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A Systems Integral Approach in Exploring Creative Innovation in Culinary Research: The Example of Seaweed in the Context of the New Nordic Cuisine

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Abstract

Creativity and innovation in culinary research have gained steady academic interest over the last decade. The scholastic interest in creative innovation ranges from its artistic value to culinary creations, gastronomic experiences, and food science and technology. Creative innovation is important for food enterprises to succeed in a highly competitive market. In the context of the New Nordic Cuisine, entrepreneurs and chefs are constantly challenged to bring something new to the dining table. In this context, the processes of creative innovation remain under researched, particularly in the use of seaweed. As such, using the example of seaweed, a relatively new food in the New Nordic Cuisine, the objective of this corpus based study was to explore creative innovation from a systems integral approach, in order to uncover salient themes that contribute the processes of creative innovation in culinary research, and bringing new foods to market. For a corpus driven study, we built a small corpora of interviews with chefs, and food entrepreneurs. We enquired after what inspired and motivated them when faced with a challenge of bringing a relatively new food to market, or in creating new dishes with new available food technologies. The results suggested that food technology plays a critical role in creative innovation, and the resulting new dishes that can be presented to customers. They also suggested that seaweed in the New Nordic Cuisine is an emerging food concept, and that it is embedded in a social and cultural history and familiarity of the Nordic people.

Keywords: Culinary research; Creativity; Innovation; New Nordic Cuisine; Systems integral theory

1 Introduction

Creativity and innovation in culinary research have gained steady academic interest over the last decade. This interest ranges from the artistic value (Stierand & Lynch, 2008), the scientific aspects in cooking (Mouritsen et al., 2018; Mouritsen et al., 2012), how the processes are managed (Feuls, 2018), to their role in haute cuisine (Messeni Petruzzelli & Savino, 2014). Creative innovation is after all considered the very ingredient needed for organization and enterprise success (Harrington & Ottenbacher, 2013; Tohidi & Jabbari, 2012). It can for instance also be applied when developing sustainable seaweed based materials for creations in fashion (Buet, 2020; Hurtado et al., 2020).

We use the term "creative innovation" following the example of scholars in the field of international business (Feldman, 2008). These creativity researchers, in light of the global market-

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Nomenclature

NNC the New Nordic Cuisine (NNC) is a food movement that began as a manifesto in Denmark in 2003. It was formulated by gourmet chefs and entrepreneurs who emphasized foods sourced from the Nordic region.

HoReCa in this study, HoReCa (hotels, restaurants, and cafés) refer to business enterprises, and their actors and stakeholders that made up part of the group of individuals interviewed. As business owners, they provided rich insights on their processes of innovation and creation of new dishes, new practices as well as their food and life philosophies.

IMP Integral methodological pluralism (IMP) refers to a theoretical approach attributed to the works of Ken Wilber (Esbjörn-Hargens, 2010; Marquis, 2007; Wilber, 2007). The theoretical framework It combines notions from philosophy, psychology, and human cognitive development, that transcend disciplinary boundaries in a unified or holistic perspective that supports sustainable ecology.

Kwic Keyword-in-context (kwic) analysis, refers to a function of the concordance software AntConc. It allows users to retrieve search terms and keywords, as they are used by the respondents in the corpora. Kwic analysis is a means to locate, and provide this study with relevant respondent transcript examples, as part of the corpus data driven findings in this study.

place and increasing convergence of technology and science, tend to view creativity and innovativeness as essentially synonyms (Amabile & Pratt, 2016; Woodman et al., 1993). Similarly, creativity and innovation are co-constructing material processes, particularly in the field of culinary research, where advancements in technology enable new food applications and culinary creations (Feuls, 2018; Mele & Russo-Spena, 2016; Schumpeter, 1947). Creative innovation has also been studied from various theoretical perspectives, such as enterprise or firm ambidexterity in the field of international business studies (Chang et al., 2014; Kurniawan et al., 2020), relational sociology in economic theory (Feuls, 2018), actor network theory (Huggins & Thompson, 2015; Voeten et al., 2015), and entrepreneurship theory in small social businesses (de Bruin & Shaw, 2011; Messeni Petruzzelli & Savino, 2014). Using phycogastronomy (seaweed gastronomy) set in the context of the New Nordic Cuisine (NNC) as example, this empirically based study built upon these studies to develop a holistic model of creative innovation in culinary research. We aimed to employ an empirical basis in the field of creative innovation to build a model using a systems integral theoretical approach. The novelty of our contribution was both practical and theoretical. The model contributes to business practice knowledge by using transcribed empirical data and turned it in into a small corpus database. As creative innovation is both an activity and a process that takes place in culinary related arenas, from drawing boards to kitchens, and in the contexts of HoReCa (hotels, restaurants, and cafés), we used text analysis to uncover common creative innovation elements across different contexts and individuals. We contributed to the theory by applying a systems integral approach towards a creative innovation model/tool.

Holistic models of culinary innovation have been created in order to understand the phenomenological or lived experience of chefs (Stierand, 2009) and to understand personality, socio-

culture, time and the development of talent in the field of art (Csikszentmihalyi, 2015). We invited scholars/practitioners to pursue the challenging task of holistic, unified or system integral perspectives and theories, consolidating views from various disciplines in order to give more comprehensive overviews to objects / subjects of study. There were three research questions (RQ) addressed in this study.

RQ1 What general elements can be identified in the creative innovation process?

RQ2 How do these elements apply in the context of phycogastronomy in the New Nordic Cuisine context?

RQ3 How does a system integral perspective and model of creative innovation compare to other holistic models in extant literature?

The first two pertained to the pragmatic aspects of (i) identifying creative innovation elements and (ii) how they are observed / applied in the field of phycogastronomy. The last RQ addressed theory.
The structure of this paper is as follows. The Introduction in section 1 states the research focus of this paper within the academic inquiry of the processes of creative innovation, using phycogastronomy in NNC as an example. Section 2 gives brief overviews of state-of-the-art literature of the three subjects at hand:

1. the New Nordic Cuisine and phycogastronomy,

2. creative innovation including a systems perspective to creative innovation and

3. systems integral theory.

Section 3 details the data collection and analysis methods. Section 4 discusses the findings of the data to address the RQs of this study. We propose how elements of the creative innovation process can be modelled using a system integral perspective. Section 5 gives a synopsis of the study, as well as the limitations of our model and suggestions for further research.

2 Literature review

2.1 New Nordic Cuisine and phycogastronomy

The NNC began as a manifesto in Denmark in 2003. It was formulated by gourmet chefs who emphasized foods sourced from the Nordic region (Byrkjeflot et al., 2013; Leer, 2016; Micheelsen et al., 2014). A long-standing notion in the field of gastronomy, particularly in wine and cheese is the concept of terroir. Terroir refers to the unique resource of soil, climate and processing methods that connect products with a geographical region, people, and food heritage. These qualities allow food producers to differentiate products (Charters, 2010; Li et al., 2017; Wilkin & Sinclair, 2007). The NNC expresses the following four principles: freshness, purity, simplicity and ethics (Mithril et al., 2012). It employs the concept of Nordic terroir, leveraging the region"s cool climate, slow growth conditions and seasonal fluctuations. These properties of Nordic ingredients allow chefs to offer and be creative with them. The NNC also upholds the Nordic perspective of circular / regenerative farming, sustainable food sourcing and keeps high ethical standards of animal welfare (Bech-Larsen et al., 2016; Micheelsen et al., 2014). Nordic cuisine was put on the international culinary map with the support from actors and stakeholders from various sections of society. They include key players such as such as chefs, entrepreneurs, policy makers. It was further aided by participation from private and public organizations, institutions and communities of practice in the NNC (Bech-Larsen et al., 2016; Leer, 2016; Micheelsen et al., 2013). As part of the NNC, restaurants began offering menus consisting of culinary creations that were a remix of traditional Nordic staples, as well as foods that were up to that time rarely associated with human consumption in the Nordic countries. Seaweed, the subject of our paper, is such an example (Bech-Larsen et al., 2016; Haugan, 2015; Mouritsen et al., 2013). Seaweeds are found along coastal regions with suitable habitats around the globe. It is believed to have been part of the diet of coastal living humans from ancestral times. Newer studies

show that seaweed consumption contributes to the rapid development of the human brain (Cornish et al., 2017; Haskell-Ramsay et al., 2018). There is also a significant body of evidence suggesting that regular consumption of seaweed can contribute to the overall human health (Brown et al., 2014; Michalak & Chojnacka, 2018). Phycogastronomy has developed quite differently in Asia and Northern Europe / the Nordic region, as evidenced by the culinary history and heritage. During the Heian Period in Japan (794-1185), wild-gathered seaweeds were considered extraordinarily luxurious, consumed mostly by the noble classes. Nori became a popular ingredient in Japanese cuisine maki-zushi in the Edo period in Japan (1603-1867). Nori was specially reserved for Japanese nobility and could not be purchased in public markets. It was used in a traditional dish of boiled rice marinated with rice vinegar, sugar, salt and other ingredients such as fish, vegetables and seafood (Mouritsen et al., 2018). The consumption of seaweeds is similarly widespread in the neighbouring countries China and Korea. As such, Far Eastern countries such as Japan, Korea and China are considered phycophages and have kept the inclusion of seaweeds in their everyday foods from ancient times (Mouritsen et al., 2018).

In the European context from about 1400 years ago, seaweed harvested in coastal Scotland and Ireland was used by the poor to feed themselves in the form of Lhavan or Lhawvan (black butter). Lhavan was derived when seaweed was added to seafood and boiled for several hours, then spread on top of oat bread (Newton, 1951; Sexton, 1998). In the Nordic context, the use of seaweed was associated with poverty and thrift. Going back to the early Viking period, seaweeds washed on shore during storms along Nordic shores were picked, dried, and fed to animals, as well as used as soil fertilizers. It occasionally supplemented human diets during times of famine. This connotation of seaweed as "poor man's food" or "animal feed" remains until today in most general Nordic households, with the exception from the early 2000s. Phycogastronomy was heavily promoted by elite European and Nordic chefs (Efstathiou & Myskja, 2019; Indergaard, 2010; Mouritsen et al., 2012). Seaweed for human consumption is a relatively new concept. It is part of the NNC diet that encourages a more vegetable based nutrition. This concept might prove challenging to introduce to Nordic consumers (Haugan, 2015; MacArtain et al., 2008; Mouritsen et al., 2012). It is this challenge of repositioning seaweed in the world of Nordic cuisine and gastronomy that makes for empirical study of the elements of creative innovation particularly interesting, as it is an evolving concept aiming to entice general consumption.

2.2 Creative innovation

Using normative definitions in language use, creativity refers to the act of conceiving something original or unusual. Innovation refers to the act of implementing something new. Creativity and innovation have mostly been studied as separate concepts. In the context of culinary research, the material process of creative innovation, which is the conception and implementation of new gastronomic delights in various culinary settings is key to success for the organization's (as well as industry) competitiveness. If one were to however, consider "creative innovation" in its own semantic context, the very nature of "creativity" flouts the rigidity of structure and labelling/naming. Its very naming pigeonholes and constrains its very conceptual development. For the study of "creative innovation" as a process, one could attempt to name its elements and characteristics in a structural form that is allowed to morph and be malleable according to its context. As early as the late 1800s (Galton, 1869) different schools of thought have approached the study of creativity from various perspectives. They include: the Freudian and Jungian psychoanalytic frameworks (Ferrell, 2015; Freud, 1971; Oremland, 1999), behaviourist theory from the works of Skinner and Watson (Skinner, 1984, 1985; Watson, 1926) and human cognition from the works of Maslow (Maslow, 1961; Maslow, 1962, 1964).

Moving beyond normative definitions however, processes of creative innovation seem to permeate human evolution. Humans have been solving problems and facilitating efficiency from the fashioning of tools in the Palaeolithic Age, through the development of organized agriculture and

the domestication of animals in the Neolithic Age, to modernity. Humans constantly strive to better organize ways of living in accordance to different contexts, from tribes to urban cities (Stearns et al., 2014). The multidisciplinary nature and omni-contextual presence of creative innovation has encouraged a systems approach in both the practitioner world and in scientific theory building. This is defined as a framework that is pluralistic, with elements that are constantly evolving and interacting, striving towards a way of living that is ecologically sustainable (Capra, 2005, 2009). A systems approach has been used to understand creative innovation processes from an organizational perspective of creativity at the work place (Puccio & Cabra, 2012). This has been achieved by delving into the understanding of individuals and using case studies as method as a means towards a deeper understanding of the human mind as it goes through various stages of cognitive development (Gruber, 1983, 1988); studying personality types and creativity (Krippner & Combs, 1998); by studying tangent outcomes of creativeness such wisdom in later life and lifelong learning (Rathunde, 1995) and growth of talent in adolescents (Rathunde & Csikszentmihalyi, 1993). A systems perspective characterises the context for experiencing productivity and flow, where "flow" is defined as optimal states of performance without seemingly much effort, as introduced by Csikszentmihaly (Csikszentmihalyi, 1996; Csikszentmihalyi, 2015; Nakamura & Csikszentmihalyi, 2001). Figure 1 presents Csikszentmihalyi's systems model of creativity (Csikszentmihalyi, 2006). Csikszentmihalyi's body of work that began more than four decades ago has several illustrative models of creative processes derived from various contexts of study (Csikszentmihalyi, 2015). Figure 1 (Csikszentmihalyi, 2015) is a key example, if not the most comprehensive model of the creative processes developed by Csikszentmihalyi. The model is based on the model of Darwinian biological evolution where Csikszentmihalyi views creativity as part of the developmental force that drives cultural evolution. For Csikszentmihalyi, "Creativity" occurs at the interface of 3 subsystems. They include the Individual who is selected by the Field of gatekeepers (part of Society) into the Domain from where the novelty will then be accessible to the next generation.
Csikszentmihalyi's systems model of creativity is used here as comparative foundation to the systems integral model/tool developed and presented in this paper.

2.3 Systems integral theory

In creating the systems model of creativity, Csikszentmihalyi (2014) drew analogies between biological and cultural evolution (Atran, 1998; Darwin, 1859; Dawkins, 2006). The interrelation between biology and human culture has been noted in diverse fields of study. The past two decades saw an increasing body of literature reflecting this relationship (Eisler, 2015; Garcia Coll, 2004; Goodman, 2013; Keller, 2016; Reynolds, 2007). In alignment with the evolutionary systems model of creativity presented by Csikszentmihalyi, the framework of systems integral theory in this study has its foundation in the works of Fritjof Capra (Capra, 1985, 2005; Capra & Luisi, 2014) and Ken Wilber (Esbjörn-Hargens, 2010; Wilber, 2001a, 2001b). The difference is that systems integral theory is situated in the field of unified science and theories. Capra's approach is based on evolutionary science which can be defined as a systems approach to systems theory. It combines notions that transcend disciplinary boundaries in a unified or holistic perspective that supports sustainable ecology. Wilber's integral methodological pluralism (IMP) is based transpersonal theory and integral epistemology. IMP is a methodological framework, transcending notions found in various theories of philosophy, psychology and human cognitive development (Marquis, 2007; Saiter, 2009; Wilber, 2007).
At the core of systems integral theory are synthesis and differentiation, depending on the context of application, researcher/practitioner perspectives adopted and the subject of study. Our framework is based on a four-quadrant model that reflects the perspective of the language pronoun system, I (singular subjective), We (plural intersubjective), It (singular objective), and Its (plural interobjective). Systems integral describes the relationship between the part and the whole, both in its structural nature as well as

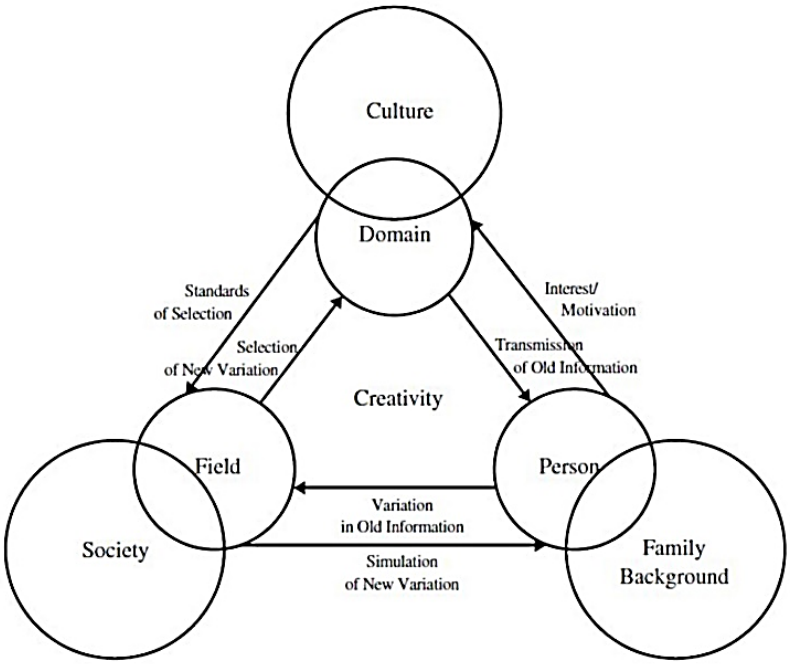

Figure 1: Systems model of creativity by Csikszentmihalyi (2014), p.166)

in its dynamic interactions (Capra, 1985). The idea is that in order to understand any complex system (creative innovation is one such phenomenon), you will need to break it into smaller pieces in order to explain it. And you keep on splitting and deciphering until you end with fundamental building blocks such as elements, substances, particles, sub-particles etc. From these fundamental building blocks or holons (constitute part-wholes), we study their fundamental laws of interaction in context. We are then able to reconstruct the larger whole and explain its dynamics in terms of its properties and parts (Capra, 1985; Koestler, 1970; Wilber, 2001b). Figure 2 shows our adapted version of Wilber´s IMP model.

The four quadrants reflect a language-based pronoun perspective (singular subjective, I, in the upper left (UL) quadrant; plural intersubjective, We, in the lower left (LL) quadrant; singular objective, It, in the upper right (UR) quadrant and plural interobjective, Its, in the lower left (LR) quadrant). Consistent inquiries from these basic perspectives from an interior and exterior view will over a period of time, render specific types of knowledge based on this enabling methodology. Moving anti-clockwise starting with the UL, then LL, UR and LR, what can be noted is the transcending and inclusive aspect of the knowledges when integrated. All knowledge pertaining to the quadrants is related and relative in nature, where the perspectives are considered true but partial (Wilber, 2007; Wilber, 1982). Depending on context of study and perspective taken, disciplines can employ several types of paradigms and methodologies rendering different points of view, and knowledge findings. The eight methodologies and paradigms for gaining irreducible knowledge are: structuralism, phenomenology, autopoiesis, empiricism, hermeneutics, ethnomethodology, systems theory and social autopoiesis (McGregor, 2009; Saiter, 2009; Wilber, 2007). The systems integral model of creative innovation presented in this study will il-

lustrate how elements of creative innovation from other scholastic work such as Csikszentmihalyi's systems model of creativity can be understood in the four quadrant framework shown above.

3 Data collection and method

To develop the dataset, we set out to define the landscape at a seaweed conference held in September 2019 with 8 informal interviews with individuals who worked specifically with seaweed in Northern Europe and the Nordic region. This conference was chosen for the ease of access to individuals with expert knowledge and skillset pertaining to the use and cultivation of seaweed. The individuals represented various industry sectors that worked with seaweed. They were producers, product developers as well as chefs and HoReCa business owners, who used their interest and knowledge of seaweed in their menus and culinary presentations.
Data was then collected from online interviews / presentations. A total of 25 interviews and presentations were retrieved from online sources both in text as well as audio-visual formats. The texts were transcribed in accordance to the Gothenburg Transcription Standard (GTS) 6.4 (Nivre et al., 2004), using Modified Standard Orthography version 6 (MSO6) reflecting spoken language. The transcribed texts were compiled into a small, topic focused corpus that consisted of 82 427 word tokens. The text examples shown in this study occur in GTS 6.4 MSO6.
This study was corpus (data) driven – the visualisation followed a two-step data extraction process using

1. VOSviewer, a software tool for constructing and visualizing bibliometric networks (Cordeiro, 2019; van Eck & Waltman, 2007, 2014; Waltman et al., 2010) and

2. AntConc, a concordance software designed to facilitate text queries / text mining for regular phrases and expressions, performing kwic (keyword in context) analysis (Anthony, 2019).

The corpus was described as "small" as per Flowerdew (1996) with our data falling well in the range for small corpora (20 000- 200 000 words). Our study took advantage of the design and use of small corpora by:

1. greater access and ease of use for collective concordance analysis, from keywords in context (kwic) analysis to word clusters and word collocates (words that co-occur frequently) that make up the foundation of the qualitative findings of this study;

2. facilitating researcher familiarity with the corpus for more efficient retrieval of findings of relevant text examples for illustrations by means of examples;

3. a systemic approach in corpus construction where the corpus was designed and constructed towards a specific topic query and

4. a focus on a specialised subject.

In this case the corpus reflected individuals with expertise in creative innovation as well as seaweed from various industry sectors, enabling focused thematic finds in qualitative text analysis and small corpora (Flowerdew, 1996). The main purpose of constructing such a corpus was to have a depth of understanding of a phenomenon, in this case, uncovering the elements of creative innovation that were then further investigated from a systems integral perspective.
VOSviewer and AntConc both use natural language processing techniques in text mining. They differ in the extent of purpose of construct and use. In VOSviewer, the idea of visualizing bibliometric networks is often referred to as "science mapping". In this study, it was applied to analyse the small corpus for co-occurrence relations between keywords (also known as nodes) or words most often referred to in the data (van Eck & Waltman, 2014). The result of this was thematic salience sorting through word clusters. VOSviewer created a weighted network that showed the strength of the co-occurrence of keywords through the thickness of lines indicated between nodes, the more salient the node, the larger the sphere in the visualization (see Figure 3). The concordance software AntConc gaves a deeper analysis into the text, and into language in use in context. While VOSviewer rendered clusters of keywords that frequently co-occur,

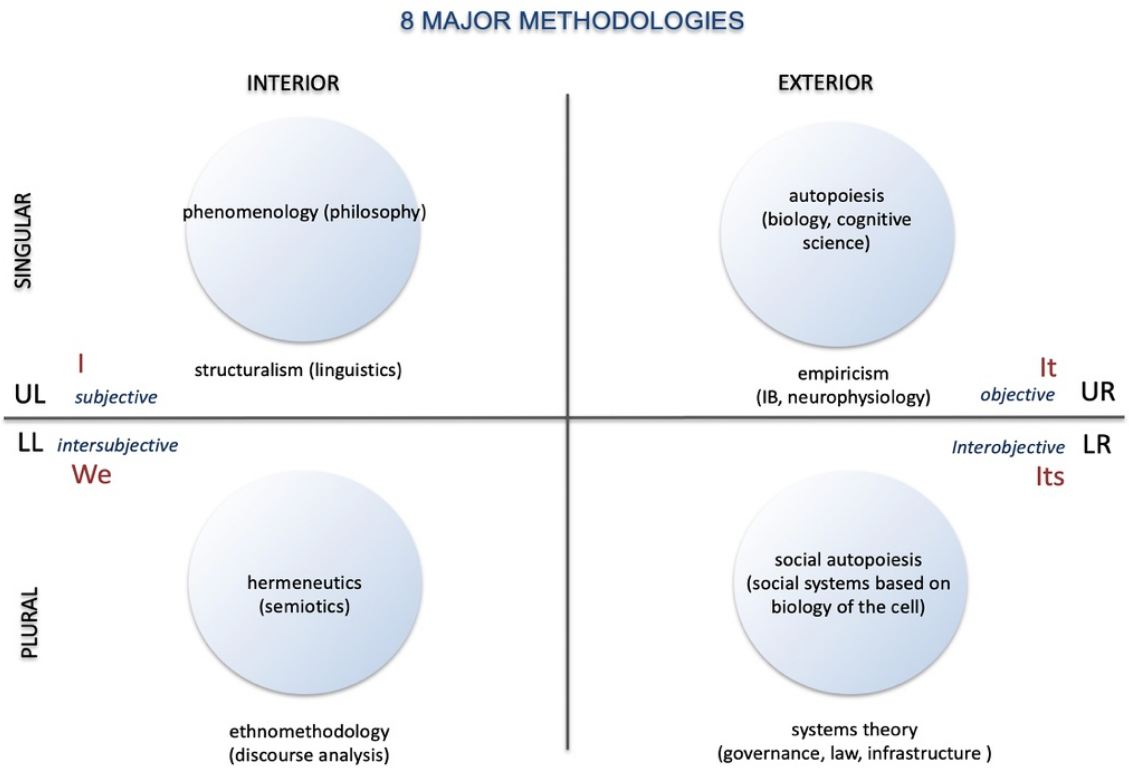

Figure 2: Integral methodological pluralism (IMP) model (Wilber, 2007): 36-37)

AntConc helped identify high frequency occurring words, word collocates, and word clusters in the corpus. It also helped identify in which context these words were used (kwic analysis) in order for it to be used in text examples. Kwic analysis also helped identify and sort accordingly, material actions, mental processes such as thoughts and behavioural intentions of the interlocuters. The purpose of the synergetic use of these two software was to create a triangulation of methods in which clusters of keywords were identified in a rigorous and systematic manner.

4 Findings and discussion

4.1 VOSviewer findings

Figure 3 shows the VOSviewer word co-occurrences network for the data. This data addressed RQ1 and RQ2 (vide supra) by means of identifying and clustering salient themes pertaining to the field of the culinary arts and science. The visual mapping was a result of binary counting with a minimum of 10 occurrences of a term. Of the 5903 terms identified, VOSviewer parameters identified 147 that met this threshold. For each of the 147 items, a relevance score was calculated. Based on this score, the most relevant terms were selected. Default choice in VOSviewer was to select 60% most relevant terms. A total of 77 terms were retrieved in this

manner in 4 semantic clusters (Figure 3).
Table 1 lists the semantic clustering of words that illustrate salient themes from our corpus. Themes can also be retrieved with axial coding, i.e. coding across the clusters. An example of an axially coded theme from this corpus is the reference to names of places, such as London, New York, Singapore, Spain etc. When focusing on creative innovation processes, we identified the first keywords of interest in this study by listing them as they occur in the VOSviewer retrieved clusters. Noticeable in all 4 semantic clusters was that the word "creativity" or its corresponding transitive verbal state "to create" was absent as a salient theme in the corpus. The word "innovate" occured in Cluster 3 (with 13 items). The words that occured in collocation with "innovate" were "child", "concept", "element", "field", "fun", "important thing", "ingredient", "inspiration", "molecular gastronomy", "science" and "study". The semantic cluster of words found in Cluster 3 seemed to occur in specifically addressing RQ1, with elements that bolstered or contributed to the innovation processes in the field of culinary science.
Cluster 1 had 33 items and addressed RQ2. It was the cluster where the word "seaweed" occured. Seaweed occured in cluster 1 despite it being marketed as a "sea vegetable" in the NNC context or in the example of one company as "sea pasta". Sea pasta is the trade name for *Himanthalia elongate* or thongweed. Seaweed is being marketed as part of the sustainable future foods scenario. We have been made aware of that phycogastronomy is currently outside mainstream in the context of the NNC and northern European diet (Transcript 15):

> there are eight there are over six billion people on earth / and they're needing to eat / needing nutrition / and we all know that if we do that under the circumstances we have today we will be challenging ourselves / and seaweed might be one of the options so the future of food for us means finding new alternatives / and also new sources of nutrition / and it has to be sustainable / and bringing them to the middle of the plate as daily food and that's actually... what we challenge ourselves and each other in getting seaweed as an alternative to rice [and] pasta / which we now / we eat every day or possibly eat everyday / so it has to be sustainable and with lots of nutrition and of course those who eat it / it needs to be delicious / otherwise we don't eat it / and that's why we say eat yourself happy / and with that we try to bring a new product / a new category / or new because it [has] already [been] existing for quite a while / but we're not used to eating it and bringing it into the future of food

In Transcript 15 the speaker addresseed the challenges of introducing a new product to an emerging market within the NNC diet: that seaweed is not a staple food, that even if people are becoming more familiar with seaweed as a food, seaweed in itself might not have a reputation of being too flavourful. The culinary heritage of eating rice and pasta in some cultures is difficult to sway and influence. The brief text example from Transcript 15 also carried connotations from other Cluster 1 collocations such as "first time", "challenge", "front", "future", "journey", "ocean", "sea" and "story". Contrasting connotations also occured such as "meat", where in the NNC, a dietary pattern rich in fruits and vegetables including the use of rapeseed, flaxseed and olive oils is highly recommended. The NNC dietary guidelines do not necessarily discourage the eating of meat but note that highly processed meats in long term consumption may be detrimental to health. Semantic connotations in Cluster 2 with 26 items revolved around the individuals as chef or cook and the interests they have outside of their culinary profession, or what inspires them in their own work. Cluster 2 reflected words that could pertain to the person such as "chef", "book" (many chefs are involved in writing their own books), or disseminating their "techniques", "dream" as well as inciting the same "passion" in others. To some chefs, the "show" and "art" of culinary presentation is important. An axially coded theme between Clusters 1 to 3 showed the advancing technologies in the culinary field and "industry" that enable new

"techniques" and "innovations" to occur so that "molecular gastronomy" can be experienced and further refined in "kitchens".

Data bias is a common challenge in small corpuses. One such potential bias is the place London, which occurred in cluster 4. This may have been caused by the experiences described in some of the transcripts. An AntConc concordance plot search for the place name "London" revealed that 6 (of 25) transcripts referred to London in relation to their kitchen experiences. A prominent feature of cluster 4 though was the value word "respect", falling into the same semantic cluster as "head chef", "cook" and "kitchen". A concordance plot analysis returned a total of 19 hits with 9 (of 25) transcripts speaking about respect in various contexts, from "respect for nature and the ingredients we use" and respect in relation to the culinary art and craft as found in Transcript 10:

> respect your predecessors [because] without them you would not have a job there / you might be offered a job at a company that's 100 or 50 or 20 years old / treat it with care / you can change some things / life involves changes and you have to be cold about it / *respect is vital*

In Transcript 21, the word "respect" occurs in collocation with "head chef" in the context of being a chef, being in leadership position and creating good team rapport:

> as the *head chef* you have to be a good leader, mentor and trainer / you have to adapt your kitchen to whatever circumstances you are in / and make sure you have a *mutual respect with your team members* / this is not a popularity contest / but it's important that as a *head chef you lead your team* in the right direction / and *treat people as individuals with respect*

4.2 AntConc keyword-in-context (kwic) findings

The VOSviewer clusters highlighted salient semantic webs that occur in the corpus. While this was helpful for identifying words associated with different contexts in being a chef and the creative innovation process, the notable absence of the word "creative" or "create" for example, indicated possible gaps in the key topic of inquiry for this study. In this section, we discuss how transitive verbs associated with the intangible aspects of creative innovation such as "to create" and "to know" are used in context. While the end product of creation is a tangible, material object, the processes of creation from idea and concept to actual prototype / object is mostly intangible. To fill this inquiry gap, we performed a wild card search on "creat*" and "know*". This retrieved kwic findings for variations of these two word groups.

Findings for "creat*"

AntConc results showed a total of 307 concordance hits with 21 (of 25) transcripts containing words with the base "create*". There were 12 concordance hits with 4 (of 25) transcripts talking about "creative processes"!. Some chefs view the creative process as being both structured and unstructured. The need for structure comes in when creative processes need to be managed in a systematic manner, for example, the study of ingredients for their properties, documenting results from different cooking techniques and designs for presentation and plating. As found in Transcript 13, the creative process for this chef is one that is structured into eight elements:

> unique / pure / texture / memory / salt / south / artisan / terroir // these are the eight most important words in < name of restaurant > / they are the backbone of everything that is created at < name of restaurant > / from a single dish to the restaurant's overall philosophy / [it is] our method of encouraging and managing the creative process / and a principle to live by

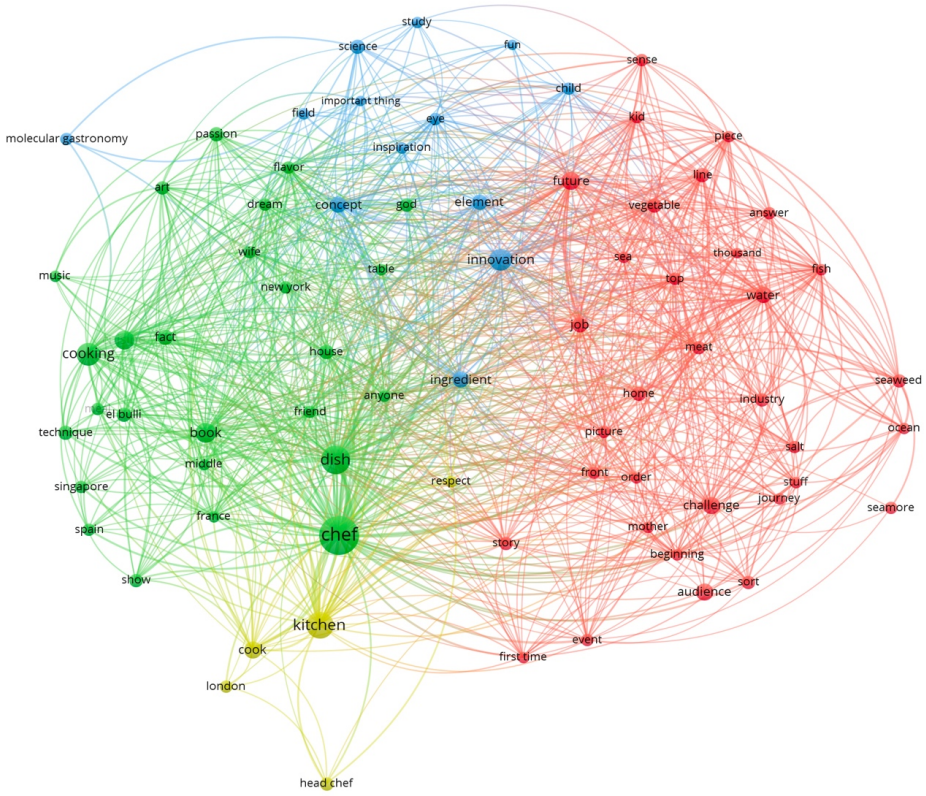

Figure 3: VOSviewer co-occurrence of keywords by strength of association and salience from the study's small corpus.

The act of creating is also associated with the capacity of creating and utilising a new language, thus expressing ideas, thoughts and concepts that were previously not possible without this new language. From Transcript 11, creating fresh cuisine with new cooking techniques was likened to the creation of a new language:

> if you have an alphabet you can then create words / with these words you then create sentences / with these sentences you can then create poems / article / text whatever you want / in cuisine and in with regards to many other disciplines / the way we would see this alphabet in our case / it would be new products / new techniques / new elaborations / new concepts and a new philosophy // I'm going to try to show you what a new language means / . . . I have a very pragmatic approach to creativity // let's see whether it's a language that you can relate to and connect to / it's a new concept called natura and these dishes were inspired by nature they're all desserts"

Because language is social, it is important that it has a shared meaning with many in order to be meaningful and useful. What can be noted here is how the element of familiarity was also present, even in the event of creating a new language. With Latin etymology, the word "natura" can be broadly understood in most modern Indo-European languages such as Dutch, French, Spanish, Italian, Portuguese and Roma-

Table 1: VOSviewer corpus salient themes reflected in semantic clusters

Cluster 1 (33 items)	**Cluster 2 (26 items)**	**Cluster 3 (13 items)**	**Cluster 4 (5 items)**
answer	anyone	child	cook
audience	art	concept	head chef
beginning	book	element	kitchen
challenge	chef	eye	london
event	cooking	field	respect
first time	cuisine	fun	
fish	dish	important thing	
front	dream	ingredient	
future	el bulli	innovation	
home	fact	inspiration	
industry	flavor	molecular gastronomy	
job	france	science	
journey	friend	study	
kid	god		
line	house		
meat	meal		
mother	middle		
ocean	music		
order	new york		
picture	passion		
piece	show		
salt	singapore		
sea	spain		
seamore	table		
seaweed	technique		
sense	wife		
sort			
story			
stuff			
thousand			
top			
vegetable			
water			

nian. That the key actor in Transcript 11 also said "I have a very pragmatic approach to creativity" further supported this idea of accessibility. "Anyone" (found in VOSviewer Cluster 2) can be creative and partake in creative innovation, and it is not only reserved for elite chefs experimenting with rarely used ingredients and innovative cooking techniques.

Findings for "know*"

Close reading of the transcripts indicated that ideas were generally developed through a concerted effort of refining existing concepts and extending / testing new applications from an existing body of knowledge and practices. While chefs might come across as creative geniuses and one with great expert knowledge in kitchens, presenting dishes in a way unexpected by the consumer leading to that unforgettable dining experience, the findings in this section stemmed from looking among others at what chefs say they "don´t know". Aside from building from an existing knowledge base, the aspect of knowing and "to know" was also tied to personal curiosity, learning and exploration. From Transcript 10:

I'm sick of know-it-alls / I know noth-

> ing I'm here to learn / I'm just sharing my experience [of] the things that have happened to me

A similarly expressed thought about "knowing" was found in Transcript 13, where the speaker associated the unknown with the perception of what is unique:

> [to be] unique / [it is] things that we know yet we don't know / ... it is about something that appears at the right environment [at the] right timing / nothing is really unique or not unique

And from Transcript 22:

> I remember the first time I saw the [name of] restaurant website / I was astonished / it was my first glimpse of food that had been prepared and presented in a range of ways / which I had never seen before and could barely comprehend / it was all so simple and understated / yet even as a novice cook at the time / I could tell that the complexity of preparing such dishes must be immense / but how was it all done and more importantly how could I do it / this triggered a desire to learn more about this new / exotic form of cuisine / and my research into a field I came to know as molecular gastronomy / this journey for knowledge opened up my culinary eyes / and introduced me to a whole host of new names and faces I would otherwise have been ignorant of

Both transcript text examples illustrated how "knowing" includes knowing one's own limitations and boundaries, i.e., knowing what you don't know. To understand how "knowing" and "knowledge" contributed to the creative innovation process, a wildcard AntConc search term "know*" used to retrieve variations of the keyword root "know". In this case, it retrieved keywords in contexts that included "know", "knows", "known", "knowledge" and "knowledgeable". Variations of the transitive verb "to know" did not appear in the VOSviewer cluster findings, but it had a concordance hit of 573 instances with 23 (of 25) transcripts containing references to "to know", further supporting the use of a kwic analysis.

An example of taking a familiar ingredient (such as salt) and working with existing consumer knowledge, expectation, and experience with the ingredient, one chef decided to deconstruct the facets of "saltiness" in this food presentation. From Transcript 13:

> [salt is] the first seasoning that we know– so salt has been very important / for me / we are always thinking that can we have a flavour that everybody understands / whether it's lemongrass / or it's chili / or it's curry– / I don't know– a cheese // somehow it's trapped in a certain boundary / but can we have one dish that everybody understands / so I was thinking salt / it's not just the physical salt / but the depth of saltiness / what I mean is for example / soy sauce / fish sauce / ham / anchovy / and sea water or seaweed / they are all different depths of saltiness

However, personal exploration and deconstruction of the familiar is but one facet of knowing. When it comes to the field of phycogastronomy and trying to make seaweed consumption more mainstream in the Nordic countries, know-how of the acquisition of raw produce is vital. Knowledge and know-how for a sustainable business and the challenges faced in seaweed growing is voiced in Transcript 15. It explained in part the core reasons why phycogastronomy is challenging to foster / cultivate due to steady access to raw material:

> it's a strict environment [much] like the wild west / by families who are doing their harvesting and fishing over years / and this being a new [seaweed] specimen / or it's not a new species of seaweed / but it's now being harvested / ... there's not a lot of [government] legislation around it / so you need to find a way looking to different types of seaweed / [and it's] hard to specify with quotas [what is being allowed] to harvest in sustainable ways / so this for

> example we only harvest fifty percent [in] certain areas because we know it's proven that it grows back year after year / so you're still being sustainable / and that's also why we are harvesting from < name of country A> / ... and probably will we are still in < name of country B> next year / where the seaweed harvesting protocols are a little bit further ahead because we need to make sure that we can grow our business

4.3 Systems Integral Approach

This section addresses RQ3. Figure 4 shows our proposed systems integral model of creative innovation in culinary science, boiled down to the elements distilled from the small corpus. Elements from current creative innovation literature, and in particular Csikszentmihalyi's systems model, were reflected in the four quadrants following the 4 primordial perspectives and were also reflected in the language pronouns. Csikszentmihalyi's domains and its sub-domains, "social system - field", "cultural system – domain" and "genetic make-up – person" fell broadly under the UL and LL quadrants of our systems integral model. The interactions and feedback loops are illustrated in Figure 4 by the circling arrows between the various communities of practices and groups of individuals in the plural intersubjective "We" (LL quadrant) perspective. These feedback loops occured in all four quadrants, but for reasons of clarity they are only shown in the LL quadrant in Figure 4.

The main difference between a systems model such as Csikszentmihalyi's and the systems integral model, is how the systems integral model can give multi-levelled, multi subjective / objective perspectives. Figure 4 reflects two types of perspectives, the first (labelled "A" in all quadrants) considers the chef (and the team) as singular subjective "Individual" or "I". Table 2 shows in broad outline, the human-centric perspective "A" and the product-centric perspective "B" as well as their elements that contribute to creative innovation into the four quadrants through applying language-based pronouns.

Starting with the human-centric perspective, when chefs who speak of their own conviction, their food and life philosophy and their passion, these elements could be categorised to form the singular subjective perspective in the UL quadrant of "I". From Transcript 19, a chef narrates his journey to finding his professional identity in what he describes as a personal and individual calling:

> my brother took me there and said / this is the perfect place for you / it's the place where you can express yourself through the food / through your passion / I said to < name > are you sure / he said / yes this is the perfect place / one week later / I was there / because the food world chose me / It's not that I chose that / that was the perfect timing / and in that moment / I realized I had to put all of myself into this world // and the simplest interest for food / step by step became a passion / and through the passion / I realized you can transfer emotions / that's what I think food is / and how I interpret food– just transfer emotions

The plural intersubjective "We" in the LL quadrant are the communities of practice, and different stakeholders in society that support a food movement such as the NNC. They may even support the emerging field of phycogastronomy, either by consumers buying the product, or HoReCa actors placing seaweed dishes on their menus. The consumers can then give feedback to the chefs through interaction either at restaurants or through online feedback forms. As the human being is at the radial centre of this perspective, the singular objective perspective in the UR refers to the enabling technologies of food prepared and presented in a different manner. An example from Transcript 11:

> let's see a technique that is a very new technique / you know liquid nitrogen / well that may seem quite strange but it's a very common product / it comes in a gas form / in this case we use liquid nitrogen / and in this case it allows us to make things that are otherwise impossible / we're making pure alcohol

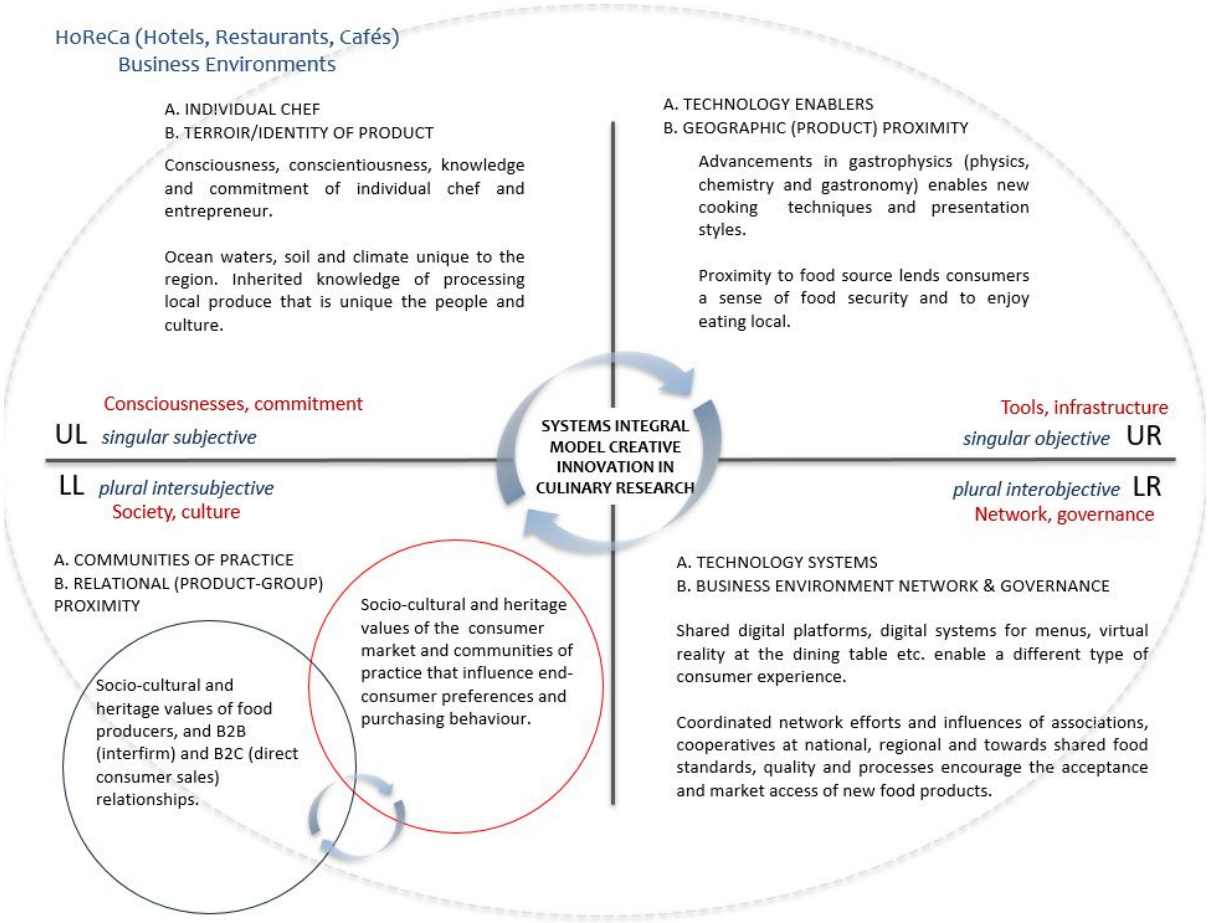

Figure 4: Systems Integral Model of Creative Innovation in Culinary Science

> sorbet / if you put alcohol in the freezer you know that it won't freeze / this is -196 deg C

A continuing theme with regards to the challenges faced in phycogastronomy is technology enablers. This was an element in the UR quadrant, and discussed under Csikszentmihalyi's systems model of creativity under "domain" which refers to "knowledge, tools, values, practices". From Transcript 7, the issue of productivity in seaweed harvest depended on the available harvest technologies, and access to technology. The need for communities of practice and interaction between chefs, food producers and consumers (situated in the LL quadrant) was also highlighted in the following text example, as a means to creative innovations:

> we hire inner-city kids to package / cook / process all of our food / they learn about 3D farming / they learn about sustainability / one of the kids at the school / it's called < name of the school > actually took the kelp and invented a 12 volt kelp powered biodegradable battery // so you know / on the blue green economy / I think we can think much bigger than this / why can't we take my farm and embed it in offshore wind farms / why don't we just harvest wind / let's harvest food / fuel / fertilizer / let's bring it back

Table 2: Systems integral model, human-centric ("A" perspective) and product-centric ("B" perspective)

Perspective	I (UL quadrant)	We (LL quadrant)	Its (UR quadrant)	Its (LR quadrant)
A	Consciousness	Social practices	Technology enablers in the kitchen for the Chef	Industry structure and network
	Commitment	Organizational support	Digitalisation / Internet for HoReCa	Business Environment Network
	Belief	Culture	Alternative food product	Governance
	Passion	Consumer awareness	Relatively new ingredients	Logistics Infrastructure
	Inspiration	Intergroup communication and feedback		Trade agreements
	Aspiration	Values		
		Heritage		
B	Terroir	Product-consumer proximity	Geographic proximity and access to raw produce	Industry structure and network
	Product Identity	Product branding through cultural practices, values, food heritage	Geographic proximity of product to consumers	Systems architecture and network
	Country of origin (COO)	New product support through purchase and consumption	Harvesting technologies	Logistics infrastructure
			Food processing technologies	Trade agreements

The second perspective (labelled "B" in all quadrants) considered the material product as singular subjective "I". In the field of food production and gastronomy, food products are branded, and given characteristics / qualities pertaining to terroir and place-of-origin. For example, in the NNC, products native to the Nordics are used and spoken about as being characteristic of / reflecting the Nordic region climate, soil, air and values (in how the food is processed) and marketed as "flavours of the North". The personification of raw products and products, through conscious and conscientious product branding, builds product identity. This product identity can also be studied from the perspective of the above mentioned four quadrants. Taking the example of seaweed pasta, from Transcript 15, product branding and identity is achieved via association with credible partners such as a bank as business partner, and new food wrapping technology companies that will help decrease the carbon footprint of each package of seaweed pasta sold. All branding and product identity building, depending on the perspective of study, can be situated in the LL quadrant (for supporting business / social partners), to the UR quadrant (for technology enabling partners and product geographic proximity, from harvest to plate) and in the LR quadrant, which is looking towards future regional trade agreements:

> besides the Netherlands / the seaweed pasta is also sold in Germany / Switzerland / Denmark / Great Britain and Australia / various other countries are expected to follow / after the crowdfunding the < name of bank > entered into a partnership with < company name > / the bank not only functions as its personal banker / but even introduces its products at trade fairs abroad // ...the bank is an important bank known for investing in the food and agriculture section // ...as to the transport of the harvest / that is being looked at too / transporters whose trucks would formerly

> travel back empty after having delivered their flowers in < country name > / in the harvesting months now return to < name of country > with a load of seaweed / [so that] the company's ecological footprint will remain as small as possible

The broadest perspective that included and transcended all other perspectives in the four quadrant model was the plural interobjective perspective located in the LR quadrant. The LR quadrant pertains to the broadest perspective of network and governance. For the individual chef (the "A" perspective) or food producer, what could be identified as a subject of study located in this quadrant was how digitalisation is revolutionizing their workspaces and how they communicate with their own community of practice as well as their consumers. One example is how digitalisation and the use of the internet for consumers has made the flow of serving food more efficient. From Transcript 11, the chef and restaurant owners explained how productivity and dining experiences were enhanced for the consumers by use of the internet:

> it's not [the most] logical thing that we'll find in the world / [but] you find long wine lists in restaurants / so if you get there maybe three hours before / [okay] / otherwise you won't have time to read it / in this case the internet can be used very efficiently and wonderfully / you can hang your wine list on internet / and you can look through it at ease / and you get an idea of the wines / and what things are a bit special / and at least you've got an idea when you're out at the restaurant

Because creative innovation is a delicate balance between structure and freedom from structure, project management and management of ideas is important. This can be improved by digitalisation, and software that help HoReCa manage the organization of documents better, whether it's coordinating their supply chain or table bookings, or managing staff shifts etc. From Transcript 17, structured innovation was referred to and helped by placing projects in an organisation wide internal digital platform:

> by actually bringing these projects to life in a digital platform / you increase your productivity significantly / and further / you also increase the quality of the output of the projects / because you've been efficient in producing something that actually adds value / and when the productivity is there the quality is there / the profitability also sneaks in on you because then you've been efficient in providing something that that creates value to your customers // ... it's also about joint work because it is more fun to go to work every day if you're part of the well-oiled machine / rather than spending most of your day discussing with your colleagues who should do what and when / and why don't I get the information I need when I need it etc

Systems of technological networks, available software that can be implemented at the organization or between organizations in a shared digital platform, will affect how creative innovation proceeds.

From the second "B" perspective of the product, the successful acceptance and adoption of new food products might require both an upward movement such as the NNC and the encouragement of eating more greens, that includes sea vegetables, as well as a top-down legislation effort, whether in the form of NNC dietary guidelines, or lowering trade barriers to favour access to certain raw foods. Pertaining to individual chefs and food producers as active stakeholders in ground up movements, the actions and commitment made by them will influence the relationship towards a great number of network actors including those from farm cooperatives to consumer associations, both governmental and non-governmental that in turn have the power to initiate/create the overarching legal frameworks within with their businesses operate.

Our four quadrant model enabled an unfolding of deeper elements as compared to the more traditional systems models for describing creativity

in current culinary research. One can use the systems integral model of creative innovation to elucidate how, depending on the researcher's purpose of study, the model, using a language-based pronoun system, can encompass multiple points of view. Various types of inquiries such as Individual, Group, Social, National, Environmental etc. are made possible with our model.

5 Conclusion

This study used phycogastronomy in the context of the NNC as example to study the processes of creative innovation. Based on 25 transcripts turned into a small but topic focused corpus, elements and characteristics of the creative innovation process were identified using a systems integral approach. A model of the findings from the small corpus was proposed and shown in Figure 4. The model showed that creative innovation can be studied from three perspectives, two of which are human-centric and the third one is product-centric. While our systems integral approach gave wider and deeper insights into creative innovation, the advantage of applying a systems integral approach was also its limitation. Depending on the researcher's expertise, interest and study perspective, the four quadrant model can be applied in different contexts, to study different themes. Some might find this model too broad and all-encompassing so that it becomes unhelpful to them. With growing bodies of knowledge, most academic fields are coming to realise the need for a unified / holistic approach of which systems integral theory is one such approach. In the case of studying creative innovation in gastronomy per se, our corpus driven findings suggested that a holistic approach to understanding its elements and management is more helpful compared to focusing solely on individual psychology and passion or cultural / community support.

Our data corpus revealed that phycogastronomy in the NNC context remains an emerging concept. Its challenge is reflected through the entire supply chain from harvest to consumer acceptance. Within our small corpus, several chefs and HoReCa stakeholders have voiced how technology affects their businesses, as well as given them inspiration towards new dining experiences. Our data found a clear effect of technology enablers in gastronomic innovation. They included digital, technical, and innovative food preparation technologies. It has, according to those who implement it, accelerated, and structured the process of creative innovation, suggesting that there are clear advantages of a more widespread implementation of such technology enablers.

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