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To cite this article: Andrea Chiarini & Emidia Vagnoni (2015) World-class manufacturing by Fiat. Comparison with Toyota Production System from a Strategic Management, Management Accounting, Operations Management and Performance Measurement dimension, International Journal of Production Research, 53:2, 590-606, DOI: [10.1080/00207543.2014.958596](https://doi.org/10.1080/00207543.2014.958596)

To link to this article: <http://dx.doi.org/10.1080/00207543.2014.958596>



Published online: 22 Sep 2014.



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World-class manufacturing by Fiat. Comparison with Toyota Production System from a Strategic Management, Management Accounting, Operations Management and Performance Measurement dimension

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(Received 16 April 2014; accepted 19 August 2014)

Toyota Production System (TPS) and the derived lean production have cast a shadow over the models of world-class manufacturing (WCM). Yet, some groups such as Fiat have reinvented WCM. Fiat's WCM is quickly becoming a sort of alternative to TPS-lean production. By means of semi-structured interviews and a direct observation of the documentation of Fiat's model, this research wants to find the theoretical elements that underpin the model. The methodology is mainly based on grounded theory. The theoretical elements were coded and classified within four dimensions: strategic management, management accounting, operations management and performance measurement system. The four dimensions and their elements were compared for the first time with the same dimensions of TPS-lean production. Fiat's WCM seems to have a 'grand strategy' focused on quality and cost savings where quality must be reached with no trade-off with other strategies. Safety is pursued above all else and Fiat's WCM cannot be implemented without this first achievement. A particular system called 'cost deployment' measures wastes and losses on processes. The performance measurement system is structured and fosters day-by-day management as well as computer-based management. Furthermore, the performance measurement system is based on a complex and formal auditing and benchmarking process.

Keywords: world-class manufacturing; lean production; Fiat; strategic management; accounting management; operations management; performance measurement

1. Introduction

In the last decades, Toyota Production System (TPS), just-in-time (JIT), total quality control (TQC) and, later, lean production have been implemented by many companies leading them to reinvent their strategic management, management accounting system, performance measurement system and operations management.

In 1984, two American authors, Hayes and Wheelwright (1984), proposed a new model named world-class manufacturing (WCM), linked to the principles of TPS, JIT and TQC. In fact, in those years, there was a huge debate about the supremacy of Japanese industry over Western industry. In the late 1970s and 1980s, American and European companies learnt a new industrial lesson based on JIT and TQC from Japanese companies such as Toyota. American authors like Deming (1986), Feigenbaum (1956, 1991) and Juran, Gryna, and Bingham (1974) had been urging for the implementation of TQC and total quality management (TQM) for decades, especially in the USA, while Japanese authors (Shingo 1981; Monden 1983; Shingo 1983; Ishikawa 1985; Ohno 1988) began to reveal and to theorise the tools and principles of the Japanese production model and philosophy, often related to Toyota.

Inspired by Hayes and Wheelwright's (1984) research, Schonberger (1986) reinterpreted WCM creating a new model. As the literature review section will show, his book about WCM has been often quoted and it launched a debate around WCM in the late 1980s and 1990s. However, from the late 1990s, WCM started fading away to make way for lean production. This term, lean production, first appeared in the famous book, *The Machine that Changed the World* (Womack, Jones, and Roos 1990). According to Lewis and Slack (2003), Womack and colleagues' book was one of the most cited in operations management and nowadays, for many academics and practitioners, lean production is synonymous with TPS (Chiarini 2013b). In fact, lean production is not that far from the principles and tools described by Schonberger in his studies concerning WCM. According to Holweg (2007, 420), Womack and colleagues' book about lean production included studies on JIT and TPS that had been published by Schonberger (1982), Hall (1983) and Monden (1983) almost a decade earlier.

Nonetheless, WCM has not been completely cleared away. Although lean production cast a shadow on all the theoretical models that stemmed from TPS; in the 2000s, some worldwide companies renovated and reinvented WCM.

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These companies gathered together in the WCM Association and they started sharing a WCM model for excellence influenced by TPS and TQC. Companies such as Ariston Thermo Group, Elica, Embraco, Fiat Industrial, Fiat Spa & Chrysler, Royal Mail, Sistema Poland, Unilever and Volvo Powertrain are part of this association.

The group related to Fiat sells vehicles under the Fiat, Alfa Romeo, Lancia, Abarth and Fiat Professional brands and Chrysler brands such as Chrysler, Jeep, Dodge and Ram brand vehicles, as well as luxury cars under the Ferrari and Maserati brands. Fiat also operates in the components sector, through Magneti Marelli and Teksid, and in the production systems sector, through Comau and in after-sales services. Hereinafter, for the scope of this paper and for simplicity, only the brand Fiat will be used.

In 2006, Fiat officially launched its WCM model for the group companies and the suppliers, and the plan is to involve 180 plants and 550 suppliers by the end of 2014 (Ketter 2010). By means of WCM, Fiat declared to its shareholders in the period 2006–2009 savings of about 730 million euros.

In considering the WCM approach and its implications for companies' performance, this paper mainly aims at analysing the theoretical foundations of the WCM model recently implemented by Fiat, from the perspective of strategic management, management accounting, operations management and performance measurement system. The following research questions are addressed: is the new WCM by Fiat a real breakthrough model or just 'old wine in new bottles'? What theoretical elements underpin the model? What are the relationships between Fiat's WCM and the previous WCM? And, most important, what are the relationships between Fiat's WCM and lean production or TPS?

The remainder of this paper is organised as follows. Section 2 summarises a literature review of WCM, TPS and lean production and describes what kind of strategic management, management accounting, performance measurement system and operations management these models have generated. The following section deals with the methodology of the research and data collection methods. Sections 4 and 5 present the results of the research. The results are then compared to the TPS-lean production model in Section 6. The summary and conclusions section evaluates the research's path, the findings of the research and deals with the limitations of the paper.

2. Literature review

The term WCM was first introduced by Hayes and Wheelwright (1984). The authors introduced a set of principles, best practices and techniques which would lead any company to superior performance (Flynn, Schroeder, and Flynn 1999) and these elements are mainly related to research inside Japanese and German companies. Hayes and Wheelwright thought that the 'sense of direction' of a world-class manufacturer should be to become a superior performance company, especially in operations management.

The initial work of Hayes and Wheelwright is more focused on strategy and values change for getting superior operational performance rather than proposing a specific deployment of the strategies through specific tools. Moreover, they opened an interesting debate in the literature related to how being excellent achieving a clear set of strategic priorities. For instance, a company should not pursue at the same time a strategy of cost leadership and differentiation. In fact, this particular issue of a trade-off between two kinds of strategies was first raised by Porter (1981).

Hayes and Wheelwright neither analysed changes to the management accounting system, nor to the performance measurement system. However, Hayes and Wheelwright's study launched the principles of WCM around the world, urging that Western industry needed a deep strategic change.

The most relevant and cited work concerning WCM is Schonberger (1986). In his book, *World Class Manufacturing – The lesson of simplicity applied*, he revisited WCM principles and strategy filling the gap between strategic management and the processes and tools needed by a company to achieve strategies. Schonberger did not explore strategic management systems in terms of trade-offs, for him, it was taken for granted that a company had to implement world-class practices to achieve a high level of product quality and cost reduction by avoiding wastes. According to Schonberger, the innovative managerial practices in operations should be mainly based on Japanese manufacturing systems TPS, JIT and TQC (Mahadevan 1998) including all their tools.

Schonberger did draw attention to the importance of simplifying management accounting, steering it to find the causes of wastes. According to Schonberger (1986, 43), WCM needs a better management accounting with fewer accountants because when manufacturing is complex with many wastes cost accounting and management accounting are complex too. Furthermore, Schonberger (1986, 44) claimed that: 'accounting time must be spent keeping track of and categorising the contributors to waste and delay'.

Traces of a request for simplified management accounting and for accountants more dedicated to finding the causes of waste ex ante rather than measure the waste ex post can also be found in Shingo (1981), Ohno (1988) and Deming (2000). Therefore, it can be assumed that the original Japanese TPS was directed towards a simplification of management accounting.

At the same time, Cooper and Kaplan (1987), Kaplan (1983, 1984) asked how the improvements introduced by innovative production systems such as TPS and TQM–TQC could be measured. He put forward the well-known change accounting system based on activity-based costing (ABC) and activity-based management (ABM). However, Schonberger did not seem interested in a new kind of management accounting system such as ABC. According to Jazayeri and Hopper (1999), Schonberger (1984) and other following authors who investigated WCM were even reluctant to implement ABC as a new management accounting system. In Schonberger's book (1986), the discussion on what specific performance measurement system to use with the WCM model was poor. In different sections, the author simply quoted that it is fundamental to measure performance, such as production lead time, inventories and cost of quality; however, a performance measurement system was not suggested.

TPS and lean production have their own specific theoretical foundations. Since 1960s, many Japanese industries have used a particular tool inside strategic management for developing strategies. This particular tool is called 'hoshin kanri'. Hoshin kanri was methodologically invented by the Japanese Union of Scientists and Engineers in 1958 under the influence of Peter Drucker's teachings (Jackson 2006). One of the first Japanese companies to use hoshin kanri along with lean production was Bridgestone, in 1964. Since then, for many Japanese companies, hoshin kanri has been regarded as synonymous with strategic management (Witcher and Butterworth 1999). However, according to Tennant and Roberts (2001), the use of hoshin kanri is not widespread in Western organisations, which often prefer to associate lean production and strategic management using other systems such as balanced scorecard (BSC) (Kaplan and Norton 1996; Bhuiyan and Baghel 2005; SerdarAsan and Tanyaş 2007; Seyedhosseini et al. 2011; Habidin and Yusof 2012).

Neither the authors who have put forward hoshin kanri, nor the authors who have investigated lean production and BSC have dealt with the trade-off among strategies as discussed by Hayes and Wheelwright (1984). According to many authors (Sugimori et al. 1977; Ohno and Kumagai 1980; Monden 1981; Shingo 1981; Ohno 1988; Womack, Jones, and Roos 1990; Dennis 2007; Womack and Jones 2010), the grand strategy of the original TPS as well as lean production is waste reduction and consequently a reduction in lead time. In fact, the elimination or reduction of wastes leads to a shorter lead time and more value added (Dennis 2007).

Lean production has also converged towards the ABC and time-driven ABC theories (Kaplan and Anderson 2007). As Kaplan claimed (1983), traditional management accounting systems based on the allocation of overheads are usually related to mass production and are inadequate for lean production. In response, many authors investigated how ABC can merge with lean, especially emphasising the positive relationships between the two worlds (Greenwood and Reeve 1992; Cooper 1995; Cooper and Kaplan 1988; Adler, Everett, and Waldron 2000; Kim and Ballard 2001; Ittner, Lanen, and Larcker 2002; Tornberg, Jämsen, and Paranko 2002; Gosselin 2006; Johnson 2006; Chiarini 2013a).

However, a second line of research seems to follow Schonberger's idea and the original Japanese one of a simplification of the management accounting system rather than a management accounting change, which led to the concept of value stream accounting (Maskell 2000; Maskell and Baggaley 2000; Rother and Shook 2003; Maskell and Kennedy 2007). The centre of gravity of this accounting system is an extended value stream organisation, from design to shipping, in which all the costs become direct with respect to the value stream.

TPS-lean production originally was implemented in shop floor processes and tools such as 5S, Kanban, total productive maintenance (TPM) and single-minute exchange of die (SMED) are nowadays well known and codified (Black 2007; Lee and Jo 2007). Yet, its potential soon affected all other processes such as marketing, sales, human resources and design. This approach is called lean office or lean transactional (Thompson 2000; Keyte and Locher 2004) and it is focused on reducing wastes. However, lean is not as effective when applied to design and engineering processes (Baines et al. 2006; Li 2013), especially, the management of reliability and quality problems.

Over the years, TPS-lean production has also developed a particular approach to performance measurement system. According to Maskell and Baggaley (2003, 115), in a lean environment, the continuous improvement team should manage key performance indicators (KPIs) from the value stream at least once a week and the operators on the shop floor should manage visual and day-by-day metrics. The main goal is to find the causes and reduce all the wastes as soon as possible with no delays. Moreover, on the shop floor, TPS-lean urges principles such as visual management and day-by-day control by operators. This important process comes from the original way of managing quality in Japanese industries, the Japanese TQC, sometimes opposed to the more Western-oriented TQM (Strang and Kim 2005).

3. Methodology

This research is mainly an inductive qualitative inquiry based on direct observation of Fiat's WCM model's documentation and semi-structured interviews with 13 managers who are applying the model. Three of them are part of Fiat's management and the other 10 are part of the management of Fiat's suppliers. The data and information so gathered have

subsequently been analysed by means of grounded theory. Grounded theory was chosen because of its ability to inform contemporary professional practice, and to offer understanding of actors' actions (Parker and Roffrey 1997).

The semi-structured interview in this study is organised around an aide memoire or interview guide (see Appendix A); the interviewer can discuss each topic collecting notes and suggestions from the interviewed managers.

The 13 interviewees were chosen on the strength of the following aspects:

- The most significant interviewees were with the three Fiat managers. The first one was a former president of the WCM Association and has participated directly in Fiat's WCM development. Furthermore, the manager can be considered an expert on TPS. He went to Japan before developing Fiat's WCM and deeply knows all the differences among the models. The other two provided further details in order to deepen our knowledge of the model and to better understand relationships amongst the group and Fiat's suppliers.
- The other 10 managers belong to Fiat's suppliers. They know Fiat's WCM model and they are trying to implement it in their plants with the support of Fiat's experts.
- All the interviewees have a good knowledge of JIT, TQC–TQM and TPS-lean production.
- The managers belong to companies which have implemented in the past different tools and principles derived from JIT, TQC–TQM and TPS-lean production.

The semi-structured interviewer guide (Appendix A) has been structured according to the relevant issues found in the literature review about the mentioned models, in particular:

Strategic management issue. What are the differences introduced by Fiat's WCM in terms of strategies? Is there any kind of trade-off? Has the company to use a specific tool such as hoshin kanri or BSC? What are the peculiarities of Fiat's WCM? Is there a grand strategy?

Management accounting issue. Is there a particular management accounting system supported by Fiat's WCM? What is the real change introduced by the model? To what extent has management accounting been affected by the WCM model?

Operations management issue. What are the implications for operations processes in terms of involvement of people and managers?

Operations management, tools and principles issue. What set of tools, principles and methodologies was introduced by Fiat's WCM and what are the differences with respect to the classic set derived from JIT, TQC and TPS-lean?

Performance measurement system issue. What are the important measures introduced by the model? At what level and with which frequencies are they managed and by whom?

Data were also gathered from Fiat's official documentation available online within Fiat Group's website. The documentation was partially analysed before the interviews to allow the researchers to learn the correct terminology and processes used in Fiat's organisation.

In grounded theory, there are three basic types of coding: 'open', 'axial' and 'selective'. For the purpose of this research, open coding and axial coding have been mostly used to handle the data collected through the qualitative inquiries.

Before summarising the interview process, the next section will describe the analysis by direct observation of the official not-restricted documentation of Fiat's WCM model.

4. Observation of Fiat's WCM documentation

Fiat's WCM model is structured by many documents copyrighted by Fiat. Starting from publicly disclosed information on Fiat's websites, three main issues are considered relevant to contribute to the aim of the study. First, Fiat's declaration that WCM is a model based on the most competitive issues of TPS and on the benchmark of European production systems (FIAT Power Train 2011); second, Fiat's declaration that the WCM is focused on the main concepts of total industrial engineering, TQC, TPM and JIT; third, Fiat also declares that for its model, a direct discussion with Japanese experts occurred. It seems that this model in some ways is directly related to Japanese industrial principles and philosophy.

Fiat's WCM is underpinned by 10 managerial pillars and 10 technical pillars. The 10 managerial pillars are: management commitment, clarity of objectives, roadmap to WCM, allocation of highly qualified people, commitment of organisation, competence of organisation, time and budget, level of detail, level of expansion and motivation of operators. As shown in Table 1, at a different level, the managerial pillars are linked to 10 technical pillars, which are safety, cost deployment, focused improvement, autonomous activities, professional maintenance, quality control, logistics and customer service, early equipment – early product management, people development and environment.

Table 1. Fiat's WCM pillars.

<i>Managerial pillars</i>									
Management commitment	Clarity of objectives	Roadmap to WCM	Allocation of highly qualified people	Commitment of organisation	Competence of organisation	Time and budget	Level of detail	Level of expansion	Motivation of operators
<i>Technical pillars</i>									
Safety	Cost deployment	Focused improvement	Autonomous activities (Autonomous Maintenance and Workplace Organisation)	Professional maintenance	Quality control	Logistics and Customer service	Early Equipment/ Early Product Management	People development	Environment

Source: Fiat Group website.

Fiat's WCM is not a never-changing model. In the last years, an energy sub-pillar was introduced in the environment pillar to reduce waste and achieve greater energy efficiency.

A brief observation of Fiat's WCM pillars highlights the emphasis on the pillars related to 'safety' and 'environment' management. Moreover, it is interesting to notice the emphasis given to 'management commitment' and 'clarity of objectives' within the managerial pillars. The latter could be mainly related to the achievement of strategic objectives such as safety, cost saving, quality and environmental sustainability which are integral parts of the strategic management of WCM. This is also disclosed in the sustainability report of the group (FIAT 2012).

Fiat's deployment is made of its own techniques and principles with no connection to the Japanese hoshin kanri system. Fiat's WCM does not formally require either BSC or hoshin kanri. Moreover, safety has its own resources, indicators and it is considered the starting point for implementing WCM. There is no WCM implementation in any company if safety is not managed according to Fiat's rigorous requirements.

According to the Fiat website and documentation, the 'cost deployment' pillar is one of the most fundamental and distinctive of the WCM models. It is across-the-board all the other pillars and it also represents a relevant novel process and an important challenge in terms of management accounting system and performance measurement system. Cost deployment is directly supported by the board of directors, who have strongly sponsored the model. Considering documents' analysis, 'cost deployment' is the fundamental link between the improvements required and the measurement of the savings achieved. As Figure 1 shows, this particular management accounting system is developed by means of seven steps which represent seven steps for implementing cost deployment.

The cost deployment process stems from the focus on losses; the concept of loss seems to be something deeper than the seven wastes introduced by Ohno (1988) in the TPS. According to Fiat's WCM documentation, although a waste is a surplus of inputs in creating an output, a loss is not a used input already assigned to a process. In particular, these losses can be grouped in three categories according to their origin: machines, personnel and material/energy. Examples of losses are stoppages for failure, stoppages for set-up, people waiting for instructions, strikes, absenteeism, product rework and operating motions. The analysed documentation does not show any evidence of a relationship between the WCM approach and cost accounting systems such ABC or traditional accounting. In any case, whatever the management accounting system, the cost deployment process has to be strongly integrated with cost accounting and even the budget preparation process.

It is interesting to notice that in Fiat's WCM model, in the same manner as TPS-lean, quality for customer satisfaction is taken for granted and considered at its highest level. First and foremost, cost deployment drives to reduce wastes and losses for achieving customer satisfaction. Naturally, quality and customer satisfaction are fundamental issues of strategic management. Moreover, there is no trade-off between safety and savings. Safety and quality must be pursued regardless of savings. Cost deployment does not affect safety and quality management.

From the 10 technical pillars at the base of the model in Table 1, stem several methodologies and standards. Methodologies and pillars are fundamental to the application of Fiat's WCM. All Fiat's plants as well as their suppliers are subjected to a performance measurement system firstly based on a self-assessment, and then to an audit by Fiat's auditors. A score from 0 to 5 is assigned to the plant for each methodology applied. When the score is 0, the methodology has not been applied. In contrast, when the score is 5, it means that the methodology has been completely

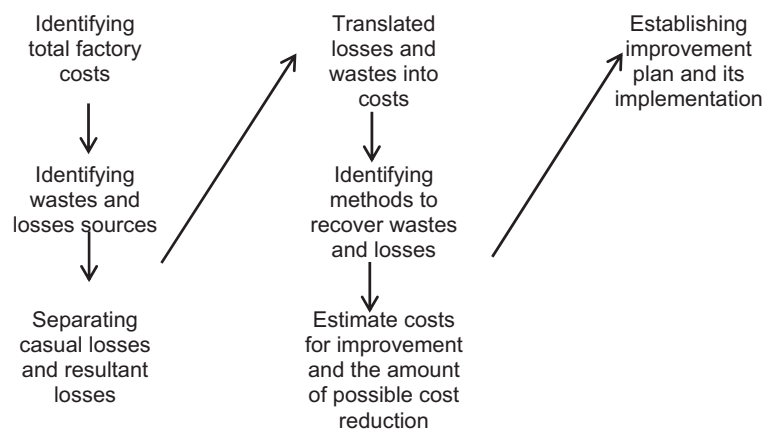


Figure 1. The cost deployment flow.
Source: Adapted from Yamashina (2013, 69).

understood and implemented in all the processes involved. The audit is based on seven steps of implementation for each methodology. The sum of all the methodology scores establishes an overall score from 0 to 100 (named ‘Methodology Implementation Index’); according to the achieved total score, the plant is awarded one of the following four levels: bronze, silver, gold and world class. The award gained by the organisations represents a certification and it can be also used by different organisations as a benchmark process. The certification with the four different levels is issued directly by the WCM Association and not by Fiat.

Moreover, within the performance measurement system, the documents’ analysis allows us to quote that a different range of KPIs is defined at different levels. The KPIs are related to lead time, work in process, overall equipment effectiveness (OEE), internal and external quality, service level as well as safety, ergonomics, environment (Chiarini 2013d) and people involvement. Furthermore, visual management and control are carried out day-by-day or even in real time, as recommended in the TPS-lean production approach.

It is out of the scope of this research to classify the applied tools in Fiat’s WCM. However, tools well known to operations management researchers, such as 5S, 5WHYs, cause and effect diagram, FMEA, Kanban, Poka-Yoke, SMED to mention but a few, can be found. Therefore, at first glance, it seems that Fiat’s WCM tools are directly derived from lean production-TPS, TQC and JIT. Naturally, these tools have received a particular personalisation related to Fiat’s processes.

All the pillars highlight and stress the concept of worker involvement and their empowerment and self-responsibility especially through on-the-job training. The concept is particularly highlighted and stressed in the technical pillars dedicated to safety, focused improvement, autonomous maintenance, quality control and people development. For instance, workers are responsible for daily performances of the workplace and they have continually to increase their skills and awareness, and learn from their own mistakes and from best practices. This view of the responsibility principle is derived from Japanese culture. Indeed, since their origins, TPS, JIT and TQC have been studied for their participatory management and the humanistic view and growth of the worker (Ishikawa 1985; Jayamaha et al. 2014).

Table 2. Open coding for the results from the documentation observation.

Label	Description of the phenomena	Open codes
O ₁	Safety is considered a ‘must-have’. There is no WCM implementation without safety management	Safety first: target 0 injuries
O ₂	There is no trade-off between different strategies such as quality, safety and cost leadership	No trade-off among the strategies
O ₃	Quality and cost saving are the ‘grand’ strategies of the model. Strong commitment and involvement of the management on the issue are expected. Quality for customer satisfaction must be fundamental and taken for granted	Quality and cost saving are the ‘grand strategies’
O ₄	Fiat has got its own tools and systems for deploying strategies. No use of Japanese tools such as hoshin kanri	No request, at manufacturing level, for specific tools and systems such as hoshin kanri or the BSC
O ₅	Management accounting is focused on measuring cost saving through the economic quantification of wastes and losses	Management accounting focused on wastes and losses quantification
O ₆	WCM requires a management accounting system. Specific systems such ABC or value stream accounting are not formally required	Management accounting does not require ABC or value stream accounting
O ₇	Cost deployment has to be strongly integrated with the official management accounting system	Cost deployment integrated with the management accounting system
O ₈	OM is affected by several tools and techniques directly derived from JIT, TPS-lean and TQC even if personalised	Use of personalised JIT-TPS-TQC tools and techniques
O ₉	Workers are definitely involved in the development of the technical pillars. Skills and awareness are continually increased especially using on-the-job training and lessons learnt from the field	Involvement and empowerment of operators
O ₁₀	Performance measurement system is structured at different levels with use of typical KPIs such as lead time, OEE, cost of internal and external quality, etc.	Performance measurement system structured at different levels with classic TPS metrics
O ₁₁	Performance measurement system also reaches shop floor level. Visual Control is handled day-by-day or even in real time by the operators who are responsible for the daily performances	Day-by-day visual control for operators
O ₁₂	Performance measurement system is also based on self-assessment and an external audit. This measures the maturity of WCM implementation in terms of pillars, tools and techniques	Internal and external auditing for measuring the implementation level
O ₁₃	The plants are awarded with a different level of certification: bronze, silver, gold and world class. The certification is used as a benchmark among the plants	Certification award for the plants as a benchmark

Table 3. Axial coding from the documentation observation.

Open codes	Axial Codes
O ₁	Safety first
O ₂ , O ₃	Quality and cost saving are the grand strategy
O ₄	No request of specific tools such as hoshin kanri
O ₅ , O ₆	Management accounting focused on cost saving with no particular accounting system required
O ₇	Cost deployment integrated with the management accounting system
O ₈ , O ₉	Operations managed through personalised Japanese techniques and principles
O ₁₀ , O ₁₁	Performance measurement system at different levels including day-by-day management for operators
O ₁₂ , O ₁₃	Performance measurement system also based on auditing and benchmarking

4.1 Grounded theory categories from the direct observation of the documentation

Open coding is usually the first step of grounded theory. The observations from the documentation were analysed in detail and the phenomena were labelled. Strauss and Corbin (1990) suggested that words in the description of the phenomena should be highlighted and stated in a short phrase in order to create the open codes. Table 2 shows the first open coding of the documentation observation and the open coding categories that emerged.

Grounded theory, at this point, tries to group the open codes which emerged from this first step into axial codes. These latter are the theoretical categories which underpin the WCM model. Table 3 shows how the open codes have been grouped.

Following the described methodology, theoretical categories of Fiat's WCM model were found from the direct observation of the documentation. These categories will be completed by the categories that emerge from the results of the interviews.

5. Results from the interviews

5.1 Impact of Fiat's WCM model on strategies

The companies to which the managers belong clearly had a strategic management system before implementing Fiat's WCM model. Every manager reported that after 2–3 years, WCM had an aggressive impact on the results in particular on the cost reduction, safety indexes and quality indicators. According to all the interviewed managers, WCM has to be strongly integrated with the business plan. However, according to the suppliers' managers (7 out of 10) it is interesting to note that the savings have mainly affected the shop floor, the supply chain and, in part, the engineering departments. It seems that other kind of processes or functions such as marketing, sales or human resources have not been affected yet by cost reduction. Furthermore, all the interviewed managers claimed that since the introduction of the WCM model, safety and environment has been raised to a higher strategic level. In the matter of safety and environment, the Fiat's manager who was a former president of the WCM Association, said:

I know very well TPS because I studied the model directly in Japan several years ago. What I can say is that perhaps due to the strict European legislation regarding safety and environment, from the beginning we thought WCM as a model strongly integrated with safety and environment. By contrast, in Japan they added safety and environment strategies later. Hence the integration is not as strong as in our WCM.

Two other suppliers' managers said: *'In the past we applied Lean and TQM, but there was no trace in our business plan either of strategies for safety or for the environment. We just followed the specific legislation'*. As to the differences from other models, in particular TPS-lean, 100% of the interviewed managers underlined with different words, but with the same concept, that WCM allows a better quantification of wastes and losses. The latter are compared to a defined budget for the pursuit of their reduction.

5.2 The trade-off in terms of strategies

As emerged from Section 5.1, Fiat's WCM is mainly focused on strategies for operations rather than sales and marketing. In particular, quality and cost saving for the production shop floor seems to be the grand strategy. The question that arises is, therefore, whether or not there is a trade-off with other strategies as Hayes and Wheelwright (1984) discussed in their first WCM model. According to all the interviewed managers, cost saving by means of the cost deployment

pillar cannot be sacrificed for any other kind of strategy. Each company aims at achieving the higher economics objectives, cutting down costs, especially in the operations management, and without detriment to the quality and reliability of the product, as well as safety. All the interviewed managers confirmed that quality for customer satisfaction is taken for granted and safety is achieved without any trade-off with saving. Safety, as already discussed, is the first mandatory step for implementing Fiat's WCM.

5.3 Tools or systems for developing and deploying the strategies

According to 100% of the interviewed managers, the model does not contain suggestions concerning specific tools or systems such as hoshin kanri. The suppliers' managers confirmed that with the advent of Fiat's WCM they did not change the previous system in use to deploy strategies.

5.4 The path for implementing WCM

When the suppliers started implementing WCM, they already had a lean model implemented and elements of TQM–TQC. Hundred percent of the interviewed managers implemented the cost deployment pillar first in order to also evaluate the efficacy of the previous implemented models. Cost deployment is considered the most peculiar pillar with regard to the WCM model. The majority of the suppliers' managers, eight out of 10, declared that Fiat's WCM model, when it is well implemented, is not so different from lean implementation in terms of the pillars concerning focused improvement, autonomous activities by the operators, professional maintenance, quality control, logistics and people development. The interviewed managers also reported that the pillar pertaining to early equipment and early product was considered less important than the others because it involved the engineering department. According to Baines et al. (2006), also in the TPS-lean model processes linked to engineering are less stressed than typical production processes.

5.5 Managers', workers' and staff's involvement, skills and awareness

This issue particularly recalls the principles introduced by TPS-lean and the previous WCM models. TPS sinks its roots into a profound involvement of the management and all the staff, especially workers (Chiarini 2013b). Ohno (1988), Monden (1983) and Deming (1986) discussed principles such as people involvement and empowerment, self-responsibility of each worker and participatory management (Liker and Convis 2011). The Fiat's manager who developed the model said: 'As far as people involvement concerns, we have planned our model in the same way as the original TPS'. In fact, all the other managers declared with similar words that these principles are more or less the same as those implemented in TPS-lean or TQM–TQC; hence, Fiat's WCM does not bring novelty with regard to personnel involvement. However, a particular culture note emerged from the discussion with six managers from suppliers. Some suppliers perceive Fiat's WCM model as a complex one and demanding in term of standards and in what has to be applied. The Fiat's manager who developed the model studied and worked directly in Japan before developing Fiat's WCM and during the interview he stated: 'Workers in Japan have an innate sense of following rules and roles that we European sometimes do not have. This is one of the reasons why WCM has many standards and controls to fulfil in order to secure a proper application'. According to Picken (1987) the innate sense of following rules typical of Japanese managers and employees are directly influenced by the Shinto religion and value system. Shinto is based on the innate goodness of human nature and the intrinsic capacity of people to grow towards it. Picken (1987) analysed the behaviour of Japanese workers concluding that in the same way they have an intrinsic capacity of following rules for the company's sake (Kondo 1998). In contrast, in Western societies, the worker is expected to perform more according to external factors such as remuneration and self-realisation.

5.6 Tools and techniques dedicated to operations management

As previously mentioned, it is out of the scope of this research to investigate the differences in terms of specific tools. However, 100% of the interviewed managers confirmed that many of Fiat's WCM tools are directly derived from the Japanese systems TPS, JIT, TPM and TQC and even the American Six Sigma (Chiarini 2013c) with a due adaptation to the processes of the automotive industry and Fiat's organisation. What is different and perhaps worth mentioning is the capacity to generate new practices for implementing the tools and techniques in operations. Moreover, eight managers underlined how every time a tool is implemented, WCM forces consideration of it from the safety point of view. None of the managers had implemented similar tools with such a strong integration before, especially with safety management.

According to the Fiat's manager who developed the model, all the best practices are just shared among Fiat's plants and some lessons learnt can be sometimes transferred to other members of the WCM Association.

5.7 WCM's management accounting system

As already mentioned, one of the major contributions of Fiat's WCM is the introduction of the cost deployment pillar and its link with the management accounting systems. Each interviewed manager highlighted several times the importance of this pillar and how cost deployment forces the company to quantify all the wastes and losses. All the suppliers' managers declared that they had their own management accounting system for calculating the cost of product before the introduction of WCM and still have their systems. They use in particular ABC and they reckon it can be useful for calculating wastes and losses.

It is interesting to note that all the interviewees declared that accounting managers are dedicated along with the production managers to calculating wastes and losses and to managing their reduction. Therefore, the management accounting introduced by WCM is really an across-the-board system.

5.8 Performance measurement system within Fiat's WCM

All the interviewed managers were unanimous that Fiat's WCM introduces a detailed and ramified set of KPIs at all organisational levels. Many of these are derived from TPS-lean and are similar to those proposed by TPS-lean. The peculiar principle of TPS-lean is the speed and frequency of the measuring process. For example, on the shop floor, KPIs are measured each hour or each day and managed by the operators through visual control. Fiat's WCM is also focused on speed and frequency of the measuring process. In fact, they had three levels, where the first two are represented by a strategic team made up of senior managers and the board of directors.

Furthermore, in a complex organisation when the model reaches its maturity stage, performance measurement system tends to deeply permeate all the processes. Fiat's managers confirmed the extent and the complexity of the KPI system with no less than 3000 KPIs for all the levels and functions. In the model, there are particular KPIs such as creativity level of the plant, number of improvement suggestions per person in the plant, number of production engineers classified in terms of individual contribution and number of best practices created.

According to eight managers, Fiat's WCM model prefers to use in an intensive way an electronic performance measurement system. All the KPIs should be officially integrated in the enterprise resource planning (ERP) system or other electronic system and all the machines and the shop floor workplaces should be interfaced. According to 100% of the interviewed managers, visual management and control by the operators are an indisputable fact in Fiat's WCM as in the TPS-lean model. On the shop floor, all the measurements should be registered and displayed in an electronic way, including the problem-solving and decision-making processes. Obviously, this would be an ideal state reached in a mature stage of implementation. Indeed, so far only the plants directly run by Fiat have reached such a technological target. Interestingly, a supplier's manager said:

In the 1980s and 1990s we, production managers, dealt with the principles of Computer Integrated Manufacturing (CIM) and it seemed that we had to manage factories with no lights in other words factories completely automated and computerised with any workers. Fiat seems definitely to have integrated the (few) positive aspects of the CIM with the 'humanisation' of the Toyota Production System.

Anyhow, according to the Fiat's manager who developed the model, the level of automation can be also related to the particular geographic area where the plant is located and/or to the characteristics of the process. For instance, many plants are trying to combine low-cost automation and WCM to the detriment of CIM principles.

Fiat's WCM performance measurement system is deeply characterised by the auditing system, too, as described in Section 4. The auditing system allows companies to measure their performance level and even to benchmark each other through the score and the different levels of awards certification: bronze, silver, gold and world class. However, two suppliers' managers with similar words reported that the auditing system can be sometimes bureaucratic and not as useful as are other performance measurement systems. For the Fiat managers, the audit system is a peculiar key success factor, since without a formal periodic check the implementation tends to slow down and furthermore, the audit system creates a positive competition within the plants that speeds up the overall route map.

Table 4. Open coding of the results from the interviews.

Label	Description of the phenomena	Open codes
I ₁	Strategies from WCM are mainly focused on operations such as production, quality, supply chain and engineering departments. Purchasing is involved through the supplier programme	WCM strategic management mainly focused on operations
I ₂	WCM strategies strongly integrated with business plan	WCM integrated into business plan
I ₃	Safety first, quality at the most high level and there is no trade-off with savings	Safety first. Quality for the customer with no trade-off with costs
I ₄	Cost saving has to be pursued separate from safety management, quality for the customer and marketing strategies	Cost savings integrates other strategies through the loss and waste chase, except for safety and quality
I ₅	Fiat's WCM can be adapted to whatever system or tool for developing and deploying strategies	No request for specific tools to develop and deploy strategies
I ₆	Fiat's WCM could function with lean-TPS tools	Fiat's WCM could function with lean-TPS tools
I ₇	Processes related to the engineering and design departments such as early product and early equipment management can be applied later in certain circumstances	Engineering processes can be affected by WCM at a later time
I ₈	Participative management, people empowerment and skills continually improved	Participative management, people empowerment
I ₉	WCM has many standards and controls to fulfil because the people have a different cultural approach	More formal approach
I ₁₀	Best practices continually developed and shared among Fiat's plants	Best practices continually developed and shared
I ₁₁	Tools and techniques developed and applied to improve safety management at the same time	Specific tools also for improving safety management
I ₁₂	The management accounting introduced by WCM has to be integrated in the official ERP for calculating the cost of the product	WCM management accounting has to be integrated in the official cost accounting
I ₁₃	ABC is not directly required by Fiat's WCM, but it can be helpful for calculating wastes and losses	ABC as a more suitable management accounting tool
I ₁₄	Accounting managers have to be side by side with production managers for measuring and controlling production costs	Production and accounting department involved in the management accounting system
I ₁₅	No simplification of the management accounting is recommended or requested. Value stream accounting could be difficult to implement	No simplification of the management accounting
I ₁₆	Performance measurement system deeply ramified with hundreds of KPIs at all levels. Many KPIs are far beyond TPS-lean classic measures	Performance measurement system very ramified and innovative
I ₁₇	Performance measurement system automation and computerisation combined with operators empowerment	Electronic performance measurement system and operators empowerment
I ₁₈	For some suppliers the auditing process for measuring the performances is considered too demanding	Auditing process demanding for some suppliers

5.9 New grounded theory categories from the interviews

Table 4 shows the first open coding of the interviews and the open coding categories which emerged. The table shows only those phenomena that did not emerge from the direct observation of the documentation.

Grounded theory suggests, at this point, that open codes are grouped into axial codes. These latter are the theoretical categories which underpin the WCM model and will be integrated with those from the documentation observation. The following table shows the final axial coding process.

The axial coding has delivered the theoretical elements which underpin Fiat's WCM model. By the means of these elements, Fiat's WCM can now be compared to TPS-lean production.

6. Comparison between Fiat's WCM and TPS-lean production

The comparison described is mainly based on the results shown in Table 5, which represent the theoretical elements of Fiat's WCM. For each theoretical element, a comparison has been made and is presented in Table 6 along with a brief discussion.

First and foremost, Fiat's WCM cannot be implemented when the company is not assuring a robust safety system. An entire pillar is dedicated to safety management and this issue is considered mandatory.

Table 5. Axial coding from the documentation observation and the interviews.

Open codes	Axial codes (Theoretical categories of Fiat's WCM)	Core category
O ₁	Safety first	Strategic management
O ₂ , O ₃ , I ₃ , I ₄	Quality and cost saving are the grand strategy	Strategic Management
I ₂ , I ₁	Safety and quality within the strategic management without trade-off with saving	Strategic management
O ₄ , I ₅	WCM strongly integrated into Business Plan. Transactional processes less involved	Strategic management
O ₅ , O ₆ , I ₁₃ , I ₁₅	No request of specific tools and systems such as hoshin kanri	Strategic management
O ₇ , I ₁₂ , I ₁₄	Management accounting focused on cost saving with no particular accounting system and simplification	Management accounting
I ₈	Cost deployment integrated in the official management accounting. Accounting and production together involved in the management accounting	Management accounting
O ₈ , O ₉ , I ₆ , I ₇	Participative management, people empowerment	Operations
I ₁₀ , I ₁₁	Operations managed through personalised Japanese techniques and principles.	Operations
O ₁₀ , O ₁₁ , I ₁₆ , I ₁₇	Engineering processes can be applied later	Operations
O ₁₂ , O ₁₃ , I ₉ , I ₁₈	Best practices developed and shared for all the tools, including safety and environment management	Operations
	Performance measurement system very ramified at different levels and innovative. It includes day-by-day management for operators. Complete automation and computer-based management is recommended	Performance measurement system
	Performance measurement system based on a complex and formal auditing and control. Internal and external benchmarking	Performance measurement system

Starting from the strategic management perspective, it can be noted that TPS-lean considers waste reduction to be the grand strategy. In the TPS-lean model, less waste leads to less lead time. Fiat's WCM is careful about lead time, which is one of the most important KPIs in the performance measurement system and one of the most important objectives in the strategic management. However, because quality and cost saving are grand strategies, they are the priorities and lead time is linked to them. As a consequence of that, TPS-lean, in its original Japanese development, places more emphasis on reducing wastes and on finding the causes of wastes rather than measuring them with particular management accounting systems. In contrast, Fiat's WCM does not take into consideration this approach and prefers to follow a school of thought similar to ABC-ABM system, where it is important at the same time to find the causes of the wastes and losses and to measure them in an accurate way. Within the strategic management, Fiat's WCM does not have a particular tool, such as the Japanese hoshin kanri, for this function. In addition, Fiat's WCM places a unique emphasis on safety which leads to a strong integration between safety and the other strategies.

Fiat's WCM does not recommend either ABC or other kind of management accounting system and proposes its own algorithm for measuring wastes and losses; therefore, companies which implement Fiat's WCM have to evaluate how to integrate this algorithm in their official systems. In contrast, the Japanese management accounting simplification does not need any particular information system, even though in Western companies TPS-lean has been sometimes associated with ABC using the systems that officially manage it.

The performance measurement systems of the two models are not that distant. Many KPIs are similar and typically derived from the original Japanese TPS. As an interesting note, Fiat's WCM introduces new KPIs related to the ability of people to propose solutions and establish best practices, as well as the distribution of production engineers inside the organisation. The fast and continuous capacity of creating new best practices and event tools and techniques, which will be shared among Fiat's plants, also seems to be a novel concept introduced by Fiat's WCM. A widespread computerisation and automation of the performance measurement system and tools application are another relevant issue to identify the peculiarity of Fiat's WCM when compared to TPS-lean.

Lastly, Fiat's WCM introduces a formal kind of auditing and control process for measuring performances and the implementation state at the same time, which does not belong to typical Japanese industrial culture. In fact, the practice of such an auditing process can be found in other Western models, especially American models. Related to this kind of audit, there is the interesting possibility of achieving four different levels of awards from the WCM Association.

Table 6. Comparison between Fiat's WCM and TPS-lean production.

Theoretical categories of TPS-Lean	Theoretical categories of Fiat's WCM	Dimension
Waste reduction is the grand strategy. Fewer wastes lead to less lead time. Safety and environment are important but they are not so integrated at strategic management level	Safety first. There is no WCM implementation without following safety management requirements Quality and cost saving are the grand strategy Safety and quality integrated within the strategic management without trade-off with savings	Strategic management
Strategic management focused on both operations management and transactional processes	Each pillar focused on their KPI: i.e. lead time reduction pursued through the logistic pillar WCM strongly integrated into Business Plan	Strategic management
Hoshin kanri is the original Japanese tool for developing and deploying strategies. At a strategic management level, TPS-lean can be also implemented with BSC	No request of a particular system for developing and deploying strategies such as hoshin kanri transactional processes (e.g. marketing) less involved	Strategic management
Japanese companies prefer a simplified management accounting, usually based on value stream accounting. TPS-lean can function with ABC and time-driven-ABC integrated in an official management accounting, usually by means of an ERP	Management accounting focused on cost saving with no particular accounting system and simplification, ABC is sometimes preferred Cost deployment integrated in the official management accounting. Accounting and production together involved in the management accounting	Management accounting Management accounting
Participatory management, people empowerment Operations managed through original Japanese techniques and tools. There is a lack of particular tools for design and engineering	Participatory management, people empowerment Operations managed through personalised Japanese techniques and principles. Tools and techniques also for the design processes, although design processes can be affected at a later time (especially for suppliers)	Operations Operations
Best practice developed and shared among operators	Best practices developed and shared for all the tools, including safety and environment management	Operations
Performance measurement system at different levels, including day-by-day management for operators	Performance measurement system much ramified at different levels and innovative. It includes day-by-day management for operators. Automation and computer-based management is recommended according to the plant and country characteristics	Performance measurement system
No need of complex and formal audits or controls	Performance measurement system based on a complex and formal auditing and control. Internal and external benchmarking	Performance measurement system

7. Summary and conclusions

WCM comes from the original work of Hayes and Wheelwright (1984). The strategic management system of this first WCM model focused on a trade-off between strategies, following the debate opened by Porter (1981); there was neither grand strategy, nor were there plans to achieve it. For instance, in this WCM model, a company should not pursue a cost leadership strategy and differentiation at the same time. However, Hayes and Wheelwright's WCM lacked research into a suitable management accounting system as well as a performance measurement system and specific tools for the operations management.

Schonberger (1986) overcame the limitations of the previous WCM in terms of trade-off between strategies and began to deal with management accounting and tools and techniques for operations. These latter were, substantially, the classics derived from the Japanese TPS, JIT and TQC. Following a traditional Japanese concept, Schonberger proposed a simplification of the management accounting system in which accountants along with production people are more focused on the contributors to waste and delay rather than on complex cost product measurements.

Lean production was launched all around the world by the publication of Womack and colleagues' book (1990) and soon, in Western industries, it became synonymous with TPS.

TPS-lean has its own strategic management system derived from the Japanese hoshin kanri tool, although researchers have successfully studied the combination of TPS-lean with the BSC. Inside the lean-TPS strategic management, the grand strategy is the reduction of the process lead time.

Although the original Japanese TPS, as well as Schonberger's WCM, tries to put forward a simplification of the management accounting system and product cost measurements, usually by means of value stream accounting, some Western industries have implemented TPS-lean along with ABC. However, in this way, the accounting activity of measuring seems to become a priority and detrimental to the simplification of the management accounting typical of the Japanese TPS.

TPS-lean has its own performance measurement system usually based on a consolidated and limited number of measures. The peculiar principle of TPS-lean is the speed and frequency of the measuring process. For example, on the shop floor, KPIs are measured each hour or each day and managed by the operators through visual control.

TPS-lean proposes for operations management, including the office processes, a consolidated set of principles and tools. Participatory management, people empowerment and awareness and the continuous increase of operator skills are the foundations of the operations management.

Is Fiat's WCM just old wine in new bottles? Not at all, this is the main conclusion of this research. Surely, it is a wine that comes from the same Japanese vineyard as TPS but it has its own flavour and body.

According to Table 6, from a strategic management point of view the grand strategy of Fiat's WCM is quality cost saving through a peculiar process or pillar called cost deployment. Within the strategic goals, safety and quality for customer satisfaction and even environment and energy management are fundamentals and are integrated with all the other strategies in the strategic management; this distinguishes Fiat's WCM from TPS-lean and all other models. Safety and quality cannot have a trade-off with cost savings and other strategies. In particular, health and safety are a prerequisite for the implementation of the entire model.

Because cost deployment is part of the grand strategy, Fiat's WCM requires an articulated management accounting system for measuring both the original seven Ohno's wastes (Ohno 1988) and losses. Whereas Japanese TPS prefers simplifying the measurement for all costs, focusing on the immediate investigation and removal of the cause of waste, Fiat's WCM proposes particular algorithms for quantifying losses and wastes. However, it is not clear how the cost deployment could be integrated in the official management accounting system for calculating the cost of the product, even though this is highly recommended by Fiat's WCM. The preferred management accounting of Fiat's suppliers seems to be ABC. Anyhow, in each model, it is by now consolidated that accountant managers have to be side by side with production and operations managers in the search for the causes of waste.

Fiat's WCM seems affected by operational and formal dimensions (Langfield-Smith 2008) and particularly focused on operations management, whereas TPS-lean over time has taken on transactional processes such as marketing, sales, accounting and so on. Fiat's WCM considers the involvement of engineering and design departments fundamental to the model.

Some relevant differences between Fiat's WCM and TPS-lean seem to originate from typical cultural differences between the Western and the Japanese worlds. Participatory management and people empowerment are taken for granted in every model, including Fiat's WCM. However, Fiat's WCM is less static in using tools and best practices, and this leads to a fast and continuous increase of them. The creativity of people in inventing new tools and best practices is even a KPI of the performance measurement system. Fiat's WCM performance measurement system is particularly measured and controlled in its performances and level of implementation. Indeed, hundreds of KPIs and a complex internal-external auditing system are at the bottom of Fiat's WCM model. Interestingly, Fiat's WCM performance measurement system recommends a predominant use of information technology and automation for collecting and analysing data; at the same time, operators are involved in daily control of the shop floor as in TPS-lean.

This research brings novelty and implications for practitioners and academics. For the first time practitioners can really compare TPS-lean with Fiat's WCM. Considering that Fiat has thousands of tier 1 and tier 2 suppliers this comparison represents concrete help for weighing the pros and cons of both models and for blending different elements.

Such a structured model and the limitations of this research introduce many lines for new academic inquiries. First of all, this research is mainly based on data and information gathered from an observation of documentation and 13 interviews with managers. The managers could have introduced some bias due to the kind of industry or their own knowledge about the models. Consequently, considering that Fiat's WCM is applied in many companies, a quantitative inquiry based on a survey could validate the results of this research and help to develop an implementation guideline.

Fiat is a member of the WCM Association and shares some knowledge with the other members. However, it seems that other members have their own implementation models. Academics and practitioners could investigate other WCM implementation by means of case studies.

Lastly, an interesting line of research could be related to which kind of management accounting is better for the models and whether or not is necessary.

Acknowledgements

The authors want to thank Dr. Massone, sometimes quoted as ‘the Fiat manager who participated in developing the model, former president of the WCM Association’. He gave us a first and important theoretical framework of the model and many suggestions for the comparison with TPS. A special thanks to Giovanni Rapello, Powertrain WCM Manager at CNH Industrial, who was the first manager interviewed and arranged the meeting within Fiat Group Automobiles. A special thanks also to Dr. Ragusa, who gave us important suggestions about the model and for correcting some theoretical mistakes. We want also to thank all the other interviewed suppliers’ managers who preferred to remain anonymous.

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Appendix A. Interviewer guide

Strategic Management	<p>Q1. Think about the strategies which your company is trying to reach. Do you think the introduction of WCM has brought relevant differences? Think about other models such as TQC-TQM, JIT, Lean production-TPS. What kind of differences in terms of strategies' support has WCM brought?</p> <p>Q2. Have you made any kind of trade-off in terms of strategies? (For instance, quality-cost, cost-differentiation of the products, etc.)</p> <p>Q3. Are you using a particular kind of tool or system for developing and deploying the strategies? In particular are you using hoshin kanri or balanced scorecard?</p>
Operations Management	<p>Q4. Which are the most important pillars? Is there a specific path for implementing WCM?</p> <p>Q5. In what way are managers involved in the implementation? Are all the staff and workers involved or are there some differences? Q6. Is there a particular way for increasing skills and awareness of the operators?</p> <p>Q7. What are the most important tools and techniques applied in the operations processes? With regard to TQC-TQM, do you believe that WCM introduces new kinds of tools or a different approach to them? And what (if any)?</p>
Management Accounting System	<p>Q8. Does WCM need a particular accounting system such as ABC or TDABC? In what way are the introduced savings measured by WCM?</p> <p>Q9. To what extent has WCM affected the MA? Has WCM introduced simplification in your accounting system?</p>
Performance Meas. System	<p>Q10. What kind of measures or KPIs has WCM introduced? How are workers involved in managing such KPIs (e.g. visual management or day-by-day control)?</p> <p>Q11. How do managers usually control the implementation level and efficacy of the results achieved by WCM?</p>
