The communicative effectiveness of Lean mapping tools: a comparison between Value Stream Map and Makigami

M. Zanchi, P. Gaiardelli[a)]

a. Dipartimento di Ingegneria Gestionale dell'Informazione e della Produzione, University of Bergamo, Viale Marconi, 5 20044 – Dalmine (BG) – Italy (matteo.zanchi@unibg.it, paolo.gaiardelli@unibg.it)

Abstract: Mapping tools have shown, over the years, their effectiveness in enabling the full potential of Lean management (LM) programs within factories. Usually deployed as "first use" practices, mapping techniques provide a wide range of benefits, starting from the identification of waste sources in value stream, up to become a blueprint for Lean implementation, as they help design how the whole door-to-door flow should operate. To this matter, two main mapping techniques can be deployed whenever it comes to a Lean optimization program: the Value Stream Map (VSM) and Makigami. Born and developed in different contexts, both of these mapping tools have shown their usefulness in providing a clear picture regarding the state-of-the-art of any given process. Still, it is not clear from scientific literature which practice best responds in terms of communicative effectiveness and which tool is most recommended depending on the context of application. Based on a real case study of a manufacturing company operating in the production of dies for aluminum profile extruders, the following paper aims to depict which tool is best suited to the proper representation of a design process in light of seven different characteristics, found in literature, used to evaluate communication effectiveness, referred as "7 Cs". The results of the research show how effective VSM and Makigami respectively are in representing the information flow of a typical design process, but with a different ratio within the different communication dimensions.

Keywords: VSM, Makigami, Lean Office, Visual Management, Mapping

I. INTRODUCTION

The sheer manufacturing nature of the Japanese production model, currently known as "Toyota Production System" model, from which the LM was derived, has inevitably directed the development and adoption of such practices, especially in the first stages of diffusion, towards contexts similar to the ones from which it originally developed, and therefore of industrial belonging [1]. Yet, it soon became evident that the implementation of the LM concepts needed to extend beyond the production area to include other settings, such as office-based functional areas [2, 3] and divisions unrelated to the production ones. This recognition caused some sort of revolution throughout the Lean concept, which made it clear that using such a methodology in fields besides manufacturing may provide even better outcomes.

In such contexts, the waste inherent in service processes is of particular importance. The reduction of waste in these processes is frequently associated with immaterial factors, which are typically difficult to identify since they are frequently connected to the usage of IT technologies. Thus, the transaction—the fundamental unit that makes up the pure service activity - is the core element of these processes, which are also referred to as transactional processes. The examination of waste associated with transactional operations initially employed Ohno's classic subdivision proposal. However, several authors recently have established ten different waste categories: 1) realisation before or after schedule; 2) inactive personnel waiting for paperwork, information, or data; 3) slow actions or procedures; 4) the accumulation of data and/or information that has to be processed, increasing the Work In Progress; 5) inherent flaws or mistakes made during service implementation that necessitate rework; 6) customer inefficiencies and external expenses caused by a lack of quality; 7) extra service features that the consumer did not seek; 8) duplications inside flows; 9) excessive staff movements within the office or between different departments or locations; 10) needless transit of items or papers [4].

Identifying non-visible waste is not an easy issue to deal with, as in the case of information flows, therefore there is a need to adopt proper instruments to make sure that such kind of waste can be made noticeable and consequently tackled through Lean practices. To this matter the utilisation of visual management tools represents a viable way to prosecute this goal.

The Lean concept includes the principle of visual management of data and information coming from the workplace. The Japanese idea of Mieruka refers to the observation and analysis of activities using pictures, graphs, figures, and indicators [5]. Therefore, concentrating on the visual component is a crucial strategy for pursuing continuous improvement. The Lean philosophy leaves full autonomy in the choice of the tool to be used, as long as it promotes effective communication with the interlocutor.

Mapping tools are very helpful when it comes to visual management and may be used either in the form of VSM or Makigami. With these two tools, it is possible to estimate the downtime within the office, although this is an extremely difficult task, since many activities require confirmation from a supervisor or customer, resulting in considerable waiting times. Furthermore, the same task involves many more variables, which complicates the definition of waste, added value, and defect. The decision between the two is important since it involves achieving different quality characteristics, which takes a varying amount of time and money to accomplish.

There is currently no comparison data available to help management or teams decide which mapping tool is the most suitable to employ given the actual needs of the organisation. In reality, there are many examples of VSM in the literature that provide detailed explanations of the procedures required for its development as well as the outcomes obtainable by adopting such an approach both in predictable contexts and when processes are subject to high variability [6, 7]. On the other hand, there is no or very little information on the expected benefits of utilising Makigami, making this decision between these two instruments a typical "leap into the void".

Aim of the following article is, therefore, to illustrate which one of the mentioned tools is most appropriate for the accurate portrayal of a design process based on an actual case study of a manufacturing firm engaged in the production of dies for aluminium profile extruders.

Following this brief introduction, the paper is structured as follows: Section II illustrates the methodology adopted to conduct the research; Section III describes the context regarding the current knowledge on the topics of Visual Management, with particular regard to mapping tools (respectively being VSM and Makigami), and requirements needed to achieve an effective communication, referred as 7 Cs; Section IV depicts, based on a real case study, the results deriving from the adoption of the two different mapping tools in the light of the previously mentioned factors of communication efficacy; finally, Section VI concludes the paper by providing current limitations of the research performed and possible future areas of exploration for further researches.

II. Methodology

Coherently to the main purpose of the following research, consisting in the comprehension of the communication effectiveness of Lean mapping tools (respectively VSM and Makigami), it was decided that a case study approach would have been the best course of action. A single case study was chosen, in particular, because as agreed among experts, it is the best method to comprehend how the specific characteristic of the forementioned instruments have a different role in providing the right pieces of information to personnel working within the same context [8].

The study was conducted throughout two main stages. In the first phase, a literature review was conducted to understand the current knowledge regarding the themes of Visual Management, with particular focus on Lean mapping tools and, parallelly, the main features required to general mean of communication to enable a fully effective transmission of information. To do so, Scopus and Web of Science databases were used to get access to relevant papers on the mentioned topics.

Following, the second stage consisted in assessing the effects on communication deriving from the adoption of the two considered mapping tools within the design office of the company under study. An optimization team, consisting of the manager and two technicians from the design office assisted by the Lean manager, analyzed the process under observation. The latter was then mapped using VSM and Makigami, respectively. Then, two researchers jointly conducted the assessment, interviewing each member of the optimization group using a checklist to identify the degree to which each tool met the communication dimensions identified in the literature. To this matter, a 5-point Likert scale was used to carry out the assessment over communication efficacy (1 – very low; 2 – low; 3 – average; 4 – high; 5 – very high). Subsequently, any disagreements between the evaluations provided by each respondent were settled at later meetings, resulting to a consensus decision. The evaluation was done merely at the end of the project.

III. Context

A. VSM

The VSM technique successfully combines process inputs, outputs, activities, actors, and information flows to offer a precise, quick, and simple-to-understand depiction of the entire production process [9]. Other than production contexts, VSM tool have proven to be applicable within transactional office environments, yet with some difficulties [10]. Secondly, by putting the required improvement interventions into a structured roadmap, VSM helps to discover the non-value added sources that are hidden in the process, defining the optimum management approach towards optimisation. Finally, it promotes the growth of cohesive teamwork built on a single language and a methodical procedure that creates the groundwork for a shared improvement strategy [11].

Since aggregated analysis would result in the loss of important information, VSM should concentrate on one product at a time. Three key components that make up the VSM's structure are as follows: 1) material flow diagram which shows the journey of a product through all the required transformations from the raw material arriving from the supplier to the finished product travelling to the client. Product warehouses are scattered throughout the production steps; 2) mapping of information flow resulting from customer or supplier orders, production planning, resource management, etc.; 3) the time line serves as a waste indication for the process under analysis. It typically consists of a square wave, which makes it possible to distinguish between value added (VA) and non-value added (NVA) time. It also enables the detection of waste within the process.

B. Makigami

Makigami serves as a valuable and significant mapping tool for assessing non-value added activities and overall process performance in transactional processes [12]. Despite being a very effective technique for locating waste in processes, Makigami is not a typical Lean-TQM tool and may have been originated from the BPR swim lane. Makigami can be seen as a form of Lean VSM integration with BPR metrics-based flow [13].

The structure of the Makigami, which is characterised by strong dynamism, derives from the juxtaposition of four different components: 1) the swim lane diagram, which is the first part of the Makigami, helps people visualise the actions and roles of the smaller processes that make up a larger activity from planning to completion. When multiple departments are involved in a process and they are working together, the swim lane is frequently employed, while these departments are reported on the diagram in accordance with how they are arranged in either a vertical or horizontal direction; 2) documentation is the area immediately below the swim lane where a list of the hardware, software, files, and paper documents that are used or presumably generated during each activity is kept. It makes it feasible to map every component of a transactional process that is not immediately apparent but plays a key role in the operations that are completed. It is a very adaptable component that each business can set up according to its requirements and adopted tools; 3) time analysis emphasises the development of each activity, whether or not it is value added. This element comes back to the time line characteristic of VSM. Here, process's buffer data are also present. Traditional flow measurement measures like lead time (LT) and process time (PT) are indicated as well as the "value created" index, which is calculated as the proportion of time spent on value added activities to lead time, is another extensively used index; 4) The final component, problems and solutions, lists the issues that were discovered while the process was being observed, along with potential fixes that have not yet been explored.

Makigami tool has several benefits: 1) complicated processes are made clearer since it makes it possible to identify task assignments, inefficiencies, waste, work in process (WIP) of team members and the roles and responsibilities associated with each action and department in one glance [14]; 2) it increases collaboration and idea exchange by making it easier for all employees to grasp the entire process, which enhances communication; 3) it supports the identification of participants in the flow, their roles, as well as the inputs and outputs with which they interface [12]; 4) it provides a very adaptable structure that can quickly change to meet the needs of the team, allowing for the emphasis of aspects and roles that are more crucial to the process; 5) analysis ease, thanks to the visual depiction of activities [12], that enables the team to perform a thorough analysis quickly enough to ensure the possibility of pursuing continual development.

C. Communication effectiveness

Due to the intangibility of the components involved and the difficulty in measuring them, evaluating the efficacy of communicative activities may be rather challenging. Indeed, because anything that is transmitted communicatively may be open to the recipient's perception, communication features cannot be categorised using strict criteria. Therefore, communication can be recognised as effective when the sender aims to use all of the available instruments to ensure that the recipient fully understands the message.

In this instance, one of the most widely employed classification criteria in assessing the communicative effectiveness of information tools is constituted by the so called "7 Cs of communication", as identified by Cutlip [15], which in our case will be used to provide a strategic comparison between VSM and Makigami. Professor Scott M. Cutlip attempted to enumerate all the qualities necessary to effectively communicate, by categorising them. The 7 Cs of communication, as they are now called, are: 1. Completeness - in order for communication to be effective, the information being sent must be comprehensive enough for the recipient to comprehend it fully and with the least amount of ambiguity possible; 2. Conciseness - details that are consciously regarded superfluous should not be conveyed, increasing the likelihood that comprehension will be challenging. Conciseness is the desire to concentrate on what is crucial, resulting in a summary that must be comprehensive; 3. Consideration - the sender must be able to determine the sort of receiver (s)he is directing her/his message to. (S)he can employ communicative filters in this way to make the notions easier to understand; 4. Concreteness - the speaker must strive for pragmatism, based on straightforward, accurate, and substantiated evidence that back up the information he intends to communicate; 5. Courtesy - the sender must establish the optimum environment for communication, refraining from pressuring the interlocutor to respond and instead working to gain his availability and attention; 6. Cleareness - regardless of the interlocutor's cultural background, the language used to deliver the message must be straightforward and clear. Use of suitable terminology is a must for simplicity in order to avoid any ambiguity and keep the focus on the substance; 7. Correctness - to effectively communicate, one must use proper grammar, punctuation, and approach the addressee with some rigour.

IV. RESULTS

The company is engaged in the production of molds for aluminum profile extruders. Since the majority of the manufactured products can be considered prototypes, the group's production system is based on an Engineer To Order (ETO) procedure. The production process begins with the prototype design phase, for which the responsible organizational unit is the technical office. The design office is where the drawings of the various components that will constitute the finished product are created. The first design activity for the order is carried out by the designer and is the profile preparation phase. During this initial phase, orders are divided into new or repetitive projects (molds that have already been designed and built previously, requiring only small modifications). All repetitive projects, once the preparation phase is completed, are assigned to a draftsman who, after making any necessary modifications, issues the work sheet for the cutting and turning department. In the case of a new mold, however, the designer, after completing the profile preparation, sends it to the affiliated company that will take care of implementing the required modifications, allowing the designer to proceed with the project study in the meantime, during which all decisions regarding the assembly's characteristics are made. After the design phase is completed, the study is sent to the customer for approval. Once the approval is obtained, it can be returned to the draftsmen. They, after making any modifications requested by the customer, issue the turning drawing for production and simultaneously send the project to the affiliated company for the completion of the blueprint and the creation of the model. The design process concludes with the control of the blueprint by the reference designer and the delivery of the documentation to the CAM (Computer-Aided Manufacturing) department for the issuance of work programs for the machines.

The strategic importance of the design phase, which in a macro view of the production flow, takes approximately half of the time available for the entire process, drove the company to an intervention aimed at optimising and minimising waste also outside the production department. The managerial decision was to intervene by starting from the heart of the technical department, the design area, where various components that will make up the finished product are conceptualised and developed.

The comparison model used includes, as highlighted in the context section, the 7 Cs of communication defined in literature.

A. VSM

The information needed to construct a VSM is: the collection of cycle times of each operation (for which, in this case, data collection of micro-operations was not required, but the time of the overall operation was sufficient) and the identification of system buffers. For the former the presence of a Lean team member was required to accompany the operator, noting the actual times, with the possibility of taking several measurements together, only having to check the start and end of the activity. It is generally recommended to take at least ten surveys per operation, varying according to importance and difficulty. On the other hand, for the latter information were gathered through work sampling which, with a frequency of three or four daily observations, were completed within fifteen to twenty days, depending on the complexity of the process. The only cost to be incurred for the construction of a VSM was associated to the commitment of the Lean team member dedicated during the fifteen to twenty days to the exclusive acquisition of data.

Mapping a transactional process through a VSM did not provide sufficiently complete communication. Since it was not possible to reason on physical parts, but on data or files, it was complicated to fully understand the process only through the operational steps that constitute it, whereas it would have been indispensable to know exactly the flow of documents. At the same time, there was a lack of information on cycle time, since the operator did not work as a machine, but performed micro-operations, not mapped by the VSM, to complete his task. Secondly, the VSM came across as being far too concise, as it lacked completeness and did not present the essential information that could favour immediacy of communication. In terms of "Consideration", the use of VSM did not allow the needs of the receiver to be fully considered. In fact, since the transmission of concepts was governed by a well-defined iconography, it was not possible to shape the arguments according to the recipient's experience, leading to misunderstandings and misinterpretations. Clarity was the communicative element most influenced by iconography. Although the use of regulated and standardised language should reduce the possibility of conveying a confusing or ambiguous message, interlocutors often did not know the meaning of the forms used, misunderstanding the concept or needing further explanation. Furthermore, the results presented through the VSM are certainly concrete since they highlight the current situation of the stream under analysis and were derived from sampling activities carried out in the field. Nevertheless, the lack of specific information limited the receiver's ability to fully understand the message. In terms of "courtesy", presenting a VSM certainly favours the predisposition of the interlocutor to a constructive dialogue, although, as mentioned above also for consideration, the language used was not always suitable for the recipient, being regulated by specific iconography. Lastly, VSM was constructed from the results obtained from the various measurements taken on the flow, analysed over a sufficiently long period of time to reveal any possible errors. The message was thus transmitted correctly, guaranteeing the reliability of the instrument.

B. Makigami

The construction of a map by means of Makigami requires the following information: the identification of system buffers, the detection of the cycle times of each operation (in this case, a collection by micro-operations was required, which must then be classified into value added or non-value added activities), the identification of the documents used and then generated within the individual operational phases, in order to allow a better understanding of the flow. At discretion, the software, hardware and work folders used can also be included. The stratification required for the operations performed by the operators will require sampling that will certainly last longer than in the case of VSM, in the present study seven weeks. As far as the cycle time collection process is concerned, the presence of a permanent Lean team member to observe the operator was required, so that (s)he could simultaneously note down information on documents and tools used. In this case, therefore, more time was required to complete the task, depending on the number of operations the process consisted of and their respective length. As in the case of VSM, it is a good idea to make at least ten records per phase. In the case of mapping through Makigami, the data collector was the only cost to be incurred, although obviously with a greater impact than with VSM, as the time required for the activity was longer.

C. VSM – Makigami comparison

In the case of Makigami, the mapping of a transactional process turned out to be highly comprehensive, as the detection of the documents used and then generated allowed the flow to be fully and precisely identified. The work sampling was carried out by means of an extremely specific stratification of the activities performed by the employees of the technical department, and the same time records, through each micro-operation, offered a timely view of the process. Secondly, if on the one hand the VSM was too concise, not communicating some essential information to the receiver, on the other hand, the wealth of data presented by the Makigami, not allowing to immediately highlight the area to focus on, could make the presentation of the flow too tedious. Speaking about "consideration", the demands of the receiver, who needs a language that cannot be misunderstood, but is easily and quickly understood, were fulfilled thanks to the absence of dedicated iconography and the use of simple forms, making the flow easy to read. The timeline itself was extremely clear, linear and effective. Likewise, the document section was well structured, despite the fact that the amount of information contained here could facilitate confusion. The specificity of the results presented allowed both the recipient and the Lean team to understand the flow completely using the data collected, thus making Makigami a highly concrete tool. In terms of "courtesy", if the simple and minimal language used by the Makigami facilitated the receiver's predisposition to an active participation within the brainstorming on the contrary, the richness of the data presented might attract the receiver's attention, distracting him/her from the dialogue and confrontation with the Lean team. The absence of an iconography, differently from the VSM, favoured a clear and immediate transmission of information about the process through the Makigami which, finally, has also proven its correctness as the represented map realistically reflects the characteristics of the flow.

Table 1 reports an overall view of the results respectively provided by VSM and Makigami tools in terms of communication efficacy, in the light of the 7Cs identified in literature.

TABLE I. COMPARISON MODEL - VSM AND MAKIGAMI

Parameter	**VSM**	**Makigami**
Completeness	Low. Lack of information about the process does not allow a full understanding of the production flow	High. The data collected is extremely specific and leaves no room for doubt
Conciseness	Very High. The information presented is very concise, maybe too much	Low. The large amount of data presented does not allow for a compact structure
Consideration	Low. The use of iconography cannot satisfy the customer's communicative demands	High. The language used is simple and straightforward in all constituent elements
Concreteness	High. The data comes from data collection carried out in the field and is therefore reliable	High. The data come from data collection carried out in the field, are verified and are therefore reliable and realistic
Courtesy	Average. The VSM favours the emergence of a constructive dialogue, although the absence of some information may favour requests for clarification	Average. The absence of iconography favours the emergence of a constructive dialogue, hindered, however, by the richness of the results that could distract the receiver's attention
Clearness	Low. Standardised iconography is often the cause of doubts and possible misunderstandings	High. The absence of a dedicated iconography and the possibility of moving the components favour expressive clarity
Correctness	High. The results presented reflect the characteristics of the flow	High. The results presented realistically reflect the characteristics of the flow

V. CONCLUSION

Thanks to the study carried out, it was possible to fill in the gaps in the literature regarding the implementation of Makigami, for which there was only some information on the implementation process, but no evidence at all on the opportunities that can be pursued through the use of this tool.

A comparison between the two mapping tools typical of the Lean methodology, VSM and Makigami, showed how the latter can certainly offer a qualitatively better level of communication in the face of a greater use of time than that achievable through a simple VSM, which is probably unsuitable for the analysis of a transactional process. In particular, the preference towards the use of the Makigami tool rather than the VSM is denoted by the fact that, concordantly especially with the dimensions of 'Completeness' and 'Clearness', the former shows greater efficacy both in providing a more detailed and complete view of the process concerned, and in terms of readability and accessibility. Often, in fact, the use of an iconographic language, characteristic of the VSM tool, can sometimes be an obstacle to the comprehension of the key information reported in such maps by people who are new to this mapping approach, especially if not properly trained.

Such dimensions are unquestionably more important in an office setting than factors such as the Conciseness, which may be more important when dealing with operational settings characterised by limited time for consultation. In this case, in fact, mapping is simply required to provide the user with an immediate view of the process, at a first glance.

There is no doubt, however, that the analysis of a single case study, linked to a particular organisational and cultural context, cannot allow for these results to be considered as definitive or universally appliable, thus representing only the starting point of a possible stream of research. For this reason, it is definitely considered useful that further research may be carried out in the future in new contexts that would allow the evaluation of the reaction of a different managerial organisation within different kind of processes, to enhance the applicability and generalizability of the results that can be pursued by the adoption of Makigami and VSM tools respectively.

VI. References

[1] Detty, R. B., & Yingling, J. C. (2000). Quantifying benefits of conversion to lean manufacturing with discrete event simulation: a case study. *International journal of production research, 38*(2), 429-445.

[2] Lins, M. G., Zotes, L. P., & Caiado, R. (2021). Critical factors for lean and innovation in services: from a systematic review to an empirical investigation. *Total Quality Management & Business Excellence, 32*(5-6), 606-631.

[3] Chen, J. C., & Cox, R. A. (2012). Value stream management for lean office—A case study. *American Journal of Industrial and Business Management, 02*(2), 17–29.

[4] Chiarini, A. (2016). *Lean Organisation for Excellence. Hoshin Kanri, Value Stream Accounting, Lean Metrics e Toyota Production System e Lean Agile Scrum: Hoshin Kanri, Value Stream Accounting, Lean Metrics e Toyota Production System e Lean Agile Scrum.* FrancoAngeli.

[5] Romero, D., Zanchi, M., Powell, D. J., & Gaiardelli, P. (2022, September). Cyber-Physical Visual Management Systems in the Digital Lean Manufacturing World. In *Advances in Production Management Systems. Smart Manufacturing and Logistics Systems: Turning Ideas into Action: IFIP WG 5.7 International Conference, APMS 2022, Gyeongju, South Korea, September 25–29, 2022, Proceedings, Part II* (pp. 575-585). Cham: Springer Nature Switzerland.

[6] Luz, G. P., Tortorella, G. L., Narayanamurthy, G., Gaiardelli, P., & Sawhney, R. (2021). A systematic literature review on the stochastic analysis of value streams. *Production Planning & Control*, 32(2), 121-131.

[7] Luz, G. P., Tortorella, G. L., Bouzon, M., Garza-Reyes, J., & Gaiardelli, P. (2022). Proposition of a method for stochastic analysis of value streams. *Production Planning & Control*, 33(8), 741-757.

[8] Dyer Jr, W. G., & Wilkins, A. L. (1991). Better stories, not better constructs, to generate better theory: A rejoinder to Eisenhardt. *Academy of management review, 16*(3), 613-619.

[9] Rother, M., & Shook, J. (2003). *Learning to see: value stream mapping to add value and eliminate muda*. Lean enterprise institute.

[10] Chiarini, A. (2012). *Lean organization: from the tools of the Toyota Production System to lean office* (Vol. 3). Springer Science & Business Media.

[11] Zanchi, M., Sala, R., & Gaiardelli, P. (2022, September). A Benchmarking Study on Existing VSM Software. In *Advances in Production Management Systems. Smart Manufacturing and Logistics Systems: Turning Ideas into Action: IFIP WG 5.7 International Conference, APMS 2022, Gyeongju, South Korea, September 25–29, 2022, Proceedings, Part II* (pp. 604-612). Cham: Springer Nature Switzerland.

[12] Chiarini, A., & Gabberi, P. (2022). Comparing the VSM and Makigami tools in a transactional office environment: exploratory research from an Italian manufacturing company. *Total Quality Management & Business Excellence, 33*(1-2), 127-145.

[13] Kuo, A. M. H., Borycki, E., Kushniruk, A., & Lee, T. S. (2011). A healthcare Lean Six Sigma System for postanesthesia care unit workflow improvement. *Quality Management in Healthcare, 20*(1), 4-14.

[14] Modrich, R. U., & Cousins, B. C. (2017). Digital Kanban boards used in design and 3D coordination. 25th Annual Conference of the International Group for Lean Construction (IGLC), 9-12 July 2017, Heraklion, Greece.

[15] Cutlip S. M. Center A. H. & Broom G. M. (1985). *Effective public relations* (6th ed.). Prentice-Hall.

XXVIII Summer School “Francesco Turco” – « Blue, Resilient & Sustainable Supply Chain »

Appendix A. MAKIGAMI

PERSONA/ENTE	1	2	3	5	6	7	8	9	10	11	12	13
Progettista	Profili da preparare	Preparazione profilo		Preparazione studio				Studi da controllare	Controllo studio			
Disegnatore						Studi Cina da completare	Completamento progetto Cina				Progetti approvati	Completamento progetto
Consociata			Realizzazione Profilo		Realizzazione Studio							
Cliente										Approvazione studio		
FTE		0,65		3,87			4,91		0,66			1,39
Lead Time	2,18		0,24		0,49	1,57		0,22		0,70	0,34	
WIP	31,6		4,8		10,4	22,7		3,2		11,4	4,9	
Process Time (min)		6,1		27,8			46,6		10,9			20,2
VA Time (min)		3,2		16,3			0,6		0,4			6,6
NVA Time (min)		2,9		11,5			46,0		10,5			13,7
N° Rilevazioni		15		20			28		6			14
Cartacei		Foglio lavoro assieme UT Ordine cliente Profilo cliente		Foglio lavoro assieme UT Ordine cliente Profilo cliente			Foglio lavoro assieme UT Ordine cliente Profilo cliente Profilo cliente maggiorato Bozza studio Foglio invio consociata		Foglio lavoro assieme UT Ordine cliente Profilo cliente Profilo cliente maggiorato Profilo definitivo Bozza studio + Particolari Foglio invio consociata Tavola studio + Particolari			Foglio lavoro assieme UT Ordine cliente Profilo cliente Profilo cliente maggiorato Profilo definitivo Bozza studio + Particolari Foglio invio consociata Tavola studio + Particolari Risposta cliente
File		Dxf profilo cliente Note Cliente		Dxf profilo cliente Pressa cliente Archivio Balster/Inserti			File Studio (zip) Profilo definitivo Archivio Balster/Inserti		Note Cliente			-
Software		Microsoft AX® Smart-File Manager		Microsoft AX® Ricerca similare HyperCAD Smart-File Manager			Microsoft AX® Active Ph Navel HyperCAD		Microsoft AX® HyperCAD			Microsoft AX® Active HyperCAD Ricerca similare
Hardware		Stampante Scanner		Stampante Scanner			Stampante Scanner		-			Stampante
Cartacei generati		Profilo cliente maggiorato		A3 pressa per bozza Foglio invio a consociata			Tavola studio + Particolari Profilo definitivo		-			Disegno di tornitura (2) Tavola progetto
File generati		PDF profilo maggiorato		PDF bozza studio PDF Foglio consociata			-		-			Progetto archiviato

Appendix B. VSM