Product Development KPIs: a case study analysis in Food and Fashion companies

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Abstract: Two of the main industries that are currently paying huge attention to Product Development (PD) are Food & Fashion (F&F). Even if the remaining supply chain processes (production, distribution, sales) are managed in different ways and dissimilar outsourcing policies are adopted, PD is the most valuable process that both the industries are emphasizing. In the Italian context, F&F also represent two of the three excellences of the Made in Italy (Furniture is the third element), also known as "3F". Therefore, this research constitutes a progress of a previous work, which has examined critical success factors, PD features and PLM functionalities in the two sectors. The aim of this study is to analyse how to control, to monitor and to enhance PD through Key Performance Indicators (KPIs) in F&F companies. From the methodological point of view, case study is adopted as a research strategy, designing two questionnaires with a common structure in order to obtain the required information. Indeed, different companies, belonging to the sectors of interest, have been selected and interviewed. As a result, KPIs are identified and classified. Moreover, a comparison between the previously listed metrics is performed and the drivers affecting similarities and differences are highlighted. This research helps to fill the literature gap, given the few contributions related to product development in the F&F supply chains. It also represents a valuable insight for practitioners who are trying to improve business processes and to increase the control over product development.

Keywords: Key Performance Indicators, KPIs, Product Development, Fashion industry, Food industry.

1. Introduction

Product Development (PD) represents the core process for many industries because it allows the transformation of a market opportunity into a product available for sale (Krishnan and Ulrich, 2001). Food&Fashion (F&F) companies are trying to streamline this process in order to reduce time-to-market, to propose more innovative products and to be competitive in the international market. These two sectors are particularly important for the Italian context due to the innate history culture, creativity, design and lifestyle (Aiello *et al.*, 2015). This paper lays its foundations on a previous study, investigating similarities and differences between these sectors, focusing on their PD process and on their main critical success factors (CSFs). Moreover, the authors analysed how F&F companies manage the entire set of information throughout PD and the strategic role of Product Lifecycle Management (PLM) solutions. Starting from the results obtained in the previous work, this study aims to identify which are the main Key Performance Indicators (KPIs) characterizing the PD process both for the food and fashion industries. In fact, as said before, PD is considered the core process that lead F&F company to achieve success in the market (Baldwin and Sabourin, 2000; Tyler and Gnyawali, 2002; Tyler, Heeley and

Bhamra, 2006; Chryssochoidis, 2008; d'Avolio, Bandinelli and Rinaldi, 2015). This is the reason why it is very important to measure how the process evolves over the time, going to understand the performances characterizing each PD process phase. In order to achieve this objective, a first literature review has been carried out in section 2, defining the level of knowledge of the KPIs evaluating food and fashion PD process. With the aim to compare the information found in literature with results from practice, the authors decide to develop different case studies by the help of a questionnaire. The methodology of the paper is described in section 3, while the findings coming from the empirical research is described in section 4. Finally, session 5 concludes the paper, presenting some thoughts and future researches.

2. Literature Review

The literature review has been conducted with the aim to acknowledge general-purpose product development performance indicators, metrics and their classifications. The starting purpose was also to get an idea of industry specific KPIs, so that they would be listed and proposed to the interviewees.

The following keywords have been searched over Scopus:

- Concerning the *food case*: "product development" AND ("food OR "food industry" OR "food sector") AND "performance";

- Concerning the *fashion case*: "product development" AND ("fashion OR "fashion industry" OR "fashion sector") AND "performance".

Concerning the literature analysis, several articles have been extracted but, after a careful reading and screening, only few articles were considered aligned with the search topic. The results of this work clearly demonstrate a gap in the scientific literature. In fact, literature is really lacking in terms of industry-industry product development KPIs: a list of performance indicators adopted to measure the main tasks within the PD process has not been identified, concerning both the F&F industries.

Nevertheless, several studies analyse the significant factors in fashion firms performance (Mattila, King and Ojala, 2002; Moore and Fairhurst, 2003; de Brito, Carbone and Blanquart, 2008; Chan, Ngai and Moon, 2017), but these are focused on Manufacturing, Marketing, Retail needs and sustainability issues.

Concerning the food industry, (Van Der Vorst, 2006) presents a framework of Logistics performance indicators on three hierarchical levels (supply chain network, organization and process); while Zokaei and Simons (2006) (Zokaei and Simons, 2006) examined a list of KPIs from a consumer perspective. Furthermore, Aramyan et al. proposed a novel conceptual model for supply chain performance measurement in an agri-food supply chain, consisting in four main categories of performance measures (i.e. efficiency, flexibility, responsiveness and food quality) (Aramyan *et al.*, 2007).

Thus, the existing literature is more concentrated on supply chain processes. In conclusion, the results of the literature review highlight the lack of knowledge about PD performance for both the F&F industries.

2.1 Cross-industry analyses

The literature review has then involved product development KPIs not strictly related to a specific industry, but adopted by any sector.

Dombrowski et al. (2013) (Dombrowski, Schmidtchen and Ebentreich, 2013) provide a great contribution to product development KPIs. Concerning the PD process, in comparison with production, the authors highlight that: (i) the focus is on information flow, instead of material flow; (ii) tasks are cognitive, instead that physical and standardised, and based on creative ways of finding solutions; (iii) tasks are often unique (e.g. product planning), instead that repetitive; (iv) process times of weeks or months are common, while production process times can be measures in seconds or minutes.

Some researchers have supported the present study providing classifications for performance measures and KPIs (Sherman *et al.*, 2005; Aramyan *et al.*, 2007; Yeh, Pai

and Yang, 2009; Dombrowski, Schmidtchen and Ebentreich, 2013; Noshad and Awasthi, 2014; Piotrowicz and Cuthbertson, 2015).

In Table 1 the main categories and the related KPIs are listed together with the authors.

According to Dombrowski et al. (2013), effectiveness (design the right products), efficiency (designing in the right way) and capabilities are three crucial target groups for product development and a set of performances could be associated to each group (Dombrowski, Schmidtchen and Ebentreich, 2013). Piotrowicz and Cuthbertson (2015) introduce quality, responsiveness and employees in addition to efficiency (Piotrowicz and Cuthbertson, 2015), while Aramyan et al. (2007) present two main categories, i.e. flexibility and product quality (Aramyan *et al.*, 2007). Several product development KPIs have been identified by Sherman et al. (2005) and Yeh et al. (2010). From Noshad and Awasthi (2015), some KPIs within the product quality classification have been included (Sherman *et al.*, 2005; Yeh, Pai and Yang, 2009; Noshad and Awasthi, 2014).

Since these classifications concern a wide range of purposes for performance measurement, the groups that more fit the analysis are: efficiency, cost control, capabilities, employees, product quality, time reduction, product development, innovation, effectiveness, sale/revenue.

Table 1: KPIs classification

Categories	KPIs	Authors
Efficiency, Product Quality	New product quality level	Yeh et al., (2009) Dombrowski et al. (2013)
Efficiency	High value added tasks	Dombrowski et al. (2013).
Efficiency, Cost Control	Total costs	Piotrowicz & Cuthbertson (2015)
Efficiency	New product cost	Piotrowicz & Cuthbertson (2015) Yeh et al., (2009)
Capabilities, Employees	Employees skills	Piotrowicz & Cuthbertson (2015) Dombrowski et al. (2013)
Employees	Employees satisfaction	Piotrowicz & Cuthbertson (2015)
Employees	% of labour cost spent on training	Piotrowicz & Cuthbertson (2015)
Capabilities	Skilled organization	Dombrowski et al. (2013)
Capabilities	Skilled suppliers	Dombrowski et al. (2013).
Product quality	Sensory properties & shelf life	Aramyan et al. (2007)
Product quality	Product safety	Aramyan et al. (2007)

	and health		
			revenue from new products
Product quality	Product reliability & convenience	Aramyan et al. (2007)	
Product quality	Production systems characteristics	Aramyan et al. (2007)	
Product quality	Compliance with quality	Noshad & Awasthi (2014)	
Product quality	Low defect rate	Noshad & Awasthi (2014)	
Product quality	% of products non-rejected upon inspection	Noshad & Awasthi (2014)	
Product quality	Rejection in incoming quality	Noshad & Awasthi (2014)	
Product quality	Costs of quality	Noshad & Awasthi (2014)	
Product quality	Customer acceptance	Yeh et al. (2009)	
Time reduction	Time to market	Yeh et al. (2009)	
Product Development, Time reduction, Efficiency	Product development cycle time	Sherman et al., (2005) Yeh et al., (2009) Dombrowski et al. (2013)	
Product Development	Product prototype development proficiency	Sherman et al. (2005)	
Product Development	Product launch proficiency	Sherman et al. (2005)	
Product Development	Technological core competency fit	Sherman et al. (2005)	
Product Development	Design changes	Sherman et al. (2005)	
Innovation	New product success rate	Yeh et al. (2009)	
Effectiveness	Degree of novelty of the product	Dombrowski et al. (2013)	
Effectiveness	New product launching frequency	Yeh et al. (2009)	
Effectiveness	Degree of congruency of the project with the business strategy	Dombrowski et al. (2013)	
Effectiveness	Economic efficiency during the product lifecycle (ROI)	Dombrowski et al. (2013)	
Sale/revenue	Sale/revenue objectives	Yeh et al. (2009)	
Sale/revenue	Growth rate of	Yeh et al. (2009)	

3. Methodology

The aim of this study is to analyse how to control, to monitor and to enhance PD through KPIs in F&F companies. PD process is characterized by many specific phases. In the case of food and fashion industries, it is possible to notice several similarities and differences concerning this process. The results of the literature review show the low level of knowledge about the topic. In order to fill this gap, the authors have decided to develop different case studies both for the food and for the fashion industries.

The case study analysis involves two sources of information:

- a questionnaire, which has been used as a guideline for many semi-structured interviews with the company's managers (IT and R&D managers);
- semi-structured and open interviews (the latest coming from consulting activities).

The questionnaire represents a continuation of the previous work. In fact, the analysis started from the identification of the main CSFs, in order to understand which are the strategical company goals. After that, PD process phases and PLM functionalities related to the PD process have been identified. In this study, the analysis is finalized thanks to the identification of the main KPIs evaluating the PD process both for food and fashion industries. The complete list of KPIs is the result of literature review and interviews.

The analysis has been, first of all, held separately. In fact, two questionnaires with common topics and sections have been developed and then submitted to the selected companies to be investigated.

The questionnaire is composed of two sections: the first describes the general features of the company and the second concerns process performance indicators. Each case has detailed whether or not is adopting a specific KPI within the complete list.

In order to achieve homogeneity in the two samples, companies selected respected the following requirements: constituting a brand managing finished products, being owned brands, having at least a BU in Italy and an international profile and being medium-large firms established in their business for several years.

The selected companies have been contacted and asked for their willingness to be investigated through case study; the companies analysed have been finally selected among those which indicated their availability for a field investigation.

The seven food companies (Table 2) interviewed manage Milk and Yogurt, Pasta and sauces, Confectionery and chocolate, Tomato sauces, Cheese, Coffee, Confectionery and Biscuits products. The cases have been classified on

the base of their market segment, as following: Fresh products (cases 1 and 5), Pasta and canned food (cases 2, 4 and 6) and Confectionery products (cases 3 and 7). This market segmentation is based on the typology of product analysed. All the cases decided to outsource the activities of Distribution and Sales, because they are not considered core processes for the sample analysed.

The six fashion companies (Table 3) interviewed manage leather goods (LG), made-to-measure (MTM), outerwear and ready to wear (RTW) products. According to Saviolo and Testa (2005) (Saviolo and Testa, 2005) the cases range from the luxury market segment to the lower-end brands (cases 2, 3 and 4): this market segmentation is based on price levels. Case 1, 5 and 6 conduct all the supply chain processes internally while, in the other cases, production is outsourced to suppliers located in Italy and in Europe.

Product development represents the core process for all the companies interviewed, belonging to food and fashion industries.

Table 2: Food companies features

Cases	Main Products	Market segment (product categories)	Outsourced activities
Case 1	Milk and yogurt	Fresh products	Distribution, Sales
Case 2	Pasta and sauces	Pasta and canned food	Distribution, Sales
Case 3	Confectionery and chocolate products	Confectionery products	Distribution, Sales
Case 4	Tomato sauces	Pasta and canned food	Distribution, Sales
Case 5	Milk and yogurt	Fresh products	Distribution, Sales
Case 6	Pasta and sauces	Pasta and canned food	Distribution, Sales
Case 7	Cheese, Coffee, Confectionery and Biscuits	Confectionery products	Distribution, Sales

Table 3: Fashion companies features

Cases	Main Products	Market segment	Outsourced activities
Case 1	LG	Luxury	None
Case 2	RTW	Diffusion	Purchase, Production
Case 3	RTW	Diffusion	Purchase, Production
Case 4	Outerwear	Diffusion	Production
Case 5	LG	Prêt-à-porter	None
Case 6	MTM	Luxury	None

The questionnaire has been earlier validated and tested. Once this first phase has been concluded, questionnaires have been sent to the company's IT and R&D managers

and discussed through an interview. The collected results have been elaborated and submitted to the company's managers for approval. In conclusion, the results obtained from the case studies have been validated by the company's top management.

Once the responses of the two different questionnaires have been analysed, a comparison between F&F results has been performed and similarities and differences have been found.

4. Results

Starting from the analysis of the literature, a series of ad hoc KPIs - both for food and fashion industries - have been identified by the development of case studies. Furthermore, a common categorization for KPIs has been defined.

Specifically, it was decided to use the following categories to classify the F&F product development KPIs:

1. Cost: includes KPIs measuring product-related costs;

2. Innovation: includes KPIs measuring the degree of product innovation within the entire set of items developed;

3. Quality: includes KPIs measuring product quality standards and requirements;

4. Time: includes KPIs measuring time schedule in product development tasks;

5. Output: includes KPIs measuring results, in terms of output produced during product development;

6. Resource: includes KPIs measuring input, in terms of resources invested and involved in product development.

These groups and the following KPIs have been inspired by the ones identified during the literature review, but have been customized basing on the examination of interviews.

Moreover, the analysis has focused on the similarities (Table 4) and the differences (Table 5) between the F&F product development KPIs. The tables show the KPI category, the related KPI and its description, detailing how it is measured.

Concerning the similarities (Table 4), the analysis showed that both sectors focus more on one particular KPIs category: *Cost*. In fact, although the KPIs in common belong to different categories (as it is possible to infer from table 4), the interviews showed that the cost KPIs are those to which is associated a greater importance. In particular, the common cost KPIs are: (i) *New product cost*, (ii) *Production annual cost* and (iii) *Prototypes annual cost*.

With regard to the differences, the analysis showed that most of the KPIs refer to measures belonging to specific activities characterizing the industry of reference. Specific KPIs for the fashion industry are for example *Number of samples per season* and *Number of fitting sessions per season* while

for the food industry *Product safety and health* and *Sensory properties & shelf life*.

However, other differences refer to the importance that each sector assigns to specific categories. In this respect, in addition to *Cost*, food most important categories KPIs are *Quality* and *Innovation* while for fashion are *Output*, *Resources* and *Innovation.*

Table 4: PD Food and Fashion KPIs – similarities

Classification	KPIs	Description
Cost	Prototype cost/Production cost	Ratio between the average prototype cost and the average production cost
Cost	New products cost	Average annual cost of new models or products
Cost	Production annual cost	Average annual cost to produce products
Cost	Prototypes annual cost	Average annual cost to produce prototypes
Innovation	Number of carry over	Average number of carry over developed during a season or year
Innovation	Number of products	Average number of products developed during a season or per year
Innovation	Number of prototypes	Average number of prototypes developed during a season or per year
Time	Product development cycle time	Average time to develop a collection or product (from concept to production)
Time	Time to Market	Average time to keep a collection or product available for sale
Time	Compliance with the product engineering schedule	Ratio between the actual and the planned time to engineer products during a season or year
Output	Compliance with Marketing Brief	Ratio between the average number of planned models/products and the average number of actual models or products
Quality	Defect rate	Ratio between the number of defects in production and the number of total products calculated per season/year

Table 5: PD Food and Fashion KPIs – differences

Classification	KPIs	Description	Fashion	Food
Cost	Effectiveness of planned cost	Ratio between actual cost and planned product cost		X
Cost	Sample cost/Production cost	Ratio between the average sample cost and the average production cost	X	
Cost	Total annual cost of changes in new products	Cost of changes in new products		X
Cost	Samples annual cost	Average annual cost to produce samples	X	
Cost	Technological constraints in production	The capability to produce with a normal production cycle or the need to purchase new technology and/or machines due to the introduction of a new product		X
Innovation	Number of new models per season	Average number of new models developed during a season	X	
Innovation	Growth rate of revenue from new models	Economic growth of revenues from new models developed	X	
Innovation	Revenues innovation growth	Revenues rate related to the new product introduction		X
Innovation	New product success rate	Annual success rate related to the introduction of new product on the market		X
Output	Number of samples per season	Average number of samples developed during a season	X	
Quality	Product safety and health	Level of safety and healthy in the new product		X
Quality	Regulatory requirements compliance	Rate of products that comply with current regulations in the food sector		X
Quality	Internal customer satisfaction	Success rate by internal clients (company employees) on selected products		X
Quality	Rejection in incoming quality (per season)	Average number of rejected materials per season	X	
Quality	Number of defective prototypes per year	Average number of defective prototypes developed per year		X
Quality	Sensory properties & shelf life	Level of sensory properties & shelf life of the new product proposed		X

Quality	New product quality level	Average annual quality of new product		X
Quality	Skilled suppliers	Ranking among the most skilled suppliers	X	
Quality	External customer satisfaction	Success rate by external clients on selected products		X
Resource	Human resources (FTE) - Product Development	Average number of HR employed in the PD Department	X	
Resource	Number of colours per season	Average number of colours developed during a season (e.g. Spring/Summer)	X	
Resource	Human resources (FTE) - Design	Average number of HR employed in the Design Department	X	
Resource	Number of fabrics per season	Average number of fabrics managed during a season (e.g. Spring/Summer)	X	
Time	Change and product evolution in design	Time spent to perform changes in new products		X
Time	Number of fitting sessions per season	Average number of fitting session during a season	X	

These comparisons between the two sectors have allowed to recognise common and industry specific KPIs and the drivers related to these (see Figure 1). Cost KPIs are measured in any company interviewed: evaluations about product costs, revenues, margins are the most consolidated throughout the years. Moreover, they are quantitative KPIs, associated to clear and easy to measure metrics.

As mentioned before, the most adopted KPIs in the Food industry concern the quality and innovation categories. Product quality is crucial for the sector since the earliest stage of design and several regulatory requirements have to be fulfilled to this aim. Innovation is another key issue: new products are introduced by these companies to satisfy the consumers' most hidden desires. A new product to be developed means a big project with lots of assessments and tests, hence measuring the degree with whom the company is able to introduce innovation within its products has not to be overlooked.

Coming to the Fashion industry, whichever is the market segment, measuring Time KPIs is a categorical imperative to avoid losing control on product development tasks. The timing is really tight in these companies, hence one of the objective is to streamline PD process and reduce bottlenecks and not value-added tasks. Resources and

output have to be controlled because, in order to respect the collection schedule, other kind of wastes may occur (too many useless fabrics, prototypes…). Innovation KPIs are still not so stressed because craftsmanship is a big value and many customers are enchanted by the traditions behind the brand.

Figure 1 - Common and industry-specific KPIs

5. Conclusions

The paper has analysed product development KPIs in the food and fashion industries. The PD process is considered core for both the sectors: monitoring and controlling its performances is becoming more and more crucial.

As a first step, a literature review has been conducted and several general-purpose indicators have been acknowledged. The lack of researches concerning industry-specific KPIs has triggered a case study analysis, more focused on F&F needs.

A questionnaire has been designed to support several interviews and to gather as much information as possible on the KPIs adopted by food and fashion companies and on the way they are measuring them.

Product development KPIs have been listed and classified. Moreover, the authors have highlighted the common indicators for both the industries, the ones that are more related to the single sector and the drivers influencing differences.

This research helps to fill the literature gap, given the few contributions related to product development KPIs in the F&F supply chains. It also represents a valuable insight for practitioners who are trying to improve business processes as well as to increase the control over product development.

A further development may be to enlarge the samples of F&F companies, involving more cases. Furthermore, other industries, focusing on product development, could be analysed and additional case study analyses might be performed. Another research step will be to understand

how the use of PLM solutions affects the performances identified.

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