Synergy of Stretch Cost Targets and Concurrent Processes:
Creating Dynamic Tension for Target Cost Management
in Japanese Manufacturing Firms

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Abstract

This paper aims to examine how specific management accounting systems create dynamic tension that contributes to organizational performance. In particular, this study chooses target cost management and derives two unique elements, stretch cost targets and concurrent processes. Based on tension management perspective, we assume that their complementary use enhances dynamic tension that enhances cost reduction. Using hierarchical regression analysis for Japanese manufacturing firms, expected result cannot be gained. However, sub-group analysis reveals their joint use enhances cost reduction for firms belong to process industries. This result reflects "Japanese process industries" that are good at products of high quality and technology.

Key Words

Dynamic tension, Target cost management, Stretch cost targets, Concurrent processes, Cost reduction, Cross-industry analysis

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Introduction

There are two distinct use of management control systems (MCS) (e.g. Ahrens and Chapman, 2004; Simons, 1995). One type of control aims to measure deviations and implement corrective actions to achieve preset performance targets. The other type enables employees to search for new opportunities, stimulate dialogue, and new idea generation to enhance organizational learning or formulation of new strategy in uncertain environment. These different types of controls have been contrasted like mechanistic vs organic, negative vs positive lever of controls (Chenhall, 2003; Mundy, 2010; Simons, 1995).

Management control researchers have payed attention to tensions among these opposing types of controls in recent years (e.g. Henri, 2006; Marginson, 2002; Widener, 2007). Different role of controls don't act independently but in combination and using them jointly creates tensions because they are used to achieve competitive objectives. Tensions cause anxieties and fear and may result in negative dynamics, however, they are also source of change and creativity (Lewis, 2000). Hence, tension management is needed to enhance creative tensions (Lewis, 2000). Previous research indicated that balanced use of different roles of MCS creates dynamic tension which contributes to organizational unique capabilities and performance (e.g. Bedford, 2015; Chenhall and Morris, 1995; Henri, 2006).

This paper aims to investigate how specific management accounting systems generate dynamic tension. Particularly, this study focuses on target cost management (TCM). TCM means a system of profit planning and cost management at earliest stages of product development that is price led, customer focused, design centered and cross functional because most of the manufacturing costs are determined at an early stage of product development (Ansari et al.., 2007; Kato, 1993a, b). TCM has been developed in Japanese manufacturing industries and contributed to cost advantage (Hiromoto, 1988; Japan Accounting Association, 1996; Kato, 1993a, b; Monden and Hamada, 1991).

TCM systems are composed of multiple elements such as upstream management, setting and decomposing cost targets, mile-stone management, value engineering, supplier relationship, and costs tables (e.g. Okano, 1995; Tani, 1996; Yoshida, 2003). Particularly, this paper focuses on two elements that create tensions in TCM activities: stretch cost targets and concurrent processes. Setting stretch cost targets creates tensions by creating gaps between present capabilities and target performance. Also, it creates tensions among other design measures such as quality and functions. Concurrent process where managers belonging to various departments interact to also accompany tensions because they may have competitive objectives or different viewpoints. Using stretch cost targets and concurrent processes create tensions, however, their joint use enhance knowledge generation and contribute to cost reduction (Iwabuchi, 1992; Koga and Davila, 1999; Shimizu, 1992b). It can be said that dynamic tension is created if their joint use enhances TCM performance (Henri, 2006).

Using hierarchical regression analysis with survey data in Japanese manufacturing firms, it was not found statistical meaningful relationship between their joint effects term and cost reduction by full sample analysis. However, the following sub-group analysis, it was found that their joint effects term enhances cost reduction only in process industries. This finding is interpreted from several aspects. For example, the results reflect characteristics of “Japanese process industries” (Fujimoto and Kuwashima, 2009).

The current study contributes to management accounting literature in three ways. First, previous literature largely ignored how using specific management accounting systems create dynamic tension (except for Frow et al., 2010). Therefore, it has been unknown that what or how unique elements of individual management accounting systems contribute to create dynamic tension. Reviewing TCM literature from tension management perspective and testing combination effects of stretch cost targets and concurrent processes may provide new insights on how specific management accounting systems create dynamic tension. Second, previous research only focused on the use of MCS such as diagnostic and interactive (Simons, 1995) that create tensions. Relatively less attention has been given to the design of them. By considering combination effects of stretch cost targets and concurrent processes, this paper provides new evidence about a series of processes about how inherent tensions are created by designing management accounting systems and how they are submitted to dynamic tension by the use of them. Third, previous research were limited to examine tension management at business unit level by building on Simons (1995)'s framework (e.g. Bedford, 2015; Frow et al., 2002; Marginson, 2002; Mundy, 2010; Henri, 2006). Evidence about how top-management uses MCS to influence middle-management to realize competitive objectives such as implementing current strategy and emerging new strategy have been accumulated, however, relatively little research examined tension management at specific situation such as new product development (Jørgensen and Messner, 2009; Lewis et al., 2002; Ylinen and Gullkvist, 2014). This paper proposes additional insights about tension management in the context of new product development by focusing on TCM activities, particularly manager's horizontal collaboration.

The reminder of this paper is structured as follows. The next section provides theoretical model in tension management for TCM and introduces hypothesis. Section 3 indicates research method and variables measurement. In section 4, analyses and results are presented. Subsequent section interprets the results. Finally, conclusions, limitations and implications for future research are provided.

Literature review and hypothesis development

Tensions among different roles of MCS

Traditionally, it has been considered that using formal control systems is inconsistent with innovation. Control systems are characterized as mechanistic because they aim to measure deviations, focus on unfavorable variances, and implement corrective actions to achieve preset performance targets (Anthony, 1965; Chenhall, 2003). Innovation or creative activities that accompany uncertainty about causal relationship between manager's efforts and performance are inconsistent with accounting controls (Abernethy and Brownell, 1997; Rockness and Shields, 1984).

In contrast, Simons (1987) found empirically that prospector firms use formal control systems highly than defender firms. This result is inconsistent with prior studies, however, he interpreted the results from types of controls. Later, he classified two types of controls: diagnostic and interactive control (Simons, 1995). Diagnostic control systems are similar to traditional mechanistic type of controls that aim to measure deviations and implement corrective actions to achieve preset performance targets. Interactive control systems are organic type of controls that enable employees to search for new opportunities, stimulate dialogue, and idea generation to enhance organizational learning and emerge new strategy. In contrast to diagnostic control, interactive control is characterized as positive lever of control and useful in uncertain context where strategic change and innovation activities are highly needed (Abernethy and Brownell, 1999: Bisbe and Otley, 2004).

Recent studies have showed empirical evidence about tensions among different types of control systems on organizational capabilities and performance (e.g. Chenhall and Morris, 1995;

Henri, 2006; Widener, 2007). Chenhall and Morris (1995) considers that combined use of formal control systems and organic processes is paradoxical, however, control systems can support translation of ideas that are generated from organic processes into effective innovation that is consistent with organizational objectives. They reveal empirically that their joint use enhances organizational performance for entrepreneur firms. Henri (2006) indicates combination of diagnostic and interactive controls provides opportunities to enhance organizational dialogue about strategic objectives and derive new idea generation, thereby enhance organizational capabilities such as market orientation, entrepreneurship, innovativeness, and organizational learning. He identifies dynamic tension is created if their joint use enhance organizational capabilities or performance[1]. Following research, Widener (2007) also confirms empirically that interactive control systems enhance organizational learning through the formal structure of diagnostic control systems. Other studies show combination of controls doesn't only contribute to organizational capabilities and performance but also contribute to product development and project performance (e.g. Bedford, 2015; Lewis et al.., 2002; Ylinen and Gullkvist, 2014). These studies provide empirical evidence that opposing types of control systems are not mutually exclusive but interdependent, and effective organizations combine them in order to create dynamic tension that contributes to organizational capabilities and performance.

Next, this paper considers how organizations create dynamic tension in TCM activities. TCM activities accompany various tensions. For example, engineers are held responsible for not only functions or quality but also costs and design delivery time. Competing needs create tensions. Also, dual chain of command such as departmental managers and project leaders create

[1] Henri (2006, p.533) explains the notion that dynamic tension denotes contradictory but interrelated elements (Lewis, 2000), and two phenomena in a dynamic relationship that involve both competition and complementarity (English, 2001). In addition, Henri (2006, p.534) points out that "the notion of dynamic tension is not necessarily new in the academic literature, and is related to other terms such as conflict, paradox, dilemma, and contrast (English, 2001)"

tensions for engineers. Particularly, this paper chooses two elements that will create inherent tensions in TCM activities: stretch cost targets and concurrent processes.

Stretch cost targets

The equation of TCM is "Target Cost = Expected Sales Price – Target Profit" (Kato, 1993b). Target price is driven by marketplace and target profit is determined by organizational medium and long-term profit planning (Japan Accounting Association, 1996; Kato, 1993a, b).

Calculating cost targets from expected sales price reflects customer orientation. TCM orients to exclude excessive quality and functions completely through thinking customer needs. (Japan Accounting Association, 1996; Kato, 1993a, b). In order to set price, it needs to analyze customer needs and forecast how markets evaluate quality and functions accurately (Cooper and Slagmulder, 1999; Japan Accounting Association, 1996; Kato, 1993a, b).

As cost targets reflect medium and long term profit planning, they exhibit formal targets to be achieved (Japan Accounting Association, 1996). The more TCM systems are sophisticated, activities of cost reduction are developed to focus on whole products or functions of products. That is cost targets are calculated from how much each product contribute to organizational profit (Kato, 1993a, b). This means "infusing target costs into products" (Kato, 1993b, p.42).

In Japan, the level of cost targets set from above equation tend to be stretch seemingly impossible to achieve without substantial effort (Hiromoto, 1988; Kato, 1993a, b; Tani et al.., 1994). The very difficult level is inconsistent with goal setting theory that suggests challenging but achievable goals are desirable (Locke and Latham, 1990), however, they contribute to drastic cost reduction in Japan (Kato, 1993a, b; Tani et al.., 1993a).

Concurrent processes

Traditional approach of new product development, sequential engineering, known as "throwing it over the wall", focuses on developing a structured process with clear-defined and sequential phases (Kato, 1993a, b; Takeuchi and Nonaka, 1986). Each department curries out the jobs in isolation and they don't interact with other departments. The sequential process takes long development time and has a risk of getting problems on cost, quality at the later stage of product development (Kato, 1993a, b; Takeuchi and Nonaka, 1986).

Concurrent processes are completely different from traditional approach. Concurrent processes are also called rugby style product development (Takeuchi and Nonaka, 1986) or simultaneous engineering, characterized involvement of the managers of product planning, development, design, production preparation and manufacturing as the cross-functional team in product development processes (Carter and Baker, 1992). The overlapping and parallel processes which various functional engineers are involved in the early stage of the project shorten time to market greatly and contribute to high productivity and performance in Japanese manufacturing firms (Clark and Fujimoto, 1991; Takeuchi and Nonaka, 1986).

Previous research indicated concurrent processes are also a key component for TCM systems (e.g. Tani, 1996; Yoshida, 2003). Tani et al. (1993b) provides two features of concurrent processes for TCM. The first is that drastic cost reduction will not be realized without cooperation among cross-functional engineers. The second is that collaboration among cross-functional managers brings creative ideas into product development than interaction among members belonging to same departments. Co-operation with various managers before drawing a blueprint triggers many creative ideas because when there are many choices to reduce costs.

Yoshida (2003) reveals empirically that interaction among managers from different departments is more effective on cost reduction than the effect of each tool.

Dynamic tension generated by using stretch cost targets and concurrent processes

Empirical research which investigate the effect of using specific goals and concurrent processes are scarce. Gopalakrishman et al. (2015)'s experimental study indicate using specific goals under concurrent processes are less effective on cost reduction than under sequential processes because high task uncertainty deteriorates manager's controllability. However, their study ignores dynamics in TCM activities that promote knowledge creation by using specific cost targets under concurrent processes.

Some studies aim to clarify dynamics in TCM activities. Shimizu (1992a) focuses on the role of cost targets information in TCM activities. Building on knowledge creation theory (Nonaka, 1990), he explains how target cost tightness encourage or discourage knowledge creation activities for each individual. He explains theoretically that as long as the tightness of cost target is well managed, involved individual can understand existing solutions or previous experiences that give little help to hit the target, then begin to seek new solutions under quite chaotic environment. Shimizu (1992b) tries to extend his previous discussions of role of cost targets information at individual level to at group level. As a result, he identifies the roles of cost targets information as a catalyst of transmission of knowledge and information. As cost targets information act as a commonly shared objectives for each individual or a team, it becomes easier to drive team efforts, horizontal and vertical interaction, cross-functional activities. He explains existing solutions or previous experiences are denied and new solutions are developed by knowledge creation at group level in the case of level of cost targets are stretch.

Also, Iwabuchi (1992) focuses on the role of shared information among departments from a case study. He explains shared information lead to the cooperative efforts among different functions, then, collection of expertise and professional experience and knowledge turn into unique solutions.

Koga and Davila (1999) indicate challenging cost targets initiate intensive interactions between product and process engineers and frequent monitoring of the gap between the target and cost estimate. Cost targets act as a catalyst for organizational leaning among the managers. They also provide a possibility that cost targets cannot generate good actual performance without cooperation among various functional managers.

From the above, using stretch cost targets under concurrent processes is paradoxical from a viewpoint of controllability principle (Gopalakrishman et al.., 2015), however, their joint use may enhance TCM performance from a viewpoint of tension management perspective. Building on this perspective, concurrent processes enhance TCM performance through the structure of stretch cost targets that act as a shared objective (Chenhall and Morris, 1995; Henri, 2006; Shimizu, 1992b; Widener, 2007). And also, setting stretch cost targets not only derive new knowledge by creating chaotic environment at individual level but also enhance new idea generation at a group level by combined with cooperation among individuals that have different viewpoints (Iwabuchi, 1992; Koga and Davila, 1999; Shimizu, 1982b). It can be said that dynamic tension is created if their joint use enhances TCM performance (Henri, 2006). From the above, following hypothesis are developed.

Hypothesis. Using stretch cost targets and concurrent processes jointly enhances TCM performance.

Method

Data collection

A cross-sectional questionnaire survey to executive officer or director of accounting department of 847 firms in manufacturing industries, which were listed on the first section of the Tokyo Stock Exchange, was conducted in 2014. In total, 130 firms responded and an overall response rate was 15.3%. The total sample we use for analysis is 98 after removing firms that don't use TCM and missing data. Table 1 shows the sample for analysis.

In order to test whether respondents and non-respondents have different characteristics such as industry and size, Chi-square statistics are used. The distribution of respondent firms and non-respondent firms across the industry is the same (p= .69). In terms of size, respondent firms have significantly more employees than non-respondent firms and the p value is .05, but no significant difference exist in sales volumes (p= .15). In sum, there is a possibility that our sample shows actual condition of bigger firms in the first section of the Tokyo Stock Exchange.

Variable measurement

Environmental complexity and uncertainty moderate the relationship between TCM elements and performance (e.g. Tani et al.., 1993a; Yoshida, 2001). In order to measure the potential impact of TCM elements on performance, the effects of these environmental factors are controlled. Items are measured by Tani (1995) which has been employed in survey of Japanese firms. In this research, environmental complexity and uncertainty are measured respectively by three instruments as follows. The items are degree of (1) diversity of product market, (2) community of technology with competitors, (3) diversity of sales promotion for measuring the concept of environmental complexity. The items are degree of (4) competitiveness of product market, (5) frequency of developing new product and technology, (6) accuracy of estimating customer demand for measuring the concept of environmental uncertainty.

Stretch cost targets and concurrent processes are composed of one instrument respectively as follows. The question for measuring stretch cost targets, the extent of difficulty to achieve cost targets, is (7) Are cost targets set at the challenging level that cannot be achieved easily at starting point in product development processes? The question for measuring concurrent processes is (8) Are not only design engineers but also many related cross-functional members involved in product development processes? The synergy effect, dynamic tension, of stretch cost targets and concurrent processes is measured by a product term of Question (7) and (8) as mentioned above. Interaction terms are strongly correlated with independent variables. Hence prior to the formation of the product term, two independent variables are centered respectively.
TCM performance is measured by (10) the effectiveness of TCM activities to cost reduction. All items are measured on 1-7 Likert scales. Descriptive statistics of the construct are presented in Table 2. Correlation matrix is in Table 3.

Results

In order to examine the joint effects of stretch cost targets and concurrent processes, using hierarchical regression analysis is appropriate. This analytical method aims to examine increase in R^2 by performing multiple regression analysis by explanatory variables that are presumed causal priority and introducing subsequent variables later (Cohen et al.., 2003). In this paper, hierarchical regression adds control variables in model 1 and two explanatory variables (stretch cost targets and concurrent processes) are included in model 2. In model 3, joint effects term is included to gauge the relative contribution.

Table 4 summarizes the results of hierarchical regression analysis. R^2 of the first model is not significant (R^2= .058, p= .473). In model 2, changes of R^2 are significant (ΔR^2= .167, p= .000) and both stretch cost targets and concurrent processes enhance cost reduction (β= .333, p= .006, β= .285, p= .018, respectively). In the third model that introduces the joint effects term, however, increase in R^2 is not statistical significant (ΔR^2= .004, p= .518). Therefore, it cannot be said that the joint effect of stretch cost targets and concurrent processes enhance cost reduction by full sample analysis.

Next, subgroup analysis are implemented. All sample is divided by industries: assembly and process industries (Table 6, 7)[2]. In assembly industries, change of R^2 of the first model is not significant (R^2= .182, p= .152). Increase of R^2 in model 2 is significant (ΔR^2= .231, p= .001) and it was found using stretch cost targets enhances cost reduction (β= .511, p= .001). But the relationship between concurrent processes and performance are not significant (β= .211, p= .184). In the third model, the amount of change of R^2 is not statistical significant (ΔR^2= .036, p= .103). Hence, it cannot be said that hypothesis is supported in assembly industries.

In process industries, increase of R^2 of the first model is not significant (R^2= .149, p= .359). Changes of R^2 are significant (R^2= .140, p= .036) and concurrent processes enhance performance (β= .437, p= .018). After introducing product term, amount of change of R^2 is statistical significant (ΔR^2= .062, p= .073). Thus, results suggest that dynamic tension, synergy effects of stretch cost targets and concurrent processes, is created in process industries.

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[2] The reason why we choose industry as a sub-group is there are differences about TCM capabilities between assembly and process industries. At first, TCM has been developed in assembly industries such as machinery, electric appliances, transportation equipment, and precision instruments (Japan Accounting Association, 1996; Sakurai, 1989; Tanaka, 1995).These firms had faced on diversified customer needs and shorter product life cycles from the 1980s, they had to develop numerous products with quite different characteristics (Sakurai, 1989). In order to achieve low-cost, high-quality, and timely-introducing new products simultaneously in accordance with changing various customer needs, it is required to manage costs in the early stages of product development processes. So, TCM has matured in assembly firms and has been developing in processing firms (Okano and Suzuki, 2007).

VIF (Variance Inflation Factor) of all independent variables that are introduced is less than 2.5. This indicates multicollinearity is not likely a problem.

Discussion

The results of this paper suggest that dynamic tension, synergy effects of stretch cost targets and concurrent processes that contribute to cost reduction, is created in process industries. Statistical meaningful relationship was not found for full sample and assembly firms. This section explains what means this results by interpreting not only the joint effects term on performance but also each explanatory variables on performance.

First, the positive relationship between stretch cost targets and cost reduction were found in assembly industries. The reason could be explained by differences in product architecture and cost structure among two industries. Products in assembly industries are composed of many parts and components. Major cost elements of these industries are direct material costs, direct conversion costs, and die costs (Tanaka, 1995). In these industries, cost targets are decomposed into functions, parts, and departments highly (Kato, 1993a; Tanaka, 1995). Also, Koga and Davila (1999) considers performance goals may play as significant coordination role for more complex products such as automobiles, in which greater number of managers are involved in product development. In contrast to these assembly industries, it is difficult to achieve cost targets perfectly in a planning and design phase in process industries, because added-values are mainly developed by production processes. Therefore, setting stretch cost targets is more effective in assembly firms than in processing firms.

Second, it couldn’t find concurrent processes and the product term improve TCM performance in assembly industries. It seems like inconsistent with Koga and Davila (1999).

However, it may show that the extent of cross-functional collaboration is not a critical determinant of TCM performance for assembly industries that can achieve cost reduction constantly. This interpretation is similar to previous literature that revealed control systems are either used to avoid innovation excess for entrepreneur firms that always pursue innovation and also used to enhance innovation by increasing information processing for conservative firms that lack innovation (Bisbe and Otley, 2004; Miller and Friesen, 1982). Also, Gopalakrishnan et al. (2015) proposes a possibility that too much collaboration among various cross-functional managers enhance task uncertainty and may cause costly redesign and coordination.

Third, the results can be explained from a historical view point of TCM. Yoshida (2011) shows advanced TCM practices at Toyota from case research. In recently, cost targets are already achieved when cost targets are decomposed into parts at the beginning of product development processes. This means that cost targets are mostly equal to estimated costs at that time because of TCM capabilities; such as databases or know how accumulated through a long time experience. In this case, collaboration between different departments is used to just adapt to changes occur afterward. Thus, TCM systems have attained maturity in assembly industries now. This interpretation is consistent with the view that the more TCM is sophisticated, the role for cost reduction becomes smaller (Kato, 1993a). On the other hand, TCM in process industries have been developing now (Ansari et al.., 2007). Therefore, there are great potential to reduce costs in these industries.

Forth, the relationship between joint effects term and performance in process industries reflects characteristics of “Japanese process industries” (Fujimoto and Kuwashima, 2009). Previous literature about product development indicated that fine-tuning product development between parts and functions are needed in assembly industries such as automobile, consumer electronics, and computers (Clark and Fujimoto, 1991). In the case of products of process industries, factors such as epoch-making invention of process technology, investment, amount of R&D expenses have been considered important extremely (Fujimoto and Kuwashima, 2009). However, Fujimoto and Kuwashima (2009) proposes that firms in process industries in Japan, particularly firms that treat industry materials also gain capabilities that achieve intended functions accurately by customers that propose extremely strict constraints about quality and costs. In order to achieve severe customer needs, firms in these industries have to realize total optimization in the steps of operation. In terms of cost reduction, knowledge sharing with customers about customizations may lead to reduction of development costs. Also, collaboration with sales and development departments may lead to better understanding of customer needs accurately and enable to avoid excessive customization. Hence, concurrent processes at an early stage of product development are effective on cost reduction.

Conclusion

The current study aimed to investigate how TCM, as a specific management accounting system, creates dynamic tension that enhances TCM performance. Particularly, this paper choice two elements that will create tensions in TCM activities: stretch cost targets and concurrent processes. Based on the data from a questionnaire survey, statistical significant relationship between the combination effects of them and TCM performance were not found by full sample analysis. However, sub-group analysis divided by assembly and process industries, meaningful relationship was found only in process industries.

This paper contributes to current management accounting research by three ways. First, previous research largely ignored how specific management accounting systems create dynamic tension (except for Frow et al.., 2010). Thereby, it has been unknown that what or how peculiar elements of individual management accounting systems contribute to create dynamic tension. This paper focused on TCM because TCM activities accompany various tensions and TCM systems are composed various elements in order to achieve competitive performance. Particularly, this paper selected two elements, stretch cost targets and concurrent processes, by reviewing previous literature on TCM and restructuring them from a viewpoint of tension management. That allowed to hypothesize their combined use enhance TCM performance by creating dynamic tension. Second, previous research only focused on the use of management accounting systems such as diagnostic and interactive, however, less attention has been given to the design of them that creates inherent tensions. This paper choice cost targets as a factor which create tensions. In addition, not focusing on single effect of stretch cost targets but on joint effect with concurrent processes, a series of processes about how inherent tensions are created by designing management accounting systems and how they are submitted to dynamic tension by the use of them are revealed. Third, previous research were limited to examine tension management at business unit level by building on Simons (1995)'s framework (e.g. Bedford, 2015; Frow et al., 2010; Henri, 2006; Marginson, 2002; Mundy, 2010). This paper proposes additional insights about tension management in the context of new product development by focusing on TCM activities, particularly manager's horizontal collaboration.

There are also several limitations. First, the numbers of survey instruments are not enough. Second, this paper have limited the dependent variable in the cost reduction. The purpose of TCM is not only cost reduction but also high quality and multiple functions (Kato, 1993a, b; Tani et al.., 1994). Hence, it needs to consider other dependent variables. Third, the results of this paper may be unique to Japan. This paper cannot guarantee that the observed relationships generalize for manufacturing firms in other foreign countries. Forth, this paper didn't consider strictly which stage cost targets exhibit. As Shimizu (1992a) shows, stretch cost targets act as either facilitator or constraint for knowledge creation and its function is determined on when to exhibit cost targets. Thus, results may vary by considering the stages. Finally, results of this paper are limited to explain the cross-industry influence. Intra-industry differences in cost reduction processes are not revealed.

Future research about tension management for TCM should consider the effects context variables on TCM systems and performance. Yoshida (2001) indicated empirically that elements such as stretch cost targets, concurrent processes don't always enhance TCM performance and their effect is different between computer and air conditioning. This is because they face different business environment such as novelty of technology and market dynamism. Therefore, it seems like that ideal tension management is dependent upon factors such as technology and market environment. Empirical research that guarantee this expectation, Henri (2006) confirmed that effect of balanced use of diagnostic and interactive control systems on organizational capabilities depends on degree of environmental uncertainty and organizational culture. In addition, in order to interpret accurately our results that using stretch cost targets and concurrent processes enhance TCM performance in process industries, it needs field investigation about TCM practices in these industries. Unfortunately, there are few studies. By clarifying TCM activities in these industries, it may enhance our knowledge about current state of Japanese manufacturing industries and this enables to understand why using stretch cost targets and concurrent processes enhance cost reduction in process industries.

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Table 1. Sample for analysis

industry	sending	valid response/rate		use for analysis
assembly industry				52
machinery	120	12	10.0%	10
electrical/electronics	154	27	17.5%	25
transportation equipment	62	16	25.8%	15
precision equipment	28	2	7.1%	2
process industry				46
food	69	13	18.8%	10
textile mill	41	4	9.8%	4
pulp/paper	11	2	18.2%	2
chemical	128	18	14.1%	13
drugs/medicines	38	5	13.2%	4
oil/ coal	11	1	9.1%	0
rubber	11	2	18.2%	1
glass/ clay	33	4	12.1%	3
steel	32	4	12.5%	3
non-ferrous/fabricated metal	24	4	16.7%	2
fabricated metal	37	8	21.6%	4
other manufacturing	48	8	16.7%	0
total	847	130	15.3%	98

Table 2. Descriptive statistics on variables

	Mean	SD	Median	Min	Max
1. diversity of product market	3.77	1.572	4	1	7
2. community of technology with competitors	3.51	1.220	3	1	6
3. diversity of sales promotion	3.85	1.409	4	1	7
4. competitiveness of product market	5.17	.908	5	2	7
5. frequency of developing new product and technology	4.69	1.327	5	2	7
6. accuracy of estimating customer demand	3.86	1.140	4	2	6
7. stretch cost targets	3.73	1.359	3.50	1	7
8. concurrent processes	5.23	1.275	5	2	7
9. stretch cost targets ×concurrent processes	.2539	1.01886	.1172	-1.77	3.33
10. cost reduction	5	1.176	5	2	7

Table 3. Correlation Matrix

	1	2	3	4	5	6	7	8	9	10
1	1									
2	.294**	1								
3	.351***	.142	1							
4	.130	-.053	.069	1						
5	.232*	.307**	.283**	.318**	1					
6	.160	.016	.083	.203*	-.036	1				
7	-.049	-.036	.183†	.013	.006	-.011	1			
8	-.044	-.058	-.037	.134	.195†	-.048	.257*	1		
9	.014	-.243*	.012	.021	-.240*	-.108	.250*	-.156	1	
10	-.011	-.070	.091	.000	.173	-.066	.352***	.344***	-.035	1

Notes: † p<.1, *p<.05, **p<.01, ***p<.001

Table 4. Results of hierarchical regression analysis for full sample

Full sample (N= 98)						
	Model 1		Model 2		Model 3	
variable	β	95%CI	β	95%CI	β	95%CI
constant	5.147***	[4.906, .5.388]	5.162***	[4.941, 5.384]	5.185***	[4.952, 5.417]
1.	-.034	[-.304, .236]	019	[-.230, .267]	.030	[-.222, .283]
2.	-.169	[-.433, .094]	-.133	[-.376, .110]	-.150	[-.400, .099]
3.	.078	[-.187, .343]	.019	[-.232, .271]	.019	[-.233, .271]
4.	-.092	[-.378, .195]	-.124	[-.387, .140]	-.113	[-.379, .153]
5.	.272†	[-.012, .556]	.216	[-.051, .483]	.199	[-.074, .472]
6.	-.049	[-.295, .197]	-.032	[-.257, .194]	-.045	[-.275, .185]
7.			.333**	[.100, .566]	.358**	[.112, .604]
8.			.285*	[.050, .520]	.267*	[.025, .509]
9.					-.080	[-.326, .165]
R^2		.058		.225		.229
ΔR^2		.058		.167		.004
ΔF		.937		9.589***		.422

Notes: † p<.1, *p<.05, **p<.01, ***p<.001

Table 5. Results of hierarchical regression analysis for firms in assembly industries

firms in assembly industries (N= 52)						
	Model 1		Model 2		Model 3	
variable	*β*	95%CI	*β*	95%CI	*β*	95%CI
constant	5.366***	[5.033, .5.699]	5.244***	[4.949, 5.539]	5.295***	[4.999, 5.591]
1.	.167	[-.154, .489]	.290*	[.004, .576]	.314*	[.032, .596]
2.	-.477*	[-.852, -.101]	-.357*	[-.690, -.025]	-.380*	[-.708, -.053]
3.	.158	[-.162, .479]	.003	[-.288, .294]	.033	[-.255, .321]
4.	-.267	[-.658, .124]	-.249	[-.591, .094]	-.213	[-.551, .126]
5.	.386 †	[-.037, .808]	.414*	[.043, .786]	.359 †	[-.011, .729]
6.	.152	[-.163, .466]	.126	[-.152, .403]	.073	[-.206, .352]
7.			.511***	[.226, .797]	.556***	[.271, .841]
8.			.211	[-.104, .527]	.232	[-.079, .542]
9.					-.254	[-.561, .054]
R^2		.182		.412		.449
ΔR^2		.182		.231		.036
ΔF		1.663		8.434***		2.771

Notes: †p<.1, *p<.05, **p<.01, ***p<.001

Table 6. Results of hierarchical regression analysis for firms in process industries

firms in process industries (N= 46)						
	Model 1		Model 2		Model 3	
variable	*β*	95%CI	*β*	95%CI	*β*	95%CI
constant	4.849***	[4.510, .5.188]	4.892***	[4.559, 5.225]	4.739***	[4.375, 5.103]
1.	-.182	[-.643, .278]	-.229	[-.665, .208]	-.331	[-.769, .107]
2.	-.002	[-.376, .371]	.010	[-.346, .366]	.195	[-.206, .596]
3.	.020	[-.433, .472]	.089	[-.349, .526]	.239	[-.216, .694]
4.	.026	[-.382, .435]	-.131	[-.535, .273]	-.222	[-.626, .182]
5.	-.025	[-.431, .381]	-.170	[-.574, .234]	-.135	[-.529, .259]
6.	-.401*	[-.781, -.021]	-.310 †	[-.674, .054]	-.201	[-.574, .171]
7.			.019	[-.371, .409]	-.236	[-.707, .235]
8.			.437*	[.080, .794]	.668**	[.239, 1.097]
9.					.384 †	[-.038, .805]
R^2		.149		.289		.351
ΔR^2		.149		.140		.062
ΔF		1.138		1.138*		3.412 †

Notes: †p<.1, *p<.05, **p<.01, ***p<.001