Fuzzy Front End Integration: Describing Roles and Defining Boundaries on Multi Companies

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Abstract--**The Fuzzy Front End (FFE) is the early phase of the Product Development Process, responsible for the idea generation and an important driver of Innovation success, but with difficulties such as its dynamism and ambiguity. The models developed in the literature have not discussed the roles and activities. To tackle this issue, this research aims to examine the division of labor and its logic in a complex industry. The main question that guided this research is "how is the integration among companies in the FFE in a complex industry?" This is a qualitative and exploratory research, based on multiple-cases-studies, analyzing the projects of chain constituent parties of the packaging industry, which has a complex and problematic relation among its parties, Brand Owner, Design Agencies and Packaging Producers. Each project was classified by type of innovation, strategy, the way of relationship among companies; and checked the division of labor for activities of opportunity identification, target and technology evaluation, ideas generation and screening; explaining the logic of involvement of each company in each project. There are different roles among the agents because some contingencies such as degree of strategic importance, degree of novelty, reputation, and reliability mediated their relationships.**

I. INTRODUCTION

The Front End of Innovation – FEI, also called the Fuzzy Front-End – FFE, is the predevelopment phase [6] which refer to the early stages of the new product development – NPD [33, 19]. [33] were pioneers in using the term "fuzzy front end" for the early stages of new product development (NPD). [6, 7] has indicated that the predevelopment phase is responsible for idea generation. Later, [28] expanded the Cooper's ideation stage, adding three stages to manage technical uncertainty, but technology uncertainty is one of the difficulties of the front-end activities. [25] investigated that the critical information exchanges occurring in the integration of marketing and R&D activities, affecting the success in the front-end of Innovation. [20] indicate that the success of innovations can be found in the front-end process, which is the point just preceding the continue/no-go decision.

[2] pointed that in the fuzzy front end, the managers have been neglected concepts based customer or market knowledge. [38] developed a structural equation model based on the information-processing approach and suggested that the front end is an important driver of NPD project success of the Japanese new products. These findings could be evaluated in other countries or industries and, then, to valid the NPD in general. [3] found some paradoxes about ideation capabilities: firms with an explicit focus on ideation practices experience some negative consequences of the resulting formalization, and then both freedom and limitations on search for creative solutions can facilitate ideation process. [17] suggested that managers of project portfolios need to pay attention to the front end, focusing on the strategic setting of ideation, the formalization and institutionalization of the ideation process, integration mechanisms, stakeholder management and ideation culture. [11] identified that solutions provided by problem solvers from analogous markets demonstrated substantially higher levels of novelty, suggesting systematically search across firma-external sources of innovation that were formerly out of scope for most managers of new product ideation.

Several authors divide the Fuzzy Front End phase in other sub-phases in order to organize its tasks, assess and understand the function of each one. Thus, [6] classifies the FFE phase into idea generation and screening, market and technical assessment, concept definition, concept development, concept test and concept evaluation. [33] subdivide the initial planning activities into three stages: the general nature, the detailed business plan, and a detailed product specification, budget and schedule. [20] present a system view of the front end consistent with growing empirical evidence of the need to simultaneously examine overall product strategy (foundation elements) with project-relevant input such as product ideas, market analysis and technology options. [19] developed a circular model to indicate that ideas flow, circulate and iterate across and among five elements (idea genesis, idea selection, concept and technology development, opportunity identification, opportunity analysis).

Despite the growing research about the FEI in recent years, there is a need for further research on the theme to better understand the dynamics in the critical concept phase. This is a long and poorly understood phase [31]. The formal processes designed for the front end are insufficient, the rules and roles are not described, and it is necessary to balance the interactions between the activities in the FEI to get a better-structured New Product Development – NPD – later. The main FEI models developed at the literature have not discussed the key elements or uncertainty in the front-end phase such as resources and activities, rules and roles, and the integration such as knowledge management and information screening activities among the functional areas and among the companies (client, creation, suppliers).

To tackle this issue, this research aims to examine the FEI in a complex industry, and the roles and activities for the front end phase, the division of labor and the logic that explains this division. Therefore, the research can develop a

taxonomy of front end process, linking the division of labor with the contingencies that justify each process and project.

- The main question that guided this research is "How is the integration among companies in the FEI in a complex industry?"

The secondary questions are:

- What are the activities and techniques of integration that the companies realize on the front end for the search, generation, screening and analysis of ideas?
- How is the division of labor?
- How is the knowledge sharing?
- What are the output of the FEI?
- Does companies manage the FE as part of a normative model of the process?

In addition, the specific objectives are:

- To describe the supply chain and division of labor, the roles of each company on the New Product Development;
- To describe the activities and techniques of integration that the companies realize on the front end for opportunity identification, target and technology evaluation, ideas generation and screening
- To define the boundaries between FEI and the New Product Development;

The packaging sector was selected because of the value chain in the concept creation phase: there is a complex relation among its parties and, as in other industries involving many players, the interaction among different companies is problematic. These parties are the Consumers Good Industry, which here we call "Brand Owner", the Design Agencies and the Packaging Producers.

This proposal is divided into the following sections: this section about the relevance of this work and the objective. So, a review on the main models of the Front End of Innovation or Fuzzy Front End; the Method; then, the discussion and a proposal of a framework of analysis. At last, Conclusions, References and Appendix.

II. THE FRONT-END OF INNOVATION

Fuzzy Front End is the part of the products development cycle before actual development begins. FFE is the phase in which it is decided whether or not funds should be invested in order to develop the idea [25]. It is a long, poorly understood phase, but usually full of opportunities for improvement that can be analyzed quantitatively and transformed into benefits to the companies [31].

The Fuzzy ideas contain elements that can succeed or fail and therefore this phase needs to be managed carefully so that the internal competition in the FFE can be productive [22]. The FFE has many opportunities for lower costs and great enhancements towards the market [32]. [22] define the FFE phase as the period between the moment when an opportunity is first examined and the moment when an idea is deemed as ready (Fig. 1).

The pre-development phase is difficult to define because there are many difficulties in this phase [20], such as its dynamism and the low levels of formalization [28], or the problematic interaction between different departments [15]. Several attempts have been made in the literature, as detailed in the table 1. The terms used by a number of authors are equivalent, with the prevalence of the term of Fuzzy Front End.

Models for front-end innovation

Several authors divide the Fuzzy Front End phase in other sub-phases in order to organize its tasks, assess and understand the function of each one. [15] classifies the FFE phase in two stages: the concepts generation and the project assessment. Also [5, 9. 30, 2] classify the FFE into two phases, initial and late activities. The initial activities are broad and include the structuring of the problem [30], identification and exploration of opportunities [2]. In these activities, technology has higher weight [5]. The later

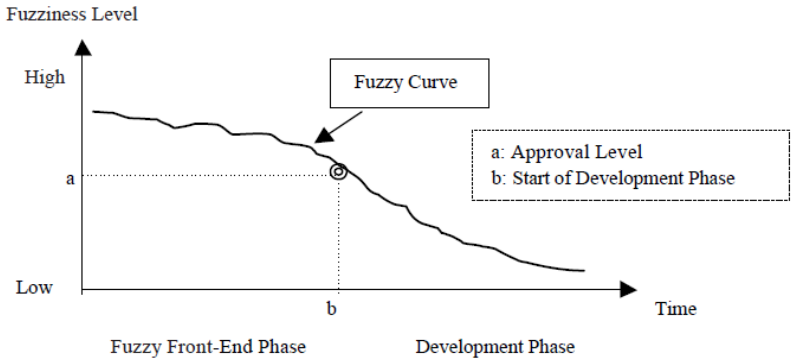

Fig 1: Pattern of the fuzziness level through the NPD (New Product Development)
Source: Adapted from Kim and Wilemon (2002)

TABLE 1: FEI DEFINITIONS

Research	Terminology	Concept of Front-End of Innovations
Cooper (1988)	Predevelopment stages	Steps that precede development of product (ideation, preliminary assessment, concept) often ignored, nut where success and failure are largely decided.
Moenaert, De Meyer, Souder & Deschoolmeester (1995)	Fuzzy Front End	The planning stage of an innovation project that has a great effect on the commercial performance of the project. Successful project teams are characterized by a maximum uncertainty reduction during planning, by a maximum increase of R&D and marketing integration and communication. Information flows between these function help the, to achieve this efficient uncertainty reduction.
Murphy & Kumar (1996, 1997)	Predevelopment stages	From the generation of an idea to its development. Particular activities play pivotal roles in achieving the objectives of each stage (Cooper's model).
Khurana & Rosenthal (1997, 1998)	Fuzzy Front End of NPD or Front end	The early phases of NPD, cross-functional, strategic, conceptual and planning activities which typically needed the detailed design and development of a NP. The FE related success factors are identified into foundation and project-specific elements. The project-specific activities focus on the individual project and require the project team's effort to ensure a useful product definition and project plan. The foundation elements cut across projects and form the basis for project-specific activities.
Reinertsen (1998, 1999)	Front end planning – Fuzzy Front End	The fuzziest zone between when the opportunity is known and when we mount a serious effort on the development project. Fuzzy front-end can be described in terms of its economics: the expense, time to screen an opportunity, and the effectiveness of the screening process.
Koen, Ajamian, Boyce et. al. (2002)	Front End of Innovation (FEI) The NCD model	The activities that take place prior to the formal and well-structured New Product and Process Development or "Stage Gate™" process, in comparison with NPPD, the activities in the FEI are often chaotic, unpredictable and unstructured They use the term FEI, as opposed to FFE that implies that this portion of the innovation process is mysterious, resulting in a lack of accountability and difficulty in determining who is responsible to manage the activities in this area. They define the outputs in each phase (elements of Engine) and Technology Development Process.
Kim & Wilemon (2002)	Fuzzy Front-end	Period between when an opportunity is first considered and when an idea is judged ready for development. The outcomes of the FFE are classified into product definition, time, people, and people dimensions.
Herstatt & Verworn (2002, 2003,2004, 2008)	Fuzzy Front-end	The early phases that have the highest impact on the whole process and the result (I put-output process), since it will influence the design and total costs of the innovations extremely. The FFE is the least-well structured part of the innovation process, and has market and technology uncertainty

Source: The authors (2016)

activities consist of the information gathering and concept development, preparing the transfer for the product development process [2]; the later activities also involve aspects of idea generation [30], and in these activities, market is seen as having higher weight [5]. [28] suggest splitting the FFE in three phases, namely: generation of ideas, definition of the products, project assessment.

Thus, [6] classifies the FFE phase into idea generation and screening, market and technical assessment, concept definition, concept development, concept test and concept evaluation. Fig. 2 illustrates a detailed process model for undertaking these predevelopment activities.

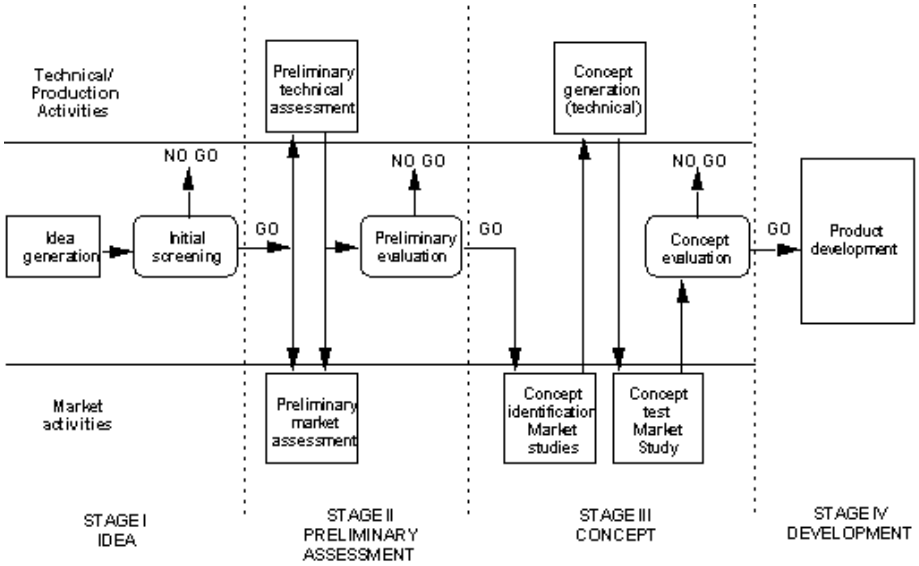

Fig. 2: The Up-Front or Predevelopment Steps n the new Product Process
Source: Cooper (1988)

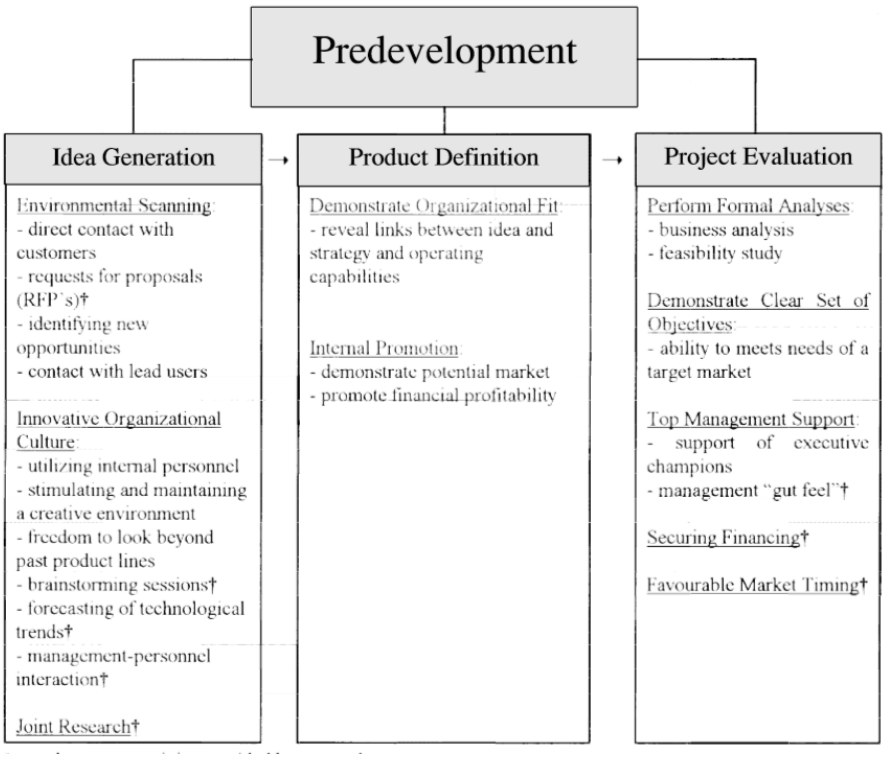

Fig. 3: Predevelopment stages
Source: Murphy & Kumar (1996)

[28] test the Cooper's model in 11 companies to describe the activities in each phase and verified that This model serves as a check-list for the activities and factor found to the important In predevelopment stages. Also, they checked that actual 'go/no go' development decision may be influenced by non-analytics factors including management 'gut feel'. However, the authors did not any definition about responsibilities and integration in each phase (Fig. 3).

[33] subdivide the initial planning activities into three stages: in the first stage, the company determines the general nature. Then, the company will prepare a detailed business plan, creating an investment opportunity for the project and once the decision to invest has been made, the company enters the third stage, a detailed product specification, budget and schedule. This is illustrated in Fig. 4.

[20] present a system view of the front end (Fig. 5) consistent with growing empirical evidence of the need to simultaneously examine overall product strategy (foundation elements) with project-relevant input such as product ideas, market analysis and technology options.

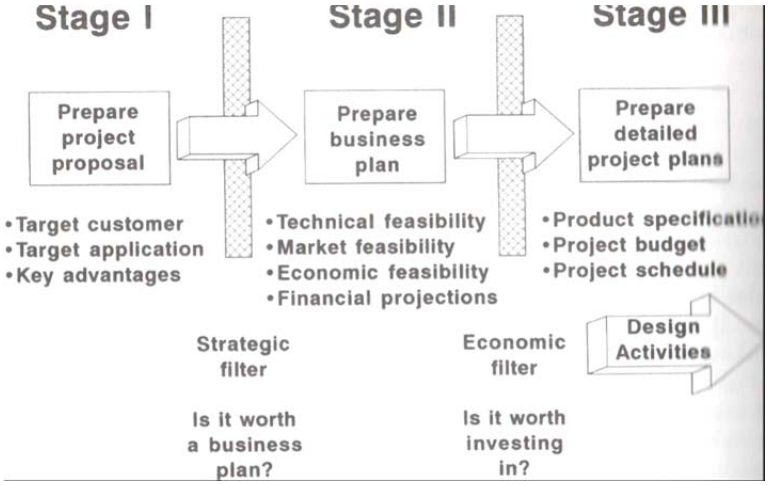

Fig. 4: Subdividing front-end planning into three stages
Source: Smith & Reinertsen (1991)

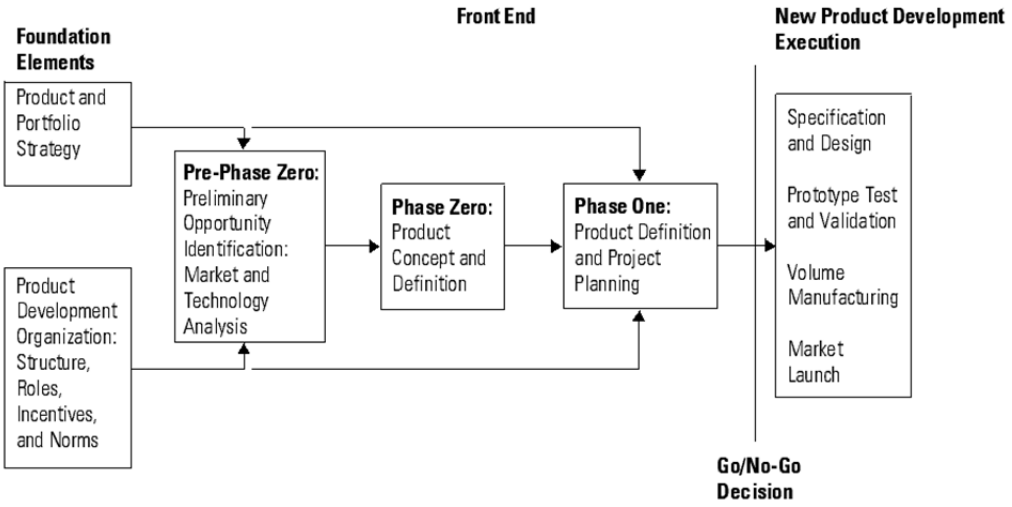

Fig. 5: A Stylized model of the Front End of NPD
Source: Khurana & Rosenthal (1997, 1998)

[19] use the term "Front End of Innovation" (FEI) as opposed to Fuzzy Front End (FFE) because that FFE implies that this stage can never be managed due to lack of accountability and difficulty in determine who is responsible to manage the activities tin this area. The authors developed a theoretical construct – defined as the New Concept Development (NCD) model, demonstrated in Fig. 6. In contrast to linear, staged-and-gated processes, the model is circular to indicate that ideas flow, circulate and iterate across and among the five elements. This NCD model consists of three key parts:

1. The inner area defines the five key elements comprising the Front End of Innovation (FEI);
2. The Engine or "bull's eye" portion which drives the front-end elements and is fueled by the leadership and culture of the organization;
3. The Influencing Factors, or environment on the periphery, consists of organizational capabilities, business strategy and the outside world (i.e., distribution channels, customers and competitors).

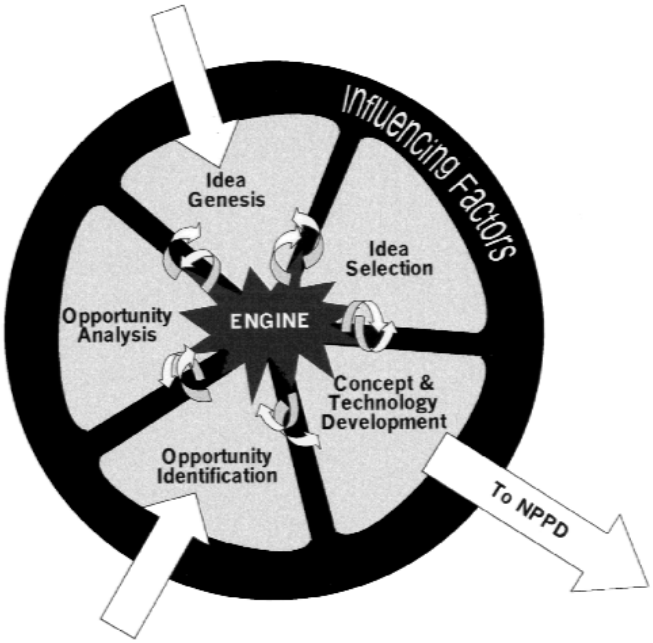

Fig. 6: The NCD model
Source: Koen, Ajamian, Boyce et. al. (2002)

TABLE 2: DIAGNOSING FE ACTIVITIES

Research	Findings	Gaps in this research
Cooper (1988)	- Deficiencies in each step	
Murphy & Murphy & Kumar (1996)Kumar (1996)	- Actual 'go/no go' development decision may be influenced by non-analytics factors including management 'gut feel'; - This model serves as a check-list for the activities and factor found to the important predevelopment stages.	- Small sample size - Disproportionate number of managers and engineers - Cooper's model is short - No definition about responsibilities and integration in each phase
Khurana & Rosenthal (1997, 1988)	- Successful companies effectively integrate their business and product strategy when identifying new opportunities in their front end - Identify problems that are symptoms of poor practices in the Front end	- Small sample size - More focused research is needed on varieties of effective formality - Better understand the relation product strategy and product innovation (two-way interface) - Identify transferable techniques to assist product development teams in distinguish at the outset from those which must be left uncertain until a later time
Reinertsen (1998)	- One alternative for structuring Front-end processes, measuring time, defining responsibilities and some activities about documentation	- No definitions about integration in each phase - It doesn't describe knowledge sharing activities and ideas / concept assessment activities - Small sample size
Koen, Ajamian, Boyce et. al. (2002)	- High correlation between Leadership and Culture and the innovation level of the company - The importance of managing the Technological component and suggested that more firms should adopt the methodologies indicated in some research – technology Management articles. - Establishes terminology to describe its key elements, describe the activities and outputs in each phase (elements of Engine)	- Explain better why the Concept and technology development's proficiency levels of highly innovative companies are similar to those of low-innovation companies. - - determine and evaluate multiple components and key characteristics of each element of the NCD model and develop reliable constructs

Source: The authors (2016)

All these sub-phases precede the detailed design phase and product development, and can contribute to the success of the product development process [7, 10, 23]. The main models are presented in the table 2.

[2] suggest exploring the FFE on concept characteristics to better understand the dynamics in the critical conceptualization phase. The concepts may be based on technology, services, visual impressions or on the company's core value, certain customer groups or business opportunity. The authors also suggest exploring the FFE on discontinuous innovations, because most research has been done on incremental innovations.

[24] presents a systematic literature review of the FEI research field, analyzing the state-of-the-art of the literature. According to the authors, there are few studies which aimed at clarifying the knowledge structure of the FEI research field and some of them focus on discovering and discussing specific topics rather than looking for the entire field.

The models demonstrated here have not discussed the key elements or uncertainty in the front-end phase. In addition, they have not discussed the roles and activities, how is the integration and information sharing, the division of labor and the logic that explains this division. On the other hand, it is possible to identify, from the main models examined, there is a general flow of the FFE activities: opportunity identification, target and technology evaluation, ideas generation and screening. From the verification of these gaps, it is important to analyze how is the integration in each of these FFE activities in a complex industry with dynamic relationships.

Among the papers on Fuzzy Front End, some focus on integration. Some authors operationalized the concept of integration: degree of R&D-MKT involvement and information sharing [25], cross-functional teams [26, 4, 16], MKT- Manufacturng integration [36], knowledge-based project- [1], collaborative foresight [39,16], integrating knowledge [13], inter-functional culture and link among operations practices [27]; open innovation [35], Integration of technology roadmapping and portfolio management [29], customer integration [37, 14].

III. METHOD

Based on the discussion concerning the Fuzzy Front-End models, it is important to recall the main question of this research: how is the integration among companies in the FEI in a complex industry?

The research question leads to the description of the supply chain, the roles and activities for the front end phase, the division of labor and the logic that explains this division. Therefore, the research can develop a taxonomy of front end process, linking the division of labor with the contingencies that justify each process and project.

For instance and following the [11] recommendations, this study is a qualitative and exploratory method with a multiple-cases-studies approach. This method can have new things to be gleaned about the FFE, such as the constituent

parties' effort in order to work in a very integrated manner and through the sharing of many information in this phase.

First of all, it was carried out a bibliographic search from sources referring to Front-End of Innovation to identify the activities and techniques of integration that the companies realize on the front end for the identification of opportunities, target and technological evaluation, ideas generation and screening.

For planning the theoretical framework, we chose the Web of Science database as the source of information, which is the one of the largest multidisciplinary databases, and according to the following steps: select the keywords "front end of innovation" OR "front end innovation" OR "fuzzy front end" OR (predevelopment AND product), select the Research areas "MANAGEMENT" OR "BUSINESS" OR "ENGINEERING INDUSTRIAL") and focus on document types "ARTICLE" OR "REVIEW", examining the period between 1988 (when Cooper first wrote about this phase) and 2015. The result is 202 papers.

Then, we used these keywords to refine the search string, selecting the the papers that discussed the theme "integration", and the research found 23 papers.

In addition, it was carried out a documentary research through trade journals of the packaging industry, websites and communication materials of the companies to identify specific terms of the packaging sector.

A. Design of the research

It was adopted the method of multiple cases, having as units of analysis the success/failure projects of companies. The sample is composed of the executives from different companies, connected to value chain of the Brazilian Packaging Industry.

The empiric research is according to the following steps:

We select a project and identify the brand owner, the design agency and suppliers. Then, we select who are the interviews and applied them a checklist to describe the FFE activities, assessing five activities/dimensions: opportunity identification, target customer, technical feasibility, ideas generation and idea screening. In each activity, we checked the division of labor, that is, who does what; and why does or why not, that is, why each company is involved or not in each activity.

The dimensions are on the literature. We highlight the main activities in each model. The opportunity identification dimension list the customers' and technological trends and needs and reproduces the champions of innovation. The target customer classifies and discuss the own customers and those of the other companies. The technical feasibility compares and measures the technical elements and infer technological specification for the future products. The ideas generation converts specifications in ideas and has outputs such as draws, prototype and redesign. The idea screening question the interfaces, realizes test, debates the project planning (budget, schedule, and resources) based on the selected ideas. The checklist with these activities is presented at Appendix.

Each project was classified by type of innovation (incremental, radical or platform) and if is strategic for the Brand Owner or not. The relationships among companies were also classified as casual, frequent or fixed in each project.

To verify the integration among companies on the front-end, it was checked the type of integration. Each project was classified as cross-functional team, client-design integration, client-supplier integration, design-supplier integration, knowledge sharing, customer integration.

To explain the integration among companies on the front-end, it was checked the division of labor in each activity, who does what, aiming to explain the logic of involvement of each company in each project. The contingencies can be degree of strategic importance, degree of novelty, reputation, reliability, technological solutions, market research, satisfy it customer, way of doing it. The contingencies are on the literature.

Therefore, the study was conducted as shown in fig. 7: selection of projects (success/failure), definition of companies, definition of interviewees, application of checklist with interviewees, analysis of analyzed process.

Fig. 7: Research Design
Source: The Authors, 2015

B. Sample

The roles are the same constituent parties described at Fig. 8 about the Packaging Value Chain, and it is based on literature review (Porter, 1993) and on our experience. Each of the companies plays several roles. On top of the Value Chain, we have the Brand Owner who demands the job from the Design Agency. In addition, basically, we have five kinds of producers: Machinery and Equipment's Manufactures, Converters and packaging printing industry, Suppliers of Raw Materials, Suppliers of lids and labels.

Converters and packaging printing industries are divided into steel, aluminum, aseptic carton, composite can, wood,

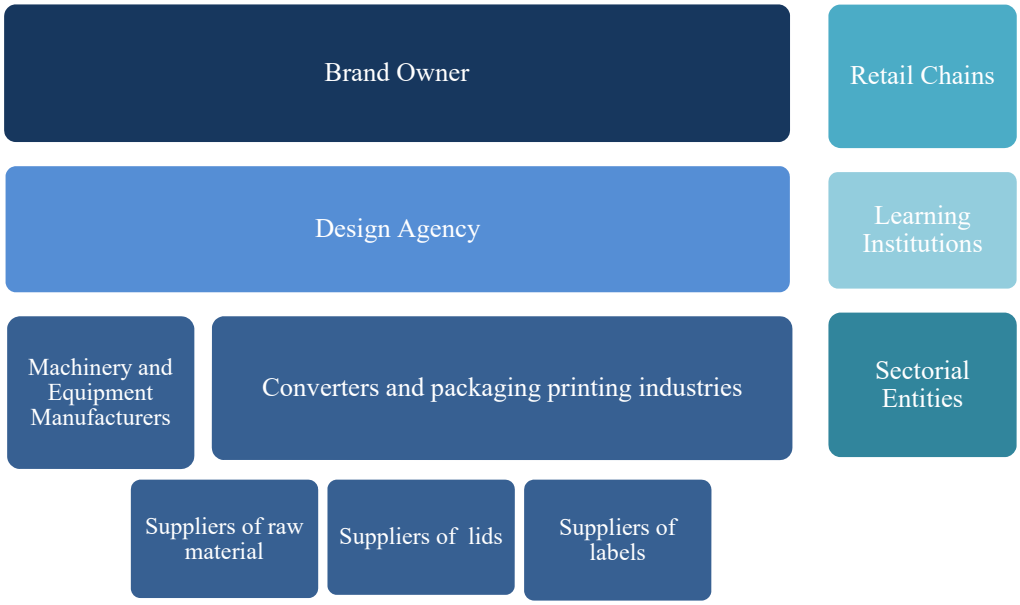

Fig. 8: Value Chain of the Brazilian Packaging Industry
Source: The Authors, 2015

paper (mono and composite bags), carton paper, undulated cardboard, flexible plastic (mono and composite), rigid plastic, glass.

We also have other organizations that supports this Industry. For example, Retail Chain, like Walmart or Kmart, Learning Institutions, which are the universities on general and sectorial entities that regulates the rules in this industry.

TABLE 3: BRAZILIAN PACKAGING LIST

Number of companies/ sector	
Brand Owner	24
Design agency	30
Manufactures of machines and equipment	17
Converter/Packaging printing industry	53
Suppliers of raw materials	40
Suppliers of lids	9
Suppliers of labels	8
Retail chains	5
Learning institutions	3
Sector entities	9
Consultancies	19
Research and data companies	6
Manufactures of containers and big bags	6
Adhesive, paint, pigment and varnish suppliers	15
Recyclers	1
Drum recovery and remanufacturing companies	2

Source: Adapted from ABRE, 2016

This value chain contains constituent parties which are more involving in packaging development projects. Other constituent parties are not represented in this value chain, but may work in some specific projects. These constituent parties are: consultancies, research and data companies, adhesive, paint, pigment and varnish suppliers, manufactures of containers and big bags, drum recovery and remanufacturing companies. The Brazilian Packaging Association (ABRE) has 247 associated companies, of which, 24 Brand Owner (Table 3). We approached some Brand Owner, and 7 of them returned. Therefore, we selected 7 projects to describe.

The interviewed are responsible for innovation management such as director and manager of R&D, engineering, new business, marketing, CEO and owners.

IV. DISCUSSION: A FRAMEWORK TO ANALYZE THE FUZZY FRONT-END

In each activity of the FEI, certain amount of companies work more or less. For example, at idea screening phase, Brand Owner (BO) and Design Agency (DA) can work together. Already at the reduction of technology uncertainty phase, Brand Owner (BO) at Machinery and Equipment Manufacturer (MEM) work together. This allocation will also depend on the project: for each project, specific companies, with specific capabilities, will be called upon to work specific tasks.

From 4 Brand Owner approached, we selected 4 projects described in table 4. As projects contains confidential information, they received a code: P means project and the letters A, B, C, D are the name of the projects. As firms received code: BO means Brand Owner, DA means Design Agency, C means Converter. Thus, BOA means the Brand Owner A, BOB means the Brand Owner, DAC means Design Agency C, and o so on. As already mentioned, each project was classified by type of innovation (incremental, radical or platform) and if is strategic for the Brand Owner. The relationships among companies were also classified as casual, frequent or fixed. To verify the integration among companies

TABLE 4: CHARACTERISTICS OF THE PROJECT RESEARCHED

Project	Sector	Innovation	Strategic	Brand Owner	Design Agency	Converter	Type of relationship	Type of integration
PA	Foods	Radical	Yes	BOA	DAA	CA/ CB	Casual	Cross-functional team
PB	Non-Alcoholic Beverages	Radical	Yes	BOB	DAB	CC / CD / CE	Frequent	cross-functional team
PC	Food	Platform	No	BOC	DAC	CF	Frequent	client-supplier integration
PD	Cosmetics, Personal Care and Health	Incremental	Yes	BOD	DAD	CG/ CH/ CI	Fixed	knowledge sharing

Source: The Authors, 2016

on the front-end, it was checked the type of integration. Each project was classified as cross-functional team, client-design integration, client-supplier integration, design-supplier integration, knowledge sharing, customer integration.

Project A (PA):

Bring to Brazil the on-the-go concept for a chocolate cream with straws wafer, but with a modern packaging that would attract the consumer's attention. The packaging has been ergonomically designed with hand grip measures and is ideal for a snack on-the-go. It has a central wall which is also sealed making the separation of the chocolate cream and wafer straws so that the consumer can combine them according to your taste. The package uses the decorating process through technology In Mould Label (IML), the first in this category to use this technology. She was also very successful, despite the many challenges facing the project, the process of injection molding that is offset from the center because of the wall separating the chocolate cream of straws wafer. The chocolate packaging provides a good size impression since its height is proportional to the height of the wafer straws. The IML label facilitates the recycling of packaging, since it has the same property of plastic resin and merges into the pot during injection. This innovation is radical and strategic for the Brand Owner. Both the design agency as the suppliers are involved in almost all activities of the FFE.

Project B (PB):

In research with young people aged 18/24 years, there was a need for a package for on-the-go consumption attractive, easy to use, modern and funky. The proposal was delivered with a glass lid that could be consumed in various situations (car, walking, etc.), without the product leaking. To ensure that there would be no leaks, we used the dimensional accuracy of the injection process to be no change in the locks of the cover / diameter of the cup. The filling line is 100% automated, with no need for manipulation (the aluminum seal and plastic lid are coupled automatically). The set cup / lid facilitates movement in consumption, allows stacking on the shelf and consumer refrigerator. The hole in the lid has a special dimension that guarantees the perception of the product and its angulation is ideal for a pleasurable drinking experience without touching the nose. The visual identity of the brand was modernized and there is the possibility of reuse of the cups for various purposes. This innovation is radical and strategic for the Brand Owner. Both the design agency as the suppliers are involved in almost all activities of the FFE. It is possible identify similarities between projects A and B in relation to the type of innovation, strategy and integration. Both projects are radical and strategic for the brand owners, and in the two projects, both design and suppliers were involved in all activities of the FFE. Radical innovations need more attention to detail and greater involvement of all companies participating in the development process later.

Project C (PC):

Developing new sachet structure that provides convenience and usability, reducing product waste. One of the design challenges was the correct volume setting more suitable sachet for Brazilian consumers. Through a survey came up to 12g for ketchup and mayonnaise, 8g for mustard. Also, was developed between Brand Owner and machine manufacturer a specific knife design to ensure sachet easy-open and with good dispensing of the product to avoid waste in the opening and consumption, as well as dirt on handling the packaging, which inhibits full use of their content. Research conducted with a Research Institute showed that the consumer opens two sachets of each bundle with a snack, but not consume the whole (average = 35% waste). A sachet for easy handling and better dimensioned as customs of the Brazilians. The project was developed in order to eliminate product waste by consumers, both the proper portioning of each type of product, as the effective ease of opening the package and functional structure that directs the application of the sauce and induces full use of the product. With the new iconic and differentiated form of the new mayonnaise sachets, mustard and ketchup, it was possible to provide better usability and while achieving a significant reduction in product wastage. This innovation is platform and is not strategic for the Brand Owner. The design agency only works in the idea generation and selection phases; and the suppliers are involved in almost all activities of the FFE. The most usual changes in the platform innovations are technological.

It makes more sense that the suppliers are more involved than the design in the FFE.

Project D (PD):

Developing a line inspired by the personality of each of the fragrances to create a playful and charming address for each. The goal was to establish a greater connection and identification with their consumers. The kit enchants small consumers by creating through its packaging emotional comfort strongly related to children's universe: playing house. Playful character, simple and pastel colors contours, the kit explores the delicacy and beauty that exist in dolls houses. Different typefaces adorn parts: in light colors to peach colored to candy and pop to cherry. In offset printing, packaging is made of cardboard and form a box whose front flaps forming the open structure of a house. Inside, the perfume bottle is encased in a plastic blister that protects it from minor bumps and dents. Moreover, the package has a plastic strap, fixed with adhesive to avoid unduly open. The project was developed with a knife to take advantage to the maximum the use of paper, aiming at the elimination of waste. Moreover, the package does not use glue dots, maintaining its structure through folds and grooves. Packaging delight the consumers young people who may collecting them, use them as houses of dolls and decorative objects. This innovation is incremental and strategic for the Brand Owner. The supplier is only involved with the buying activity; and the design is only involved in ideation activity. The brand owner uses its own knowledge to this project, sharing information internally.

To verify the integration among companies on the front-end, it is checked the division of labor for activities of opportunity identification, target costumers, technology evaluation, ideas generation and idea screening. Then, it attempts to list the logic that explains the involvement of each company in each project. The contingencies can be degree of strategic importance, degree of novelty, reputation, reliability, technological solutions, market research, satisfy it customer, way of doing it. The table 5 contains the results of this checklist.

There is integration among the companies but there are different roles among the agents in the packaging creation, technology transfer and production process according to marketing and commercialization decisions. There is a triadic relationship in the Packaging Industry, which involves the three main constituent parties of the chain. The roles of these three key players emerge clearly because their relationships are mediated by commercial borders within the FFE. One of the difficulties for innovation in this industry happens in the Front End, due to the withholding information among the constituent parties. The Brand Owner does not share market data and consumer surveys. The packaging producers do not share technology state of the art. Mediating and aligning the information in an effort to reduce the obstacles, are the design agencies, working as a broker. The theoretical contribution of this work is therefore the description and the organization of the roles in the Front End of Innovation, how different players work with concepts and the integration of concepts in the FEI to obtain better results at the later stage and the definition of the boundaries between the FEI and the development itself.

TABLE 5: DIVISION OF LABOR

Project (companies)	Activity						Logic of contingency
	OI	TC	TE	IG	IS		
PA							
BOA	x	x	x	x	x		High degree of strategic importance
DAA		x		x	x		High degree of novelty / Reputation/ reliability
CA/ CB			x	x	x		Owner of technological solutions/ reliability
PB							
BOB	x	x	x	x	x		High degree of strategic importance
DAB	x	x		x	x		Market research/High degree of novelty / Reputation/ reliability
CC / CD / CE			x	x	x		Owner of technological solutions/ reliability
PC							
BOC	x	x	x	x	x		Satisfy their customer
DAC				x	x		Reputation/ way of doing it
CF		x	x	x	x		Owner of technological solutions
PD							
BOD	x	x	x	x	x		Satisfy their customer
DAD				x			Reputation/ way of doing it
CI	Only buying						Reputation

Source: The Authors, 2016

V. CONCLUSIONS

Due the uncertainty and ambiguity that surround the Fuzzy Front End (FFE), this phase has difficulties such as its dynamism and the low levels of formalization, but it is responsible for the idea generation and an important driver of innovation success.

The main question that guided this research is "How is the integration among companies in the FEI in a complex industry?", "What are the rules and activities of integration in the FFE?" and "What is the logic of each type of innovation process?". To tackle this issue, this research examined the FEI in the packaging industry because it has a complex and problematic relation among its parties - Consumers Good Industry, which here we call "Brand Owner", the Design Agencies and the Producers. We interviewed some executives responsible for innovation management who described one project and identified the roles in each activity. Each project was classified by type of innovation (incremental, radical or platform) and if is strategic for the Brand Owner or not; and the relationship among companies involved in each project were also classified as casual, frequent or fixed.

We realized that there is integration among the companies but there are different roles among the agents in each activity of the FFE - opportunity identification, target and technology evaluation, ideas generation and screening. Their relationships are mediated by some contingencies such as degree of strategic importance, degree of novelty, reputation, reliability, technological solutions, market research, satisfy it customer, way of doing it. It is possible identify some patterns such as according to the type of innovation and strategy, there is a specific integration. Therefore, radical innovations need more attention to detail and greater involvement of all companies participating in the development process later. The most usual changes in the platform innovations are technological. It makes more sense that the suppliers are more involved than the design in the FFE. And incremental innovations dos not need integration and involvement of design suppliers.

The roles of these three key players emerge clearly because their relationships are mediated by commercial borders within the FFE. One of the difficulties for innovation in this industry happens in the Front End, due to the withholding information among the constituent parties. The Brand Owner does not share market data and consumer surveys. The packaging producers do not share technology state of the art. Mediating and aligning the information in an effort to reduce the obstacles, are the design agencies, working as a broker. The theoretical contribution of this work is therefore the description and the organization of the roles in the Front End of Innovation, how different players work with concepts and the integration of concepts in the FEI to obtain better results at the later stage and the definition of the boundaries between the FEI and the development itself.

The theoretical contribution of this work is the description and the organization of the roles in the Front End of Innovation, how different players work in each activity of the FFE to obtain better results at the later stage and the logic that explain these relationships. Therefore, it will be possible reduce fuzziness and uncertainty, changing from a fuzzing phase to a more formalized phase.

There are some limitations in this work that can be corrected through other research in the future: deepen the literature of integration and contingencies to extract more dimensions to be explored in other empirical research.

Still, increase the sample. Four projects is a small number to set standards, despite the exercise of relating the type of innovation and strategy to the type of integration in FFE be very important for innovation literature.

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APPENDIX - CHECKLIST

Opportunity Identification

- ☐ My company produces conference reports, communication materials and / or portfolios of partners and distribute internally.
- ☐ My company often conducts internal planning sessions to review opportunities.
- ☐ My company collects / assembles innovation champions and makes them available internally through window (physical or virtual).
- ☐ Customer, design and Suppliers agencies are involved in setting goals and priorities of new products.
- ☐ My company visit other companies to identify opportunities.
- ☐ My company shares with other links involved in the same project as market research, consumer, competitors, the state of the art technology.
- ☐ Other companies share with other links involved in the same survey design as labeled, consumers, competitors, the state of the art technology.
- ☐ My company conducts joint research with governments to recognize laws, policies and regulations important for the company's business.
- ☐ There geographic feature or physical approach between my company and the partners involved in the same project.
- ☐ My company seeks information on scientific and technical production bases, research groups, portals Government agencies information, scientific institutions or professional social networks.
- ☐ My company seeking information on technical and scientific events, workshops or premium / researchers acknowledgments.

Target Customer

- My company reproduces photos and videos of their customers using their products are on the market and distributes between the departments.
- My company exemplifies and classifies its customers.
- My company analyzes consumers of other companies.
- My company conducts joint research with universities to recognize consumer trends.
- Customer, design and Suppliers Agency analyze and interpret together the needs of customers.
- My company makes open innovation activities for the community suggest / imply product innovations.
- My company is related to the sales staff to inquire about consumer reviews.
- My company observes videos of consumers using competitors' products.

Technical Feasibility

- My company has access to forecasting technology trends.
- My company sets technical elements and usability for their products.
- My company dedicates a personal or department to search technology.
- My company analyzes the technical features of competing products.
- My company makes contracts with suppliers of selected technologies in the early stages of the product development process.
- Customer Design Agency and Suppliers involved in the same project seek and analyze together technologies.
- My company makes networking with R & D institutions and technological research groups access to important technologies.
- My company provides a network for exploring ideas and projects, acting as an interface between applicant undertakings and providers of technology.
- My company makes use of external ideas or licensed technologies.

Ideas Generation

- [ ] My company conducts brainstorming, mind mapping, cyberspace and / or forums to generate and discuss ideas.
- [ ] My company demonstrates ideas through drawings, prototypes, illustrations.
- [ ] My company creates awards for domestic employees with their new product ideas.
- [ ] Customer, design and Suppliers Agency are jointly involved in generating ideas.
- [ ] My company provides a network for exploring ideas and projects internally, using talents and creativity of employees.
- [ ] My company launches project announcements, technological calls, awards and fellowships for students / professionals to generate ideas.
- [ ] My company makes videos and schemes with users testing the prototypes / mockups of ideas.
- [ ] My company uses spreadsheets and financial reports to describe the project budget and schedule of the selected ideas.

Idea Screening

- [ ] Customer, design and Suppliers Agency test and criticize together the ideas generated.
- [ ] My company builds a matrix to relate the ideas with the company's business strategy.
- [ ] My company uses techniques such as focus groups, meeting with experts, interactive meeting face-to-face and / or observations with potential users to select ideas.
- [ ] My company uses technical and economic models, portfolio methods, checklists escoring models to select ideas.
- [ ] My company conducts marketing surveys after the ideas were selected.
- [ ] My company develops materials to communicate the technical, functional and aesthetic the idea selected for the user community.
- [ ] My company rewrites business strategy, if necessary, after you have selected the ideas for new products.
- [ ] Customer, design and Suppliers Agency are involved in finding commercial application for the ideas generated.
- [ ] My company carries out tests, experiments, survey, face-to-face interviews and frequent interactions with potential users.
- [ ] My company has articles in technical and scientific events and leads workshops on the selected concept.
- [ ] Customer, design and Suppliers agency develop together the project schedule and budget of the selected idea.
- [ ] My company organizes or rearranges suppliers after the idea was selected.