Beyond the old game design: a new design paradigm in Game Studies through C-K Theory

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ABSTRACT
This paper presents C-K Theory (Hatchuel, et al., 2003) as the adequate theoretical formalism to understand, explain, and communicate what happens during the act of designing games and as the instrument to translate into practice existing game design contributions. To frame the need for such a theoretical approach, the paper offers an overview of game design, providing a general definition, outlining its main characteristics and scope, and pointing out some shortcomings and the lack of epistemological knowledge about design theory within Game Studies. In addition to introducing C-K Theory and contextualizing its ontological characteristics as a design theory, the paper presents an explanation of how C-K Theory operates and exemplifies it by visualizing the design of a published game. The paper concludes by addressing some potential issues surrounding C-K Theory that may arise within the Game Studies community due to previous widespread preconceptions and ideas about game design.

Keywords
game design, C-K theory, design theory, MDA, generativity, design ontology, problem-solving, reflection-in-action, design research

INTRODUCTION
2022 kicked off with an insightful exchange of ideas in the discussion list [Gamesnetwork] (2022) of the Digital Games Research Association with a conversation thread titled “Recommended pedagogical canon?”. The thread sparked when one list member asked if there was a series of games that could be used to introduce people from outside the Game Studies context to the main concepts of game design. Among several recommendations provided by the list members, one comment resonated among some of the conversation participants: despite all the many existing game design contributions and their usefulness, it is challenging to introduce and explain game design to people from other contexts.

Further to what was said in this discussion, this thread highlighted an important issue about the theoretical components of game design. Design, and therefore also game design, implies not only conceptualizing but also working with constraints imposed by different stakeholders, avoiding arbitrary implementations (Lawson, 2005), producing documentation, communicating with the stakeholders and reaching agreements (Daalhuizen, 2014) and explaining how decisions are made (Hatchuel, et al., 2017). Could this challenge around the understanding, communication and accessibility of game design to people outside of Game Studies stem from shortcomings and incongruence around the aforementioned focal areas of design?

The lack of epistemological views on the nature of design in Game Studies has been hinted at to varying extents on a few occasions. Aki Järvinen (2008) has argued that game design literature is mostly inspirational, and designers must follow their intuition and rely on their own resources to find out how to integrate game elements and

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eventually create a game. Joris Dormans (2012) claimed that there is not much differentiation between the resources for the analysis of games and the resources for the design of games. Katherine Neil (2012) has not only asserted that designers lack design abstract tools for their work, but also has pointed out the limited evidence around the applicability of game design contributions. Orita Almeida and Correa de Silva (2013) concluded that there is a lack of tools for a game design practice. And at a GDC talk, Stone Librande (2015) pointed out that discourses about game design always revolve around elements of games but not about how to actually design.

This paper introduces C-K Theory (Hatchuel, et al., 2003) to Game Studies, the current paradigm within engineering design and the Design discipline to understand, explain and communicate (e.g., document) design from a theoretical perspective with documented applicability in different academic fields and industrial and commercial contexts (Hatchuel, et al., 2017). With the help of C-K Theory, it is possible to understand, explain, and therefore also teach, what game designers abstractly do while they are designing, how designers deal with constraints and requirements, how the knowledge from the guidelines, rules of thumb, and models that comprise game design can be incorporated into the act of designing, and basically, how to rationally design games.

GAME DESIGN: ITS FORM, CONTOURS AND EDGES

Game design refers to the activity of designing a game. Game design is also a focus within Game Studies to understanding and studying the design of play and especially (computer) games (Deterding, 2016). This focus aims at prescribing and describing how to design games. Game design is also seen as a step within the production of a game before the development, where all kinds of conceptualization work take place (Fullerton, 2008). These several discourses can be identified in the literature as follows:

- Game design is the process undertaken to create an experience for a player collated and shaped by rules, goals, structures, themes and ideas (Brathwaite, et al., 2009; Perry, et al., 2009; Rogers, 2010; Salen, et al., 2004) in the form of a well-organized, structured, balanced and choices-affording (Fullerton, 2008; Rouse, 2001) game (Oxland, 2004; Rollins, et al., 2004; Sylvester, 2013), from which meaningful play (Salen, et al., 2004; Sylvester, 2013) stems. Game design is done by working with principles and components of games (Järvinen, 2008), especially rules (Oxland, 2004; Rogers, 2010; Rouse, 2001; Salen, et al., 2004; Schell, 2008) and goals (Brathwaite, et al., 2009), as well as metaphors (Järvinen, 2008); while communicating those ideas to the other members of the development team (Rollins, et al., 2004).
- Game design takes place at the beginning of the development or production of the game, and thereafter continues in the form of supervision and verification (Bates, 2004; Fullerton, 2008; Pedersen, 2003; Rollins, et al., 2004; Rouse, 2001; Schell, 2008). It implies such tasks as conceptualizing, prototyping (physical and digital) playtesting, documenting the design, as well as working on the functionality, balance, completeness, fun and accessibility of the game (Bates, 2004; Fullerton, 2008; Oxland, 2004; Pedersen, 2003; Rogers, 2010; Rollins, et al., 2004; Salen, et al., 2004; Schell, 2008).

Just as Game Studies developed its own scholarly approach to explain the phenomena of games with its own means and methodology (Mäyrä, 2008), game design developed on its own terms and in accordance with the logic, understanding and needs of the game industry (Freyermuth, 2015) and academia. On the one hand, the industry has strongly influenced the traditions, practices and types of knowledge that constitute the literature on game design (Perez Dominguez, 2019). And on the other hand, game design has become one of the most accessible teaching areas from Game Studies in response to

the increasing skill demands of the industry and the growing interest in video games (Deterding, 2016).

Game design literature consists of contributions by both industry people and academics. Besides the cornerstone texts *Game Design Workshop* (Fullerton, 2008) and *Rules of Play* (Salen, et al., 2004), other popular contributions within academia are a vocabulary known as formal abstract design tools (Church, 1999), a pyramid-shaped tool for the taxonomical analysis of games (Lindley, 2003), the well-known compendium of game dynamics called game design patterns (Björk, et al., 2004), a vocabulary for game designers called games ontology (Zagal, et al., 2005), visual notation systems such as the game atoms (Koster, 2005), petri nets (Bura, 2006) and Machinations (Dormans, 2012), as well as numerous books framed within the industry with guidelines, recommendations, rules of thumb and anecdotes (Barwood, et al., 2006; Bates, 2004; Costikyan, 2002; Crawford, 1982; Koster, 2005; Pedersen, 2003; Perry, et al., 2009; Rollins, et al., 2004; Rouse, 2001). Additional knowledge referenced in the literature as important for the design of games are Semiotics (Salen, et al., 2004) and the theory of Flow (Csikszentmihalyi, 1990).

The efforts surveying game design over the last years (Kreimeier, 2003; Dormans, 2012; Neil, 2012; Orita Almeida, et al., 2013; Kultima, 2015; Dormans, et al., 2017) have not only compiled all the available knowledge on the subject, but have also pointed out its shortcomings: game design contributions operate at inspirational level and the game designer must take it from there intuitively to design games (Järvinen, 2008). As well, these contributions focus on analyzing games (Dormans, 2012; Järvinen, 2008; Orita Almeida, et al., 2013; Librande, 2015) but neglect the practical side of how to design (Järvinen, 2008; Librande, 2015; Neil, 2012; Orita Almeida, et al., 2013), and lack validation around their applicability in real-life scenarios (Dormans, 2012; Neil, 2012).

An example of this situation is the MDA model, one of the most mentioned game contributions in Game Studies and considered as "the way" to design in several books and papers (de la Hera, et al., 2021; Pedro, et al., 2020; Thomas, et al., 2019). The MDA (Hunicke, et al., 2004) is named after the focal components game mechanics, dynamics, and aesthetics, and is defined by its authors as an approach for the understanding, analysis, design and development of games if seen as complex systems. However, the MDA does not provide the theoretical elements to know how to shift or "jump" between the mechanics, dynamics and aesthetics while designing a game. Designers must find their way around based on their expertise and skills. Also, there is a literature gap on the applicability of MDA as a specific approach to develop games in real contexts with customers and other stakeholders imposing fixed constraints.

Nevertheless, there have been a few efforts to bridge the gap between Game Studies and Design as an academic discipline. Jussi Kuittinen and Jussi Holopainen (2009) drew parallels between Bryan Lawson's design model depicting the role of constraints in the design context (2005) and some of the most popular game design contributions. The book Game Design Research (Lankoski, et al., 2017) covers different design ontologies and frameworks existing within game studies, but with limited input from the Design discipline. Perez Dominguez (2018) identified which game design contributions are actually design methods. And through a decade-long research, Annakaisa Kultima (2018) identified that the design of games in practical contexts revolves around variable project requirements; integrates visions, priorities, and values (e.g., player-centric views, usability) from different actors; encompasses a plethora of ideas informing the design; is an iterative process incurring costs but also recycling, reducing and tuning ideas and resources to accomplish the best results; and is nurtured

by the ecosystem where it takes place, which can be the market, the game community, the players, etc. (Kultima, 2018).

Specifically on the theoretical explanation of how to design within Game Studies, Donald Schön´s reflection-in-action and his version on the concept of framing (1983) were introduced as an answer, first in *Rules of Play* (Salen, et al., 2004), and afterwards have been echoed in other texts (Salen, 2007; Kuittinen, et al., 2009; Kultima, et al., 2010; Kultima, 2015). However, this standpoint does not explain the act of designing; it is not adequate for what design is as it will be elicited through the rest of this paper.

C-K THEORY: THE CURRENT PRADADIGM OF DESIGN THEORY

C-K Theory (Hatchuel, et al., 2003) is a formalism to understand, explain, analyze, undertake, visualize and communicate design, the act or mechanism of designing. To properly understand its highly abstract nature, it is necessary to provide an overview of how design is defined from a C-K Theory perspective, and what constitutive features C-K Theory has that make it a valid and complete design theory. After addressing these points, C-K Theory can be explained in terms of its operability.

In terms of C-K Theory, design is more than producing an object. Design is the attainment of the whole definition of the properties and characteristics of a hitherto unknown but desired object[1] allowing the designer its creation, implementation and realization (Le Masson, et al., 2017). To reach this definition, the designer works with previously known knowledge and situations, such as design briefs, constraints, conventionalities, data, wishes, needs, etc. However, these known elements on their own and as they are do not guarantee the existence of the new object. It is the intervention, reasoning, re-ordering, and restoring of properties around elements undertaken by the designer which lead to the new object. By doing this, the designer expands the knowledge by bringing to life something previously non-existent (Le Masson, et al., 2017).

This scenario entails several conditions around the act undertaken by the designer and the desired outcome (Hatchuel, 2018). Before the design starts, the designed objects are unknown, otherwise they would not be designs but rather copies of something else. Design is not obtained through deduction, induction, or abduction; otherwise designing would be a matter of just following these reasoning patterns. Designs are not about discovering pre-existing phenomena, otherwise design would be limited to science and observation. Designs are expected to afford functions and properties formulated prior to the design process; otherwise, design would just consist of random idea emergence (Hatchuel, 2018).

As design theory[2], C-K Theory represents the current predominant paradigm for design in the field of engineering design and among members of the Design subdiscipline design theory (Design Theory Special Interest Group[3]). C-K Theory illustrates fully the ontological elements of most design theories: the affording of generativity, the splitting condition and the synergy of forces of the social spaces (Hatchuel, et al., 2017). The definition and implications of these elements are the following:

- Generativity[4] is the ability to produce new proposals from known blocks of knowledge, specifications, information or assumptions, but that differ from any previously known combination of these blocks (Hatchuel, et al., 2011; Hatchuel, et al., 2013). Generativity implies knowledge creation and hence the incorporation of new and independent knowledge into the previous knowledge as well as the reordering of knowledge due to the impact of the new entities (knowledge, ideas, propositions) on the others and the emergence produced among them. Generativity implies working with characteristics and properties

out of the frame of a problem; finding new alternatives outside the original scope. Generativity goes beyond decision making, optimization, problem solving and combinatorics (the combining of properties or information). Whereas these activities may also be involved in design, they are limited to searching for an outcome around a set of known and fixed information, specifications or parameters, which are not intended to change and constitute a set of closed-world assumptions (Hatchuel, et al., 2017).

- Splitting condition implies that due to the tendency to break with the determinism and modularity of what was previously known, new propositions are produced that are different from already known propositions. This refers to the capability of paying attention to neglected dimensions within the design context, adding or revealing new knowledge layers, and even changing the identities of the design context and of that what is being designed through the inclusion and independence of new knowledge structures (Hatchuel, et al., 2017).
- Social spaces refer to the social relations, from organizations and institutions, shaping and impacting the knowledge structures entangled in the act of designing (norms, conventionalities, standards, expectations) and forming the ecosystems where designs exist and are judged as a success or failure (Meijer, et al., 2015; Hatchuel, et al., 2017). As well, this characteristic refers to the property of bridging material, social, economic and cultural boundaries and including people and organizations from different contexts and disciplines in projects of different scales and scopes (Hatchuel, et al., 2017).

These three elements define innovation in design. On the one hand, high innovative designs showcase high levels of generativity, a strong splitting condition (neither determinism nor modularity) and an unlocking synergy among the different forces within social spaces. While low levels of generativity, a restricted splitting condition caused by strong determinism and modularity, and serious roadblocks around the norms and rules established within social spaces inhibit innovation (Hatchuel, et al., 2017).

Apart from its theoretical and abstract components, C-K Theory has a particular applicability property: it can be used both as a research method and as a design method to study rigorously specific design situations and for the development of design innovations, respectively. For instance, C-K Theory has been used to analyze the teaching style of arts and industrial design at the Bauhaus, the prestigious German design institution from the decades of the 1920s (Le Masson, et al., 2015), to analyze the generativity of architectural sketches (Brun, et al., 2015), to study the development of several ("smart") technologies (Le Masson, et al., 2017), as well as for the analysis of the design of the so-called indie games (Pérez Domínguez, 2019).

In addition, a vast body of literature documents collaborations of researchers with institutions, organizations and companies exemplifying the applicability of C-K theory as a design method for the development of innovations in several fields, including development cooperation, mobility, aeronautics, automotive design, healthcare, software (Hatchuel, et al., 2017), bioengineering (Nagel, et al., 2016), public policy (Bertheta, Elsa T. , et al., 2016; Pluchinotta, Irene, et al., 2019) and artificial intelligence, among other kinds of industrial implementations (Hatchuel, et al., 2009; Hatchuel, 2018; Hatchuel, 2018; Le Masson, et al., 2017). When used as design method, designers visualize and document their knowledge, project specifications, as well as their potential ideas according to the structure and operability of C-K Theory.

The documented academic and industry versatility of C-K theory resides in its generic approach: it applies to and works for any practice, field or discipline of design (Hatchuel, et al., 2018). It facilitates the dialogue between professionals by allowing them to trace and visualize their reasoning and the logic followed when designing. (Hatchuel, et al., 2017). As well, its structure and operability as design method[5] aims at inducing high levels of generativity, the disruption of determinism and modularity, and the augmented synergy of the different forces across the social spaces where design takes place, which in turn favor innovative design.

Operability of C-K Theory

C-K Theory (Hatchuel, et al., 2003) is formulated around the reasoning styles and perspectives of both the artist and the engineer or researcher: the former trying to devise new worlds and the latter trying to unfold new knowledge (Le Masson, et al., 2017). It is based on the principle that design is produced by the interplay of two types of propositions: on the one hand, the knowledge, information, specifications, norms, conventionalities known to the designer; and on the other hand, all the presumptions and potential alternatives that the designer thinks about, works on and inquiries into (Hatchuel, et al., 2003). The aim of the design is to reach a validated definition of a hitherto non-existing object (material or immaterial) through the deliberately followed reasoning of the designer around these propositions to bring the object into existence (Hatchuel, et al., 2009; Hatchuel, 2018; Le Masson, et al., 2017).

The two types of propositions involved in C-K Theory have specific names, characteristics, and logic. One type of proposition is KNOWLEDGE, which is abbreviated as K. K refers to all what is known or accepted as true or false by the designer; in other words, ideas that hitherto have a logical status for the designer (Hatchuel, 2018; Hatchuel, et al., 2018; Le Masson, et al., 2017). K includes abstractions of known objects, partly known relations among such objects, conflicting views, beliefs, properties of objects to design with, design constraints of any kind, rules of thumb, conventionalities, the defining elements of the specifications around which the design should revolve, and whatever the designer considers as true or false (Hatchuel, et al., 2009). Examples of K can be the belief that games must have basic and obligatory elements, such as rules and objectives, also demographic data on the target players, a specific game design model chosen to follow, knowing what is possible and not possible to produce with a game engine, or considering the idea that a videogame must have viral elements for social media because it is common nowadays.

The other type of proposition is CONCEPTS, abbreviated as C. C refers to all the assumptions of the designer that represent possibilities or alternatives to explore. Ideas that hitherto are neither true nor false for the designer based on the current K (have no logical status) (Hatchuel, et al., 2018; Le Masson, et al., 2017). They are “what if´s” or “what would happen if´s”. C consists of linguistic constructs derived from the brief, specifications, requirements, or desires motivating the design, as well as from the knowledge of the designers. They are ambiguous, equivocal, desirable but as yet not known how to be accomplished or constructed with the knowledge available at the time (Le Masson, et al., 2017) and within the context of the design. Examples of C are considerations on having a game without goals and rules but not knowing yet how to accomplish that, wondering if turn-based interactions could be good options that a specific group of players could like, pondering the possibility of gamifying a game by adding conversation and the sharing of feelings as a mechanic, as well as very untypical and unconventional ideas. In short, C consists of possibilities and alternatives whose way to accomplishment is yet unknown.

The interplay and unfolding between K and C entails different transitions and transformations always based on a different logic until the designer completes the

design. These events should be understood as abstract or conceptual; however, C-K Theory can also be visualized - as it is done in this paper - to facilitate its understanding and as it is done when C-K Theory is used as design method. First, in a practical context, it all starts from a brief, an idea based on needs or a wish, as a series of abstract specifications, as descriptions revolving around an undefined object whose properties or characteristics are not wholly known for the designer. As short or as extensive as this idea may be, it is formulated around incomplete and ambiguous properties of a hitherto unknown object (Hatchuel, et al., 2009; Hatchuel, et al., 2018). This formulation is considered in C-K Theory as the first or original C. On the one hand, it is informed and takes properties or characteristics from already existing knowledge of the designer or the stakeholders of the project; and on the other hand, points at a desired unknown object, whose characteristics or properties must be defined to complete the design.

Next, the reasoning of the designer goes branching this first C into new Cs, into new "what if's" or possibilities to try out or test. The operation of generating new Cs from other Cs is called a partition (C -> C) and refers to the designer's search for new semantic propositions with sufficient decidable properties to be considered as new Ks. The branching generated by partitions is done by refining, choosing and structuring propositions; and for that, the designer may turn to the use of imagination, inspiration, analogies and metaphors. Cs also get tested and validated by the designer through prototyping, mockups or by acts of serendipity, surprise and discoveries. There comes the point when the designer transforms a C into a proposition she, he or they can recognize as having a logical status, as true or false; when the designer identifies in a C an idea or formulation making sense, a piece of knowledge, a decision, an inference or a defining statement for the design. This is the point when a C becomes K through an operation called conjunction (C -> K).

On the side of K, transformations of K also happen, called expansions (K -> K). K gets re-ordered, reshaped and re-modeled, through inferences, deductive thinking, decomposition and optimization, as well as through the integration of different knowledge domains. The designer learns and expands their repertoire, discards old beliefs and replaces them with new conclusions. An expansion can imply learning, experimentation, remodeling or re-ordering of knowledge, and social assessment. In turn, Ks will input into Cs through disjunctions (K -> C), contributing with new properties or characteristics to explore, to be considered in the design.

Through this interplay, both Cs and Ks go influencing and impacting each other as well as themselves through the different operators previously described (K->C, C->C, C->K and K->K). Both go through testing and validations, they are both expansive, and generativity is present or identifiable to different extents in both (Le Masson, et al., 2017). There will be a point at which the designer will realize that she, he or they have obtained a proposition that meets the decidability demanded by the very first C; a CONCEPT that through validation (C -> K) represents the definition, and understanding, of a new and hitherto sought and desired object or entity, including its attributes, properties and conditions of existence. The new object is then fully defined (realizable, or has even been realized or produced), constitutes new KNOWLEDGE in the repertoire of the designer (Hatchuel, et al., 2009; Hatchuel, et al., 2011; Hatchuel, et al., 2018) and abstractly represents the completion or closure of the act of designing.

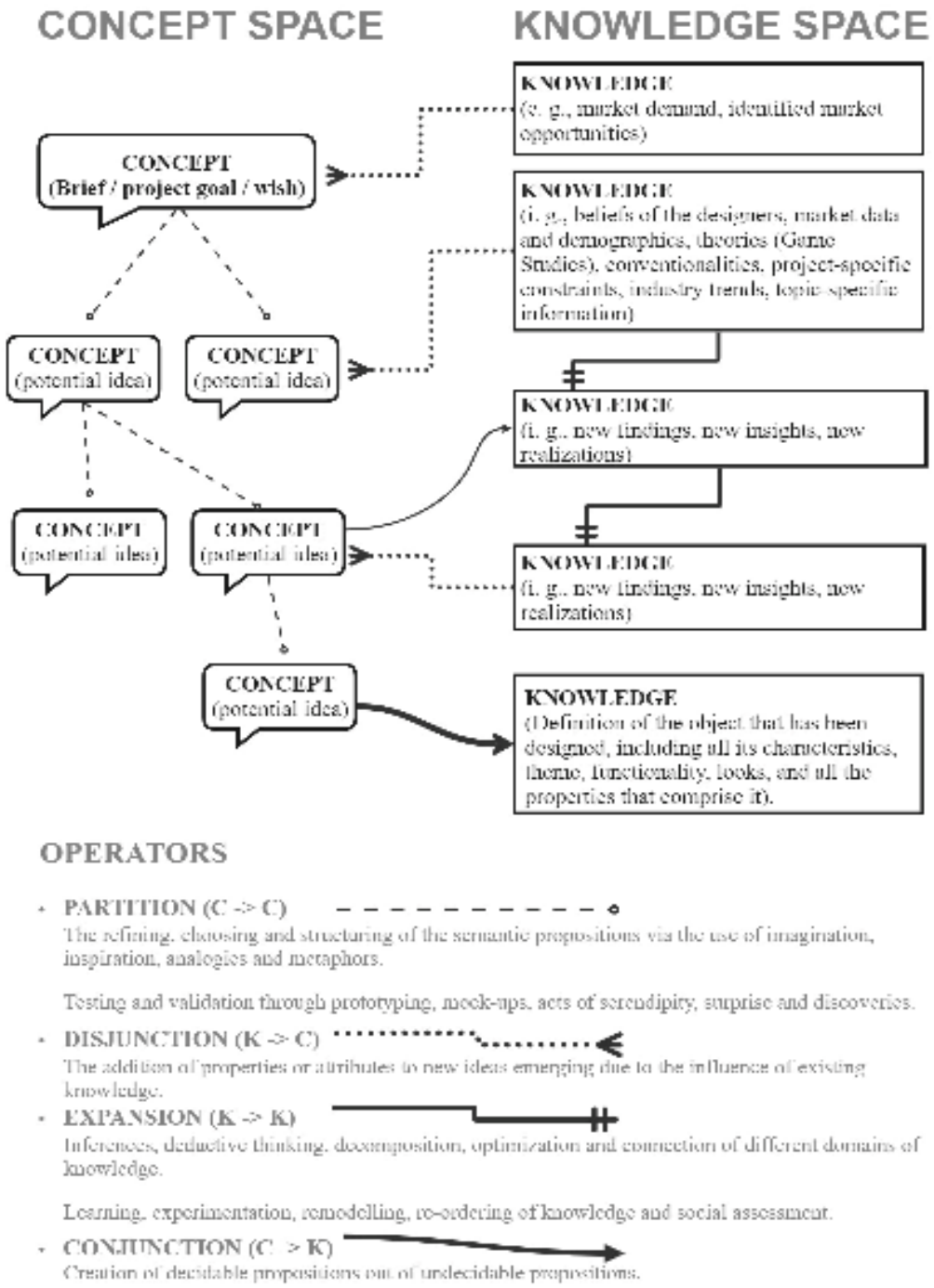
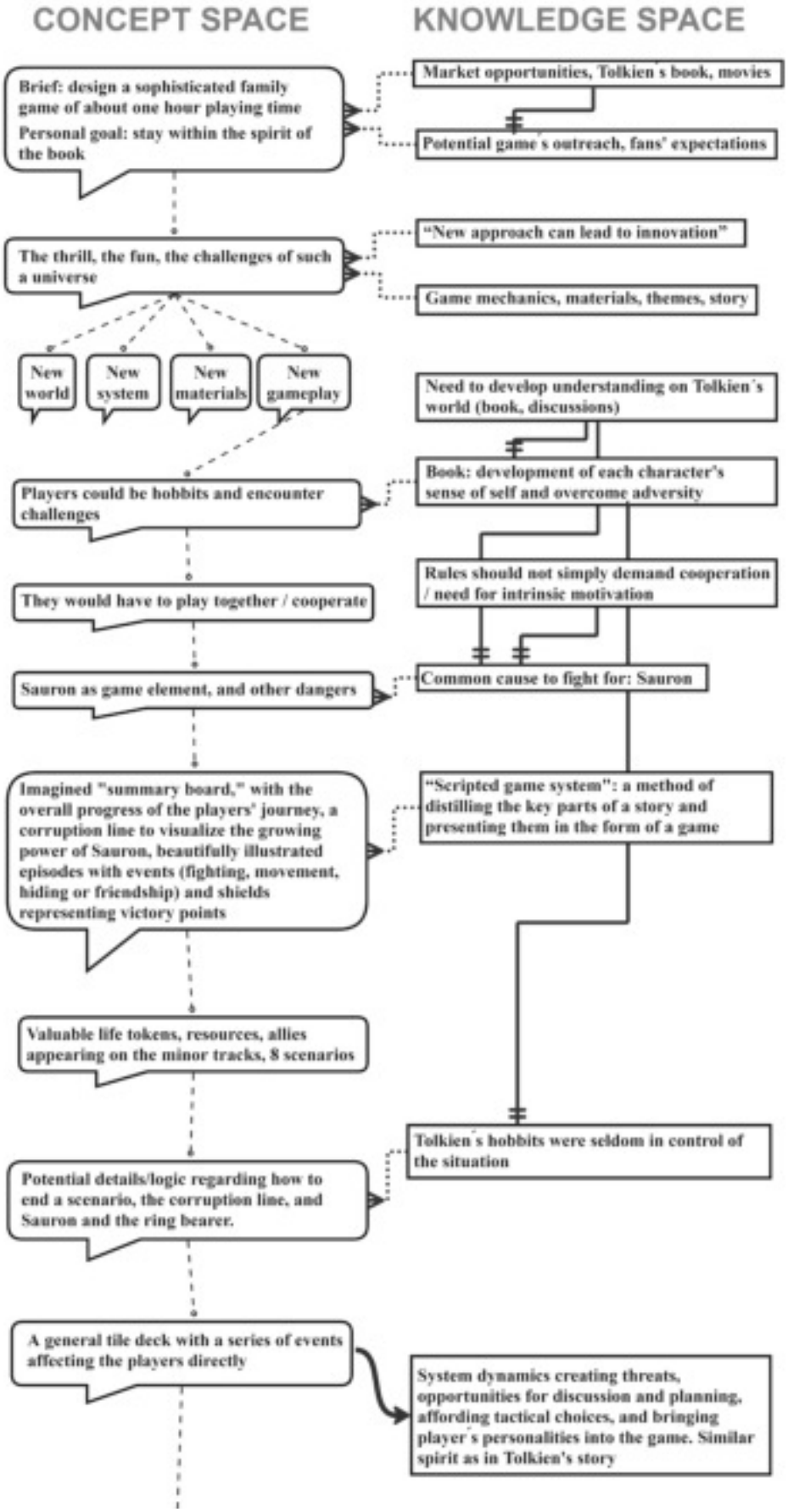


Diagram 1: Visual reinterpretation of C-K theory. The left side is for Cs and the right-side area for Ks. The operators the designers execute (Le Masson, et al., 2017) for the transformation of Cs and Ks are also depicted.

Illustrating the design of a game with C-K Theory

Rainer Knizia wrote an essay for *Rules of Play* (Salen, et al., 2004) about the design of the *Lord of the Rings* board game (Knizia, 2000). Knizia explains he was commissioned to design a sophisticated, hour-long family game. As part of the design, Knizia worked on developing his understanding of Tolkien's universe (1954) and explored different environments and aesthetics of the saga. He ended up creating a cooperative strategy game focusing on the hobbits in their quest to destroy the ring of power while avoiding becoming corrupted by Sauron. The design of the *Lord of the Rings* (Knizia, 2000) can be visualized with C-K Theory as follows:


CONCEPT SPACE
KNOWLEDGE SPACE
Brief: design a sophisticated family game of about one hour playing time
Personal goal: stay within the spirit of the book
Market opportunities, Tolkien´s book, movies
Potential game´s outreach, fans' expectations
The thrill, the fun, the challenges of such a universe
"New approach can lead to innovation"
Game mechanics, materials, themes, story
New world
New system
New materials
New gameplay
Need to develop understanding on Tolkien´s world (book, discussions)
Players could be hobbits and encounter challenges
Book: development of each character's sense of self and overcome adversity
They would have to play together / cooperate
Rules should not simply demand cooperation / need for intrinsic motivation
Sauron as game element, and other dangers
Common cause to fight for: Sauron
Imagined "summary board," with the overall progress of the players' journey, a corruption line to visualize the growing power of Sauron, beautifully illustrated episodes with events (fighting, movement, hiding or friendship) and shields representing victory points
"Scripted game system": a method of distilling the key parts of a story and presenting them in the form of a game
Valuable life tokens, resources, allies appearing on the minor tracks, 8 scenarios
Tolkien´s hobbits were seldom in control of the situation
Potential details/logic regarding how to end a scenario, the corruption line, and Sauron and the ring bearer.
A general tile deck with a series of events affecting the players directly
System dynamics creating threats, opportunities for discussion and planning, affording tactical choices, and bringing player´s personalities into the game. Similar spirit as in Tolkien's story

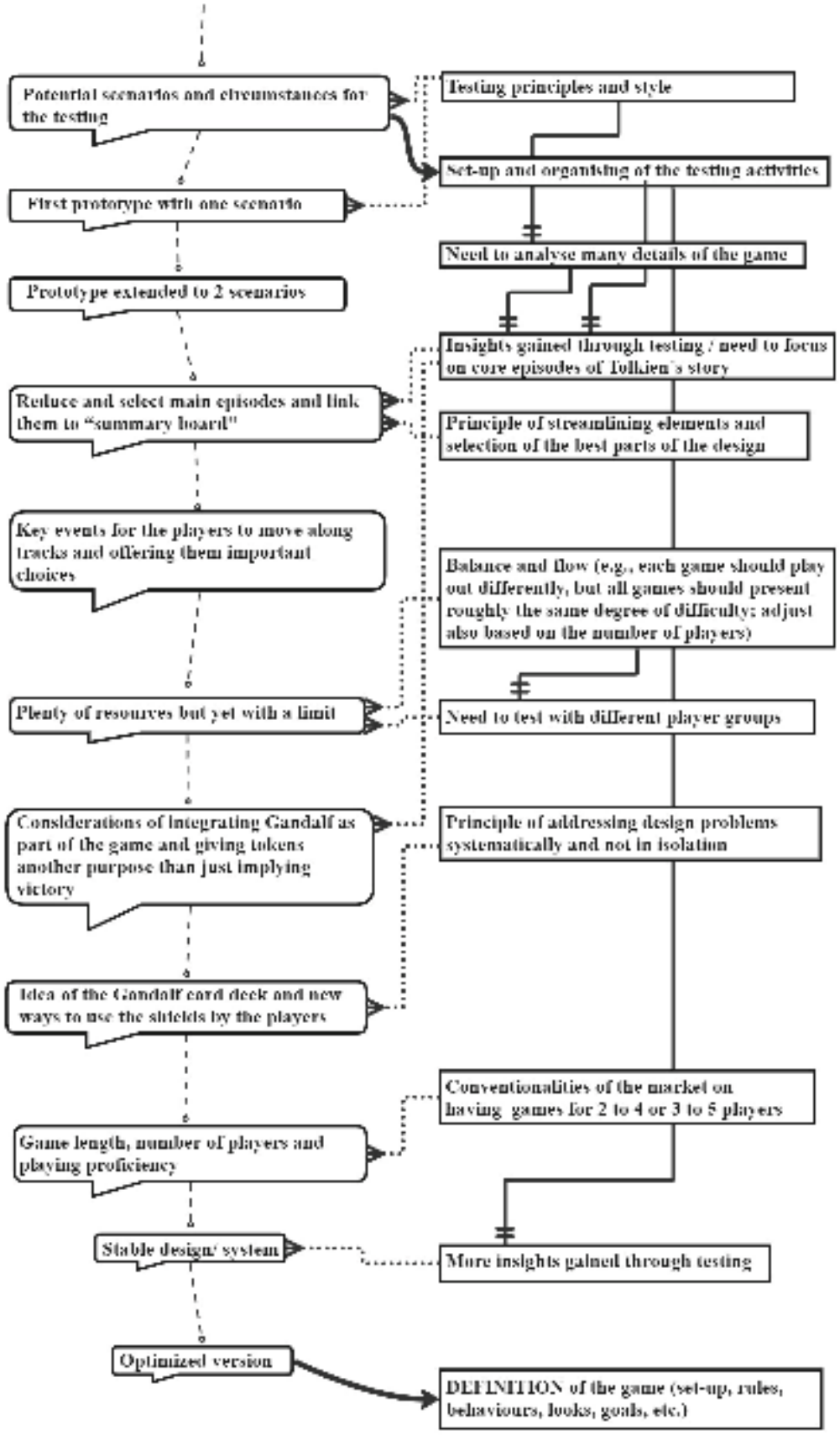


Diagram 2: Design of the *Lord of the Rings* board game (Knizia, 2000) following the structure of C-K Theory.

In the previous diagram, the first C is both the brief Knizia gets from the stakeholders as well as his personal wish to stay truthful to the spirit of Tolkien's work (1954). These statements represent a C because it is unknown at this point how to accomplish them. This C kicks off the design and got influenced for its formulation by a prior existing K both the stakeholders and Knizia, as the designer, have, such as knowledge about the books, the story, the movies and needs of the market. Another K is inferred by Knizia from the previous K. In other words, this K emerges by reasoning and represents an expansion in K, when he realizes the game can reach a large audience because of the large fan base of the Tolkien universe and that fans will have high and very specific expectations.

Other Ks are the knowledge Knizia has on how to tackle projects by starting from a different approach each time and acknowledging there are basic game elements to consider. These Ks influence and add properties as inputs to the ideas branching in the C space through disjunctions. Thus, he starts considering potential new Cs, which also branch into new Cs, such as a desired thrill, fun and challenges, exploring worlds and materials and trying to think of a gameplay that could be interesting, among many other potential options he might not talk about in the essay.

The search for potential feasible Cs incites Knizia to expand Ks by identifying some limitations, such as the type of knowledge he lacks, the need to find out exactly what excites fans, and the complexity and extensiveness of the story. This leads Knizia to turn Tolkien's book (1954), learn, research and discuss the story with a colleague many times. This event leads to a knowledge expansion by creating a new K, when Knizia realizes what for him is the real focus of the book: the personal themes of the characters and their attempts to overcome diversity. This specific K leads to a new disjunction sparking new branching elements and the emergence of several of the most important Cs of the design: the potential ideas that players could play hobbits, the cooperative game style, and including challenges.

The C implying challenges and overcoming obstacles led Knizia to ask himself what kind of challenges and obstacles existed in the book. Knizia also identified the need to intrinsically motivate players to act cooperatively due to a strong enough cause and not forced by the game rules. Then, by inductive and deductive thinking, Knizia comes up with Sauron as a potential solution and integrates the idea of this character as well as other challenges into a new C.

A K representing Knizia´s precepts and personal guidelines called “scripted game system” influences a disjunction and the spawning of a new C: the potential first set-up of the game, the “summary board” including a player´s journey, a corruption indicator, the role of Sauron and different scenarios or worlds. New Cs branching at this point about the use of resources, the role of the players as hobbits and details about the scenarios and card decks are influenced by previous Ks. Next, Knizia also realizes the impact of these elements on the game; the kind of system dynamics, the possibilities and the atmosphere they create for the players. This represents a conjunction, a realization providing Knizia new knowledge about what he has achieved so far.

Knizia´s beliefs and approach to playtesting then come into action. He generates Cs by pondering how to conduct and organize the playtesting and gather feedback. He branches new Cs by coming up with the potential situations he wants to test and validate, and he also generates new Ks by validating, according to his knowledge and experience, the methodology for those testing situations. As a result, Knizia arrives at a C in which he reflects on the reduction and selection of the number of episodes and their integration in the "summary board".

Next, Knizia turns to his Ks about balancing and flow, which revolve around his experience on how to work with difficulty and adjust the availability of resources depending on the number of players. Also, influenced by previous Ks gained through the testing, Knizia has obtained a new C, consisting of considerations about including Gandalf and changing the role of shield tokens to make them more relevant than just simple victory points. Knizia applies here a K representing a design principle about addressing these new Cs integrally instead of in isolation. A new C arises about the potential play length, number of players, their proficiency and other implications. Knizia takes into account a K about market requirements and the need to shrink down many elements to get a lean but working design. After more testing, balancing and polishing of elements, Knizia reaches the outcome: the definition of the whole game known today as *Lord of the Rings* (Knizia, 2000) and the means for the publishing company to manufacture, print out, distribute, sell and promote the game.

An important note on this exemplification of game design through C-K Theory is the fact that it is based on an essay (Salen, et al., 2004). In the text, most of the time except for the beginning of the design, Knizia only refers to exploring a single alternative instead of several options to compare and choose from. For this reason, almost all partitions in C lead to a single branching instead of two, three or more branching paths. This also implies that the exemplification follows the ordering and a sequencing that Knizia presents in the text. However, the design of this or any other games does not necessarily need to be linear, sequential or bound to an industrial process. Design can also have interruptions, loops, unexpected turns, ups and downs, restructurings, full-stops, among many other events (Le Masson, et al., 2017). The act of designing can also extend through the different phases of the production of a game and go beyond what is commonly regarded as the game design stage. An example can be found in recent research about the design undertaken by prominent independent game designers, showing that many of these designers work at the same time on what is often referred to as game design, game development and playtesting. These designers even continue to conceptualize their games and integrate more ideas until relatively shortly before the game's release (Perez Dominguez, 2019).

POTENTIAL DISCUSSIONS WITHIN THE GAME STUDIES COMMUNITY

The previous presentation about C-K Theory can lead to several discussions and interrogations within the Game Studies community. First: is it necessary to know and use C-K Theory, considering designers can design without the need of a theoretical standpoint explaining what they do? As an academic discipline, Game Studies has the purpose of providing theoretical standpoints explaining everything related to games and play. C-K theory represents a suitable theoretical approach to overcome the shortcomings pointed out regarding Game Studies and the act of designing. The simple understanding of design as the interplay between “what if´s” or possibilities and knowledge sheds clarity about what designers do while creating their games. In addition, C-K Theory as a design method is a useful tool for visualizing and communicating design decisions and for tracking what happens while designing. However, game designers do not need to use C-K Theory as a design method for their games. Game designers and their stakeholders can always decide how to design.

Where do game design contributions fit in the context of C-K theory? Game design contributions, as guidelines or precepts that game designers can consider as true assumptions, fall in the category of KNOWLEDGE. A game designer can employ this K to create and influence new Cs and add properties to them. Through different reasoning activities, this K may expand to new Ks. K can also help validate Cs. However, these resources alone do not guarantee quality or success for the designers;

these factors depend on their skills, their ability to work, identify and reveal imperceptible constraints, as well as on the design context (Löwgren, et al., 1999).

Another potential discussion can revolve around problem-solving (Simon, et al., 1972; Simon, 1996) and reflection-in-action (Schön, 1983). First, as already stated by explaining the ontological elements of design theory, design can imply solving a problem but goes beyond (Hatchuel, et al., 2017). Second, if problem solving does not involve creating something and is only about finding a solution to a question or conflict, then, it is not design (Hatchuel, et al., 2018). Also, by paying attention to the whole context of Schön´s thesis, and how he explains his concept around the professions of engineering, architectural education, management, psychotherapy and town planning, it is possible to understand that reflection-in-action refers to how professionals in any field, including designers, draw on their reflective experience to practice their profession. However, this standpoint does not explain the act of designing nor relates to the aforementioned ontological elements of design theories.

The concept of framing is also associated to Schön (1983). However, Horst Rittel (1972; 1987) and Herbert Simon (1972; 1996) introduced the idea of structuring or formulating the settings of a problem long before. The important thing to note is that the structuring of the design context is implicit in the activities of designers (Dorst, 2015). Moreover, according to Kees Dorst´s research and case and protocol studies (Dorst, et al., 2001; Dorst, 2015; Lawson, et al., 2009), experienced designers tend to rework and reinterpret the conditions of the design context whereas novice designers tend to observe and consider conditions and precepts as fixed.

Can C-K theory be used for the design of board games, gamification, serious games, sound design, virtual reality, monetization systems or other topics of interest within Game Studies and in the game industry? Absolutely, and not only because of the generic approach of C-K theory functioning for any practice, field, or discipline of design (Hatchuel, et al., 2018). As the design theorists S. A. Gregory (1966) and Bryan Lawson (2005) explain, design is the same act or mechanism of generativity regardless of the field of application or discipline; whether it is architecture, product design, user experience design (UX), policy design, organizational design, sustainability design or game design. What varies from one discipline or field to another are the subjects of the design, constraints (information to design with), materials and formalized procedures particular to each field or trade (Lawson, 2005).

CONCLUSION

C-K Theory (Hatchuel, et al., 2003) as the current design theory paradigm with extensive academic validation in different disciplines and within different industries (Hatchuel, et al., 2017; Le Masson, et al., 2017) is the adequate theoretical formalism to understand, explain and undertake any type of design, including game design. In addition to providing epistemological knowledge about design so far unavailable in Game Studies, C-K Theory also represents a theoretical tool to overcome the shortcomings pointed out by academics and to understand how to work and integrate the different game design contributions in practice and in the classroom. The benefits of its application also extend to the execution of game design; for a more reasoned or conscious design practice, for enhanced communication on how design decisions are made, and for accountability among designers and stakeholders.

The inclusion of C-K Theory and design theory knowledge in Game Studies implies both a reordering of previously available knowledge as well as its extension and expansion (Hatchuel, et al., 2017; Le Masson, et al., 2017). This implies, on the one hand, identifying how C-K Theory benefits or complements the most popular game design contributions, such as the MDA (Hunicke, et al., 2004) or Fullerton´s formal

and dramatic elements (2008). And on the other hand, identifying what is the role of other contributions in light of the current paradigm of design theory and assessing to what extent they are still valid or not.

C-K Theory also opens the door to a new area of study in Game Studies: the ontology of design; generativity, the splitting condition, and the synergy of social spaces, through the methods of design theory. This involves studying, explaining and visualizing, either with C-K theory or another formalism, how throughout the history of games or in concrete or contemporary contexts and situations, how new and different knowledge emerged from previous knowledge or how knowledge from other domains is or has been integrated and transformed for the design and development of games, how determinism and modularity have been maintained or disrupted throughout the history of games, and how institutions, organizations and even events and circumstances have influenced or continue to influence, accelerating or restricting the decisions made for the design and development of games.

Game design, as presented up to now by Game Studies, represents a series of constructs developed around the understanding, interconnection and mutual influence of the academic community and the game industry. Despite the long time that game design contributions have been available, the theoretical foundations about design have been missing. Turning to other disciplines, such as Design and design theory as this paper does, can help answer critical unresolved questions within Game Studies, as well as validate the discipline, strengthen it, and make it more accessible to other disciplines and people.

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ENDNOTES

[1] The outcome of the design is not necessarily something tangible; it can also be something abstract (Hatchuel, et al., 2003; Le Masson, et al., 2017). Examples can be a law, a business strategy or the rules of a street game.

[2] The term design theory refers to both a subdiscipline of Design studying design theories as well as to a single design theory, an overarching theoretical standpoint to explain the act or mechanism of designing (Le Masson, et al., 2017). As a subdiscipline, its focus is the study, formalization and development of the theories explaining how design happens (Hatchuel, et al., 2017). The literature also covers other formalisms as design theories (Le Masson, et al., 2013).

[3] Established in 2008 and currently involving hundreds of members from different disciplines and academic institutions, the Design Theory Special Interest Group (DT SIG) of the Design Society has been responsible of producing an ecology of theoretical knowledge for the understanding, dissemination and application of design theories for education and for the development of scientifically validated innovations with industrial application (Hatchuel, et al., 2017).

[4] Hatchuel, Le Masson, Reich and Subrahmanian (2017) differentiate creativity and generativity. Creativity is seen as an ideation based on available blocks of knowledge; while generativity goes beyond comprising the reordering, expansion and integration of new knowledge. Thus, generativity may involve ideation, but ideation does not imply generativity.

[5] Design can also be approached through logical and mathematical formulations (Hatchuel, et al., 2007; Le Masson, et al., 2017).