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Knowledge dynamics as drivers of innovation in Haute Cuisine

Running heads:

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Abstract

This paper analyses current innovation processes in Haute Cuisine and develops new insights into the nature of Haute Cuisine innovation and its institutional and organisational preconditions. The paper proposes an innovation paradigm that explains the roles of symbolic, synthetic and analytical knowledge during the various phases of innovation and challenges the innovation activity in Haute Cuisine as a linear model. It also explains the continuum between tacit and explicit knowledge throughout the innovation process. Symbolic knowledge has instilled Haute Cuisine and culinary tendencies, is a key element in its marketing and has allowed local cuisine to be branded internationally. The article aims to fill a research gap that has recently arisen on the existing tensions between idea creation and exploitation in Haute Cuisine innovation. The role of science appears as a tool that supports a chef's creativity but does not substitute or drive it. This paper fulfills an identified need to study the innovation processes of Haute Cuisine to which academia has dedicated scarce attention. The paper analyses a case study, with a strong institutional focus, a complex and relevant example of the innovation tendencies in Haute Cuisine. It presents a rich case that comprises the complete process from AQ4 the original inspiration to the final commercialisation.

Keywords

Haute Cuisine
innovation
symbolic knowledge

1. Introduction and objectives

Haute Cuisine presents a challenge to innovation academics for various reasons. On the one hand, it is a growing economic industry. By itself, it represents a relevant sector in the worldwide economy. The role of gastronomy in tourism is recognised as very significant by the reports of the World Tourism Organization which attributes 5% of Spanish tourism turnover to gastronomy. Additionally, and especially due to Ferra Adriá popularity, the sector has a high impact in the media: TV programmes, blogs, websites, journals, books, etc. However, it is a field that has received scarce although growing interest from academia. As an example, a search in the web of science gives only an outcome of 79 results while a search in Google for the term draws 445,000 results.

Why is relevant to analyse Haute Cuisine innovation? Which are the existing research gaps in this field? In first place, the sole suggested linear model for Haute Cuisine innovation (Ottenbacher and Harrington 2007a, 2007b) has been challenged by various authors who claim its systemic characteristics (Capdevila, Cohendet, and Simon 2015; Lane, Lupp, and Lup 2015; AQ5 Messeni-Petruzelli and Savino 2014; Stierand, Dörfler, and MacBryde 2014; Svejenova, Mazza, and Planellas 2007). This thought has been supported as well by other ethnographic studies (Fine 2009, 88, 89; Leschziner 2015, 84). Additionally, the linear model doesn't explain a major phase of innovation, which is its diffusion and adoption, which has facilitated its popularity. A stream of literature has analysed this aspect more comprehensively (Beaugé 2012; AQ6 AQ7 Leschziner 2015, 152–156; Manniche and Larsen 2013; Opazo 2012; Slavich, Cappetta, and Salvemini 2014; Svejenova, Mazza, and Planellas 2007).An influential factor in the adoption process is the Haute Cuisine recognition by the Michelin guide and other institutional agents (Durand, Rao, and Monin 2007; Lane 2013). A third aspect, not yet solved, relies on the identified tensions between the exploration (creativity) and exploitation (adoption) phases of innovation that affect innovators in general, and chefs in particular, and that have been AQ8 outlined by various authors (Andriopoulos and Lewis 2009; Fine 2009, 176, 89; Knight and Harvey 2015; Lane, Lupp, and Lup 2015; Leschziner 2015, 100; Slavich, Cappetta, and Salvemini 2014). Finally, in a fourth place,

AQ 9 there has been a controversy on the drivers and origins of creativity in Haute Cuisine (Albors 2013; Capdevila, Cohendet, and Simon 2015; Fine 2009, 29; Gomez and Bouty 2009; Gomez, Bouty, and Drucker-Godard 2003; AQ 10 Lane, Lupp, and Lup 2015; Leschziner 2015, 7, 8, 93; Messeni-Petruzelli and Savino 2014; Opazo 2012; Slavich, Cappetta, and Salvemini 2014; Svejenova, Mazza, and Planellas 2007; Stierand 2015; Stierand, Dörfler, and MacBryde 2014; Stierand and Lynch 2008). An additional question, in this respect, is the role of academy and science in Haute Cuisine chef's creativity. Questioned by some authors (i.e. Abecassis-Moedas, Sguera, and Ettlie 2016), it has been identified by others as critical (Capdevila, Cohendet, and Simon 2015; Gomez and Bouty 2009; Leschziner 2015, 52; Svejenova, Mazza, and Planellas 2007).

Consequently, the objective of this paper is to analyse the innovation process and patterns in Haute Cuisine services, taking into account recent academic contributions. The central research questions would be related to the drivers of Haute Cuisine innovation, its facilitating factors and those that promote its successful adoption by customers. It also addresses the current tensions between creative and innovation phases in Haute Cuisine innovation. Additionally, the contribution of art, design, industry and science to the newest innovation waves, as well as the development of a new language in the culinary profession (Messeni-Petruzzelli and Svejenova 2015). The main contribution of this paper is the suggestion of a holistic model that facilitates the understanding of Haute Cuisine innovation from a knowledge process point of view collating the various phases in the development, diffusion and adoption of Haute Cuisine innovations. In this sense, the model attempts to explain the role of knowledge variety in Haute Cuisine innovation. It aims to expand the academic context of innovation in the field, which, as it will be discussed in the article, has been limited to aspects of new product and services development. It also has practical application for Haute Cuisine education and training as well as marketing since there is still an unresolved question in this context: Which are the drivers of the newest Haute Cuisine agile adoption and diffusion worldwide? Our contribution aims to answer this question by analysing the innovation process from a novel perspective, knowledge conversion.

The paper is organised in the following sections. First, the paper introduces the reader to the context of Haute Cuisine and its increasing role in public media. It then discusses new trends such as the influence of science in Haute Cuisine and whether this has changed innovation processes in the industry. A short review of the literature dealing with Haute Cuisine innovation follows. The third section suggests a model for analysis and understanding of innovation in Haute Cuisine based on knowledge dynamics. There follows a description of the research methodology. In the fifth section, an Haute Cuisine innovation case study is described and discussed. The paper then summarises the research conclusions and proposes future research.

This research is a further step in the analysis of Haute Cuisine innovation, aims at contributing to filling the already discussed research gaps in published research on Haute Cuisine innovation and delivers arguments for further discussion.

2. The context of Haute Cuisine services

To introduce the reader to the subject, it is pertinent to briefly discuss the context of Haute Cuisine and the progressive influence science has on this trade and thus the role of knowledge dynamics in its evolution. This section will conclude with a brief summary of academic literature relevant to the innovation process in Haute Cuisine. That will be the basis for the model suggestion that will be addressed in the following section.

2.1. Culinary services in Haute Cuisine: the role of knowledge in its evolution

We could start the discussion by asking ourselves: What is Haute Cuisine? And the role of knowledge in the trade? The idea of Haute Cuisine, differentiated from home cooking, was born according to some authors (Beaugé 2012) in the seventeenth century, marked by two episodes: the publication of '*Cuisinier Francois*' by Francois La Varenne in 1651 as well as the conflict of Louis XIV with the nobility and the aspirations of a middle class. On the other hand, the Research Chefs Association has defined a term, Culinology®, as '… the blending of culinary arts and the science of food …'[1] This definition would help us define the context of Haute Cuisine and its evolution and balance between arts and science. Although for some authors (This 2008) it is wrong to mix science and art, Haute Cuisine has evolved following both patterns. Escoffier wrote in 1907, '… cooking is undoubtedly a fine art and an accomplished chef is as much of an artist in his particular branch of work as a painter or a sculptor …'

AQ 11 Trubek (2000) has analysed the evolution and development of Haute Cuisine knowledge up to the present His basic argument lies in the democratisation of Haute Cuisine after the French revolution on one side, its exportation from France to the rest of Europe on the other. Therefore, the diffusion through the evolution from explicit to tacit culinary knowledge that led to the creation of professional cooking schools, such as the *Ecole Professionnelle de Cuisine et des Sciences Alimentaires* by an association of French cooks, was pioneering. Later, culinary exhibitions in Britain and France contributed to the spread of the culinary industry in Europe. A relevant milestone was the attempt by Escoffier et al. (1903) to codify and document French restaurant processes with his manual *Le Guide Culinaire* in order to train professional chefs and kitchen staff. This manual became a classical Haute Cuisine text, and his normative aspects limited Haute Cuisine creativity (Stierand 2015). This situation changed during the mid-1960s when a group of chefs[2] revolutionised Haute

creativity (Stierand 2015). This situation changed during the mid-1960s when a group of chefs "revolutionised Haute Cuisine by launching nouvelle cuisine as an innovative reaction (Rao 2008). The launch of the Michelin restaurant guide in 1926 awarding stars to restaurants in accordance with the report of external inspectors was another significant landmark.[3] There are 3166 restaurants worldwide (representing the acme oh Haute Cuisine) classified by the Michelin Guide: 131 with three stars, 507 with two and 2, 518 with one.[4]

But what is the role of knowledge in Haute Cuisine? For many authors studying Haute Cuisine from an ethnographic point of view, the difference between a good cook and a chef lies in the latter's socially constructed knowledge. The habitus of a great chef, or his or her knowing in practice as defined by Bourdieu (1990), is a mixture of personal predisposition; knowledge acquired through rigorous training and repetitive practice; knowledge of the rules integrated and internalised by cooks; and knowledge gained through reflexive thinking about practice (Gomez, Bouty, and Drucker-Godard 2003). This will affect his relationship with the team and the innovatively developed behaviour (Bouty and Gomez 2010). In the same direction, Fine (2009, 229) signals that '… cooks base their discourse in a social construction of meaning within aesthetic realms of knowledge …' and, alternatively, Leschziner (2015) points out that chefs respond to differentiation pressures (innovation) through knowledge exchange with peers and the environment. The role of knowledge transfer in the chef's creativity has been recognised by many authors (Slavich, Cappetta, and Salvemini 2014) as well as the combination of diverse knowledge bases and practices (Capdevila, Cohendet, and Simon 2015; Manniche and Larsen 2013). To introduce the reader to the subject, it is pertinent to briefly discuss the context of Haute Cuisine and the progressive influence science has on this trade and thus the role of knowledge dynamics in its evolution. This section will conclude with a brief summary of academic literature relevant to the innovation process in Haute Cuisine. That will be the basis for the model suggestion addressed in the following section.

In general, it could be observed that in the same way as haute couture affects the fashion industry, Haute Cuisine plays a key role in trend setting, image building and in setting quality standards for culinary services as a whole (Surlemont and Johnson 2005). Following the previous discussion, Haute Cuisine has been considered both a craft (Gomez and Bouty 2009; AQ12 Stierand and Lynch 2008) and an industry (Ottenbacher and Harrington 2007b; Surlemont and Johnson 2005). Recently, Lane (2013) has stressed that Haute Cuisine innovation has been strongly influenced and subject to hierarchisation by Michelin guides and how these yield a strong symbolic power.

Both aspects, craft and industry, incorporate the need for scientific and technical knowledge of the trade. This subject will be discussed in the following sections.

2.2. Innovation in Haute Cuisine

Hipp and Grupp (2005) outline some aspects of innovation in services that are quite applicable to hospitality and Haute Cuisine. Among them, the relevance of the human factor and personal skills, the role of science as a supporting element for the development of innovative products and services, the difficulty of separating process and product innovation, intangibility and thus the barriers to appropriability. The latter is a subject discussed extensively by some authors in the case AQ13 of Haute Cuisine (i.e. Capdevila, Cohendet, and Simon 2015; Leschziner 2015; Svejenova, Mazza, and Planellas 2007), the integration of customers in the innovation process and the barrier to innovation caused by the small size of organisations. These authors concur with others that knowledge is one of the relevant aspects, especially in the case of creative and cultural industries (Caves 2002).

Sipe and Testa (2009) have proposed a framework for innovation research in the field of hospitality. This framework is composed of drivers of innovation, outputs and its connection with business performance. In this model, innovation is defined as 'a multidimensional knowledge structure' where knowledge, beliefs and behaviour play a relevant role in the pursuit of 'innovation enabling competencies and processes' (Siguaw, Simpson, and Enz 2006, 41). The authors recognise from their research some ambiguity in this field about innovation outputs and define three basic types of innovation: administrative (management), service and product.

A growing stream of academic literature has recently dealt with the specific field of Haute Cuisine innovation and creativity. Harrington (2004a) has analysed culinary innovation outlining the Haute Cuisine chefs' role in leading innovation as an impulse that involves tacit skills capable of developing non-imitable competitive advantages. This author underlines the importance of learning by doing in this context.

Ottenbacher and Harrington (2007a, 2007b, 2008) studied and compared German, Spanish and New York Michelin-starred chefs' innovation processes, re-evaluating the previous new service development model. They contrast these with new product development models and outline that they are less formal and more organic, deal less with the market and financial costs analysis and rely fundamentally on networking with colleagues and suppliers of raw materials and ingredients. They outline that they are more iterative in nature. According to these authors, successful outcomes are based on the chefs' tacit skills and knowledge. However, they still rely on sequential development innovation processes following operation's management philosophy.

This latter approach has been challenged by other authors such as Stierand, Dörfler, and MacBryde (2014) who claim the systemic aspects of innovation in this sector. Central to the system is the creative chef who relates with three subsystems: the customer, the restaurant guides and media and the Haute Cuisine culture. The system dynamics embody a strong creative drive by the chef who is incorporated and contrasted by the sector gatekeepers – guides and critics – as well as the final customers. Other authors have proposed that Haute Cuisine is rather a highly creative complex process where ideation and innovation are interlinked in a continuum where adoption forms part of the route (Capdevila, Cohendet, and Simon 2015). Analysing the case of Ferra Adria, Svejenova, Mazza, and Planellas (2007) argue that four mechanisms are the base of Haute Cuisine innovation: creativity, theorisation, reputation and dissemination. Lane, Lupp, and Lup (2015) recognise the critical role that chefs play in innovation; they propose to disaggregate idea creation from implementation but do not AQ14 suggest an alternative model. Messeni-Petruzelli and Savino (2015) propose alternatives to the innovation process in Haute Cuisine based on the recombination of traditional multicultural ideas and pose that innovation processes may be different depending on by recombining ideas collected from abroad has also been suggested by AQ15 Leschziner (2015, 54–56).

Other authors (Stierand and Lynch 2008) indicated the experimental character of culinary innovation involving the creation of a new idea aimed at solving a problem and the conception of a new value through teamwork and dissemination. In this context, the master–apprentice relationship between a chef and his or her team and the integrated learning process are a relevant aspect of the innovation process. Another aspect of Haute Cuisine innovation is the tension between originality and conformity that chefs face having the pressure to differentiate from others (Leschziner 2015, 95). As a matter of fact, chefs recognise that their innovation pattern represents their brand image (Albors-Garrigos et al. 2013).

Haute Cuisine innovation has been characterised as well by being led by chefs. Innovation comprises a chef's creativity driven by his or her artistic aspirations. The diffusion aspect of innovation involves a process of learning and networking influenced by the traditions of the gastronomic world (Stierand and Lynch 2008). However, chefs' creativity must experience a social evaluation depending on perception and knowledge from domain gatekeepers (i.e. critics and/or Michelin inspectors) to recognise the quality of an innovative idea (Stierand, Dörfler, and MacBryde 2014). The innovation diffusion aspects must be considered. In this respect, Svejenova, Mazza, and Planellas (2007) explain how an entrepreneur chef such as Ferran Adrià initiated changes and innovation in Haute Cuisine and led its dissemination. The chef's commitment to creativity generates a flow of new challenging ideas that are solely accepted in the industry due to his or her reputation and leadership. These ideas promote change and acceptance due to public and media dissemination and are facilitated by marketing tools.

Finally, the third group of authors has centred their research on the creative process of Haute Cuisine chefs. Gomez, Bouty, and Drucker-Godard (2003) and Gomez and Bouty (2009) have studied extensively the creation processes of Michelin-starred chefs. They have outlined the strong hierarchical processes of cuisine creation where chefs carry out creative activities, develop techniques, lead the team and relate to customers, while sous-chefs lead the teams and simple cooks are limited to their cooking domain. This structure also leads the apprenticeship and learning process, as well as the professional progression of chefs (Stierand 2015). These authors emphasise, on the other hand, the variety of inspiration for chefs who base their ideas for new dishes on raw materials and ingredients, music, painting, colours and look for new textures, emotions and combinations. These chefs usually have their space and time for creativity and rely on networking with an extensive social context.

AQ16 A recent line of thought (Lane 2013; Lane, Lupp, and Lup 2015; Svejenova, Mazza, and Planellas 2007) has outlined how Haute Cuisine innovation is a multistage process where chefs capture their ideas from outside and control the flow of novelty. These various stages require different inputs and practices and thus, innovation results in a complex process shaped by organisational context and institutional influences (Lane 2013). Their analysis has concluded as well that the tensions between the exploration and exploitation stages in creative environments reported by Knight and Harvey (2015) and denominated paradoxes of innovation by Andriopoulos and Lewis (2009) become acute in Haute Cuisine and their management is critical for organisational success. Chefs have to manage tensions between routine and creation, between exploring new and exploiting old ideas (Leschziner 2015, 100–103). Meanwhile, existing academic literature has not yet addressed this problem adequately. According to Knight and Harvey (2015), this paradox is based at three organisational levels: knowledge, learning and motivation, while Andriopoulos and Lewis (2009) attribute the cause of conflicts founded on knowledge management.

But does academy or science have a relevant role in driving innovation in Haute Cuisine? Some authors have pointed out that chef entrepreneurs learn to innovate through observing competent models: parents and mentors, but not academic models (Abecassis-Moedas, Sguera, and Ettlie (2016). Intuition has been recalled as a critical driver of innovation (Leschziner 2015, 105) as well as networking with other xhefs (Fine 2009, 84; Slavich, Cappetta, and Salvemini 2014). Other drivers suggested are traditions (Messeni-Petruzelli and Savino 2012), terroir and products (Bouty and Gomez 2015; Lane, AQ17 Lupp, and Lup 2015) or fairs, cuisine workshops and exhibitions (Albors et al. 2013).

2.3. The role of science in Haute Cuisine innovation

AQ18 But, does science play a relevant role in Haute Cuisine innovation? Brillat-Savarin (1826/2009) was the first gastronomy writer to mention the role of science in Haute Cuisine. However, the seminal publication on scientific cooking has been considered to be *On Food and Cooking: the Science and Lore of the Kitchen* written by McGee. He published numerous articles and books on the scientific nature of the culinary arts, which have been followed by prominent AQ19 chefs worldwide (McGee 1984; McGee 1999).

The pioneering researcher on scientific cuisine is, without a doubt, Nicholas Kurti. Although he was initially a physicist with cooking as a hobby, he was the first supporter of applying scientific knowledge to cuisine processes. As early as 1969, he proposed using microwave technology, a recent invention, to cook a 'reverse Baked Alaska' (Kurti 1985). A subsequent milestone is Hervé, considered the father of molecular cuisine (This 2008).

Kurti and This were the first researchers to try to find answers to explain food colour changes during cooking or the variation in results of cooking rice or pasta in different conditions, etc. They utilised their knowledge on biochemical processes to explain the chemical and physical reactions of food.

Another relevant scientist who must be mentioned here is Davide Cassi, professor of theoretical physics and a prominent researcher on materials, molecular gastronomy and graph theory. He is considered today one of the fathers of the molecular cuisine trend. Cassi is a founding member of the working group on physical and molecular gastronomy that leads the biannual Molecular Gastronomy Congress in Erice (Italy). The first molecular cooking manual was published by Cassi and Bocchia (2005). However, as it has been pointed out, two leading chefs, Blumenthal and Adria, leveraged on molecular gastronomy to develop totally new restaurant concepts (Cousins, O'Gorman, and Stierand 2010).

But, what could be considered innovative in Haute Cuisine? Chefs view a dish as '… a combination of ingredients, techniques, and presentation, embedded in traditions culinary conventions, technical knowledge, fad, and creativity …', then whether any of these are prioritised (Leschziner 2015, 64), the combination would lead to an innovative dish. Technology or science then may play a contributing role by facilitating innovation (Piqueras-Fiszman, Varela, and Fiszman 2013; Ruiz et al. 2013).

But, does academy or science have a relevant role in driving innovation in Haute Cuisine? Some authors have pointed out that chef entrepreneurs create by learning from parents, colleagues and mentors, but not from academy models (Abecassis-Moedas, Sguera, and Ettlie (2016). Intuition has been recalled as a critical driver of innovation (Leschziner 2015, 105) as well as networking with other chefs (Fine 2009, 84; Slavich, Cappetta, and Salvemini 2014). Other drivers suggested are traditions (Messeni-Petruzelli and Savino 2012), terroir and products (Bouty and Gomez 2015; Lane, Lupp, and Lup 2015) or fairs, cuisine workshops and exhibitions (Albors et al. 2013).

Moreover, some authors (Bouty and Gomez 2015; Gomez and Bouty 2009) accentuate how a minority of chefs base their inspiration on science, having chemists as advisors, which inspires new textures and combinations of ingredients (Svejenova, Mazza, and Planellas 2007). A common aspect in the chefs' innovative patterns, which these authors have identified (Gomez, Bouty, and Drucker-Godard 2003), is the registration of their innovations in a codified form: technical notes, recipes, cooking techniques, photographs, etc.

On the practical side, most food critics point out that the gap between the science lab and the kitchen has been reduced. In this regard, two famous avant-garde chefs have contributed to this: Heston Blumenthal and Ferra Adrià (Svejenova, Mazza, and Planellas 2007). They were pioneers in using liquid nitrogen to freeze mousses and siphons to make squid ink foam. In this sense, a food critic noted in 'TIME Magazine' that 'This is the great revolution in the kitchen right now: the incorporation of industrial techniques in the kitchen, and the cooperation between scientists and cooks.'[5] The case presented in this paper follows this pattern of collaboration.[6]

3. Suggestion of an innovation model for Haute Cuisine and culinary services

As has been discussed in previous sections, some authors (Gomez and Bouty 2009; Gomez, Bouty, and Drucker-Godard 2003; Stierand and Lynch 2008; Svejenova, Mazza, and Planellas 2007) have emphasised the relevance of knowledge creation, conversion and transfer in Haute Cuisine innovation processes. This fact will lead our innovation analysis from a knowledge process point of view.

3.1. Knowledge modes in creative processes

Having recognised the creative aspects of culinary services, and especially Haute Cuisine as well as the already mentioned existing tensions between the various innovation phases, could we explain these tensions from a knowledge perspective? In this direction, let us analyse the knowledge modes involved in their associated processes. In this respect, we must first distinguish between analytical and synthetic knowledge. The former abounds in economic activities where scientific knowledge prevails, and where knowledge creation is founded on cognitive, rational processes and formalised paradigms, often focused on understanding phenomena with a high content of explicit and codified knowledge. The latter

refers to industries where innovation occurs primarily through the application of existing knowledge, or through combinations of existing knowledge. Often, this occurs in response to the need to solve specific technical problems with a lower content of explicit knowledge (Asheim and Coenen 2005; Asheim and Gertler 2005; Todtling and Trippl 2006).

Secondly, in the so-called creative (Caves 2002) or cultural industries (Power 2007), where arts and industry converge (Martin and Moodyson 2010), the predominant knowledge is symbolic. This process is established in the creation of cultural meaning through transmission of certain cultural codes. Innovation is based on products where essence is an impression, an experience or an image, and goods are often intangible. The crucial knowledge here will be extensively tacit and its transfer informal through metaphors, images or tales (Doyle and Sims 2002).

However, should it be considered a continuum between these types of knowledge? For Polanyi (1967), all knowledge is either tacit or based on the tacit knowledge that is known but cannot be articulated. A seminal theory by Nonaka (1991) considered both types complementary and proposed a tacit–explicit knowledge transformation process model based on the case of the development of a home bakery appliance by Matshushita. In spite of its popularity, it has raised substantial controversy, and it has been challenged with various arguments, among them the cultural differences between Japanese and Western knowledge focus, as well as an unorthodox understanding of tacit and explicit knowledge (Brataianu 2010; Tsoukas 2005).

However, this continuum between tacit and explicit knowledge is of extreme importance in our case. As mentioned, some authors (Gomez and Bouty 2009) who studied chefs' activities have placed the utmost relevance on chefs' knowing and their competencies when creating or interpreting a new recipe. The final results of two chefs when cooking the same recipe may be quite different due to their interpretation and tacit knowledge. It is necessary then to refer to Polany's original interpretation of tacit knowledge, as socially articulated, and its relationship with explicit knowledge (Tsoukas 2005). We could assume that this continuum occurs during all the phases of innovation (Table 1).

Table 1. Characteristics of synthetic, analytical and symbolic knowledge bases.

Analytical knowledge	Synthetic knowledge	Symbolic knowledge
Innovation by creation of *new* knowledge	Innovation by application or novel combination of *existing* knowledge	Innovation based on immediate impressions, experiences and/or images of consumer
Relevance of scientific knowledge often based on deductive processes and formal models	Relevance of applied, problem-related knowledge (engineering)	Relevance of visual and sensory perception
Deductive processes	Inductive processes	Behavioural processes
Research collaboration between organisations and scientists	Interactive learning with clients and suppliers	Founded on close interaction between creator and consumer
Dominance of explicit codified knowledge: Patents, publications and/or technical notes	Dominance of tacit knowledge and know-how, craft and practical skills	Almost exclusively based on tacit knowledge, craft, practical and search skills. Influence of cultural education

Source*:* Asheim and Gertler (2005) and Martin and Moodyson (2010).

About the third category, symbolic knowledge, its relevance to the Haute Cuisine sector has already been recognised by various authors. Manniche and Larsen (2013) have outlined the relevance of symbolic knowledge in the area of gastronomy innovation. Cousins, O'Gorman, and Stierand (2010) stress that behind the nouvelle cuisine movement lies an experience based on symbolic contents. Bouty and Gomez (2013) associate Michelin *chefs*' inspiration with terroir products as well as aesthetics, textures and plate design combining a symbolic approach. Their research concludes that their idea generation is not cognitive but rather encompasses feelings, perceptions and aesthetic judgements (Gomez and Bouty 2009). According to Fine (2009, 229), chefs communicate through the language of their work. Furthermore, some authors (Zomerdijk and Voss 2011) have defined a distinctive set of services, experiential services, where customer experience is the core of the services offered. In this type of service, where Haute Cuisine could be included, mental stimulation and visual formats of presentation play a fundamental role with symbolic and analytical knowledge being predominant in certain phases of product development (Feiersen, Wong, and Broderick 2008).

3.2. Innovation development in Haute Cuisine

March (1991) and Cooke (2005) proposed three phases to define the dynamic process that transforms knowledge into profitable and valuable final products: exploration, examination and exploitation.

Exploration and exploitation were proposed by March (1991): knowledge exploration is a phase of *finding new economic opportunities in order to profit from them, and this entails search and discovery activities and risk-taking* since their returns are

opportunities in order to profit from them, and this entails search and discovery activities and risk-taking since their returns are uncertain and distant while knowledge exploitation involves basically refining existing competencies, technologies and paradigms while the returns in this phase are positive, closer and predictable. Likewise, March (1991) advances that both stages involve conflicting knowledge management processes, thus emanating certain innovation tensions.

Cooke (2005) improved this model by proposing a third phase amidst exploration and exploitation, knowledge examination, where testing, experimentation and validation activities take place with the aim of improving knowledge content and evaluating its added value about its final commercial exploitation. According to this author, this phase is decisive for determining the consistency and applicability of exploratory knowledge. Recent research has determined that the firm's knowledge base determines their engagement in R&D, and innovation activities as well as their innovation drivers (Pina and Tether 2016).

It must be taken into account that the three mentioned phases often overlap, and take place simultaneously, while some steps may be avoided in other cases. In innovation processes in those services where knowledge is a critical issue, all knowledge categories are present (Strambach 2008) and knowledge creation is weakly formalised (Hipp and Grupp 2005). This evidence was found in Haute Cuisine innovations (Albors et al. 2013). Following Strambach's paradigm (2008), Table 2 below summarises the predominant knowledge categories for the Haute Cuisine innovation process (Albors et al. 2013; Svejenova, Mazza, and Planellas 2007).

Table 2. Innovation phases and related activities.

Innovation phases	Analytical	Synthetic	Symbolic
Exploration	Scientific advice from specialists	Pre-experimental activities, dish pre-design drawings	Michelin guidelines, Exploring demands, inspirational activities
Examination	Scientific feasibility and trials. Laboratory tests and validation	Feasibility studies, prototyping and/or design	Proof of concept, photography, chefs and customer perception analysis
Exploitation	Recipe writing, photographic and video documentation	Series production readiness, Production testing	Marketing; branding. Michelin inspector reports

Source: Based on Strambach (2008), Svejenova, Mazza, and Planellas (2007), and Albors et al. (2013).

In the case of Haute Cuisine, various authors (Harrington 2004a, 2004b; Ottenbacher and Harrington 2007a, 2007b) have proposed an innovation model, based on the classical theory of new product development. This model comprises seven phases: idea generation, screening, business analysis, concept development, final testing, training and commercialisation. In our interpretation, the first two could correspond to examination. Business analysis, concept development and final testing could be equivalent to the examination phase. Finally, final testing, training and commercialisation could be equivalent to the final phase of exploitation.

The process of exploration starts with idea generation. Chefs follow their intuition and creativity (Bouty and Gomez 2013; Gomez, Bouty, and Drucker-Godard 2003) and are inspired by paintings, sculpture, music, raw materials and, occasionally, by science (Fine 2009, 229, 230; Gomez and Bouty 2009; Leschziner 2015, 101). Other authors mention visiting a colleague's restaurant, cooking literature or technology, markets, culture, cooking shows, previous experience with former masters (Byrkjeflot, Pedersen, and Svejenova 2013; Stierand and Lynch 2008) and ideas from customers as inspiration sources (Ottenbacher and Harrington 2007a). It is interesting that science has been indicated as supportive of the creative process (Albors et al. 2013; Arboleya et al. 2008; Gomez and Bouty 2009; Ruiz et al. 2013; Stierand and Lynch 2008). This phase has a high content of symbolic and tacit knowledge. Aesthetics has a crucial role here (Fine 2009; Leschziner 2015). The step of screening consists of selecting new courses and corresponds to a stage door process in new product development. The basic selection criteria are raw material availability or seasonality, as well as the fit with their cooking style. Eventually, intuition or 'gut feeling' may play a relevant role (Albors et al. 2013; Leschziner 2015, 101, 102; Ottenbacher and Harrington 2007a). Here, symbolic and synthetic knowledge will fuse. A chef's habitus, as mentioned, is a critical competence (Bouty and Gomez 2013; Gomez, Bouty, and Drucker-Godard 2003).The recombining aspects of innovation in this and the following phases where old and traditional ingredients play a relevant role have been outlined by Messeni-Petruzelli and Savino (2012) and Leschziner (2015, 84).

The examination phase will include trial-and-error and concept development. The first requires a great deal of experience and skill from the chef. Tacit knowledge is still fundamental, while explicit knowledge would play a communicating role. Intuition and practice will contribute to the combination of ingredients and cooking, leading to success. Haute Cuisine activity involves *knowing* as contextual, embodied and situated knowledge, which enables the solver to sift relevant features of the problem and to supplement information evoking additional conceptual or procedural knowledge (De Jong and Fergusson-Hessler 1996). The tests are carried out in the kitchen and lead to the development of the product

concept. The higher the classification of the chef, the longer these steps will take (Albors et al. 2013; Ottenbacher and Harrington 2007a). Here, there will be a partial conversion of tacit to explicit knowledge to define the product (dish) in a technical note, working instructions or photographs.

The concept must be able to analytically reflect the symbolic knowledge desired in idea creation, though the recipe may require inspiration and skills to interpret it (Bouty and Gomez 2013 ; Gomez and Bouty 2009 ; Gomez, Bouty, and Drucker-Godard 2003 ; Stierand and Lynch 2008 ; Svejenova, Mazza, and Planellas 2007). Science and technology will have, when required, an important role in this phase where analytical knowledge will prevail (Arboleya et al. 2008 ; Ruiz et al. 2013 ; Svejenova, Mazza, and Planellas 2007). This aspect is outlined by some authors who, on the other hand, have stressed the AQ25 relevance of science in the fashion or symbolic aspects of molecular cuisine (Cousins et al. 2009). In the examination phase, the potential added value of the new product must be tested. Therefore, this phase has to include test trials and validation exercises. Regarding technology, equipment pilots are developed and tested, and the IP results are protected and registered. In the case of new dishes, prototypes and recipes are developed through pilot cuisine trials with colleagues and selected customers. Additionally, there are presentations at gastronomy and culinary conferences, exhibitions and trade fairs (Svejenova, Mazza, and Planellas 2007). In some cases, there may be political support when culinary services project particular national or regional profiles (Byrkjeflot, Pedersen, and Svejenova 2013).

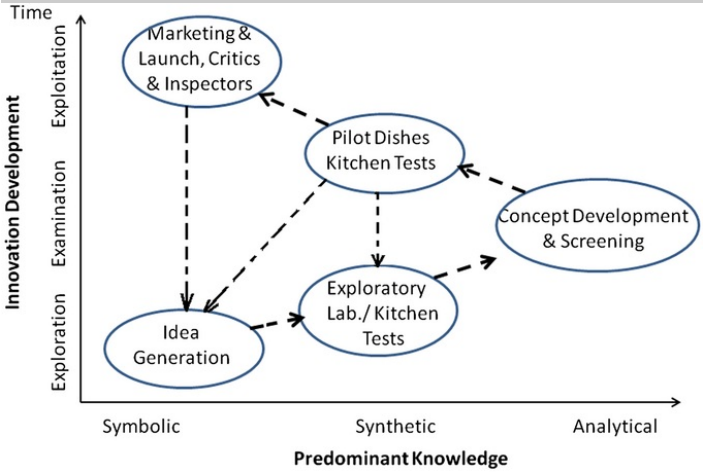
Finally, during the exploitation phase, final testing will be carried out. Tests are carried out among employees holding leading positions (senior chef, sommelier, sous-chef), or regular customers. Often, tests require real conditions in order to test the symbolic message the course tries to convey (Albors et al. 2013; Gomez and Bouty 2009 ; Ottenbacher and Harrington 2007a). Here, the concept of 'Harmony' of an achieved product as outlined by some chefs (Stierand and Dörfler AQ26 2012) contains a high proportion of symbolic knowledge. The knowledge must be converted into explicit knowledge in order to disseminate and exploit the product with the appropriate quality that corresponds to the developed recipes. Thus, most transferred knowledge is explicit, although learning requires tacit knowledge. Commercialisation is the final stage of innovation. The dishes are introduced onto the menu, branded, marketed and disseminated. An adoption process follows, with various segments that adopt the innovation, i.e. early adopters and/or innovators. It has also been emphasised that training forms part of this phase and is crucial for product success (Gomez and AQ27 Bouty 2009 ; Harrington et al. 2009; Ottenbacher and Harrington 2007a). Service is involved and here explicit knowledge is transformed into individual tacit knowledge.

3.3. Suggestion of an innovation model for Haute Cuisine processes

As previously discussed, various categories of knowledge play relevant roles in the innovation phases of the Haute Cuisine industry. This fact is useful to partially explain the ambiguity and tacitness of the success of Haute Cuisine innovations. In this section, we will try to propose a model that helps understand the Haute Cuisine innovation process.

Figure 1 illustrates the suggested model that aims to explain the innovation process in Haute Cuisine services.

Figure 1. Suggested model for innovation in Haute Cuisine services. Source: Authors, based on Strambach (2008).



The diagonal arrows represent innovation development phases based on the exploration–examination–exploitation paradigm and the culinary innovation processes proposed by various authors (Albors et al. 2013; Bouty and Gomez 2013 ; Ottenbacher and Harrington 2007a). They also indicate flows of knowledge. The first phase of the process (exploration), where innovative ideas are generated, is based on symbolic knowledge (ideas; symbols, terroir) and has a high content of tacit knowledge. Here, creativity skills and competencies play a relevant role (Hu, Wang, and Lee 2008 ; Zopiatis 2010). Although science has been cited as a source of inspiration, we believe that, following Stierand and Lynch (2008), science has at this stage a feasibility role, with a higher weight in later phases. Explicit knowledge is also required as a communicating

at this stage a feasibility role, with a higher weight in later phases. Explicit knowledge is also required as a communicating element. The typical question posed to a scientist by chefs would be, 'Is this possible?'

At the examination phase, selected ideas must be tested first and then put into practice and made feasible through laboratory (kitchen) tests. The knowledge base now is synthetic, and knowledge content is partially converted to explicit, in a second sub-stage in this phase through concept development and concept selection steps. At this point, science plays a more relevant role where knowledge may be predominantly analytical (i.e. food composition, cooking temperatures and/or boiling pressure). Concept development implies recombining knowledge (i.e. raw products fit according to the season).

The exploitation phase involves a sub-stage carrying out final dish tests with a higher content of synthetic knowledge since products must approach a practical application. Team training will be relevant to learn explicit knowledge individually that must be put into practice or activated (Albors et al. 2013). Again, technical competencies and a chef's experience play an important role (Albors et al. 2013; Zopiatis 2010). At this stage, service must also be integrated into the product since it will be a fundamental ingredient of the final product (Hu, Wang, and Lee 2008).

Finally, the last step will be the exploitation or commercialisation of the innovation where marketing will have to facilitate transmitting the final symbolic innovation content successfully to the customer. Critics and Michelin inspectors will play a relevant role here with a symbolic weight (Lane 2013). Here, tendencies, brand and differentiation play a differentiating role. It has to be noted that both the exploitation and exploration processes entail a process where symbolic tacit knowledge will be exchanged with customers and will provide shared experience for chefs, which is basic for developing their creativity skills (Gomez and Bouty 2009; Ottenbacher and Harrington 2007a; Zopiatis 2010). There is, as well, recycling of ideas from the different experimental phases which will be recombined or used in other process steps (Leschziner 2015, 84).

We could summarise that this model highlights the relevance of various knowledge modes during the different innovation development phases: symbolic in the initial and final stages of culinary innovation (creation and adoption), while the intermediate steps combine tacit and explicit knowledge transfer. Finally, synthetic and analytical knowledge play proper roles in testing and concept building phases acting as the support of the innovation process continuum. Additionally, the model explains how the tensions which have been reported between the exploration and innovation phases of Haute Cuisine AQ28 (Lane and Lup 2014) can be attributed to the clash of the different knowledge categories which are predominant on each stage: symbolic in the exploration phase vs. analytical and synthetic in the examination stages as the case study will show.

We must reflect here that March (1991) attributes these conflicts, also denominated creativity paradoxes Andriopoulos and Lewis 2009), to the clash between short- and long-run strategies as well as due to the particular (chefs') vs. collective (team) knowledge. Other authors (Knight and Harvey 2015) argue that tensions arise in creative organisations between AQ29 creative and business stages while Lane and Lup (2015), already mentioned, explain it by the chef's individuality and need to drive his novelties (his 'creative imperative'). According to Nonaka and von Krogh (2009), leaders in organisations (here the chefs) establish the social context and influence the process of knowledge conversion, although people's diversity introduces fragility in organisational knowledge creation and conversion. Consequently, it has been suggested that a behavioural approach, the chef's capacity to enable ambidexterity, is the sole solution (Leschziner 2015, 96).

4. Research methodology

4.1. Academic support of selected research methodology

An influential author (Yin 2009) in research methodology defines a case study as 'an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident' (19). Furthermore, it has been pointed out that 'case study research is a qualitative approach in which the investigator explores a bounded system … or multiple bounded systems … over time, through detailed, in-depth data collection involving multiple sources of information (e.g. observations, interviews, audiovisual AQ30 material, and documents and reports), and reports a case description and case-based themes' (Creswell 2003, 73).

Dubé and Paré (2003) have pointed out that rigour associated with a case study should take into consideration, among other aspects, the following: design issues (i.e. research questions, longitudinal observation and alternative hypotheses), data collection and data analysis (i.e. use of preliminary data; finding comparisons). Other key aspects related to qualitative research are the relevance of the case and contribution to new knowledge.

To this effect, we have selected a case study that offers the advantages of the study of the phenomenon of Haute Cuisine innovation in a real-life context. It also offers the possibility of having access to a pilot paradigmatic case (Flyvbjerg 2006), with a long longitudinal analysis (13 years), availability of preliminary data and direct access to the main actors. On the other hand, theory building can be drawn from this case study due to its novelty, testability and empirical validity. The

fact that the case presents close links to previous academic literature (as in our case) reinforces its suitability (Eisenhardt 1989).

4.2. Research methodology

To assess the model presented above, we have selected a case study describing Haute Cuisine innovation development. Which are the reasons for choosing this case? In the first place, it represents a complex, and representative, innovation case involving all the stages of innovation including the exploration and exploitation phases which have been deemed as conflictive by academic literature. Secondly, it represents a singular case of disruptive innovation which has meant a breakthrough in Haute Cuisine from the practitioners as well from the culinary academic point of view since it covers three basic techniques such as cooking, frying and impregnation (Leschziner 2015, 52–54) that can influence as well ingredients' properties. Thirdly, it involves all the agents involved in Haute Cuisine: chefs, scientists, chefs' networks, conferences, technologists, guide reviewers and customers. Finally, in fourth place, it shows the systemic and knowledge aspects of innovation which have been dealt in the previous discussion, all in a period reveal the innovation lifetime. Before selecting the case, the authors had discussed various cases showing innovative dish developments, but none of them could be as productive as the case analysed here.

The case was analysed by means of structured interviews with the actors involved: scientists, chefs, technologists, gastronomic critics, etc. (a total of 40 interviews) and the collection of preliminary and final data, as well as contextual data from journals, specialised magazines, etc., where more than 65 documents were examined. The field study took place between October 2008 and April 2010. A second phase has been carried out among chefs, researchers and gastronomic critics, reviewing as well press clips and reports during 2013–2014 with the objective of analysing whether the innovation had become a predominant design.

The questions were focused on trying to understand the paths and motivators of the case study's main actors with the AQ31 intention of grounding the innovation model proposed in Section 3.3. Attention has been paid mainly to the predominant type of knowledge in each phase. Finally, the adoption impact has been followed on the Internet. The insight of the participant-researchers has been very useful since they are co-authors of this article.

How did we interpret the type of knowledge predominant in each phase of the product development? Questions were posed to the interviewed actors about the prevailing knowledge at each instance. The replies were quantified as to whether the predominant processes were deductive, inductive or behavioural. Either the innovation was the result of the creation of new knowledge, application or recombination of existing knowledge or by impressions, experiences and/or images. The prevalence or conversion of tacit to explicit knowledge, and vice versa was analysed as well. At each phase, we analysed whether the relevant knowledge was scientific or problem-focused or either based on visual or sensory perceptions. The same procedure was followed to examine articles describing situations or press clips. The results were quantified in a 1–5 Likert scale to facilitate an evaluation of the paramount knowledge in each of the innovation development phases. The academic literature has justified this mode of approach (Sewell 2008). The process has not been detailed here due to space limitations.

5. The case study: the Gastrovac case

5.1. Introduction and context

The case study dates back to the start of 2000. Researchers from the Institute for Food Development at the Universidad Politécnica de Valencia (UPV) had been working on a process called vacuum impregnation, defined as a technique used for enhancing the functionality of high porosity foods by filling the porous air microstructure with desired solvents and solutes. The process consisted of two steps, once the phase of immersing the product in a tank with the desired liquid had been completed. The first step consisted of applying vacuum pressure and the second of restoring atmospheric pressure in the tank.

The researchers were in contact with an association of restaurateurs that include 17 Haute Cuisine restaurateurs in the region. These chefs are willing to promote gastronomic education and training. Consequently, the team holds workshops and seminars on food and wine education among campus students and professionals in the region.

5.2. Exploratory and examination phases: chefs and scientists

The initial generating idea for this case was initiated by two Michelin-starred chefs from the east of Spain, Javier Andres from 'La Sucursal'[7] and Sergio Torres from 'Dos Cielos.' They were searching for an alternative method to cook vegetables safely while keeping certain properties: natural colour and 'crispy' texture. Both chefs were to participate at a gastronomic conference in San Sebastian (Autumn 2003), and their presentation was on cooking vegetables. They asked both researchers from UPV for an alternative to cooking vegetables 'al dente.' 'We needed to be able to present our customer's cooked vegetables with a natural aspect.' The existing alternatives to conventional boiling were microwave cooking – which was not accurate and also required constant attention from the cook – and 'cooking sous vide,' – which is a complex

technology that requires previously bagging the vegetables and posed constraints since the bag impeded the interaction of the food with the impregnating alternative fluids.[8] This problem was affecting all three elements in a dish: ingredients, techniques and presentation (Leschziner 2015, 64).

Vacuum impregnation had been a research subject for the UPV group over the previous years. As mentioned above, vacuum impregnation consisted of extracting air from a product's porous structure and filling the pores with liquids such as applesauce and avocado sauce that are impossible to attain with state-of-the-art techniques (Leschziner 2015, 196). However, this work had centred on theoretical and basic laboratory research rather than any other aspects. Some PhD and graduate master theses had also been developed on the topic.

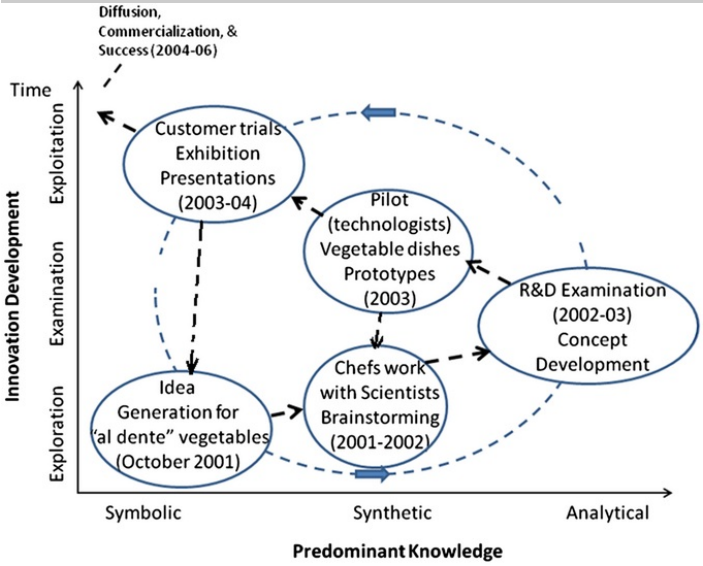
During the exploration phase, and as a result of brainstorming exercises with both chefs, the researchers concluded that vacuum impregnation techniques could be applied in the kitchen for cooking vegetables. Thus, instead of using fruits or other products, vegetables could be impregnated and cooked with water at much lower temperatures without the presence of oxygen, hence avoiding the oxidation of the vegetables, jellifying the starch and conserving the texture, colour and original characteristics of these products, especially 'a crunchy texture.' Additionally, the new technique would improve food flavour and enhance vitamin content. In the case of fried dishes, it could maintain the level of polyunsaturated fatty acids.

In the case of Sergio Torres, he outlines that 'the vegetables were more flexible now and this allowed me to prepare vegetable cannelloni with zucchini and beetroot.' Javier Andres remarks that the vegetables 'must have a bite and its color should be as genuine as raw vegetables.' Both chefs emphasised that they 'were pursuing intensifying local terroir flavours.' These requirements were clearly symbolically rooted in new tendencies. The orientation of dishes to disguise their appearance was a clear symbolic message. Pears are tasting as apples, pasta disguised as vegetables, etc.

During 2003, the researchers and chefs worked together at the UPV labs carrying out some trials. At first, there was some culture shock as chefs and scientists tried to adapt to each other's way of thinking while symbolic knowledge converged towards synthetic knowledge. 'We spent the first month just trying to agree on a common vocabulary,' says Sergio Torres. The work methodology was based on trial and error or 'learning by doing.' Then, they had to learn the scientific way, learn a systemic methodology and a planned, alternative way of working. The trials and tests had to utilise physical variables such as pressure, temperature, hardness, colours and textures (see Figure 2), while the results had to rely on objective essays and sensory analysis. It was a phase where analytical knowledge was the base and tacit (chefs') and explicit (researchers') knowledge interaction took place extensively.

AQ32

Figure 2. Knowledge phases and innovation activities in the Gastrovac innovation process. Source: Authors.



The translation of various symbolic concepts into analytical terms and vice versa posed additional problems. '… How could we translate texture into a scientific term which you can measure?' argued Javier, the chef, which was finally solved through the use of a micro laboratory press and measured in newtons, and vice versa, '… How could we convey the measure of pH into culinary terms?' observed Javier Martinez, the scientist. Furthermore, for the chefs, Javier and Sergio, it was difficult to understand the very concept of boiling at temperatures lower than 100 °C with the consideration of a second physical variable: pressure.

For the chefs, it was a burdensome and over-lengthy process. 'Were we cooking "in a vacuum" or vacuum cooking?' Within months, however, the first prototype had been completed. It was an ungainly contraption with three parts joined by

long hoses and cables. 'We called it our garage model,' says the researcher 'because it looked like something a mechanic would put together.' However, for the chefs, this phase, developing a prototype, was very creative since they felt they were contributing to creating a breakthrough cooking device. 'We gained satisfaction from turning an idea into a real prototype …' the chefs enthused.

The above paragraphs show that the tensions discussed before and between the exploration and innovation implementation phases were not based on knowledge appropriation but in the sharing of antagonistic knowledge: symbolic knowledge vs. synthetic and analytical knowledge and its conversion.

The milestone for the end of the examination phase was the presentation of the prototype, branded Gastrovac®, at the San Sebastian Conference in November 2004. The live presentation covered techniques for cooking asparagus, carrots, potatoes and marrows 'al dente' in such a way that would, in the words of Javier Andres, a leading chef, 'respect the vegetable.' The presentation was a total success. It became clear that this new technique called for a re-education of the consumer since the final product's appearance and the taste was quite different from those cooked in conventional techniques. Here, the new concept for vacuum cooking was developed and accepted by the chefs' community. Many chefs attending the conference came up to the stage to try the prototype, and even Ferra Adria was impressed by the demonstration commenting, 'it was a milestone in cooking.'

5.3. Exploitation phases: industrial development and marketing

During the San Sebastian Gastronomy Conference, the researchers began to negotiate the exploitation of Gastrovac with the general manager and owner of International Cooking Concepts (ICC), Marc Calabuig. In the meantime, the possibility of protecting the technology through a patent was evaluated. However, design or utility model application was finally applied for, and later a PCT patent was registered.

ICC is a small firm, established some 15 years ago, that develops custom-made cooking solutions to cater for the daily needs of top chefs. It has two clearly differentiated business areas: kitchen tools and appliances, and the newly developed premium food and beverages area. They work with chefs as partners at both ends of the scale, on the one hand, collaborating with them to develop tools and appliances and, on the other, trying and testing pilot products to achieve the best results. They have a workshop kitchen at their premises in downtown Barcelona where they schedule presentations for sales representatives, provide customer service and schedule a whole range of activities to bring their products closer to their users.[9] ICC represented synthetic knowledge management.

After evaluating the technology, ICC decided to purchase it and signed an agreement with the UPV and both chefs. They hired Selecta, a medical equipment designer, and manufacturer, to design the industrial version of the equipment based on the UPV researchers' drawings and garage model.

Selecta developed the first industrial prototype that was presented at Hostelco, the International Restaurant, Hotel and Community Equipment Exhibition, in 2005. Then, the first pilot series was handed to Sergio Torres and Javier Andres (the initiators) and other top Spanish Michelin chefs, such as Andoni Arduriz, Joan Roca and Ferra Adria as well as other European restaurateurs. The pilots were first tested in the kitchens of the collaborators and, after extensive trials, recipes were written and included on the menus of their restaurants. Some of these recipes can be found on ICC's website. A final version was marketed and a second version was developed later, in 2007, alongside some auxiliary gadgets, such as a smoker and a filtering system (see Figure 3).

AQ60 Figure 3.

As a means of disseminating the technology, the researchers, in conjunction with the chefs, published an article in the recognised gastronomy journal, *Apicius*. This publication included details of Gastrovac, as well as some recipes including the groundbreaking dish of Sergio Torres 'Mushrooms impregnated with forest flavours.'

5.4. Commercial exploitation and diffusion

It could be considered that Gastrovac has been a success. Until the end of 2015, Gastrovac has sold approximately 509 units, not a poor sales figure if we take into account its price (€ 4000). These units have been sold primarily (95%) to high-level restaurants throughout the world and the rest to food research labs. The initial application of the invention has expanded worldwide. Currently, the technology has new and ample applications, and it can be utilised for steam cooking of fish, vacuum frying of fish, chicken, vegetables or fruit at lower temperatures, smoking fish, marinating various types of food, etc. It has been recognised worldwide as a standard technology for vacuum cooking as the following quotes show.

The reasons are that from the very beginning, there has been a very strong involvement on the chefs' side, which has facilitated a steep adoption curve. Since the launching of the project and during the first year, 30 chefs had already purchased their own Gastrovac, including Wylie Dufresne, Joan Roca and no surprise, Adrià. The price puts the device out of the reach of most non-professionals, but Marc Calabuig, director of International Cooking Concepts that markets the Gastrovac, notes that one home cook has made the investment, and he expects more to follow. 'The line between professional cooking and home cooking is blurring all the time,' he says. Simon Rogan, chef-proprietor of Michelin-starred L'Enclume in the north of England, is a Gastrovac convert. He uses it to make deeply flavoured stocks that thicken without any thickening agents because of the sucking-in effect when the vacuum is released. He maintains, '… Gastrovac facilitates new opportunities to creativity and dish designs for cooking vegetables, meat, fish or poultry; we were not aware we were opening a new road in cooking.' [10]

Gastronomy critics have also praised the invention. Quotes include,

The newer, sleeker version of the Gastrovac, developed earlier this year, still looks like a pressure cooker attached by a rubber hose to a high-tech hot plate, but its functions are thoroughly space age. By lowering atmospheric pressure, it brings liquids to boil at temperatures much lower than normal – 55 °C for water, 80 °C for oil – while still cooking more quickly than traditional vacuum cookers. Lower temperatures and shorter cooking times keep the cellular structure – as well as the colour, texture and nutrients – of foods intact. But that's not all: by pushing a button on the Gastrovac that breaks the vacuum, the device essentially turns the food into a sponge, sucking the poaching liquid into the pores where oxygen used to be. The result is a deep, penetrating flavour, without the need for a lot of butter or oil. And because food prepared in a Gastrovac has most of its oxygen removed, it oxidises at much slower rates; sliced Gastrovac'ed peaches and apples can last days without turning brown. [11]

Francois Simon, a well-known French gastronomic writer, wrote in his blog: 'Here is a device that is appearing in every kitchen. As ugly as it is attractive, it works like this: by creating an artificial low pressure atmosphere in the absence of oxygen', Gastrovac significantly reduces oxidation, can boil at 50 °C, fry at 90 °C, limiting discoloration of the food and preserving the original flavour.

It makes a 'sponge effect': when the atmospheric pressure is restored, the food absorbs the liquid around it, allowing infinite combinations of flavours of foods raw or cooked … and has entered in most nouvelle cuisine restaurants such as those of Alain Senderens or Bertrand Guénero. [12]

Pascal Barbot, a three-starred French chef, has been one of the leaders in developing recipes and utilising Gastrovac at AQ33 his restaurant. He stated (Barbot et al. 2009) that it

… is a compact device for vacuum cooking and impregnation, patented in 160 countries and used by more than 40 first line chefs worldwide … it provides a priori definition of a new vacuum used either for food preservation but an instant kitchen, respectful of the product and offering an endless variety of combinations … with highly attractive dish designs.

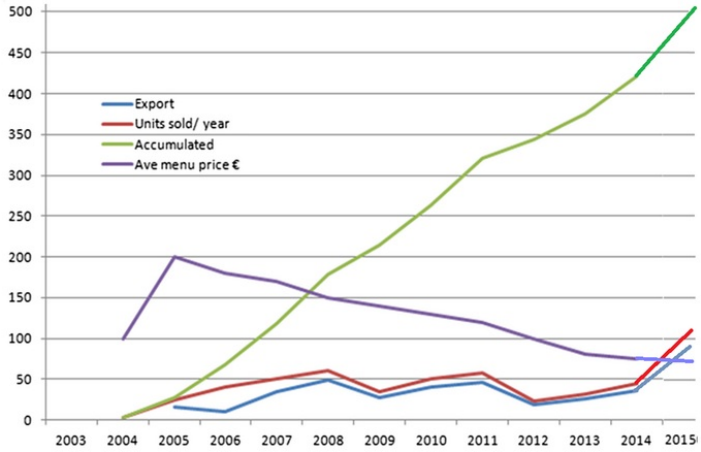
Kevin Cherkas in Malaysia recognises that

Gastrovac creates the sponge effect, that is, when atmospheric pressure is restored, the food absorbs the liquid around it … with Gastrovac we can make peach feel like butter in the mouth … and adapt it to our ethnic cuisine. [13]

The invention merited columns in scientific papers, the general press, journals and gastronomic media, such as *Apicius*.[14] This fact, as well as its presentation at various trade fairs and the recipes published on the ICC website, contributed to Gastrovac's technological dissemination.

Figure 4 below shows the evolution of the case study, and the Gastrovac units sold since the product's presentation in 2005. The figure also reflects the average menu price of the restaurants acquiring the equipment. The graphic shows the diffusion curve that reflects a quick adoption curve. The effect of adopting the technology in restaurants whose average menu price is progressively lower shows that lead chefs (higher priced menus) lead the purchasing of the technology, which is followed, on the adoption curve, by chefs at lower price restaurants. Whether lower segmented models of the equipment will be developed for domestic use is something that will depend on the speed of the adoption curve and market conditions. Nevertheless, this is something that can be expected, given the evolution of this type of gadget.

Figure 4. Units sold vs. average restaurant menu prices. Source: ICC data, 2014.



At the time of writing this article, the researcher Xavier Martinez is establishing contact with a domestic appliance manufacturer to explore the development of a domestic-oriented Gastrovac that could be produced at a much lower cost.

6. Discussion and conclusions

Figure 2 below attempts to represent the Gastrovac knowledge process innovation phases as per the model suggested in Figure 1. It epitomises all the project developments and classifies them. It shows the way the knowledge phases follow the symbolic–synthetic–analytical knowledge evolution as suggested in Figure 2. We may conclude that symbolic knowledge leads the innovation process through the idea generation process of the chef. Synthetic knowledge bridges the chef's communication with scientists, and analytical knowledge will support later science-based development.

The predominant knowledge in the exploration phase was symbolic where aesthetics or taste were defined as crunchy, crusty, bite, etc. and life colours and flavour mystification (pear taste in an apple and vice versa) were sought. During this phase and the initiation of the examination phase, chefs collaborated with scientists to pursue the above symbolic objectives. Here, it was possible to observe a tension rather than a collision between personalities consisting of the difficulties of communicating and managing conversion between symbolic and synthetic knowledge. The symbolic objectives had to be translated into physiochemical variables, basically synthetic knowledge.

The concept development was based on a predominantly analytical knowledge where problems were solved and gave way to the development of pilots, based again on synthetic knowledge where the dish designs and recipes again facilitated symbolic messages for recognising the initial objectives.

During the exploitation phase, the process included understanding and absorption of synthetic knowledge, converted into symbolic knowledge. Clients and reviewers would be attracted and approved by symbolic knowledge coded in aesthetic values.

Additionally, as in all phases, there was a conversion from tacit to explicit knowledge (learning the technique and new recipes). Here, the whole action is experimental. This step is fundamental for later diffusion and success in the commercialisation phase was based almost totally on symbolic knowledge and guidance: acceptance by critics and Michelin inspectors.

But the whole process is not linear; there is recirculation between the various phases. The initial idea of applying vacuum for cooking of vegetables has been later, after further testing, applied to frying meat and fish at lower temperatures

and impregnating and colouring vegetables with opposite flavours. Thus, the innovation has contributed to modifying flavours and dish presentation.

However, it can be observed from the case description that there is overlap between the various phases. As an example, analytical knowledge is utilised to support symbolic knowledge as a means of facilitating the chef's idea creation phase. In the general case of services, there is a certain ambiguity in the whole innovation process as Hipp and Grupp (2005) have cited and as Gomez and Bouty (2009) and Ottenbacher and Harrington (2007a, 2009) have pointed out in the case of Haute Cuisine. We believe that the model is also compatible with the suggestions of Manniche (2012) who considers the three knowledge bases as ideal constructs applicable to communities of learning (in this case, chefs) and to sectors relying on various knowledge bases.

The case study analysis allows us to understand better the suggested model and perhaps extend it to culinary services innovation. Equally, we must outline that all the phases involved in Haute Cuisine innovation have a strong tacit content and present high ambiguity where conversion from explicit to tacit knowledge, and vice versa, follows a continuum.

Here, we must outline the relevance of symbolic knowledge that has instilled Haute Cuisine and culinary tendencies. Today, few cooks dare to serve a salad or a dessert with the corresponding balsamic vinegar or chocolate decorations. AQ34 Symbolic knowledge has allowed local cuisine to be branded internationally (Byrkjeflot 2012; Manniche and Larsen 2013). Aesthetics are the base of kitchen discourse … 'chefs construct a range of Metaphors' … which are 'spread within the kitchen community …' (Fine 2009, 218). Symbolic sectors such as art and design have contributed to a new language in Haute Cuisine and thus to the culinary field (Messeni-Petruzzelli and Svejenova 2015)

It could be discussed whether the model could be applied to other cultural and creative service innovations and the determinant fact could be the predominance of symbolic knowledge and its transformation into synthetic and analytical knowledge during the innovation's development (Caves 2002; Todtling and Trippl 2006). In this direction, some authors (Berry et al. 2006) have pointed out the case of Cirque du Soleil as a creative innovation where knowledge undergoes a symbolic synthetic, analytical transformation to develop a show and allow its repetitions technically. The model contributes as a potential tool for understanding innovation in creative service environments.

The case study shows the trend in Haute Cuisine towards formalising innovation processes on the one hand, and the need to transform tacit knowledge into explicit knowledge (in all innovation phases) to stabilise quality, and to transfer this knowledge to employees or colleagues on the other hand. However, the strong tacitness of the entire process must be pointed out. This tacitness and the need for technical skills on the part of the chef constitute the main barrier to imitation as has been mentioned by various authors (Albors et al. 2013; Harrington 2004a).

Nevertheless, although so far, culinary innovation processes are based on 'learning by doing' and trial-and-error methods, and because innovation is not a formalised process, the acceptance and recurrence to scientific approaches by chefs are remarkable, as confirmed by the current take-up of Gastrovac.

Again, the role of science and technology appears as a tool that supports a chef's creativity but does not substitute for it AQ35 or drive it (Arboleya et al. 2008; Gomez and Bouty 2009; This 2008). It is as well a support for symbolic AQ36 messages (Cousins et al. 2012). The applications and recipes that can be found for Gastrovac have all been developed and approved by chefs, and include a large variety of food: meat, poultry, fish, fruits, vegetables, etc. A minority of chefs today (three-starred Michelin chefs) carry out innovation in a formalised and systematic way. A recent survey of leading Spanish chefs showed that only 4 of 26 dedicate a fixed time of their work schedule to innovation activities or have a dedicated space for them.[15]

Another relevant conclusion is the role played by top chefs as masters (Albors et al. 2013; Stierand et al. 2008) in leading AQ37 product and process innovations. The collaboration of chefs with scientists is a novelty that may announce a trend for this type of service, which may support its consideration within knowledge-intensive services taxonomy. Innovation plays a role in differentiating and branding chefs' oeuvres (Albors et al. 2013).

It is significant that this new way of cooking also needs, or is favoured by, cultural changes on the customer's side (Albors et al. 2013; Ottenbacher and Harrington 2008). Media plays a crucial role in contributing to this symbolic cultural change (Harrington et al. 2009; Ottenbacher and Harrington 2009). Leading chefs motivate the market socially, and their customers act as early technology adopters while the media plays a key diffusion role. Moreover, international networking is essential to expand these innovations (Sundbo, Orfila-Sintes, and Sørensen 2007).

Summarising, we can conclude that Haute Cuisine innovation doesn't follow a linear but a systemic model as some current schools have proposed (Capdevila, Cohendet, and Simon 2015; Fine 2009, 88, 89; Lane, Lupp, and Lup 2015; Leschziner 2015, 84; Messeni-Petruzelli and Savino 2014; Stierand, Dörfler, and MacBryde 2014; Svejenova, Mazza, and Planellas 2007). Additionally, the proposed model can help explain the innovation, diffusion and adoption phases which interact with the initial idea generation. Our case supports other comprehensive theories (Beaugé 2012; Manniche and

Larsen 2013; Opazo 2012; Slavich, Cappetta, and Salvemini 2014; Svejenova, Mazza, and Planellas 2007). It also helps understand the institutional factors as the role of reviewers and critics (Durand, Rao, and Monin 2007; Lane 2013).

In third place, the research case contributes to a better understanding of the tensions between the exploration (creativity) and exploitation (adoption) phases of innovation affecting chefs (Andriopoulos and Lewis 2009; Fine 2009, 176, 89; Knight and Harvey 2015; Lane, Lupp, and Lup 2015; Leschziner 2015, 100; Slavich, Cappetta, and Salvemini 2014) by the conflict associated with the conversion of symbolic to analytic and synthetic knowledge which the case study illustrates.

In a fourth place, the research concludes that rather than a leading role, science and academy play a supportive character solving the symbolic requirements of chefs with analytic and or synthetic knowledge (i.e. Abecassis-Moedas, Sguera, and Ettlie 2016). This fact has been identified by other authors as critical (Capdevila, Cohendet, and Simon 2015; Gomez and Bouty 2009; Leschziner 2015, 52; Messeni-Petruzzelli and Svejenova 2015; Svejenova, Mazza, and Planellas 2007).

Finally, and from the practitioner's point of view, it must be outlined that the tensions between the exploration and innovation phases could be overcome by proper management and communication of symbolic and synthetic and analytical knowledge by education and training of both scientists and chefs. Here is where modern culinary academies play a relevant role in assessing the model presented above: we have selected a case study describing Haute Cuisine innovation development. Which are the reasons for choosing this case? In the first place, it represents a complex, and representative, innovation case involving all the stages of innovation including the exploration and exploitation phases which have been deemed as conflictive by academic literature. Secondly, it represents a singular case of disruptive innovation which has meant a breakthrough in Haute Cuisine from the practitioners as well from the culinary academic point of view since it covers three basic techniques such as cooking, frying and impregnation (Leschziner 2015, 52–54) that can influence as well ingredients' properties. Thirdly, it involves all the agents involved in Haute Cuisine: chefs, scientists, chefs' networks, conferences, technologists, guide reviewers and customers. Finally, in fourth place, it shows that the systemic and knowledge aspects of innovation which have been dealt in the previous discussion, all in a period reveal the innovation lifetime. Before selecting the case, the authors had discussed various cases showing innovative dish developments, but none of them could be as productive as the case analysed here.

Disclosure statement

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[2] Paul Bocuse, Alain Chapel, Jean and Pierre Troisgros, Michel Guérard, Roger Vergé and Raymond Oliver.

[3] See Murphy (2015).

[4] Michelin Organization data for 2015 retrieved by mail.

[5] 'Hasta la Cocina', *Club de Gourmets*, 409, 14–27.

[6] *TIME Magazine*, April 2006.

[7] Both chefs worked with their brothers, but both were responsible for innovation in their restaurants.

[8] It was developed by Georges Pralus during the mid-1970s and trialled at the Restaurant Troisgros in Roanne (France).

[9] See Fernandez (2006).

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