Toyota Inspired Excellence Models

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Abstract. Toyota Production System (TPS) created in the 1950s undoubtedly marked the beginning of a new era in production and economy. The paradigm shifts introduced both in terms of the management and organization of material flows and in the way the respect for people became an important pillar, brought enormous benefits to the society. From the 1970s until today, companies and organizations around the world have been implementing this new way of organizing and managing the industry and services to achieve excellence. Since the 1970s, several TPS-Inspired Models of Excellence have been created and have been competing for their academic acceptance and adoption in companies and organizations around the world. The purpose of this article is to analyze the most popular models and compare them in terms of the following criteria: Focus on Pull Flow; Focus on Process; Focus on Respect for People (or Sociotechnical scope); Existence of associated techniques; Coverage on Indirect Areas; Popularity in scientific journals; and Popularity in books. Although being "Lean" frequently referred as synonymous of TPS, according to those criteria, authors are inclined to conclude that Kaizen Model, Toyota Way, and Shingo Model are the most comprehensive excellence models considered in this study.

Keywords: Lean Thinking, Shingo Model, Toyota Way.

1 Introduction

In several types of products, the use of a brand to replace the product name is quite common in everyday life. People use terms such as "Gillette", "Jacuzzi", or "Chiclet" when referring to the corresponding generic product. In these cases, we relax the language and collectively choose to use the brand name to designate generic products. This is happening even though there is a generic product name that can be used in most cases such as "Razor blade" or "Chewing gum". There are other cases, such as "Post-it" that it may not be easy to find a product name that is shared by most people. A similar phenomenon is occurring in the Industrial Organization and Management body of knowledge where professionals and academics use brand names such as "Lean Thinking", "Kaizen", "Shingo Model", "Theory Of Constraints", "Toyota Way", "Agile Manufacturing", and others. These and other "management brand names" worked and some of them still work as management fashions as referred by Abrahamson [1]. Management fashion is defined by the author as "*a relatively transitory collective belief, disseminated by management fashion setters, that a management technique leads rational*

management progress". The author argues that management fashion should not be treated as a special case of aesthetic fashion and that management fashion, far from being cosmetic and trivial, is a serious matter. A different definition for management fashion is the following: Management fashion is "*the production and consumption of temporarily intensive management discourse, and the organizational changes induced by and associated with this discourse*" [2]. It seems that managers' decisions to embrace new management concepts and ideas are more often informed by collective beliefs about rational or progressive managerial practice than from determined rationalization [3].

Although the aforementioned "management brands" can be seen as different management fashions, in reality some of them are very similar in concepts and the fashion part is only related to the specific fashion setter. Most of these management fashions have the same source but the truth is that so far there does not seem to be a consensus on the generic name that brings together all these brand alternatives. One of the challenges of this field is to find an appropriate designation for the organization and management paradigm created by Toyota to be accepted by most practitioners and academics. Maybe only time will tell but for now we will use in this article the designation "TPS Inspired Excellence Models - TIEM". The term "Lean" may even be the term that has collected more popularity and for many people, it is already accepted as the natural generic designation for these TIEM. The negative aspect of "Lean" designation is that its meaning is very connected mainly with one just one of the two parts of the socio-technical nature of organizations, the technical part. The 5 principles of Lean Thinking [4] are mainly about the focus on value, generation of pull flow and pursue perfection. The fifth lean principles "pursue perfection" is assumed in this article to be equivalent to "Continuous Improvement" since perfection is achieved by continuously removing waste and improving flow pulled by customers.

Other models such as Shingo Model [5] and Toyota Way [6] include also principles clearly oriented to the social part such as "Respect every individual", "Lead with humility", "Think systematically", "Develop exceptional people and teams who follow your company's philosophy", and "Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly".

Toyota, contrary to most companies, always pursued the continuous improvement of its processes but at the same time, assured that the focus on its employees was being maintained. The treatment of employees with respect and consideration, and the utilization and enhancement of their plenty capacities is one of the basic concepts of Toyota Production System (TPS). Nowadays, respect for people in the organizational context became a theme of global interest, pursued by all the organizations that seek excellence. But not always was this way. During the 1980s and 1990s, most western companies and universities were more interested in the physics concerning the flow control of materials than the human, behavior, and cultural side of TPS. For that reason, TPS is one organizational excellence model that was followed by many in the past but still arouses the interest of the most competitive companies of the present.

If we look back and scrutinize the concepts and principles of organizational excellence models that appeared after TPS, such as Theory of Constraints (TOC), Kaizen Model, Lean Production, Agile Manufacturing, Lean Thinking, Toyota Way, or Shingo

Model, we may say that many of them were probably inspired in TPS and follow its principles and concepts. Such is the case of continuous improvement, which besides being one of the main concepts of Toyota Way, is one of the five principles of Lean Thinking, a set of principles (a dimension) in the Shingo Model and one of the fourteen principles of Generic Features Model of Agile Manufacturing. The same is applied for the concept "treat the workers as human being and with consideration". Followed by Toyota Way, it is generically described in the Toyota website as "Continuous Improvement and Respect for people in everything we do". In Shingo Model this concept appears inside the dimension of Culture Enablers as "Respect every individual". Moreover, in Agile Manufacturing it appears inside the Generic Features Model as "Empowerment of all the people in the enterprise".

The objective of this paper is to analyze and compare the different TIEM in terms of the following criteria: Focus on Pull Flow; Focus on Process; Focus on respect for people (or Sociotechnical scope); Existence of associated techniques; Coverage on Indirect Areas; Popularity in scientific journals; and Popularity in books.

2 Description of the Main Excellence Models Inspired in TPS

The Toyota Production System (TPS) has inspired many models of excellence not only in production but also in the organization as a whole. Since the first journal article published in 1977 about TPS [7] models have been created and evolving to the present day (see general overview in Fig. 1). *Toyota Production System: Beyond Large-Scale Production*, was the first book in English about TPS [8], published in 1988 by Taiichi Ohno, one of TPS creators, although that version is just a translation of the first Japanese version published ten years earlier in 1978.

Models of excellence are understood here as being descriptions of how to proceed to achieve a competitive advantage in the market. In other words, they are descriptions of what to do, what principles to follow, and what tools to use to be more effective and efficient than competitors.

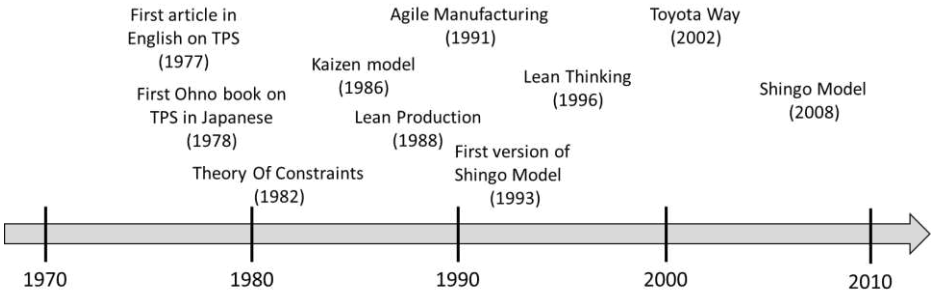

Fig. 1. Main Excellence Models.

Probably the first kind of excellence model inspired by TPS, published in English after the TPS itself, was presented by Eliyahu Goldratt in his famous and bestseller book "The Goal"[9]. One of the possible reasons that justify the success of this book is the

fact that although it is a book with technical content it was written in a novel format. This innovative way of presenting the model made it very attractive due to the ease of its reading and understanding. The model presented and coined as Theory Of Constraints, became very popular as its Optimized Production Technology method was firstly published in 1982 [10] as well as the Drum-Buffer-Rope dispatching technique published a few years later [11].

The second excellence model inspired by TPS is most probably the one presented in a book by Masaaki Imai in 1986 [12]. In that book, the author suggests that the economic success of Japan was the result of the Japanese management practices summarized in the so-called Kaizen umbrella presented in Fig. 2. Under the umbrella, a list of concepts, principles, and tools are presented as the Kaizen model guidelines or structure. From that list, it is possible to understand that the scope of the model covers the sociotechnical nature of organizations, from the technical part to the human part as expressed in the article referred earlier from 1977 about TPS. In that article, the authors argue that TPS is based on the following two main concepts: Reducing cost from the elimination of waste and treat the workers as human being and with consideration. In the items presented under the umbrella of Fig. 2 the reader can see the technical aspects such as “robotics” and “kanban”, as well as the human and behavior side as “Small-group activities” and “Cooperative labor-management relations”.

Despite the existence of this very comprehensive model, during the 1980s and 1990s in the West, the terms that became popular were mainly "Just-In-Time" and "Kanban" as being the central part of TPS. Just-In-Time was referred by Sugimori, Kusonoki and Uchikawa [13] and later referred by Taiichi Ohno [8] as one of the two pillars of TPS. During these decades, most western companies and universities were more interested in the physics concerning the flow control of materials than the human, behavior and cultural side of TPS. JIT or "Just-In-Time" was accepted as a kind of operational excellence model pursued by most industrial engineering professionals and scholars.

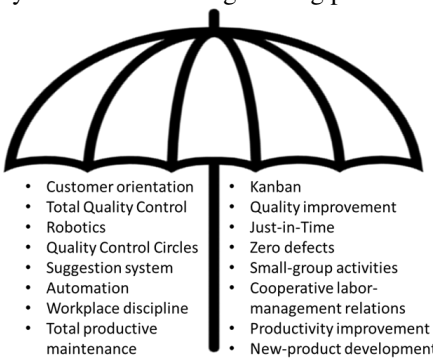

Fig. 2. The Kaizen Umbrella [12].

Both Just-In-Time and Theory of Constraints models were very much focused on just one side of the socio-technical nature of organizations, the technical side, more precisely in the material flow control. “Just-In-Time” or just “JIT” has long been connoted

in the West, in a relaxed way, as if it were the materialization of TPS or simply equivalent to TPS. After the successful publication in 1990 of the book "The machine that changed the world" [14] and later in 1996 with the publication of "Lean Thinking" book [4] the term JIT was gradually replaced by the term "Lean Production", "Lean Manufacturing", or simply "Lean". Although changing the term used, the Lean Thinking model was still very much focused on only the same technical side of the TPS as JIT.

Despite the focus of Lean Thinking was on the technical part of organizations, such as value, value stream identification, and pull flow, the principle of pursuing perfection leaves some room for the social sciences' part. While the importance of teamwork, empowerment, motivation, and Bottom-Up initiatives are also briefly referred in that original book, the focus of Lean Thinking is towards value, flow and its continuous improvement. Lean Thinking was materialized as following 5 principles: (1) identification of value, (2) identification of the value stream, (3) promoting flow, (4) promoting flow pulled by demand, (5) pursue perfection (also known as continuous improvement).

Agile Manufacturing (AM) is another famous model of excellence proposed by a group of researchers at Iacocca Institute in 1991 [15]. This model comes to life shortly after the first scientific article presenting "Lean Production" [16] and the famous book "The machine that changed the world" from which Lean production became famous and just two years before the book "Lean Thinking" being published. Maybe inspired in TPS, the AM model clearly distances itself from the TPS questioning some of its concepts and never mentioning some of the classic TPS tools such as *5S*, *SMED*, *Heijunka*, *Kanban*, and *Poka-Yoke*. In this model, there is an important component of the inclusion of new technologies and in the integration of the following 3 pillars [17]: Organization, People, and Technology. The Organization pillar refers to the innovative management structures and organizations; The People pillar refers to the skill base of knowledge and empowered people, and the Technology pillar refers to the flexible and intelligent technology. The AM conceptual framework includes Competitive foundations, Core concepts and Generic features model, as described in Fig. 3.

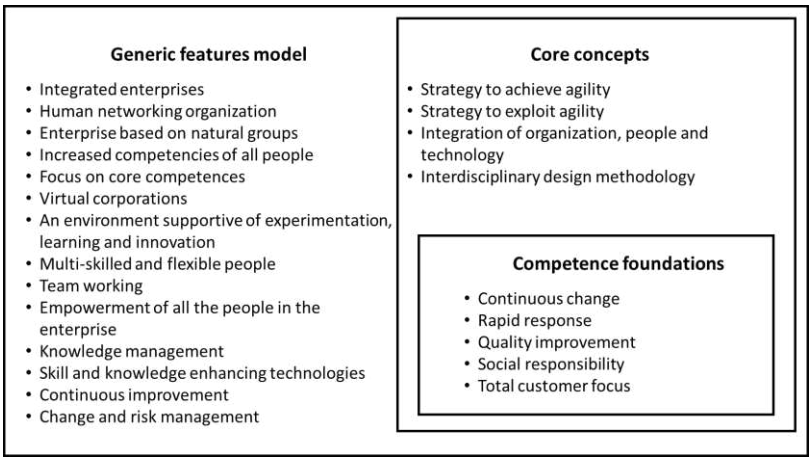

Fig. 3. Conceptual framework of Agile Manufacturing (adapted from [17]).

At the beginning of the 21st century, the social sciences' side of organizations started to gain more and more recognition in many organizations around the world. One of the companies that clearly include that invisible side in the form of principles was again Toyota by creating the Toyota Way excellence model. The Toyota Way is one of the models of excellence whose principles very effectively cover the entire spectrum of the socio-technical nature of organizations [6]. The principles with grey background in Table 1 are principles more linked to the continuous improvement side of the Toyota Way while the other ones are more linked to the Respect for People side.

Table 1. The 14 principles of the Toyota Way.

Section	Principles
Long Term Philosophy	**#1**. Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals.
The Right Process Will Produce the Right Results	**#2**. Create continuous process flow to bring problems to the surface.
	#3. Use "pull" systems to avoid overproduction.
	#4. Level out the workload (Heijunka). (Work like the tortoise, not the hare.)
	#5. Build a culture of stopping to fix problems, to get quality right the first time.
	#6. Standardized tasks are the foundation for continuous improvement and employee empowerment.
	#7. Use visual control so no problems are hidden.
	#8. Use only reliable, thoroughly tested technology that serves your people and processes.
Add Value to the Organization by Developing Your People and Partners	**#9**. Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.
	#10. Develop exceptional people and teams who follow your company's philosophy.
	#11. Respect your extended network of partners and suppliers by challenging them and helping them improve.
Continuously Solving Root Problems Drives Organizational Learning	**#12**. Go and see for yourself to thoroughly understand the situation (Genchi Genbutsu).
	#13. Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly (Nemawashi).
	#14. Become a learning organization through relentless reflection (*Hansei*) and continuous improvement (*Kaizen*).

Finally, the Shingo Model started to be developed in 1988 to support the Shingo Prize, awarding the first company in 1989 [18]. The first version of the Shingo model, also referred as "1st Assessment Model" was established in 1993 [19]. Very little emphasis was given in that version to the human side of organizations and no reference was given to continuous improvement concept. A new Shingo Model was released in 2008 [19] with emphasis on principles and culture where clear relevance was given to continuous process improvement, assigning a set of principles to that dimension.

The actual version of the Shingo Model [20] is very much an enhancement of that new Shingo Model. In the point of view of scientific publications the first article found in Scopus database referring the Shingo Model was published in 2014 [21]. In that article, the authors refer the Shingo Institute website in 2012 as the source of those principles. The ten guiding principles are categorized into three dimensions - Cultural Enablers, Continuous Improvement, and Enterprise Alignment, as shown in Fig. 4. The first dimension of the guiding principles lies on the Culture Enablers principles of respect for people and lead with humility, and they are at the bottom of the pyramid because they concentrate on the foundation of an organization: the people. This class refers to the type of behaviors required in order to effectively accommodate all the other principles. The second dimension of the guiding principles pyramid – Continuous Improvement – refers to the principles related to the production processes focus and its improvement. The "Enterprise Alignment" class refers to the formal vision and purpose of the entire organization.

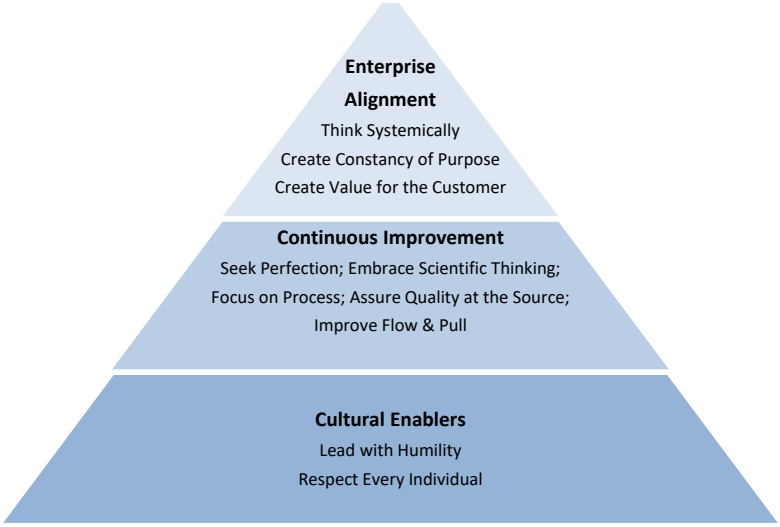

Fig. 4. Shingo Model Guiding Principles.

The principles of this model can be assigned to each one of the sides, technical and social, in a relatively easy way. The principles in the class "Continuous Improvement" can be assigned to the technical side while the principles in the other classes, "Cultural Enablers" and "Enterprise Alignment" can be assigned to the social sciences side.

3 Publications Data Analysis

The models considered in this study are the following: TPS (Toyota Production System), TOC (Theory Of Constraints), KM (Kaizen Model), AM (Agile Manufacturing), LT (Lean Thinking), TW (Toyota Way), and SM (Shingo Model). Regarding the num-

ber of publications of the different excellence models considered in this study, the results are shown in Table 2. In the same table are also presented the first published book and first journal article for each model. The data was collected from Scopus and Mendeley databases mainly because the first one is an indexed scientific database commonly recognized as including only good quality publications. The second one (Mendeley) was chosen because it includes also other articles with less impact factor and many books that are not listed in the first one. The keywords used in the search were the following: "Toyota Production System" for TPS; "Theory of Constraints" for TOC; "Kaizen" for KM; "Agile Manufacturing" for AM; "Lean Manufacturing" OR "Lean Production" OR "Lean Thinking" for LT; "Toyota Way" for TW; "Shingo Model" OR "Shingo Prize" for SM.

In Scopus database the search was performed within Article Title, Abstract, and Keywords. In Mendeley database the search is not customizable and it can only be carried out within Article Title and Abstract. The results shown in Table 2 are not 100% accurate for many reasons. Regarding "Kaizen Model" some articles may mention "Kaizen" not about the Kaizen Model, but just using the word "Kaizen" to refer to Continuous Improvement. Regarding "Lean Thinking" the search was carried out using the three keywords "Lean Manufacturing", "Lean Production", and "Lean Thinking because in most cases the authors are referring to the same general philosophy that is assumed here as Lean Thinking. Finally, in the "Shingo Model", the search included also the "Shingo Prize" keyword since the model, although not being formally published it was already existing to support the prize.

The results from the search show that LT is the most popular model both in journal articles as in books. The AM model although being very popular in the academic word through journal articles very small number of books are published. That fact maybe shows little demand by practitioners. Although not connected with Agile Manufacturing, curiously, "Agile" word gained large popularity not in manufacturing but in software development by the Agile manifesto [22]. This popularity may result from the fact that some methodologies, such as Scrum [23], were associated with it.

Table 2. Publications Data analysis of different excellence models.

		TPS	TOC	KM	AM	LT	TW	SM
Scopus	**Documents**	716	5227	1596	6657	10134	68	44
	Book	12	142	21	16	82	1	5
	Journal Article	391	3275	830	2048	4710	39	18
Mendeley	**Documents**	1337	2867	3975	1870	15424	183	87
	Book	42	45	92	3	303	15	10
	Journal	831	1978	2577	1078	9732	99	37
Year of the 1st Book		**1988** [8]	**1984** [9]	**1986** [12]	**1991** [15]	**1996** [4]	**2004** [6]	**2011** [24]
Year of the 1st Journal Article		**1977** [4]	**1985** [25]	**1986** [26]	**1994** [27]	**1997** [28]	**2003** [29]	**2013** [30]

The TOC model has been very popular among scholars with a large number of journal publications but also with an interesting number of published books (45). The large number of books may indicate some curiosity and popularity among practitioners. That attraction may be explained by the existence of a Production Planning and Control system called Optimized Production Technology (OPT) which uses a flow control technique called Drum-Buffer-Rope (DBR). TW and SM are the most recent model and that is probably the reason why the number of publications is still quite low, especially SM.

4 Comparing the models

The method to compare the models is based on 7 criteria listed in the first column of Table 3. For each criteria a "High", "Average" or "Low" is assigned to each excellence model according to authors' judgment from the available and relevant published material. The criteria were selected according to authors' point of view regarding their impact in organizational and management excellence. This way to analyze and compare these models does not pretend to be the best way but it covers the criteria that are most relevant according to the point of view of the authors. The reasons behind the selection of each one of them is presented in the following paragraphs.

Focus on Pull Flow was selected because it plays a key role in the overall performance of production. This concept or principle is one of the most important paradigm shifts proposed by TPS and copied in western companies. On the technical side of the TPS, this concept is responsible for breaking many beliefs and myths developed in the mass production era. This principle is clearly stated in all excellence models considered in this article with the exception of the AM model as can be seen in Fig. 3.

Table 3. Comparison between excellence models.

	TPS	**TOC**	**KM**	**AM**	**LT**	**TW**	**SM**
Focus on Pull Flow	High	High	High	Low	High	High	High
Focus on Process	High	Low	High	Average	High	High	High
Focus on Respect for People (or Sociotechnical scope)	High	Low	High	High	Low	High	High
Existence of Associated Techniques	High	Average	High	Low	High	High	High
Coverage on Indirect Areas	Low	Low	High	Low	Low	High	High
Popularity in Journals	High	High	High	High	High	Low	Low
Popularity in Books	Average	Average	High	Low	High	Low	Low

The second criterion, Focus on Process, is understood here as the process being the only responsible for its outcomes. People cannot be blamed for poor processes. Poor processes cannot produce excellent results so every process must be totally controlled and reliable. TOC does not show pieces of evidence of focus on process except for the bottleneck since its only concern is the throughput protection. The AM model shows little evidences in this respect and, apart from that, since it promotes the use of new technologies its reliability can be difficult to guaranty. The Toyota Way, for instance,

states in one of its principles “Use only reliable, thoroughly tested technology that serves your people and processes”.

The Respect for People criterion was included because excellence cannot be achieved without the human side of organizations. This principle is clearly stated in most excellence models considered in this article except for TOC and LT. Since the primary focus of TOC is the flow of materials little focus is naturally given to human aspects. The reality of LT is slightly different. Most Lean Thinking followers and practitioners may claim that the model is also concerned with that “respect for people” side of TPS. That seems true because “Lean” is understood by many as just a different word to refer to TPS or now the Toyota Way. The reality is that even the word “Lean” suggests ideas such as “without fat”, “without waste”, or very little quantities of WIP in the productions, nice production flow, and so on. The word “Lean” suggests much more the physical aspects of production than the aspects linked to the social sciences. Only one principle of LT can include some aspects of the “respect for people” side, the Pursue of perfection principle.

The criterion “Existence of Associated Techniques” was selected because professionals normally feel more comfortable when techniques are available to implement in order to achieve results. Techniques help the materialization of a principle or a concept and for that reason this criterion was considered here in this study. TPS, KM, LT, TW, and SM are highly linked to several tools and techniques while TOC holds only one specific technique for material flow management and AM has no specific connection to specific techniques or tools.

Coverage on Indirect Areas is an important criterion since more and more people work in indirect areas in companies. The competitiveness of any company is also achieved by the performance of its indirect areas. Based on that it is relevant the level at which the model can be applied in indirect areas such as office, intellectual, and research and development work. KM, TW, and SM are the only models covering those areas.

The last two criteria related to popularity are measure by the number of publications in scientific journals and books. TW and SM are not very popular maybe because they are very recent.

5 Conclusions

The objective of this paper is to analyze and compare some of the most popular TIEM (TPS Inspired Excellence Models) in terms of some specific criteria. The study used the formal information supplied by the creators of each model as well as data from published scientific articles and books. Although Lean Thinking, Lean Production, and simply “Lean” is widely accepted as a different name for TPS, the reality shows that formally the principles presented by their founders [4] do not cover some important aspects that were present in the original TPS model. Based on the principles and/or concepts formally defined for each excellence model considered in this study the authors conclude that Kaizen Model, Toyota Way, and Shingo Model are the most comprehensive excellence models considered. The interesting aspect of Kaizen Model is

that it was proposed in 1986 while the Toyota Way was proposed in 2003 and Shingo Model was only formally presented in 2011. Contrary to the Theory Of Constraints, Agile Manufacturing although including the social sciences side of the technical nature of organizations, does not recognize the value of pull flow, which is an important practical principle to achieve excellence. Moreover, AM does not provide nor promote the use of practical tools and techniques to achieve excellence.

Acknowledgements

This work has been supported by FCT – Fundação para a Ciência e Tecnologia within the R&D Units Project Scope: UIDB/00319/2020.

References

[1] Abrahamson, E. Management fashion. Acad. Manag. Rev. vol. 21, no. 1. 1996. doi: 10.5465/AMR.1996.9602161572.

[2] Benders, J. and K. Van Veen. What's in a Fashion? Interpretative Viability and Management Fashions. Organization. vol. 8, no. 1. 2001. doi: 10.1177/135050840181003.

[3] Perkmann, M. and A. Spicer. How are management fashions institutionalized? The role of institutional work, *Human Relations*, vol. 61, no. 6. 2008, doi: 10.1177/0018726708092406.

[4] Womack, J. and D. Jones. Lean thinking: Banish Waste and Create Wealth in Your Corporation. New York: Fee Press, 1996.

[5] The_Shingo_Institute. MyEducator - The Shingo Institute, 2020. https://app.myeducator.com/reader/web/1705a/foreword/re0xx/ (accessed Aug. 18, 2020).

[6] Liker, J. Toyota Way: 14 Management Principles from the World's Greatest Manufacturer. McGraw-Hill Education, 2004.

[7] Sugimori, Y., K. Kusunoki, F. Cho, and S. Uchikawa. Toyota Production System and Kanban System: Materialization of Just-in-Time and Respect for Human Systems. Int. J. Prod. Res. vol. 15. pp. 553–564. 1977. doi: 10.1080/00207547708943149.

[8] Ohno, T. Toyota production system: beyond large-scale production, 3ª Edição. New York: Productivity, Inc., 1988.

[9] Goldratt, E. and J. Cox. The Goal: A Process of Ongoing Improvement. Great Barrington: North River Press, 1984.

[10] Fox, R. E. MRP, KANBAN, AND OPT - WHAT'S BEST?, 1982.

[11] Goldratt, E. Computerized shop floor scheduling. Int. J. Prod. Res. vol. 26, no. 3. 1988. doi: 10.1080/00207548808947875.

[12] Imai, M. KAIZEN – the key to Japan´s Competitive Success. 1986.

[13] Sugimori, Y., K. Kusunoki, F. Cho, and S. Uchikawa. Toyota production system and Kanban system Materialization of just-in-time and respect-for-human system. Int. J. Prod. Res. vol. 15, no. 6. pp. 553–564. 1977. doi: 10.1080/00207547708943149.

[14] Womack, J., D. Jones, and D. Roos. The machine that changed the world. New York: Free Press, 1990.

[15] Nagel, R. N. and R. Dove. 21st Century Manufacturing Enterprise Strategy, An Industry-Led View. Bethlehem, PA: Diane Pub Co, 1991.

[16] Krafcik, J. F. Triumph of the lean production system. Sloan Manage. Rev. vol. 30, no.

1. pp. 41–52. 1988. doi: 10.1108/01443570911005992.
[17] Kidd, P. Agile Manufacturing: Forging New Frontiers. Addison-Wesley, 1994.
[18] Shingo Institute. The Shingo Model, 2020. https://shingo.org/shingo-model/ (accessed Jun. 08, 2020).
[19] Shingo Institute. Shingo Institute: Our history, 2106. https://www.cob.calpoly.edu/centralcoastlean/wp-content/uploads/sites/6/2017/07/Shingo-California-presentation-Feb-2016-edited.pdf (accessed Sep. 06, 2021).
[20] Miller, R. D. Hearing the voice of the Shingo principles : creating sustainable cultures of enterprise excellence. Routledge, 2018.
[21] Bhullar, A. S., C. W. Gan, A. J. L. Ang, B. Ma, R. Y. G. Lim, and M. H. Toh. Operational excellence frameworks-Case studies and applicability to SMEs in Singapore, in *IEEE International Conference on Industrial Engineering and Engineering Management*, 2014, vol. 2015-January, doi: 10.1109/IEEM.2014.7058722.
[22] Beck, K. *et al.* Agile Manifesto, *Software Development*, 2001. http://agilemanifesto.org/.
[23] Sutherland, J. and K. Schwaber. The Scrum Guide, the Definitive Guide to scrum: The Rules of the Game, 2017. https://www.scrumguides.org/scrum-guide.html.
[24] Rizzo, K. Operational and Performance Excellence: The Shingo Model. Printing Industries Pr, 2011.
[25] Politou, A. and P. Georgiadis. Production Planning and Control in Flow Shop Operations using Drum Buffer Rope Methodology: A System Dynamics Approach. pp. 1–18. 1985.
[26] Schneiderman, A. M. Optimum Quality Costs and Zero Defects: Are They Contradictory Concepts? Qual. Prog. vol. 19, no. 11. pp. 28–31. 1986.
[27] Ross, E. M. Twenty-first century enterprise, agile manufacturing and something called CALS. World Cl. Des. to Manuf. vol. 1, no. 3. pp. 5–10. 1994. doi: 10.1108/09642369210056593.
[28] Piercy, N. F. and N. A. Morgan. The impact of lean thinking and the lean enterprise on marketing: Threat or synergy? J. Mark. Manag. vol. 13, no. 7. pp. 679–693. 1997. doi: 10.1080/0267257X.1997.9964504.
[29] Fane, G. R., M. R. Vaghefi, C. Van Deusen, and L. A. Woods. Competitive advantage the Toyota way. Bus. Strateg. Rev. vol. 14, no. 4. pp. 51–60. 2003. doi: https://doi.org/10.1111/j..2003.00286.x.
[30] Naftanaila, I., C. Radu, and G. Cioana. Operational Excellence - A Key to World-Class Business Performance. Stud. Bus. Econ. vol. 8, no. 3. pp. 133–141. 2013.