of the 13 plants included the manufacture of plasterboard, door and window hardware, pharmaceuticals, lawn care products such as mowers, motor vehicles and automotive components including dash boards and metal fabrications including electrical enclosures, metal outdoor building structures and springs. Tests (*t-test* and *Mann-Whitney U test*) were carried out to examine any bias that may have been caused by differences in manufacturing processes and for state differences. There were no differences detected.

Questionnaire Distribution

The plant managers indicated the number of questionnaires that should be sent. A total of 154 questionnaire packages, including a reply paid envelope, were posted to the 13 plant managers for distribution to managers at their plants. The managers were selected by the plant managers to participate in the study. Therefore the sample was not random, but nonetheless was not influenced by the researcher. This approach does create a potential for bias, however, this limitation was balanced with the time and cost of collecting the data.

Follow-up letters and additional questionnaire packages were sent one and a half to two weeks later. To examine for non-response bias, the mean values of the variables from the first 20% of returns and those from the last 20% were compared using *t-tests* (Chenhall & Langfield-Smith 1998). No significant differences were identified, suggesting the absence of non-response bias.

A total of 79 questionnaires were returned, giving a response rate of 51 percent. Nineteen of these questionnaires had to be discarded leaving a useable sample of 60 (a useable response rate of 39 percent). Of the 19 responses discarded³, nine responses were excluded because the respondents indicated that they were not responsible for any employees, thus casting doubt on whether the individuals held a suitable position of authority at the plant. A further 10 were discarded due to incomplete responses on the managerial performance measure. Table 2 presents the descriptive statistics for the sample of managers who participated in the study.

[take in Table 2]

Variable Measurement

Degree of JIT Involvement

The instrument used to measure degree of involvement was a modified version of Vroom's (1960) psychological participation instrument. 'Participation is viewed as influence in a process of joint decision-making by two or more parties, in which the decisions have future effects on those making them' (Cook et al. 1981 p.206). Degree of involvement was operationalised as the managers' perceived influence in the decision-making process regarding JIT. Thus, Vroom's measure is appropriate as it 'sets out to measure "psychological" participation, the amount of influence which a person perceives himself or herself to possess' (Cook et al. 1981 p.206).

The instrument, which is presented in Appendix 1, consisted of four items, each with a five-point response dimension. The final score was the total of the responses on the four dimensions, giving a

score ranging from four, representing low degree of JIT involvement, to 20 representing high degree of JIT involvement. Item-to-total Pearson correlation coefficients ranged from 0.708 to 0.810 - significant at the one percent (two tailed) level, which is greater than the 0.50 benchmark suggested by Hair et al. (1998) for satisfactory internal consistency. Thus the summated scale was a reliable measure of the degree of JIT involvement variable. Cronbach's alpha supported the above findings, yielding a value of 0.78. Descriptive statistics for the degree of JIT involvement responses are presented in Table 3.

[take in Table 3]

Locus of Control

Locus of Control has been widely researched and as such there have been numerous instruments developed to measure the construct (for example, Lefcourt (1982) lists eight instruments). Rotter's (1966) complete scale (consisting of 23 items) has been used extensively, and has been found to be a reliable and valid measure for locus of control (Organ & Greene 1974; Mitchell et al. 1975; Brownell 1981, 1982b; Licata et al. 1986; Mia 1989; Tsui & Gul 1996; Bernardi 1997). However, there has been some criticism of the use of the instrument in studies where the items would seem irrelevant for the respondent. An example put forward by Lefcourt (1981) describes a dying man being asked to give a judgement about how school grades should be assigned. It is for this reason that a four-item short-form of Rotter's (1966) Locus of Control Scale was used to measure respondents' locus of control orientation. The advantage of the four-item instrument was that it did not focus on specific situations such as classroom experiences, which would not be appropriate for the managers. The four-item instrument has been used successfully as a measure of locus of control by previous researchers (Wofle & Robertshaw 1982; Sweeney et al. 1991; Li-Ya et al. 1999). The four items have the highest loadings on the Locus of Control factor and are presented in Appendix 1.

The four questions used five-point Likert scales anchored on 'disagree strongly' scoring one, and 'agree strongly' scoring five. The final score was obtained by totaling the responses on the four items. Items were scored so that disagreement indicated internal locus of control and received smaller numeric values. Higher scores therefore indicated an external orientation, consistent with Rotter's (1966) 23 item scale.

The item-to-total correlations ranged from 0.508 to 0.711 and were significant at the one percent level, suggesting that the four items are measuring the same construct. Cronbach's alpha was 0.46, which is below the generally accepted level of reliability. However, personality tests often have much lower reliability values due to the broad constructs being measured (Foster 1998 p.203). Rotter (1990

p.491) also indicated that the measure, by its very nature, would not deliver a high alpha. Descriptive statistics for the locus of control score are presented in Table 3.

Managerial Performance

Managerial performance was measured using the Mahoney et. al. (1963; 1965) self-rating measure.⁴ A subjective self-rating measure of performance was considered more appropriate for this study due to the perceived difficulty in obtaining objective, comparable performance data from the cross section of firms in the sample. The measure calls for a rating from one (very low performance) to nine (very high performance) on eight sub-dimensions, as well as an overall rating. The eight sub-dimensions of performance include planning, investigating, coordinating, evaluating, supervising, staffing, negotiating and representing. Previous studies that have used this instrument have found it to be a reliable and valid measure (Brownell 1982a, 1982b; Brownell & Hirst 1986; Brownell and McInnes 1986; Dunk 1989; Frucot & Shearon 1991; Lau et al. 1995; Chong 1998). The final managerial performance score was the overall measure.

According to Mahoney et al. (1963) the measure requires an assessment of the independence of the dimensions and that the variation in the overall rating is explained by the other eight items. Methods used in previous studies to address these criteria were conducted (Brownell 1982b; Brownell & McInnes 1986). The results demonstrated the reliability of the overall managerial performance measure. Descriptive statistics for the final managerial performance score are presented in Table 3.

ANALYSIS AND RESULTS

The hypothesis tests the effect of locus of control on the relationship between degree of JIT involvement and managerial performance. The hypothesis was tested using the following regression equation.

$$Y = \beta_1 + \beta_2 X + \beta_3 Z + \beta_4 |(X - Z)| + \varepsilon$$

where:

Y = managerial performance, as measured by the global rating on the Mahoney measure.

X = standardised locus of control score $([X_i - X]/\bar{\sigma}_x)$.

Z = standardised degree of JIT involvement score $([Z_i - Z]/\sigma_z)$.

$|(X - Z)|$ = interaction between locus of control and degree of JIT involvement

measured as the absolute value of the difference between the standardised locus of control score and the standardised degree of JIT involvement score.

The interaction term used in the above regression equation was chosen because it matches expectations of how locus of control and degree of JIT involvement affect managerial performance. As discussed previously, internals are expected to perform better in a situation of high degree of JIT involvement. In contrast, externals are expected to perform better in a situation of low degree of JIT involvement. As can be seen from the interaction term, low scores on locus of control (internal) combined with high involvement scores (high degree of JIT involvement) produce large absolute difference terms. Similarly, high scores on locus of control (external) combined with low involvement scores (low degree of JIT involvement) produce large absolute difference terms. Both of these combinations are expected to be associated with higher managerial performance. The other two combinations (internal and low degree of JIT involvement, and external and high involvement) produce lower absolute differences and are expected to be associated with lower managerial performance (Brownell 1982b).

To reject the null hypothesis in a fashion consistent with expectations a significant positive coefficient (β_4) was required. A significant coefficient (β_4) indicates an interaction between locus of control and degree of JIT involvement affecting managerial performance. The more common multiplicative interaction term was not used because, consistent with Brownell (1982b) findings, the multiplicative interaction term works well for extreme values of X and Y but does not perform well across the entire range.

Table 4 shows the results of the multiple regression.⁵ The coefficient of determination (R^2) revealed a value of 24.9 percent indicating that 24.9 percent of the variation in managerial performance was explained by the variability in locus of control, degree of JIT involvement and the interaction between the two independent variables (Hair et al. 1998, p.143). The *F-test* shows that the regression as a whole was significant at the one percent level (Levin & Rubin 1998 p.745). The interaction coefficient (β_4) was found to be significant at the five percent level, thus demonstrating that there was an interaction between locus of control and degree of JIT involvement affecting managerial performance. The positive sign of the β_4 coefficient suggests that the null hypothesis can be rejected.⁶

[take in Table 4]

To determine the nature and form of the interaction term, the regression equation derived above was plotted using the extreme values for locus of control (four represented internal, 16 represented external) and degree of JIT involvement (four represented low involvement, 20 represented high involvement).⁷ To display the result graphically, locus of control was dichotomised and the manager's degree of JIT involvement was plotted against the predicted managerial performance values. Due to the standardising of the independent variables, a value of -4.25 on the x-axis represents low degree of JIT involvement while a value of 1.9 represents high degree of JIT

involvement. Figure 1 shows that there was an interaction between locus of control and degree of JIT involvement affecting managerial performance. As expected, internally-orientated managers performed better in their job in a situation of high degree of JIT involvement. However, externally-orientated managers did not perform better in a situation of low degree of JIT involvement. Furthermore, internally-orientated managers performed better than externally-orientated managers regardless of the managers' degree of JIT involvement. Thus, the null hypothesis was rejected, but not in a manner consistent with expectations.

[take in Figure 1]

No attempt was made to interpret the main effects of locus of control (β_2) or degree of JIT involvement (β_3) on managerial performance. Main effects demonstrate the influence of each of the independent variables, while controlling for the influence of the other variable (Stangor 1998 p.194). However, a significant interaction implies that the influence of one independent variable on the dependent variable is different at different levels of another independent variable, and thus the main effects are not interpretable (Stangor 1998 p.194).

CONCLUSION AND DISCUSSION

The general aim of this study was to further the understanding of the circumstances in which JIT delivers its promised benefits. The research focused on the role of a personality variable in improving the operation of JIT. One of the expectations and working environment changes promoted under JIT, which has significant human resource management implications, is employee involvement. This study specifically achieved its objective by examining the interaction between degree of JIT involvement and locus of control affecting managerial performance.

The results of the statistical analysis provide evidence that locus of control affected the relationship between degree of JIT involvement and managerial performance. An analysis of the nature and form of the interaction revealed, as expected, that internal managers performed better in their job in a situation of high degree of JIT involvement. This result is consistent with the congruency hypothesis proposed by Watson & Baumal (1967) and supported by Brownell (1981, 1982b), Frucot & Shearon (1991) and Otley et al. (1994). However, consistent with the congruency hypothesis, it was expected that external locus of control managers would perform better under low participation. This was not the case for the current study.

There are several implications that may be drawn from the results. Firstly, the results suggest that involvement for both internal and external managers in a JIT environment is crucial. Power & Sohal (2000a) conducted a case study of three companies and found that the strategy of empowering

employees was central to the effective operation of the JIT methodology. Power & Sohal (2000b) reported similar findings based on cross-sectional survey data. Thus, it would appear that employee involvement promoted under JIT does not conflict with managers' locus of control orientation to the detriment of managerial performance. Though, it seems that employee involvement is more effective for internal managers as the results showed that internal managers' performance improved at a greater rate than external managers as degree of JIT involvement increased. However, the management and degree of employee empowerment will need to be managed wisely given that for external locus of control managers job satisfaction decreases as the degree of JIT involvement increases (Byrne & Costin, 2003). Further, Godard's (2001) research suggests that under work practices such as JIT there is a collision between the 'good' factors such as empowerment and belongingness and the 'bad' factors such as an increase in stress and a diminished work quality. The current research by looking at individual differences shows that the effect of this collision is not uniform across all individuals.

Secondly, by examining the well established locus of control congruency hypothesis, the study not only took the opportunity to explore the gap in knowledge at the individual and behavioural level with respect to JIT, but also enabled the testing of the transferability of the locus of control congruency hypothesis to another participative situation. Otley et al. (1994) maintains that replications are needed to ensure the findings will hold across different settings. Replications are considered an important research activity and provide a foundation for scientific work (Popper 1959; Ravetz 1971).

Thirdly, the findings of this research provide support for other studies (Flynn et al. 1995; Selto et al. 1995; Kalagnanam & Lindsay 1998; Chong & Rundus 1999; Mia 2000) that have applied the contingency framework to help gain an understanding of the variables that determine the success or otherwise of JIT. Conflicting findings in previous research on the impact of JIT on performance (Clarke & Mia 1993; Flynn et al. 1995; Balakrishnan et al. 1996; Kendall & Steen 1998; Callen et al. 2000) established the importance of investigating the circumstances in which JIT would be successful.

Several limitations of the current study should be considered. Firstly, this study does not explicitly consider a variety of contingency factors that could effect the relationship between degree of JIT involvement and managerial performance. Individual level variables (i.e. leadership style, degree of authoritarianism) and organisational level variables (i.e. strategy, organizational structure, reward structure) could also be important in this context. These present opportunities for future research. Also, degree of JIT involvement as part of employee empowerment is only one element of the JIT philosophy. Power & Sohal (2000a p.373) suggest 'that the combination and emphasis of the overall human resource strategy employed in the JIT environment is potentially more important than individual elements'. Thus, an opportunity exists for future research to develop models predicting

more accurately the organizational conditions necessary to facilitate the successful implementation and operation of JIT (Power & Sohal 1997).

There are several limitations associated with the research method employed in this study. Firstly, self-ratings which are highly subjective, were used to assess managerial performance. Secondly, the manufacturing plants and the subsequent managers and supervisors who participated in the study were not randomly selected. This could have introduced a degree of systematic bias and effect the generalisability of the study. Finally, studies of this kind, which employ cross-sectional surveys, do not provide confirmatory evidence of a causal relationship. Future research could seek to overcome the above by; using a more objective measure of managerial performance; randomly selecting participants; or conducting a longitudinal study.

Given the suggestion that culture may impact on the transferability of locus of control (Frucot & Shearon 1991; Otley et al. 1994) and also the questioning of the successful application of JIT practices in organisations across a range of cultures (Stower 1995; Bamber et al., 1992), the generalisability of the results may be somewhat restricted to Australia. Future research could explore this.

Despite these limitations the study does have important implications for human resource management in plants seeking to implement the JIT philosophy and practices. For these plants the evidence suggests that a high degree of employee empowerment is necessary to improve managerial performance for all personality types. However, this will require careful management as evidence exists that propound a decrease in job satisfaction for external locus of control personalities as employee empowerment increases.

Appendix 1: Degree of JIT Involvement and Locus of Control Instruments

Degree of JIT Involvement

Just-in-time (JIT) is a manufacturing philosophy based on the continuous improvement of productivity and the planned elimination of activities which do not add value to the product being manufactured. The primary elements of JIT include demand driven production, organising production in manufacturing cells, hiring and retaining multiskilled workers, emphasising total quality management, reducing manufacturing lead time and set up time, building strong supplier relationships and only having the required inventory on hand.

1. In general, how much say or influence do you feel you have on JIT practices in your plant? (*Please circle.*)

1	2	3	4	5
No influence	Some influence	Quite a bit of influence	A great deal of influence	A very great deal of influence

2. Do you feel you can influence the decisions of your immediate superior regarding things about JIT practices which concern you? (*Please circle.*)

1	2	3	4	5
To no extent	To a very little extent	To some extent	To a considerable extent	To a great extent

3. Does your immediate superior ask your opinion when a problem comes up that involves JIT practices? (*Please circle.*)

1	2	3	4	5
Never asks	Seldom asks	Sometimes asks	Often asks	Always asks

4. If you have a suggestion for improving the job or changing the process in some way regarding JIT practices, how easy is it for you to get your ideas across to your immediate superior? (*Please circle.*)

1	2	3	4	5
Very difficult	Fairly difficult	Not too easy	Fairly easy	Very easy

Locus of Control

Each item below contains a statement. Please circle the number, which best indicates your agreement with each statement as far as you're concerned. Be sure to select the response you actually *believe* to be the case rather than the response you think you should choose or the response you would like to be true. This is a measure of personal belief, so there are no right or wrong answers.

1	2	3	4	5	
Disagree Strongly				Agree Strongly	
Good luck is more important than hard work for success.	1	2	3	4	5
Every time I try to get ahead, something or somebody stops me.	1	2	3	4	5
Planning only makes a person unhappy since plans hardly work out anyway.	1	2	3	4	5
People who accept their condition in life are happier than those who try to change things.	1	2	3	4	5

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Table 1
JIT Practices Utilized by the 13 Plants

JIT Practice	No. of Plants that use each JIT Practice
Market-paced final assembly rate	9
Kanban	10
Integrated product design	6
Integrated supplier network	8
Lowering set-up times	12
Quality circles	12
Focused factory	10
Preventative maintenance programs	10
Line balancing	10
JIT education programs	6
Level schedules	9
Stable cycle rates	5
Group technology	8
Improving quality of the product	12
Improving quality of the process	12
Fast inventory transportation systems	6
Multi-skilled workers	12

Table 2
Sample Manager's Descriptive Statistics (n=60)

	Mean	Median	Minimum	Maximum
Age	42	43	25	59
Years supervisory experience	14	13	1.5	35
Years with firm	17	16	1	41
No. employees responsible for	124	53	1	740

Table 3
Descriptive Statistics (n=60)

	Mean	Median	Std. Dev.	Theoretical Range		Actual Range	
				Min.	Max.	Min.	Max.
Degree of JIT Involvement	15.06	15.00	2.60	4	20	4	20
Locus of Control	7.92	8.00	2.30	4	20	4	16
Managerial Performance	6.94	7.00	0.73	1	9	5	9

Table 4
Results of Regression: $Y = \beta_1 + \beta_2X + \beta_3Z + \beta_4|(X - Z)| + \varepsilon$

Variable	Coefficient	Value	Standard Error	t-statistic	p-value
Constant	β_1	6.724	0.132	51.050	<0.001
Locus of control	β_2	-0.205	0.088	-2.335	0.023
Degree of JIT involvement	β_3	0.271	0.088	3.072	0.003

Interaction term	β_4	0.185	0.087	2.135	0.037
$R^2 = 0.249$					
F-test, $p = 0.001$					

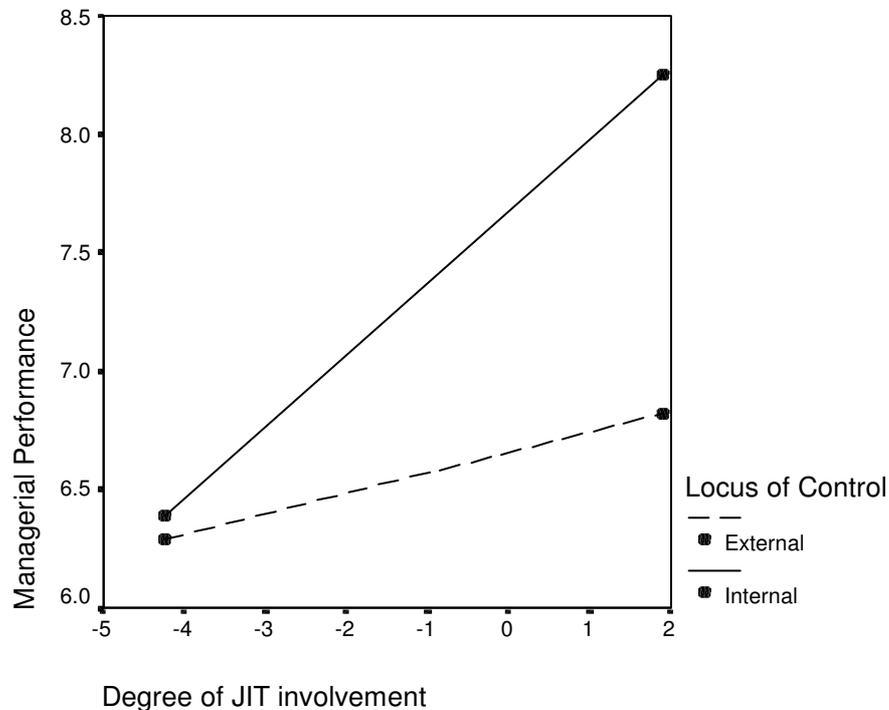


Figure 1
Managerial Performance Interaction Graph

¹ ANet, Australian Centre for Management Accounting Development (ACMAD), Australian Institute of Purchasing and Material Management (AIPMM), Australian Production and Inventory Control Society (APICS), CPA Australia, Chartered Institute of Management Accountants (CIMA), Institute Certified Management Accountants, Logistics Association of Australia and Queensland Manufacturing Institute.

² A number of other organisations were identified during the search but were discarded because (a) they were foreign firms with no Australian manufacturing plant, (b) were distributing subsidiaries for foreign firms only, (c) had been taken over by another firm already identified as a JIT manufacturer, (d) used JIT delivery but did not use JIT in the manufacturing sections of the plant or (e) were solely a transport company.

³ The mean values of the variables which could be constructed for the 19 incomplete responses that were excluded were compared using t-tests with the mean values of the 60 useable responses (Brownell & McInnes 1986). No significant differences were detected, suggesting that the exclusion of the incomplete returns did not introduce any bias.

⁴ Conflicting evidence exists as to whether superior or self-rating measures are more appropriate measures of managerial performance. It has been argued by some researchers that self-ratings tend to be more lenient than superior ratings (Parker et al. 1959; Kirchner 1965; Thornton 1968). However, in a study conducted by Heneman (1974) it was found that self-ratings possessed less leniency than superior ratings. In addition, evidence exists to suggest that self-ratings suffer less from halo error (Kirchner 1965; Nealey & Owen 1970, Heneman 1974). Halo error is the tendency to evaluate "globally" or on a single cognitive dimension and is evidenced by high inter-item correlations among the separate performance dimensions (Brownell 1982b; Frucot & Shearon 1991).

⁵ Assumptions relating to regression were considered. An examination of the residual plot revealed that the residuals fell fairly randomly, with relatively equal dispersion about zero, indicating that linearity, normality, homoscedasticity and independence of the residuals were not a major concern (Hair et al. 1998, p.173). To further test the normality of the residuals, the normal probability distribution showed that each observed value was very close to its expected value from a normal distribution (Coakes & Steed 1999, p.29). The Kolmogorov-Smirnov test was also unable to reject the normality of the residuals (Levin & Rubin 1998 p.839). The residuals were also plotted against the predicted values of the dependent variable to check for the existence of influential outliers. No obvious outliers were apparent from the residual plot and this was confirmed by Cook's distance statistic. The largest Cook's distance value computed from the data in this study was 0.725. The rule of thumb suggested by Hair et al. (1998, p.225) and Tabachnick & Fidell (1989, p.130) was used in this study, which suggests that observations with scores larger than 1.00 are suspected of being outliers. When the regression was performed, it was also important to ensure that multi-collinearity did not exist between the independent variables. A rule of thumb regarding multi-collinearity suggested by Pindyck & Rubinfeld (1976 p.68), which has been previously used by Brownell & McInnes (1986) was also used in this study. They suggest multi-collinearity among independent variables is likely to be a problem if the simple correlation between two independent variables is larger than the correlation of either or both with the dependent variable. Table Four containing the Pearson correlation coefficients between the dependent and independent variables, shows that multi-collinearity was not of concern.

⁶ Further analysis based on the assumption that Likert scales provide only an ordinal measurement scale was also performed. The Spearman rank-order correlation coefficient was used to perform this analysis (Siegel 1956). The Spearman rank-order correlation coefficient was calculated by firstly dividing degree of JIT involvement at the median into low and high involvement groups. Due to the minimal number of observations contained in the low-involvement group, the calculation of the coefficients was only continued for the high-involvement group. The correlation of the locus of control ranks with managerial performance ranks resulted in a correlation of -0.223 at a significance level of $.102$. It indicates that for managers in the high-involvement group, high-ranked locus of control scores (external) were associated with low-ranked managerial performance scores (inferior performance). This is consistent with expectations.

⁷ Previous researchers (Lau et al. 1995) have plotted the mean managerial performance for the four groups (internal/high involvement, internal/low involvement, external/high involvement and external/low involvement). However, dichotomising locus of control and degree of JIT involvement in this manner resulted in inadequate numbers in three of the four groups.