Lean Management Practice: Toyota Brazilian Plants Case

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Abstract
This paper aims to analyze the Toyota Production System (TPS) applied to Toyota Brazilian plants. The TPS is recognized as a promoter of competitiveness in the automotive environment. Nevertheless, many companies work with the TPS in an unstructured way. Case Studie has been used and collect data through interviews in four Brazilian plants of the Toyota group. This paper use factors of work organization (communication, training, incentive) and factors of production organization (problem solving methods, 5S, poka yoke) to analyze TPS. Results have indicated similarity in the daily work of the plants researched consistent with the headquarters orientation and the lean manufacturing literature despite the Brazilian cultural aspect.

Keywords: Toyota Production System, Work Organization, Production Organization, Toyota Brazilian Plants.

Introduction

This paper aims to analyze the Toyota Production System applied to Toyota Brazilian plants. This research is delimited to the shop floor production operations environment.

Brazil took the fifth position as the largest producers of vehicles in the world in 2009 (OICA, 2010). The Brazilian automotive industry sales over 3,52 million vehicles in 2010. Most of major global companies are present in Brazil, such as: Fiat, Volkswagen Group, Ford, General Motors, Nissan Motors, Toyota, MAN SE, Mitsubishi, Mercedes-Benz, Renault, Honda, Hyundai, and also the emerging national companies such as Troller, Marcopolo S.A., Agrale, Randon S.A.

Brazilian industry has seen an evolution of units produced. Brazilian automotive industry represents a significant economic sector and its production growth trend has been higher than the industry in general (SIDRA-IBGE, 2011).

Automotive companies provide a revolution in the Brazilian way to deal with suppliers, to develop products and to apply the Toyota Production System in the productive process (Salerno et al., 2009). Brazil has its own cultural aspect.

Traditionally, production management models are comprised of two dimensions: the technical dimension and the social dimension (Emery, 1959). The technical dimension refers to production organization; hereafter called the P-dimension, processes, activities, types and

physical arrangement of equipment and to the flow of material that result in services and goods. The social dimension refers to work organization; hereafter called the W-dimension.

This research use factors of production organization (problem solving methods, standard operating procedure, 5S, poka yoke, and quick changeover) and work organization (objectives, structure, communication, training, incentive and personal characteristics). They were raised from literature.

The Toyota Production System (TPS) has inspired the major automotive companies (i.e. Ford has the Ford Production System - FPS, General Motors has the Global Manufacturing System - GMS).

The depth given to TPS in the literature is not enough to cover the difficulties to adopt the TPS in a consistent and articulated way. Therefore, it is important to answer questions such as: TPS is applicable in different socio-cultural contexts (Liker; Meyer 2007)? How the TPS works in the shop floor? The answers help managers to understand the work context of TPS to implement its concepts in effective way.

This paper aims at helping to answer those questions. In order to do it, this paper is structured as following. Section 2 reviews the production management models. This leads to the P and W factors described in Section 3. Section 4 presents the method and Section 5 discusses results and analysis of the case study. Section 6 draws some conclusions.

Traditional models

The literature indicates some production management models (Muniz Jr.; Batista Jr. and Loureiro, 2010a,b). In the taylorist model and mass production focus on production organization rationalization, efficiency increase in order to obtain results: quantity and cost (Taylor 1998). In the socio-technical model, Emery (1959) considers that people behaviour at work depends on their task structure and their task contents. People performance and feelings related to their tasks are important for their satisfaction with their job. Therefore, despite the fact that the social and technical dimensions are identified as separate, both should be "jointly optimized" for obtaining results, while developing and integrating people. This proposition is essential so that the socio-technical model is not considered a social experimentation exercise but a way to develop more effective organizations.

Biazzo and Panizollo (2000) state that the differences between the socio-technical and taylorist perspective are related to work organization, that, in the socio-technical perspective, it should be taken advantage of the people intellectual and creative capabilities, allowing for continuous learning, generating recognition and social support, providing a clear relationship with social life and social value of the workers, allowing visualization of the final product ´big picture´, allowing the control on the results, allowing hierarchical differences to be minimized and groups composition to be heterogeneous.

The Production and Work factors

Relevant P-factors are the use of the following tools that contribute for the control and improvement of the daily activities of production workers. They are: Problem Solving Methods (Garvin 1993; Kolb 1984); Standard Operating Procedure (Bartezzaghi 1999; Ohno 1988; Spear and Bowen 1999); 5S (Ohno 1988); Poka Yoke (Ohno 1988; Black 1991) and Quick Changeover (Black 1991; Shingo 1989).

Relevant W-factors are objectives, structure, communication, training, incentive. Objectives represent a measurable way to relate the work of the group to the achievement of

results, indicating progress, establishing priorities and justifying the claim for material and time resources to be used in problem solving and improvement projects.

Structure encompasses the specification of roles and responsibilities of people in the working group, that is, group members, group leader and direct supervision, and also, the availability of material and time resources. The formal organization of people, material resources and time allocation stimulate the initiative and autonomy of the group members to seek support and to meet for creating, sharing, using and assessing new ideas of improvement and results gain. Barton and Delbridge (2006) state that the role of supervisors and shop floor operators is important for continuous improvement and for the plant innovation process, and emphasizes the importance of teamwork and empowerment. They also state that supervisors must translate company´s global objectives into objectives that are specific to working groups, as a workforce motivation element.

Communication is the process by which, ultimately, ideas and feelings are transmitted from people to people, from people to group, or from group to group (including to supporting groups, e.g. Maintenance and Logistics).

Training is the development of skills in production activities by emulating situations similar to working situations. Training shall provide the working groups with knowledge to action (Nonaka 1991).

Incentive is related to the stimulus to carry out action, such as, to motivate shop floor operators to make suggestions for improvement in the workplace.

Method

This section describes how the case study was carried out. Qualitative Case Study method was used in this study (Yin, 2009).

The researched plants belong to different business units from the Toyota group, whose headquarters are in Japan. The researched plants (A, B and C) are located in the Paraiba Valley - Sao Paulo state, one of the most developed industrial areas in Brazil.

The researched plants belong to a supply chain representative (Figure 1). Plant A is a tier 2 supplier because it provides plastic parts to the direct automaker's suppliers (tier 1). Nowadays plant A has been charged to work closer to TPS principles by their direct customers (plants B and C) and by the automaker itself. The profile of the plants researched is in Table 1.

The data collecting procedure used was semi-structured interviews with open questions (Table 2). Table 3 presents the interviewees' profile. The interviewees' sample was no probabilistic.

Figure 1 Researched Supply Chain

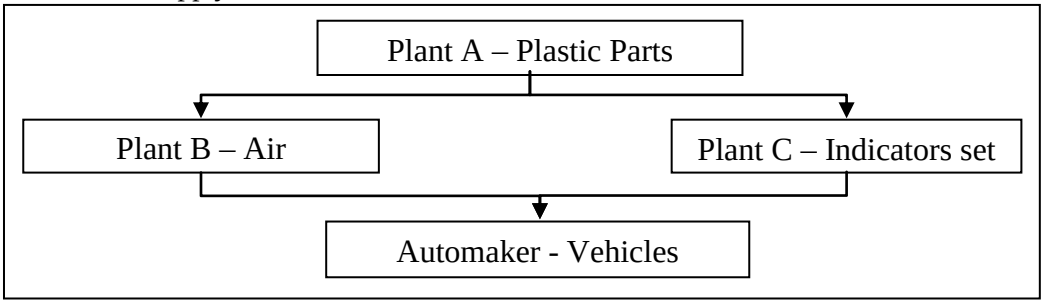

Table 1 Profile of the plants studied

Plant	A	B	C	Automaker
Inauguration year	1997	2002	1994	1998
Brazilian plants	3	1	5	2
Industrial Customer	4	1	8	Do not apply
Direct labour [people]	105	24	116	1110
Indirect labour [people]	27	30	53	740
Assembly lines	Do not apply	12	5	1
Product	Plastic Parts	Indicators sets	Air Conditioning	Vehicles

Table 2 Semi Structured Interview

	Factors	*Answer*
Work Organization	Objective	Which are the main plant-business objectives? How is the plant deploying the objectives to the worker levels? Are there corporative and operational goals (External and Internal)? What are these goals (External and Internal)?
	Structure	How is the organizational structure? Does it work?
	Communication	Are there communication plans? Do the workers understand it? Does it work?
	Training	Is there a training plan? Does it work? How are the training needs identified? Is top management committed to the training plan?
	Incentive	Which are the ways to motivate the workers? Has the plant motivated the workers to get involved in activities and goals set (Kaizen)?
	Personal characteristics	What is the profile of the workers (age, education, professional experience)?
Production Organization	Problem solving methods (MSP)	What is the problem solving method used? Does it work?
	Standard Operating Procedure	Does the plant apply Standard Operating Procedure? Does it work?
	5S	Does the plant apply 5S? Does it work?
	Quick changeover	Does the plant apply Quick changeover? Does it work?
	Poka Yoke	Does the plant apply Poka Yoke (error proofing)? Does it work?

Results and analysis

These results come from the analysis of the interview answers and from the feedback collected in the final consolidation meetings in each of the four plants.

The Brazilian companies of the Toyota group seek a credibility image. The case study shows that the plants researched have similarity of values and actions with the Japanese Toyota. Those plants look for excellence in quality of products and services. In the plants researched: focus on customer needs, supplier's involvement, and safety are relevant aspects.

Table 4 shows that all the plants researched seek new business as a way of maintaining their operations in Brazil. It was raised that in the 4 plants, they all have as External Objectives: increased return on investment and increased market share.

Table 3 Interviewees' profile

	Automaker	*Plant A*			*Plant B*			*Plant C*		
	Quality Supervisor	*Production Supervisor*	*HR Supervisor*	*Production Leader*	*Production Supervisor*	*HR Supervisor*	*Production Leader*	*Production Supervisor*	*HR Supervisor*	*TPS Coordinator*
Age [years]	44	46	27	34	43	47	33	35	50	37
Professional experience [years]	20	28	10	18	24	20	5	18	35	15
Industrial experience [years]	20	26	1	8	24	20	5	16	30	10
Experience in the automotive industry [years]	20	21	1	7	5	15	3	14	25	10
Time working in the plant [years]	20	7	1	7	5	5	3	14	20	10

Internal Objectives to labour groups are related to improved operational performance as quality levels improvement and reduced production cycle time.

Concerning the Structure factor, the research identified that there are few hierarchical levels. This happens despite the automaker has a greater number of functions and a significantly higher number of employees. This allows fast flow of information and proximity of overhead functions with reality on the shop floor, called in Japanese: Genchi Genbutsu.

Communication seeks to improve the exchange of information and the use of HORENSO, which is the combination of three Japanese words meaning: HOUKOKU, which means report, RENRAKU, which means contact, and SOUDAN, which means discussion. Regarding Internal Communication, Tiorey and Yuchi play an important role and are part of the daily routine of four organizations surveyed. Both events seek to promote an exchange of information between the workers and support areas (see APPENDIX: Toyota day-by-day).

Training (Table 5) focuses on the development of technical skills (Quality, Production, Safety, Cost, Maintenance and Environment). Suggestions and best practice programs are listed in order to improve the performance of employees and enable them to develop solutions in situations of decision-making.

New employees' integration is carried out by specific training in quality and production. It is expected that the new operator makes parts with 100% quality as soon as possible. The new operator performance is controlled by his supervisor using learning curve.

Training aims at worker specialization. There is exchange with Japan, which provide professional experience in: production processes, TPS, project management (engineers). The research rose that all plants are concerned to reduce the headquarters dependence.

"We are selecting who will go to Japanese plants, Toyota [Automaker] is chartering a plane to send greater groups." [Production Supervisor of Plant B]

Incentives such as travel and supermarket vouchers are used to stimulate workers suggestions.

Table 4: Work Organization Data

Factors		*Automaker*	*Plant B*	*Plant C*	*Plant A*
Objetive	*External*	Increase participation in MERCOSUR (3.6%) and Oceania.	Expansion of business in its own segment and opening of new business (New Products).	"Zero" defects on the client.	Opening of new business (New Products). Expand industrial park. Attendant legislation and customer requirements.
	Internal	Reduce Takt Time. Reduce Logistics costs. Reduce defects rate in process (Minor 50ppm)	Reduction of set-up by 8% per year "Zero" defects Location of components.	"Zero" defects on the process. Reduce line stops	"Zero" defects Reduce machine stops. Reduce machine *set up*. Staff capacitating.
Structure		President Coordinator Manager Operation Division Manager Manager of Dept. Head of Department Section Head Supervisor Leader Assemblers	President Director Supervisor Coordinator Leader Assemblers	Director Supervisor Charger Leader Assemblers	President Director Manager Supervisor Leader Operators
Communication		Common interest information (Newsletter). Specific daily meetings (Tyorei or Yuchi*) *see APPENDIX Departmental Meetings - weekly and monthly.	Daily meeting (Tyorei) where all issues are addressed and all involved. Weekly meetings of the board under the supervision and with those leaders.		

(Continue)

Workers have little or no previous industry experience. The automaker executive staff (managers, supervisor) is Japanese descent. The plants A, B and C already have Brazilian generation in their executive staff. The factors considered (MSP, standard operating procedure, 5S, quick changeover and poka yoke) are observed in the plants day-by-day (Table 6)

"These tools are essential for the production." [Production Supervisor Plant A]

Table 5: Work Organization Data - continued

	Automaker	Plant B	Plant C	Plant A
Training	Global Training Plan divided into: New projects Specialization New employees warm up	Needs assessment (Annual Plan) Prioritization of needs (costs / priorities) Training in operational process.	Annual needs plan Prioritization of needs (costs / priorities) Training of TPS to every 03 months for employees and partners.	Annual needs plan Prioritization of needs (costs / priorities)
Incentive	Continuous Improvement program. "Formula 1" Program. Career Plan Scholarship in English / Japanese	Continuous Improvement Program. Individual annual bonus Scholarship in English. Annual Launch between employees and their families.	Continuous Improvement Program. Special Lunch and gifts (i.e. T-shirts) International Exchange Annual Launch between employees and their families.	Continuous Improvement Program. Annual Launch between employees and their families.
Personal Caract.	Work profile: 25 years old, leadership, supervision and managers from 30 to 45 years. (85% Japanese and 15% other).	Work profile: 21 years old, leadership, supervision and managers from 33 to 44 years. (85% Japanese and 15% other).	Work profile: 30 years old, leadership, supervision and managers from 35 to 50 years. (95% Brazilian and 5% Japanese).	Work profile: 30 years old, leadership, supervision and managers from 35 to 50 years. (90% Brazilian and 10% Japanese

The Plan-Do-Check-Action cycle is driven to generate solutions. Research results were consolidated with interviewees. They indicated that leadership is the main issue to sustaining TPS. Tool implementation (kanban, 5S, standard operating procedure) is a step-by-step assignment.

"These tools are essential for the production." [Production Supervisor Plant A]

Daily meetings as Tiorey and Yuchi help a better flow of information through the shifts (see APPENDIX).

The Plan-Do-Check-Action cycle is driven to generate solutions.

Table 6 Production Organization Data

Automakers	*Plant B*	*Plant C*	*Plant A*
Problem Solving Methods		• "5 whys" • Cause and Effect • Decision matrix.	
Standard Operating Procedure	It is used in strategic positions and training for new employees or recycling.		It is used in work station for any checks.
5S	It used the concepts, but without a guideline clearly identified in the process.		Yes, using the methodology and there is a view on the subject.
Quick Changeover	Basic concept from design the maturity of the product. *("Do not imagine thinking of reducing time without quick changeover"*).		It is applied as needs emerge. There is not a guideline. Factor not yet fully incorporated into the system.
POKA YOKE	Basic concept of assyline design. *("Do not think eliminate assembly defects-failures without the use of Poka Yoke"*).		Not very usual in transactions of this company. Only used when applicable.

Research results were consolidated with interviewees. They indicated that leadership is the main issue to sustaining TPS. Tool implementation (kanban, 5S, standard operating procedure) is a step by step assignment. Common mistake stimulate to use of tools besides integrated TPS view.

Daily meetings as Tiorey and Yuchi help a better flow of information through the shifts.

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"We are selecting who will go to Japanese plants, Toyota [Automaker] is chartering a plane to send greater groups." [Production Supervisor of Plant B]

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Workers have little or no previous industry experience. The automaker executive staff (managers, supervisor) is Japanese descent. The plants A, B and C already have Brazilian generation in their executive staff.

The factors considered (MSP, standard operating procedure, 5S, quick changeover and poka yoke) are observed in the plants day-by-day (Table 6). The Plan-Do-Check-Action cycle is driven to generate solutions.

"These tools are essential for the production." [Production Supervisor Plant A]

Research results were consolidated with interviewees. They indicated that leadership is the main issue to sustaining TPS. Tool implementation (kanban, 5S, standard operating procedure) is a step by step assignment. Common mistake is "euphoria" feelings in the use of tools besides integrated TPS view.

Daily meetings as Tiorey and Yuchi help a better flow of information through the shifts.

Conclusion

The growth of Toyota Production System ideas in Brazil raises issues about its application within a different cultural context.

This paper analysed the modus operandi of the Toyota Production System researching four Toyota Brazilian plants. This paper also describes the daily activities of the plants researched.

The research evidenced that The Toyota Production System is not a privilege of the Japanese culture and can be implemented in other cultural contexts. This paper indicates strong similarities among the Brazilian Toyota plants. Also these similarities are indicated in the lean manufacturing literature. Also, the research observed a strong discipline to sustain it among the plants. All the researched plants have operator-centred orientation.

Generally, TPS research has the individualized application of lean tools. This article introduces the theme integrating P- and W- factors.

Feedback from the interviewees in the case study suggests potential for developing a methodology to assess the impact of the P- and W-factor in shop-floor environment. A replication study in others automotive companies may bring some perspectives about this sector in Brazil.

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APPENDIX: TOYOTA DAY-BY-DAY

Typical day in the researched plants begins with 05 minutes of labor gymnastics (GL). Everyone participates: executives, support staff and workers. This event is followed by a morning meeting, called Tiorey (TI), which covers the key events that occurred the day before and planning for the current day. The gymnastics is repeated by the production staff and support areas after lunch.

After the morning meeting the operators check the production process, i.e., they check the devices involved in production, they check the set up model and Poka Yokes. All these items are checked (PRE) following an orientation checklist, and it becomes a record given by the line leader. Some of these items are still checked by the production supervisor. Those practices seek discipline of tasks at the shift beginning and control of the production process.

The shift of production, illustrated in Figure 3, is divided into eight (8) production cycles (C1, C2 ... C8) that are aligned with the eight (8) supply cycles provided by Milk runs. After each cycle, the operators exchange process and every two cycles, the operators stop for a 10-minute break (Coffee). It is understood that the exchange process means, most of the time, changing work to another production process and not just a job change.

Figure 3 Activities of a typical day in a Toyota plant

GL	TIOREY	PRE	C1	C2	COFFEE	C3	C4
Lunch (1st shift) /Dinner (2nd. shift)							
GL	C5	C6	COFFEE	YUICHI	C7	C8	FINAL

Usually after the second break, there is a meeting called Yuchi, similar to Tiorey. The workers discuss the problems being faced in the day. Tiorey addresses all matters relating to the working day (visits, reports, events) and the day before. Yuchi addresses problems that are occurring on the same day.

The cycles of shifts are completed (Final) with 5S tasks and closing of production reports.