

Exploring the attitude of Bergamo's SMEs towards Servitization

Alice Rondini, Fabiana Pirola, Paolo Gaiardelli & Marzia Morgantini

ABSTRACT

Purpose: The goal of this paper is to identify, through an empirical investigation, the relationship between product-service offering configuration, internal and contextual variables affecting the servitization of Small and Medium Enterprises' (SMEs).

Design/methodology/approach: The paper is based on a quantitative analysis approach. First, a research model linking product-service offering configuration, internal and contextual variables influencing servitization was developed. Then, a cluster analysis was performed to identify common behaviours of SMEs and to assess the relationship between the selected variables.

Findings: This research identifies a servitization level rather limited among manufacturing SMEs in the Bergamo area. Moreover, the analysis proves a significant influence of some internal determinants, which emerged to be much more influential than contextual variables.

Originality/value: This paper contributes to knowledge providing an overview of the attitude of SMEs in the adoption of the servitization process. Furthermore it analyses the reasons that lead small and medium manufacturers in embracing, or avoiding, a service strategy.

Key words: Product-service offering, servitization, SMEs, survey, cluster analysis

1. INTRODUCTION

The economic globalization, combined with an increasing products homogenisation, fleeting obsolescence and continuous reduction in sale profit margins, have been radically changing companies competitive environment. Slow-moving markets have progressively transformed themselves into dynamic contexts where new players emerged (Aurich et al. 2010). In particular, low cost countries competition has made cost reduction an unsuitable strategy for manufacturing companies located in the developed economies. This has forced many companies to think over their traditional business strategies to enhance their competitive position (Fährnich & Meiren 2007). One possible path over the definition of articulated portfolios is the integration of existing products with additional services along their entire lifecycle (Neely 2008). This transformation, known as servitization of manufacturing (Vandermerwe & Rada 1988), has been demonstrated to enhance the strategic position of companies. Indeed, extending the business around services might allow manufacturers to achieve more sustainable economics returns, reduce costs, save time, increase knowledge and information and improve the image of the company. From a customer perspective, integrated product-service solutions are even more valuable than pure physical goods. In other words, servitization offers a route for increasing customers' loyalty, establishing long-lasting relationships and increasing the repurchase intent (Furrer 2010, Baines et al. 2009). Many companies all over the world are experiencing a shift in their core business, adding value by offering services. Nevertheless, it seems that the success related to servitization is restricted to big enterprises with strong organizational structures, grounded skills and top management commitment. On the contrary, how Small and Medium Enterprises (SMEs) approach this phenomenon and the reasons why they could adopt, or avoid, a servitization strategy has not been yet explored. These gaps are the main motivations that sparked off the present research, whose main goal is to understand if, and how, SMEs are facing the shift towards a service-oriented business model. In particular, this paper aims at assessing the servitization level achieved by small and medium manufacturers, identifying the relationships between their product-service offering, the context where they operate and their internal organizational and managerial orientation. In line with the analysis of literature, presented in section 2, a research model linking variables affecting servitization and product-service offerings configuration is described in section 3. Research findings

achieved from a statistical analysis carried out on a sample of 266 questionnaires provided by SMEs are described in section 4. Finally, section 5 reports the conclusions together with the identification of limitations and possible further developments.

2. THEORETICAL BACKGROUND

This literature review is composed of two main sections which cover i) product-service offerings classification and ii) contextual and internal variables (i.e. dedicated organization, company size, managerial commitment) affecting servitization.

2.1 Product-service offerings classification

There is no one ideal servitization strategy. Rather, research confirms that companies proceed along a continuum through incremental stages, with each stage characterised by increasing number and types of product-service offerings (Lay et al. 2010). Many classifications models, adopting different combinations of descriptive drivers have been proposed in literature to illustrate how the change of product-service offering translates into differing levels of servitization (Mathieu 2001, Tukker 2004, Oliva & Kallenberg 2003, Gaiardelli et al. 2014, Frambach et al. 1997). However, since “adopters of servitization do not necessarily apply the product-service classification and instead distinguish on the basis of the value proposition with their customers” (Baines & Lightfoot 2013), the authors provide a different classification model that distinguishes product-services in three types of propositions: *base services* provided for customers “who want to do it themselves”, *intermediate product-services* include solutions for customers “who want us (the provider) to do it with them” and finally *advanced product-services* that bundle together products and services in a sophisticated offering, for customers who want the manufacturer take care of everything.

2.2 Variables affecting servitization

Despite the several theses asserting the importance of servitization, literature raises the issue of the so-called service paradox, stating that making incremental profit by adding services can appear more difficult than might be expected (Gebauer et al. 2005). Moreover, current literature claims that service infusion in the manufacturing industry is still limited, servitization processes are slow and companies are unable to exploit benefits from service strategies (Oliva & Kallenberg 2003). This issue is particularly relevant for SMEs that are characterized by weaker management foundation and lower availability of funds with respect to large companies. Because of this, they have to face greater challenges in the new market competition (Lihong 2014) and they have to be able to coordinate different part of their value chain to obtain a competitive advantage. Due to these aspects, there is evidence that large firms, with higher *organizational capabilities* and more funding opportunities, have a higher level of servitization with respect to SMEs (Neely 2008).

The *size of the company*, however, is not the only variable affecting company's success in implementing service strategies. Literature cites the *strategic commitment* as one of the most determinant variables influencing the success of the servitization process. The transition from product manufacturer into service provider constitutes a major managerial challenge and the top management is the springboard towards such a cultural change (Oliva & Kallenberg 2003). Even if for most of the companies the introduction of services is pulled by the context (i.e. *customers' requests, legislation, competition*) (Gebauer 2007), companies should not simply react to market changing conditions, but they should have a *proactive approach*, triggering a cultural shift within the whole organization towards a clear and strong service strategy (Oliva & Kallenberg 2003). In addition, another determinant of servitization is the *type of product offered*. In particular, current literature states that the more complex is the product, the easier is the approach to the servitization (Furrer 2010). Other product's characteristics that push customers toward additional services include technological innovation and customization (Windahl et al. 2004). These types of products refer to markets with a business-to-business (B2B) approach. Indeed, Baines et al. (2009) assert that the potential impact of services on sales is particularly remarkable in industrial, or B2B context, where there is a strong increase in demand for services from customers.

In conclusion, despite all the discussion about the several potential advantages coming from the service infusion, it is fundamental to consider that the firm's general economic context plays a decisive role in the success of the servitization process. Thus, considering the issues that SMEs have to face when servitizing and the impact that the general economic context can have during this evolution, this paper aims at exploring the main determinants influencing SMEs servitization journey and its success.

3. RESEARCH MODEL AND DESIGN

3.1 Research model

Although literature encourages companies to develop their servitization strategy along with different product-service offering sophistication, it offers little guidance as to what extent of internal and contextual variables would lead to improved service offerings. In order to answer this question, we propose a research model that highlights the relationship between product-service offerings and the context where they operate [as shown in Figure 1].

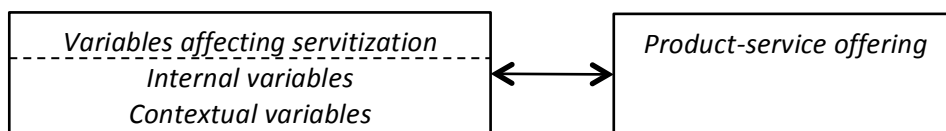


Figure 1: Research model

3.2 Research design

A quantitative deductive design was used and the hypotheses tested using a questionnaire survey. A first internal meeting held in the start of the research project, helped to design the initial sample, which was drawn from the lists of manufacturing companies operating in the Bergamo area: the initial sample consisted of 3800. A further kick-off meeting was held to define the questionnaire structure, wording and scaling (Forza, 2002). The final questionnaire was organized in three main sections concerning contextual variables, product-service offering configuration and internal variables. The questionnaire was submitted by email to about 1500 companies and the survey open from early April to late July 2014. The questionnaire can be provided by the authors upon request.

Internal variables

The main variables underlined by literature as the most relevant internal variables behind the servitization process were selected. They are: company size, strategic commitment, and organisational capabilities. In particular "top management commitment" and "strategic orientation" variables were considered related to the strategic commitment, while "dedicated service unit/personnel" was adopted to represent the organisational capabilities towards a servitization transformation.

Contextual variables

The product complexity, the type of market, the customer requirements, the competitors' strategies and the laws and regulations, identified in literature as the five main external factors influencing servitization transformation, were adopted to develop the questionnaire section devoted to explore contextual variables of servitization.

Product-service offering mapping

A map of product-service offering was defined using as main sources of information public available data from company websites and management and academic literature in the area of service for the manufacturing industry. Then services were classified on the basis of two dimensions, which are easy to be understood, are able to describe services in a unique and not misleading way and are suitable for practical applications: i) *Lifecycle*, distinguishing between pre-sales services (Pre), services for supporting the product-use (Support) and end-use services (End) (Frambach et al. 1997);

and ii) *Orientation*, distinguishing between Base, Intermediate, and Advanced services (Baines & Lightfoot 2013).

35 services were identified and classified according to the selected drivers [as shown in Table 1]. In particular, 12 over 35 can be defined as pre-sale services, 21 as support services and only 2 services as end-use services. Concerning the orientation, it emerges that the majority of product-service offerings is composed of Base and Intermediate solutions. However 11 over 35 are Advanced solutions.

<i>Service</i>	<i>Lifecycle</i>	<i>Orientation</i>	<i>Service</i>	<i>Lifecycle</i>	<i>Orientation</i>
<i>Trial period</i>	Pre	Base	<i>Help Desk</i>	Support	Intermediate
<i>Commissioning</i>	Pre	Intermediate	<i>Leasing</i>	Support	Advanced
<i>Installation</i>	Pre	Intermediate	<i>Refurbished spare parts</i>	Support	Base
<i>Insurances</i>	Pre	Advanced	<i>Green maintenance</i>	Support	Intermediate
<i>Financial support to buy services</i>	Pre	Intermediate	<i>Time based maintenance</i>	Support	Intermediate
<i>Financial support to buy products</i>	Pre	Base	<i>Condition based maintenance</i>	Support	Intermediate
<i>Support during the product development</i>	Pre	Intermediate	<i>Remote monitoring and diagnosis</i>	Support	Intermediate
<i>Customer's activities optimization</i>	Pre	Intermediate	<i>Maintenance contracts</i>	Support	Advanced
<i>Product use training</i>	Pre	Intermediate	<i>Help desk remote support</i>	Support	Intermediate
<i>Sustainable use consulting</i>	Pre	Intermediate	<i>Customer activities management</i>	Support	Advanced
<i>Sustainable use training</i>	Pre	Intermediate	<i>Short term rent</i>	Support	Advanced
<i>Sustainable product develop. consulting</i>	Pre	Intermediate	<i>Long term rent</i>	Support	Advanced
<i>Extended warranty</i>	Support	Base	<i>Pay-per-use</i>	Support	Advanced
<i>Repair</i>	Support	Intermediate	<i>Pay-per-result</i>	Support	Advanced
<i>Spare parts</i>	Support	Base	<i>Mobile App</i>	Support	Base
<i>Product upgrade</i>	Support	Advanced	<i>Take back management</i>	End	Intermediate
<i>Software upgrade</i>	Support	Advanced	<i>Retrofit</i>	End	Advanced
<i>Help desk for intervention management</i>	Support	Intermediate			

Table 1: Product-service offering map

4. RESEARCH FINDINGS

A statistical analysis was carried out to analyse the questionnaire results and to evaluate the main variables affecting the product-service offerings and the servitization process. In particular, a two-stage cluster analysis (Donicar 2003) was performed to identify homogeneous groups of companies from the point of view of the service offering:

1. First, a hierarchical cluster analysis using Ward's method and applying squared Euclidean Distance was chosen to determine the optimum number of clusters. The Ward's method was selected because the analysed dataset did not include any outlier (Ward 1963);
2. The hierarchical cluster analysis was re-run with the selected number of clusters. This second step allowed the allocation of each case to a specific cluster.

Then, the identified clusters were investigated to understand the relationships between internal and contextual variables and product-service offering. To this purpose, a one-way ANOVA test along with a Tukey's post hoc or Tamhane tests were considered to define to what extent a specific variable influences product-service offering.

The main research findings are reported as follows.

General results

A total of 303 complete questionnaires were returned, corresponding to a response rate of the 30%. Since SMEs are the focus of the research, respondents have been polished up from large companies resulting in a final sample of 266 micro, small and medium enterprises. The responding sample is almost heterogeneous. It counts 29,7% of Medium companies, 30,1% of Small and 40,2% of Micro.

A general analysis of data shows that interviewed companies mainly operate in a *Business to Business* context (82,0%) and do not belong to a group (78,6%). Moreover, their production plants are located in Italy (95,1%) and they mainly operate in the Italian market; indeed, the 16,2% of the sample states that the domestic market accounts for over 50% of their business, while the 29,7% sell exclusively in Italy. Furthermore, the analysis highlights that companies of the sample basically belong to the production of machinery sector (21,8%), metal products production (12,8%) and wood manufacturing (12,8%), which are even the most relevant manufacturing realities in the Bergamo area. From an initial evaluation it also emerges a servitization level rather limited: on average, only 6,5 services are offered over 35.

Cluster analysis

From the analysis, it was possible to identify 3 clusters that differ according to the service orientation and the service portfolio: 117 respondents were included in cluster #1, 114 in cluster #2, 35 in cluster #3. The three clusters were categorized and defined as follows:

1. Cluster #1: *Uninvolved*. It is the largest group, consisting of micro, small and medium companies that offer few services, on average 3 out of 35. These companies, operating in the Italian market, belong to the textile sector (18%), metal products (14%) and the clothing manufacturing (11%).
2. Cluster #2: *Halfway*. It is a large group of mainly micro enterprises (51,7%) that provide on average 7 services out of 35. The majority of companies in this group operate in the Italian market and belong to the field of the machinery industry (23%), wood manufacturing (19%) and metal products (8%).
3. Cluster #3: *Disposed*. It is a small group of small-medium companies that offer on average 16 services out of 35. These companies primarily belong to the production of machinery industry (74%) and the higher part of their business is out of Italy.

Based on the statistical difference of variances, a Tukey's post hoc or Tamhane tests were performed to determine where the differences between the groups were lying (Keppel, 1973). The three groups emerged as statistically different ($\alpha < 0.05$) in terms of the number of services offered and the structure of their product-service portfolio [as shown in Table 2].

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff.	Sig.
Total n° of services	Tamhane	Uninvolved	Halfway	-3,378	0,000
		Uninvolved	Disposed	-13,012	0,000
		Halfway	Disposed	-9,635	0,000
Pre-sale services	Tukey	Uninvolved	Halfway	-0,069	0,000
		Uninvolved	Disposed	-0,267	0,000
		Halfway	Disposed	-0,198	0,000
Support product-use services	Tamhane	Uninvolved	Halfway	-0,099	0,000
		Uninvolved	Disposed	-0,367	0,000
		Halfway	Disposed	-0,268	0,000
End-use services	Tamhane	Uninvolved	Halfway	-0,062	0,271
		Uninvolved	Disposed	-0,411	0,000
		Halfway	Disposed	-0,349	0,000
Base services	Tamhane	Uninvolved	Halfway	-0,556	0,000
		Uninvolved	Disposed	-1,816	0,000
		Halfway	Disposed	-1,259	0,000
Intermediate services	Tamhane	Uninvolved	Halfway	-2,094	0,000
		Uninvolved	Disposed	-6,457	0,000
		Halfway	Disposed	-4,363	0,000
Advanced services	Tamhane	Uninvolved	Halfway	-0,590	0,000
		Uninvolved	Disposed	-4,430	0,000
		Halfway	Disposed	-3,840	0,000

Table 2: Multiple comparisons

Deepening the analysis on the clusters' product-service offering, it emerged that "Halfway" and "Disposed" focus on services that support the product use and functioning, while "Uninvolved"

manufacturers mainly concentrate on pre-sales services, in particular providing information services and solutions to support the product development [as shown in Table 3].

Cluster	Lifecycle			Orientation		
	Pre	Support	End	Base	Intermediate	Advanced
Uninvolved	53,70%	35,90%	10,40%	16,72%	68,09%	15,20%
Halfway	41,10%	51,80%	7,00%	16,96%	66,23%	16,81%
Disposed	33,90%	59,00%	7,20%	14,73%	53,96%	31,31%

Table 3: Percentage of services offered by each cluster.

Regarding the product-service orientation, intermediate services are the most spread among all groups. However, in the “Disposed” group, advanced services start to diffuse, meaning that more servitized companies begin to offer solutions which focus more on product’s performances rather than on the product itself.

Concerning the main internal variables underlined by literature as the most relevant factors behind the servitization process [as shown in Table 4], it emerged that “Top management commitment” and “strategic orientation” towards services are significantly different between “Uninvolved” and “Halfway”, while there is not significant evidence with respect to “Disposed”. On the contrary, “Company size” and “Dedicated service unit/personnel” are significantly different only between “Halfway” and “Disposed”. This result suggests that a shift from a pure-product orientation towards a service-oriented perspective is sparked by a cultural change of the top management at first, but this strategic initiative is not enough to complete the shift. Organizational and structural issues are an integrated part of the servitization challenges and need to be solved in order to sustain the cultural movement. Indeed, bigger companies emerge as more servitized and better able to exploit servitization advantages, since they can rely upon higher investments capabilities. They allow dedicated and expert personnel as well as advanced performance measurement systems.

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff. (I-J)	Sig.
Top management commitment	Tamhane	Uninvolved	Halfway	-0,530	0,003
		Uninvolved	Disposed	-0,850	0,000
		Halfway	Disposed	-0,319	0,195
Strategic orientation	Tamhane	Uninvolved	Halfway	-0,208	0,001
		Uninvolved	Disposed	-0,419	0,000
		Halfway	Disposed	-0,211	0,099
Company size	Tamhane	Uninvolved	Halfway	0,196	0,188
		Uninvolved	Disposed	-0,683	0,000
		Halfway	Disposed	-0,878	0,000
Dedicated service unit/personnel	Tamhane	Uninvolved	Halfway	-0,251	0,000
		Uninvolved	Disposed	-0,550	0,000
		Halfway	Disposed	-0,300	0,003

Table 4: Internal variables multiple comparison

Eventually, referring to contextual factors of servitization, none of the identified variables, except from customer requirements and product complexity, proves to be determinant in the servitization adoption among SMEs [as shown in Table 5]. In other words it seems that the competitive environment does not play a decisive role in going beyond a product-centric orientation towards a service perspective. However, customer requirements and product complexity seem to play a decisive role in an advanced stage of the servitization process, when the company has still begun to adopt proper arrangements for implementing a service strategy.

Dependent variable		(I) Cluster	(J) Cluster	Mean Diff. (I-J)	Sig.
Product complexity	Tamhane	Uninvolved	Halfway	0,196	0,188
		Uninvolved	Disposed	-0,683	0,000
		Halfway	Disposed	-0,878	0,000
Type of Market	Tamhane	Uninvolved	Halfway	0,249	0,375
		Uninvolved	Disposed	0,233	0,462

		Halfway	Disposed	-0,016	1,000
Customer requirements	Tamhane	Uninvolved	Halfway	-0,024	0,975
		Uninvolved	Disposed	-0,266	0,001
		Halfway	Disposed	-0,242	0,004
Competitors' strategies	Tamhane	Uninvolved	Halfway	-0,066	0,626
		Uninvolved	Disposed	-0,212	0,095
		Halfway	Disposed	-0,146	0,364
Laws and regulations	Tamhane	Uninvolved	Halfway	0,001	1,000
		Uninvolved	Disposed	-0,096	0,457
		Halfway	Disposed	-0,098	0,442

Table 5: Contextual variables multiple comparison

4. CONCLUSIONS AND FURTHER DEVELOPMENTS

To succeed in modern competitive environments, companies need to rethink their overall business strategies. Theories clearly praise evident advantages coming from the servitization adoption. However very few studies examined the approach of SMEs towards this phenomenon and the most determining variables that lead this kind of companies in adopting or avoiding a service strategy.

To fill, at least partially, these gaps this paper proposed an empirical investigation to assess whether there is a relationship between the firm's product-service offering and the main internal and contextual determinants underlying the servitization phenomenon.

A survey spread to local companies operating in Bergamo allowed the identification of common patterns among them. Three clusters ("Uninvolved", "Halfway" and "Disposed"), statistically different in terms of product-service offerings, emerged. In particular, moving from the former to the latter, it may be observed a progressive enlargement of the product-service offerings and a transformation of the nature of the portfolio from a traditional product-based to a service-based strategy.

The features of the three clusters seem that the servitization journey of the local SMEs has just started. They are mainly focused on the product, which is still considered the core of the business. Only a few number of enterprises is enlarging its offering with more advanced solutions. However, SMEs are facing considerable challenges in changing their business strategy towards a more service-oriented perspective.

The research findings indicate that a relationship between the internal variables and product-service offerings exists, while contextual variables do not seem fundamental for SMEs to embrace or avoid a servitization strategy. In particular, if the cultural inclination of the top management and the strategic orientation towards services is fundamental at the early stages of servitization, organizational capabilities appear as necessary to accomplish the process. External pressures, such as legislation, market pressure or competition do not emerge as influential.

This analysis specifically refers to a limited sample of companies, thus it cannot be generalized. In addition the companies interviewed all belong to the Bergamo area that is a specific ecosystem and could differ (completely or in part) from others. Moreover, the analysis carried out are specifically related to the issues tackled in the ad-hoc questionnaire. Other investigation areas could be taken into account. Thus the guidelines obtained with this research could be tested or observed in other contexts and companies or can be expanded with future research. Future analysis also foreseen would be related to the comparison of what obtained with what can be observed in large enterprises.

REFERENCES

- Aurich, J. C., Mannweiler, C., & Schweitzer, E., 2010, 'How to design and offer services successfully', *CIRP Journal of Manufacturing Science and Technology* 2(3), 136-143.
- Baines, T., & Lightfoot, H., 2013, *Made to serve: how manufacturers can compete through servitization and product service systems*, John Wiley & Sons, 64-77.

- Baines, T.S., Lightfoot, H.W., Benedettini, O. & Kay, J.M., 2009, 'The servitization of manufacturing: a review of literature and reflection on future challenges', *Journal of Manufacturing Technology Management* 20(5), 547-67.
- Donicar, S., 2003, 'Using cluster analysis for market segmentation-typical misconceptions, established methodological weaknesses and some recommendations for improvement', *Australasian Journal of Market Research* 11(2), 5-12.
- Fährnich, K. P., & Meiren, T., 2007, 'Service engineering: state of the art and future trends'. In *Advances in services innovations*, Springer Berlin Heidelberg, 3-16.
- Forza, C., 2002, 'Survey research in operations management: a process-based perspective', *International Journal of Operations & Production Management* 22(2), 152-194.
- Frambach, R., Wels-Lips, I., & Gündlach, A., 1997, 'Proactive product service strategies - an application in the European health market', *Industrial Marketing Management* 26(4), 341-352.
- Furrer, O., 2010, *A Customer Relationship Typology of Product Services Strategies*, Gallouj, Djellal, 679 - 721.
- Gaiardelli, P., Resta, B., Martinez, V., Pinto, R., & Albores, P., 2014, 'A classification model for Product-Service Offerings', *Journal of Cleaner Production* 66, 507-519.
- Gebauer, H., 2007, 'The logic for increasing service revenue in product manufacturing companies', *International Journal of Services and Operations Management* 3(4), 394-410.
- Gebauer, H., Fleisch, E., & Friedli, T., 2005, 'Overcoming the Service Paradox in Manufacturing Companies', *European Management Journal* 23(1), 14-26.
- Lay, G., Copani, G., Jäger, A., & Biege, S., 2010, 'The relevance of service in European manufacturing industries', *Journal of Service Management* 21(5), 715-726.
- Lihong, M., 2014, 'A study on the approach of the servitization of manufacturing based on the value chain', *Aston Centre for Servitization Research and Practice*, 81-87.
- Mathieu, V., 2001, 'Product services: from a service supporting the product to a service supporting the client', *Journal of Business and Industrial Marketing*, 16(1), 39-58.
- Neely, A., 2008, 'Exploring the financial consequences of the servitization of manufacturing'. *Operations Management Research*, 1(2), 103-118.
- Oliva, R., & Kallenberg, R., 2003, 'Managing the transition from products to services', *International Journal of Service Industry Management*, 14(2), 160-172.
- Tukker, A., 2004, 'Eight types of product-service system: eight ways to sustainability? Experiences from SusProNet', *Business Strategy Environmental* 13(4), 246-260.
- Vandermerwe, S., & Rada, J., 1988, 'Servitization of business: adding value by adding services', *European Management Journal* 6(4), 314-324.
- Ward, JH., 1963, 'Hierarchical grouping to optimize an objective function', *Journal of the American statistical association*, 58(301), 236-244.
- Windahl, C., Andersson, P., Berggren, C. & Nehler, C., 2004, 'Manufacturing firms and integrated solutions: characteristics and implications', *European Journal of Innovation Management* 7(3), 218-228.

AUTHOR CONTACT DETAILS

Alice Rondini (alice.rondini@unibg.it)

Fabiana Pirola (fabiana.pirola@unibg.it)

Paolo Gaiardelli (paolo.gaiardelli@unibg.it)

Marzia Morgantini (marzia.morgantini@unibg.it).

CELS - Department of Management Information and Production Engineering, University of Bergamo, viale Marconi 5, 24044 Dalmine (BG) – Italy