Knowledge Management

At

Daimler Trucks North America: A Case Study

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Table of Contents

Knowledge Management (KM) is a vast subject is not at just implemented at the individual level. It is a complex "synergy involving individuals, collection of knowledge in human capital, procedures and tools" and flow through the organization.[7] Due to faster product development cycle and increase global competition, there is a growing need for KM for managers and project leaders to understand, utilize and continuously improve KM "control mechanism" to remain competitive, as knowledge does not flow through an organization on its own.[9] This paper explores Daimler Truck North America in order to compare literature on KM controls, by K. Turner and M. Makhija through inductive reasoning to find where theory is relevant in the trucking industry. Ultimately, the purpose of this paper is two-fold to illustrate an application as it relates to the theoretical framework of KM literature and highlight where literature can improve to make it more useful for applications.

Introduction

Organizations are not machines but living, complex, and adaptive systems.

In order for organizations to be competitive they must manage knowledge. Top performing organizations manages their process and lead their culture has been recognized as a competitive advantage.[1] The relationship of performance and knowledge is known but most companies do not know how to manage such knowledge. This link is frequently highlighted in the knowledge management literature.[1][9] The most well know aspect of KM in literature comes from the knowledge-based view of the firm [Conner & Prahalad, 1996; Grant, 1996a;Zander & Kogut, 1995]. This view is the firm's resources include all assets, information, knowledge, and organizational processes to create and implement strategies and/or continuously improve effectiveness. However, knowledge is not easy to measure or observer.

In 2006, K. Turner and M. Makhija demonstrated a comprehensive model of controls mechanisms to improve the flow and knowledge within a firm. Observable features that can be used to illuminate both the properties and use of its knowledge are organizational control systems. This model will provide the framework for this case study at Daimler Trucks North America since theories are often less helpful in practice and provides a limited view and understanding of an organizational process, management and treatment of knowledge within a firm. Comparing a theoretical model to a real practical application will advance the literature and science for further KM research and application.

Method of Work

The method used for analysis is the technique of case study research with inductive reasoning. The case study will include KM history and characteristics of the control mechanisms, and

inductive analysis of interviews conducted by the author. The data for inductive reasoning of this case was collected by interviewing team members and management then transcribing the conversations as it related to the theory.

This case study is important as KM has little application examinations needed to advance KM literature. Although, there are limited observations these facts are used to explain the relationship between facts and allows prediction of future knowledge. This paper will cover the following aspects: Brief History of KM, Literature Model Approach, Highlight Key Aspects Related to Application of Theory, KM at DTNA, and Recommendations for Future Research and Conclusions.

Brief History of KM

Information is everywhere and with rapid increases in technology, especially since the computer industry has caused explosion in data; as it is readily available to most everyone in 21st century global organizations. However, more data does not necessarily translate into new knowledge. Especially, since the human mind is subject to limiting the amount of new information.[3] Learning and Knowledge are closely related to finding patterns and how they relate with humans bring new in sight and creativity to solve the new challenges of today.[3] It is important to understand how to control the patterns in an organization for increased organizational learning to occur.

There are vast definitions and perspectives in Knowledge Management (KM) literature on this subject. "Organizations that can make full use of their collective expertise and knowledge and quickly adapt tools and processes are likely to be more innovative, efficient, and effective in the marketplace"[1]. Project and teams are becoming more common place to increase flexibility in organizations but because they are temporary

form knowledge is not always created. Since managers and/or team leaders often starts a new learning curve every time a new project begins. Ultimately, repeating past mistake and lost of performance.[4-6] That is why studying the control mechanisms of a firm's knowledge management process can lead to more effective flow of knowledge to accomplish the organization's goals.

Literature Model Approach

In 2006, K. Turner and M. Makhija present a model demonstrating the role of organizational controls in KM characterized by different combinations of knowledge attributes. "All control mechanisms influence the firm's knowledge management process by affecting how knowledge is acquired, disseminated, interpreted, and used to accomplish organizational goals."[9]

They demonstrated how particular controls - outcome, process, and clan - differ in their ability to acquire, transfer, interpret, and application of knowledge, see Figure 1 and 2.

Figure 1 [9]

FIGURE 1
The Relationship Between Controls and the Firm's Knowledge

Knowledge related to outcomes	Knowledge related to processes: Perfect		Knowledge related to processes: Imperfect	
	Outcome/process control[a]		**Outcome control**	
Perfect	**Process-related knowledge**	**Outcome-related knowledge**	**Process-related knowledge**	**Outcome-related knowledge**
	Explicit Complete Nondiverse	Explicit Complete Nondiverse	Tacit Incomplete Diverse	Explicit Complete Nondiverse
	Process control		**Clan control**	
Imperfect	**Process-related knowledge**	**Outcome-related knowledge**	**Process-related knowledge**	**Outcome-related knowledge**
	Explicit Complete Nondiverse	Tacit Incomplete Nondiverse	Tacit Mostly complete Diverse	Tacit Complete Diverse

Adapted from Ouchi (1979) and Eisenhardt (1985).

[a] The decision situation is likely to be simple when knowledge of both the process and outcome is perfect. In such cases, both process and outcome knowledge are characterized as being complete, codifiable, and nondiverse.

Figure 2 [9]

TABLE 2
The Impact of Organizational Controls on the Stages of the Knowledge Management Process

	Knowledge Management Process							
	Knowledge Acquisition		Knowledge Transfer		Knowledge Interpretation		Knowledge Application	
Control Type	Process-Related Knowledge	Outcome-Related Knowledge	Process-Related Knowledge	Outcome-Related Knowledge	Process-Related Knowledge	Outcome-Related Knowledge	Process-Related Knowledge	Outcome-Related Knowledge
Outcome	Significant	Negligible	Negligible	Significant	Diverse interpretations	Common interpretation	Originality	
Process	Negligible	Negligible	Low	Negligible	Unshared interpretations	Unshared interpretations	Precision	
Clan	Moderate	Moderate	Significant	Significant	Common interpretation	Common interpretation	Adaptability	

This model relates the knowledge-based view of the firm with organizational mechanisms to affect knowledge flow in an organization. The model demonstrates relationship with managing organizational knowledge process to the control mechanisms depending on the characteristics of the knowledge. See Appendix A for the Theoretical Propositions based on Literature model. The model and propositions were used as the base for questions, see Appendix B, used in interviews to see if the following can be found in an application: 1) outcome controls excel in the development of new knowledge, 2) clan controls are better in transferring tacit and sticky knowledge and 3) process controls are better for highly specialized knowledge.

Highlight Key Aspects Related to Application of Theory

There are three attributes which managers can use in the selection of appropriate control characteristic: Codifiabity, Completeness and Diversity. By relating KM aspects to the four KM processes: Acquisition, Transfer, Interpretation and Application, a manager can develop and utilize the control mechanism best suited for the knowledge characteristics to

improve the flow and increase organizational effectiveness for competitive advantage. The following paragraphs describe what the theory has found in appropriate use of control mechanisms through aligning the right mix of knowledge attributes to KM processes.

Codifiable knowledge is easy to understand, articulate and often written or coded, termed "Explicit knowledge"[9]. Explicit information tends to be unambiguous, observable, and indisputable. Such characteristics allow highly codifiable knowledge to be readily transferred within the organization or between individuals without loss of meaning.[1]

Completeness is the ability of having sufficient and available information for a decision or use. Often knowledge is incomplete when the environment is unstable or predictable.[10] Over time, attributes may vary to make good decisions, therefore the knowledge required also changes. Unpredictable situations require more breathe of knowledge than is usually available within, thus causing the need to search for additional knowledge so that it can become complete.

The final attribute is diversity the amount and related information in a group. Diverse knowledge usually involves multiple functional disciplines and perspectives for a decision.[9]

Outcome controls are mechanisms that focus on the specific goals desired by the firm. These controls have explicit requirement and often used as incentives for an employee's effort. Outcome controls drive the ability of creating new knowledge though searching and contribute significantly to the process related knowledge in the acquisition phase. Through reevaluation and unsystematic process that are difficult to codify or explain to others resulting in significant impact to the outcome in the transfer process.

Interpretations phase are driven in original process knowledge and common outcome knowledge. Therefore, in application outcome controls excel in the development of new knowledge where originality of knowledge is desired. To use an outcome controls managers must effectively set a clear goal of the organization when process-related knowledge is difficult to write or codify. Therefore, outcome controls excel in the development of new knowledge.

Process Controls are clear process that must be followed. These controls are most appropriate where a job is clearly specified and specialized tasks. The result of this control mechanism is precision with clear interpretation in both process and outcome related knowledge. However, it has little to no effect on the acquisition or transfer knowledge. The benefit of a process control is to reduce differences in methods for better precision of a task. As a result, process controls are better for highly specialized knowledge.

The last control mechanism is clan controls. This is a social network of informal values, beliefs and understandings. There use is best when transfer and ability to measure outcome is low. This mechanism manages less codifiable knowledge through interaction with one another to increasing diversity. Ultimately, clan controls are better in transferring tacit and sticky knowledge and can achieve long-term and broader goals.

KM at DTNA

Using the propositions and model a list of 35 questions were created for interviews with 10 people, see Appendix B for Interview Questions. There were some subordinate and mid-management participation in the interviews for basing the inductive reasoning. These individuals were selected since they all work on similar projects and goal for the

company of reducing the product cost. Improving a product for best cost requires knowledge in all departments from manufacturing processes, procedures, adjustments of controls, raw material, designs, etc; thus a very diverse cross-functional team.

The model and propositions were used as the base for questions in interviews to see if any of following can be found in an application: 1) outcome controls excel in the development of new knowledge, 2) clan controls are better in transferring tacit and sticky knowledge and 3) process controls are better for highly specialized knowledge.

Each interview was transcribed with a few examples into a table to compare each control characteristics of both process and outcome knowledge vs. each of the three KM Control Mechanisms. Table 1 Linking KM Control Mechanism to Application Interviews on Control Characteristics summarizes how DTNA is or is not using each type of control mechanism.

Table 1: Linking KM Control Mechanism to Application Interviews on Control Characteristics

Control Characteristic vs. KM Control Mechanisms	Processes Knowledge			Outcome Knowledge		
	Codifiabity	**Completeness**	**Diversity**	**Codifiabity**	**Completeness**	**Diversity**
Outcome Control	**Tacit - processes to achieve a similar outcome are variable.** Examples: "...use cost vs. weight to identify opportunities", "Number of components in design used to optimize for best cost", or "Negotiated with supplier and their competition to ensure best cost"	**Incomplete - Most team members must gain through experience.** Examples: "Trying out new designs and testing works best", "Cost are not directly tied to product but how well departments work together with suppliers to achieve optimal results", or "It is hard to express, but the team that usually does best is usually the team with the most senior members."	**Diverse - Many departments must be well coordinated to achieve optimal costs.** Examples: "Manufacturing, engineering, procurement, marketing and testing all have to work together to get the right balance or quality, functionality, and price.", "There is no one group responsible.", or "Teams using workshops with suppliers bring new insights and unique solutions to achieve targets."	**Explicit - Goal was easily stated and measureable.** Examples: "...minimize cost of the product by $2000/truck", "Achieve cost savings of $2000/truck by 2011", "Reduce average truck cost by $35", or "Remove $140/truck this year".	**Complete - teams could easily express the factors needed to achieve it's goals.** Examples: "part costs, volumes and functions", "Each idea must provide the same functionality, with reduced part costs then the previous year for all applicable models", or "Driving the customer to their optimize part cost, quality and function".	**Non-diverse - Since the measurement of outcome is the same for all teams.** Example; $/truck in year X.
Process Control	**Explicit - there was minimum evidence of individuals being held accountable.** Examples: "Finance must verify impacts to P&L", "Verification of the savings can only be done by the Finance Representative." or "Team structure was setup to be flexible will very few explicit roles/responsibilities."	**Complete - There is no SOP for team members thus show no completeness.** Examples: "There are no job descriptions", "Team members are self motivated with little daily oversight.", "Very few routines used." or "Teams need flexibility in order to meet their goals"	**Non-diverse - There is no evidence of non-diversity.**	**Tacit - There is no evidence of tacit outcomes.**	**Incomplete - There is no evidence of incompleteness in outcome.**	**Non-diverse - Since the measurement of outcome is the same for all teams.** Example; $/truck in year X.
Clan Control	**Tacit - There are medium amounts of team communication and interactions with few shared believes and values.** Examples: "Team members are co-located to increase communication but most members interact more with their own department then as a group.", "Teams meet daily for 30 minutes.", or "Only approach other team members when specialized skills are needed."	**Mostly Complete - Team members go through a large learning curve thus show mostly incomplete process knowledge.** Example: "Team structure was setup to be flexible will very few explicit roles/responsibilities." or "Occasionally, team members will switch tasks."	**Diverse - Many departments must be well coordinated to achieve optimal costs.** Examples: "Manufacturing, engineering, procurement, marketing and testing all have to work together to get the right balance or quality, functionality, and price.", "There is no one group responsible.", or "Teams using workshops with suppliers bring new insights and unique solutions to achieve targets."	**Tacit - There is no evidence of tacit outcomes.**	**Complete - teams can not change their performance target to adjust with their work style.**	**Diverse - There is only one right answer, thus is non-diverse.**

There is strong indication of DTNA using Outcome Controls. On the process knowledge there was clear evidence of tacit codifiability, incompleness and very diverse team members. First, evidence of tacit codifiablity was “Structure components are usually analyzed to look at use of cost vs. weight to identify opportunities.” Second, example was electrical components try to look at “Number of components, i.e. leads in a harness or number of control doing similar functions, in design used to optimize for best cost.” Additionally, there were wide-ranging interpretations of knowledge enhancing ability to address new contingencies. Team members expressed experience helps with finding the patterns and working well with all departments to find the best solution for the company. Two examples of this incompleteness of processes are:1) “Cost are not directly tied to product but how well departments work together with suppliers to achieve optimal results" or 2)"It is hard to express, but the team that usually does best is usually the team with the most senior members." Finally, the process knowledge demonstrates diversity with many departments that must be well coordinated to achieve optimal results. Team members consist of cross-functional expertise in Engineering, Procurement, Quality, Manufacturing, Finance and Marketing to evaluate the opportunity and scope of a project, thus showing very diverse teams. Interviews showed very different approaches to identifying where to remove cost while not impacting functionality, quality or customer satisfaction.

Everyone interviewed could clearly state their team’s goal and how it was measured. The examples in Table 1 under Outcome Knowledge Codeifiablity demonstrate their goals are explicit. Management expressed, “Their goals are clear and easy to measure. A team’s goal is minimize cost of the product by $2000/truck.” Teams also expressed their clear

goals that were non-diverse made it easy for the team members to "understand their progress" since it is tied to their performance reviews it drives their behavior to continue seeking out more sources of information to improve product costs, therefore increasing new knowledge and originality in the organization. Management suggested without these goals "Employees do not stretch and evaluate both DTNA and Supplier factors influencing strategy." Therefore there is a strong indication that outcome controls do bring new knowledge into an organization since the tacit, incomplete and process knowledge fosters knowledge acquisition, diverse interpretations with a common outcome.

As was mentioned in the literature, process controls are opposite of those in outcome controls. Since the best application for process controls are when precision is a must. It was noted in literature organizations will often for this reason it is usually dominated by one or the other. Thus, there was little evidence of this control mechanism being used at DTNA while the control mechanism is being highly used in these teams. This process control is not conductive to acquisition of new knowledge therefore management at DTNA would use less process and more outcome controls to foster new insights in reducing cost of all products. Table 1 shows a few examples of minimum specialize processes with specific skill sets to "verify impacts to P&L". Since the goal of these teams is not precision there is a strong indication that process controls would not be best for these DTNA teams.

For clan controls the process knowledge is very similar to the outcome controls. The only difference is the completeness for clan is mostly complete vs. incomplete. Team members expressed, "All necessary knowledge for completing the task can not be found

internally". As was stated in the literature, greater use of clan controls is associated with greater adaptability in the use of knowledge. Since the knowledge acquisition is internal, thus greater then process controls and less then outcome controls, which use both internal and external knowledge.

There is enough evidence to suggest that literature is correct that outcome controls excel in the development of new knowledge. New knowledge is created through trial and error with diverse teams seeking external sources as well as internal for more information. The type of control results in new knowledge through specific use of the three attributes of learning. Process knowledge is Tacit, Incomplete and Diverse: 1) Processes to achieve a similar outcome are variable. 2) Most team members must gain insight through experience. 3) Many departments must be well coordinated to achieve optimal costs. While the Outcome knowledge is Explicit, Complete and Non-diverse: 1) Goal was easily stated and measureable, 2) Teams could easily express the factors needed to achieve it's goals and 3) Measurement of outcome is the same for all teams. Additionally, since Outcome and Process are on two extremes the presence of one in place has proved to obsolete the other.

Recommendations for Future Research

Due to the time limitations it would be useful to have a large sample size. Although, DTNA is not currently using a clan control mechanism for product cost reduction, it is hard to determine when a team might need to shift towards clan controls when more in-depth insight into nuances and subtleties are needed over a longer period of time. The literature just suggests "Knowledge from which firm capabilities can emanate is more likely to exhibit characteristics that include some combination of tacitness,

incompleteness and diversity."[9] DTNA has been using outcome mechanism for eight years. To sustain this as a competitive advantage, without some of clan controls for the area of nuances and a broader understanding. One suggestion for further research is to develop a Fussy Cognitive Map (FCM). Fuzzy Cognitive Maps are structures that strongly resemble neural networks, with powerful consequences as a mathematical tool for modeling complex systems.[11] FCM are useful tools for creating and using models of uncertainty and complex processes and systems to analyze impacts of different input states on dynamic systems. The development of a FCM requires the signs and magnitudes of the relevant causal relationships by one or more experts based on subjective estimates of the causal relationships. Ultimately, use of FCM could provide more insight into the strength of the relationship of KM Control Mechanism to Control Characteristics. This would also help illustrate when management should start utilizing more Clan controls vs. outcome or process controls. The findings of this study help us to shed light on the knowledge controls are occurring in application; however, it did not allow us to quantify the effectiveness of knowledge transfer. Therefore, more deductive empirical studies are needed.

Conclusions

As the literature suggested, a organization will usually be either in outcome or process controls. DTNA is using outcome control mechanisms to increase new knowledge in order to continually reduce product costs. This is the appropriate control mechanism to use for the characteristics in both processes and outcome based knowledge of the company. New knowledge is created through trial and error with diverse teams seeking external sources as well as internal for more information. Keeping team diversity and

flexibility of roles increasing their ability to acquire and transfer new knowledge. While a clear, same and measurable goal for all teams increases the common understanding of what is needed for the company to be successful in reducing product costs. To further the literature more empirical studies would be needed with FCM to analyze impact and strength of the relationship of KM clan mechanism to both outcome and process characteristics to determine when to switch mechanism for optimal results.

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APPENDIX A

Theoretical Propositions based on Literature Model[9]

Proposition 1a: The more tacit, incomplete, and diverse the process-related knowledge, the more effective the use of outcome controls will be.

Proposition 1b: The more explicit, complete, and non-diverse the outcome related knowledge, the more effective the use of outcome controls will be.

Proposition 2a: Greater use of outcome controls is associated with greater acquisition of new process-related knowledge and is not associated with the acquisition of new outcome related knowledge.

Proposition 2b: Greater use of outcome controls is not associated with the transfer of process-related knowledge and is associated with greater transfer of outcome-related knowledge.

Proposition 2c: Greater use of outcome controls is associated with more diverse interpretations of process related knowledge and with more common interpretations of outcome related knowledge.

Proposition 2d: Greater use of outcome controls is associated with greater originality in the use of knowledge.

Proposition 3a: The more explicit, complete, and non-diverse the process related knowledge, the more effective the use of process controls will be.

Proposition 3b: The more tacit, incomplete, and non-diverse the outcome related knowledge, the more effective the use of process controls will be.

Proposition 4a: Greater use of process controls is not associated with the acquisition of new process- or outcome related knowledge.

Proposition 4c: Greater use of process controls is associated with multiple unshared interpretations of both process- and outcome-related knowledge.

Proposition 4d: Greater use of process controls is associated with greater precision in the use of knowledge

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Proposition 5a: The more tacit, complete, and diverse the process-related knowledge, the more effective the use of clan controls will be. Proposition 5b: The more tacit, complete, and diverse the outcome related knowledge, the more effective the use of clan controls will be.

Proposition 6a: Greater use of clan controls is associated with moderate acquisition of new process- and outcome- related knowledge.

Proposition 6b: Greater use of clan controls is associated with greater transfer of both process- and outcome related knowledge.

Proposition 6c: Greater use of clan controls is associated with more common interpretations of both processes and outcome-related knowledge.

Proposition 6d: Greater use of clan controls is associated with greater adaptability in the use of knowledge.

Appendix B – Interview Questions

Company Knowledge Context Questions:

1. Are incentives used? If so are they clearly aligned with desired outcome?
2. Do you measure outcome?
3. Do employees require through experience or learning by doing?
4. Are processes to achieve a similar outcome variable and difficult to predict?
5. Is flexibility present for unique solutions in problem solving?
6. Can new knowledge be created through trial and error, subjective judgment, and searching?
7. Are individual or teams diverse with multiple departmental knowledge?
8. Does new knowledge often begins within the individual and is tacit, making it difficult to communicate to other individuals? Or is it easy to transmit to other parts of the company?
9. Are wide-ranging interpretations of knowledge enhancing ability to address new contingencies?
10. Is specification of desired outcomes helping to promote objectives that drive behavior?
11. Are external information draw on greater amounts for creating new knowledge?
12. Can individuals be held accountable for appropriate behaviors and processes in which employees must engage?
13. Is the job of each individual clearly specified and specialized?
14. Do standard operating procedures and rules, routines and hierarchical supervisor-subordinate relationships exist?

15. Is behaviors communicated clearly, with individuals observed and measured to SOP (Standard Operating Procedures)?
16. Does the individual know in advance what knowledge is required to achieve their goals?
17. Are most of the knowledge internal and less often come from external sources to supply the complete set of knowledge?
18. Is it difficult to hold the individual responsible for the outcome of the entire process?
19. Can individuals comfortably change processes that have been established by the organization?
20. Do SOPs easily transmit across the organization?
21. Do individuals understand the relationship between others' tasks and outcomes?
22. Are individuals with same job responsibility able to share both process and outcomes, but this same can not be extended to the broader organization?
23. Is there a high level of focus on individual's task and conducive to creating precision through repetition to reduce errors?

24. Are there teams or members that require high amount of interaction and communication?
25. Do teams include share values, beliefs and understandings?
26. Are team members highly dependent on one another to complete tasks?
27. Can interactions in teams allow diverse knowledge, new insights and all necessary knowledge for completing the task can be found internally?
28. Do teams analyze data and search for the one right answer? Or more likely to probe both questions and answers?
29. Is group effort emphasized?
30. Can team members engage in multiple tasks and switch tasks as necessary?
31. Are broader knowledge resources of the group adequate for accomplishing a task?
32. Do teams encourage experience the knowledge over time to gain insight into nuances and subtleties?
33. Is coordination required across multiple individuals, groups or departments?
34. Are individuals able to develop a broader understanding of their work and its relationship to the work performed by others?
35. Is there ability to change performance targets, allowing individuals the flexibility in their work style?