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# The search for and identification of routine signals as a contribution to creative competitive intelligence

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## **Keywords:**

Creative competitive intelligence, competitive intelligence, strategic intelligence, trend monitoring, trend analysis, innovation, creativity, design, information gathering, weak signal, routine signal, routine.

## **Abstract**

Innovation has become very important for companies, notably for their competitiveness. In this context, I focus on creative competitive intelligence and its potential contribution. I have considered that the aims of creative competitive intelligence are to identify innovation opportunity signals for organizations and to supply relevant information for creative workers (designers, stylists, architects, landscape architects, artists, craftsmen, R&D engineers etc.). With this in mind, I proposed to look for routine signals that indicate repetition in product design. The experimentation focuses on two cases of innovation bearing on the design of home video game controllers. I have verified whether several people can recognize routine signals linked to the design of these video game controllers.

## Introduction

There are many definitions of competitive or economic intelligence. Most frequently, from the perspective of a company competitive intelligence is considered as the legal and ethical process of information management (questioning, collecting, processing etc.) that is necessary for the company's competitiveness. In France, the definition of the Martre report [23] is the reference standard, while in other countries alternative definitions are similar [25] [37] [41] [8]. Considering competitive intelligence from the point of view of what it produces, the Sharp definition [37] has particularly caught our attention: "*competitive intelligence is Knowledge and foreknowledge about the entire business environment that results in action*" ([37], p 15). With this definition in mind, its author includes prediction methods, tools and practices, forecasting the evolution of the business environment. This definition implies the existence of a competitive intelligence specifically dedicated to the exploration of the future of the company's strategic environment.

However, if we consider the future and competitiveness of a company, one factor that should not be ignored is its capacity for innovation [28]. Indeed, it is now accepted that there is a correlation between the ability of a company to innovate and its mastery of competitive intelligence [39]. The different types of intelligence (strategic, competitive, technological, etc.) are dedicated to the observation of the business environment, such that decision-makers are better informed and can respond more effectively, anticipate, adapt or take advantage of changes occurring [31]. Among the different forms of competitive intelligence, creative competitive intelligence interests me particularly, because it is specifically designed to observe the risks and opportunities for innovation and invention [12]. I focused my work on this intelligence, seeking ways and means to render creative competitive intelligence useful to the company by its direct contribution to the innovation process.

In this paper, I address the following question: vis-à-vis existing solutions, can one contribute further to the identification of opportunities for innovation or to the alert to innovation risks by competitors? To answer this question, I propose to address key aspects of the concept of innovation. Then, in relation with from some existing resources dedicated to information retrieval pertaining to innovation, I present some aspects of creative competitive intelligence that are defined as monitoring activities specifically dedicated to the process of creation and innovation. Next, I state my working hypotheses concerning the observation of certain signals to anticipate risks of disruptive innovation or to discover opportunities for incremental innovation. Finally, from a case example in the domain of video games, I present a method dedicated to this research and show that ordinary individuals can identify product design that carries an important risk of innovation.

## Innovation

According to Schumpeter [36], there are many definitions of innovation. It is considered the first successful implementation of a new idea on the market [36]. With an extended vision, innovation can take many forms: product, process, technology, market, marketing, organizational etc. [29]. In this work I am particularly interested by product innovation. According to the OECD, product innovation "*is new or significantly improved. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics*" [27]. The innovation can be radical or incremental. When it is considered to be a radical innovation, it is because there has been a profound change made vis-à-vis the "standard" product (the introduction of a completely different technology, the consideration of a new paradigm, the adaptation to a new kind of market etc.).

In contrast, when we remain in the same development environment, it is usually considered that innovation is incremental ([7], pp. 20-24, [33], pp. 52-60). There is another kind of innovation that is sometimes discussed: namely disruptive innovation. This relates to alternative technologies that are cheaper and less powerful than the mainstream technology that they propose to replace, but which, with time, are improved and better correspond to the needs of certain customers than does the main technology ([5], pp. 226-230). If disruptive innovation can create a strategic surprise and an overthrow of the design of a product, for example, it seems that a specific kind of incremental innovation exists, which can also cause a sudden change in the competitive environment. We call this kind of incremental innovation: "multi-criteria" incremental innovation. This qualification of multi-criteria incremental innovation refers to the fact that each product can be characterized by a set of variables and a large number of them can be improved simultaneously. However, it often seems that psychological inertia associated with product development limits the changes made to variables in a single category (aesthetic features, functions, uses etc.). Thus, if we consider a product from the design point of view, classical incremental innovation will contain a priori a small number of changes between two generations of the same product, whereas multi-criteria innovation will add many changes. However, multi-criteria incremental innovation can meet a significant

obstacle. This is the MAYA (Most Advanced - Yet Acceptable) principle [14]. This principle states that if an object is to be accepted in terms of new design, then it is necessary that the modifications do not radically change the nature of the object, i.e. that the object retains its typical aspect. Therefore, we suppose that there are three types of innovation that can create a strategic surprise: radical innovation, disruptive innovation and multi-incremental innovation. A priori, radical innovation creates a stronger modification than that caused by a multi-incremental innovation, but this gap is still being evaluated. Disruptive innovation is related to a completely different technology that arises to respond to relatively the same needs as competitor technology, but at a lower cost. Thus, this innovation is the object of the "classical" technological intelligence.

For the moment, my work concentrates on incremental innovation, because this represents more than 90% of innovations [32] [7]. In addition, it has the advantage of being the easiest to observe. Compared to radical innovation, it follows logically the technological advances in the field as well as evolution in trends (design, features, use, etc.) of the product or technology to which it relates ([7], p 20 – 22). Compared to breakthrough innovation, it allows the focus on one type of product, which is at first quite handy. In the context of product innovation, incremental innovation may relate to product design. In this specific context, innovation may be considered as “(a) *the incremental novelties in the design of an existing product or service, or (b) radically new products or services obtained by design effort with no or minimal technical novelty*” [26]. This is the kind of innovation that I discuss in this article, focusing on two multi-incremental innovations.

## Information retrieval concerning innovation

If we want to remain informed in order to innovate or to follow innovations in a specific area, the choice of methods and tools for competitive intelligence is not very large. The most common possibilities are: technology surveillance [1], trend monitoring [30] and prospective surveillance [11]. Since Ansoff underlined the advantages [2], technology intelligence researches weak signals to anticipate their impact on the market [17]. Some of these observations are based on the identification of product life-cycles and the analysis of "S" curves [7]. Sometimes, technology surveillance borrows creative tools from engineering such as TRIZ (Russian acronym: Theory of Inventive Problem Solving), which is the best known of these methods ([16], pp. 260-261). Trend monitoring attempts to identify the sources at the origin of trends (shows, magazines, contractors, etc.). In fact, it examines and observes the people or organizations that, usually before others, provide a new trend or fashion, an alliance or product, in relation to a specific domain ([37], pp. 172-173). Prospective monitoring develops, from analyses of past and present situations, many scenarios and some credible alternatives to imagine what may be the environment in the medium or long-term [10] and to determine what to watch [6].

## Creative competitive intelligence

I started my work with research dedicated to tools and methods pertaining to competitive intelligence that can contribute directly to the innovation process. In this vein, we are interested in the creative competitive intelligence that can be considered a kind of competitive intelligence dedicated to: (1) creative workers to help them find and disseminate new ideas [3] [40] and (2) strategic decision-makers to help them to identify threats and opportunities related to innovation [12].

Creative competitive intelligence includes competitive intelligence methods and tools adapted to creative workers as well as to the personnel of any organization with a role concerned in the search for new ideas and innovation relevant to the recognition and resolution of some risks or problems [12]. The "creative workers" for whom creative competitive intelligence is particularly dedicated mainly reflect the heart of the creative professional class as proposed by Florida [9], i.e. « *the super-creative core (...) (including) scientists and engineers, university professors, poets and novelists, artists, entertainers, actors, designers and architects, as well as the "thought leadership" of modern society: nonfiction writers, editors, cultural figures, think-tank researchers, analysts, and other opinion makers* » [9].

The existence of creative competitive intelligence can be justified by the fact that it complements the other types of competitive intelligence. Indeed, if we want to achieve a specific competitive intelligence dedicated to the process of creation and innovation, some special methods must be developed. In fact, a few other kinds of competitive intelligence, such as technological competitive intelligence or the monitoring of trends, are already contributing to this objective. Among them, TRIZ has several usable tools for competitive intelligence. Based on the analysis of patents, the TRIZ is a theory that proposes specific engineering tools ([34], pp. 21-22). The best-known of these are: the laws of technical system evolution, principles of innovation associated with the matrix of technical contradictions, separation principles and substance-field analysis. TRIZ can be considered as a set of solutions to help ensure a competitive technical intelligence dedicated to innovation. [35] Indeed, it offers many tools and methods to devise new technical solutions to a problem. The other methods of creativity that can be

used in the same vein, like the morphological analysis, Brainstorming or Synectics [22], are generally less sophisticated than TRIZ ([34], pp. 18-19) and thus, they have the advantage of being easier to handle and the disadvantage of generating less readily new and original ideas. [7] Using these methods, we can obtain some new solutions to a problem and then identify companies or research teams who have used them [13].

In this objective, if we observe that apparently nobody is interested in such a solution, there may well be an opportunity for innovation or a potential change risk to take associated with this solution, which will therefore be important to monitor and explore. Therefore, to qualify creative competitive intelligence as a competitive technological intelligence or a competitor intelligence underlines the targets of surveillance and the specific ways they will be implemented.

## The approach chosen

With regard to the existing solutions, my working hypothesis considers that we can achieve a creative competitive intelligence by seeking specific signals that indicate opportunities for innovation. This also implies that there are signals other than weak ones to identify with the goal of: stimulating the competitive and innovative capacities of a company or adding new application opportunities to the ideas of a single creative worker. In this context, I identified "routine" signals. For me, a routine signal refers to the monotony, something that does not move, or increases or decreases continuously. In fact, as these signals are associated with monotonous facts, they are generally strong but no one really notices them because they are part of the usual context. This phenomenon can be linked to a powerful psychological inertia rarely considered. For example, in France in the field of entrepreneurship over the last twenty years, fast-food shops mainly specialized in baking french fries and in making different varieties of sandwiches (ham sandwiches, hot dogs, hamburgers, doner sandwiches, pan-bagnats, etc.). However, in recent years, the number of salad, pasta or sushi bars has begun to increase significantly. We cannot say that in this case, technological barriers prevented the development of such fast food shops earlier. At most, one could highlight cultural barriers present at this time or habits that were not yet taken. But it seems doubtful that salad or pasta bars would not have found their customers in the 1980s. To explain this kind of psychological inertia, Sternberg and Lubart ([38], p 254) have proposed a theory. According to them, the acquisition of knowledge is, in a first step, a positive factor that increases the capacity of imagination and the creativity of individuals. Nevertheless, in a second step, the acquisition of too much knowledge can act as a negative factor, inhibiting the creative abilities of individuals. Li et al [20] signalled that: "*when knowledge continues to increase, because of the psychological inertia, the designer may be stuck in the framework of his knowledge or experiences, then creativity maybe go down.*" [20]. In my opinion a creative competitive intelligence must be able to report the existence of such an inertia and routine signals are indications of its existence.

## The routine signals

In this work I advocate the idea that routine signals have their place in an approach of competitive intelligence in the context of innovation. If the idea of identifying and observing signals in a monitoring context is now implicit [31], we must still clarify the "routine" part of this concept. According to the French dictionary the "Trésor de La langue Française informatisée", in its "modern" jobs, a routine can be understood in a pejorative meaning or not, or in a computer meaning. In a pejorative context, "a routine" or "the routine" can be considered as (1) a "habit of thinking or acting with **invariant patterns, rejecting a priori any notion of novelty and progress**", (2) a "regular and mechanical act, **the result of a habit more than a result of thinking**", (3) the "preconceived and **unalterable opinion that hinders evolution, progress.**" In a non-pejorative context, it describes something "which, in its **repetition**, is commonplace, **banal.**" In Computer Science, it is "all or part of a program with a **repeated or general use.**" From the English language point of view, the online Collins dictionary: "*a **usual or regular** method of procedure, the **boring repetition** of tasks, **mindless** routine, a set sequence of dance steps, a computer program or part of a program performing a specific function*".

I have put in "bold" the elements that I believe best characterize a routine. These repetitions, often usually devoid of true reflection become systematic over time and gradually oppose the idea of innovation. So, these supply many significant clues to identify opportunities for innovation. It is on this basis that I have based my hypothesis about the routine signals. However, it seems that one can hardly approach the idea of a routine signal without positioning it vis-à-vis the classical weak signal.

It was Ansoff who proposed the concept of the weak signal compared with the strong one. For this author, weak signals correspond to « *imprecise early indications about impending impactful events* » [2]. After a while, the weak signals become stronger and indicate more clearly the changes that occur in the environment of the organization [2].

This concept will be taken and further developed by various authors. As an illustration, I present the following definitions:

- « *Weak signals are scattered data that point to the emergence of potential wild card events to the decision-makers* » [24].
- « *Weak signals are first symptoms of strategic discontinuities; they are symptoms of possible change in the future* » [15].
- A weak "signal appears as a seemingly innocuous "data" but with an interpretation that can trigger an alert. This alert indicates that an event may occur that could have a significant impact (in terms of opportunities or threats). After interpreting, the signal is no longer qualified as a weak signal, but as an early warning signal" ([18], p 41).
- A "weak signal is a fact, an event that may seem paradoxical and inspires reflection ... to imagine the impossible as possible, look to the future while seeking the causes, to understand and discover the essence of the event" ([4], p 21).

A routine signal is related to a strong potential for a future stagnation, while a weak or strong signal is associated with a probable future. For a weak signal, vis-à-vis a strong signal, I will focus on the signal intensity. A weak signal is by definition of low intensity, but it announces that this intensity will increase over time or from cross referencing of information. A well-identified and correlated weak signal gives rise to an early warning sign [19]. An early warning sign is "information that our interpretation leads us to believe that an event may occur, which could have a high value to those of our company" [19]. For a routine signal, I will focus on the signal frequency. The higher and the more routine the signal, the more it is likely to be interesting. Thus, weak signals are indicators of changes that are likely to occur, which it will behoove us to adapt to, while routine signals are indicators of persistence and of conservatism that are likely to continue, for which it would be good to offer an alternative before competitors do so. The routine signal allows managers of a company to decide to create a surprise (technological, commercial, strategic, etc.), while a weak signal, once identified or turned into an early warning sign, allows those responsible to be less surprised and to prepare for and adapt to ongoing change. Both signals can interact. For example, if a routine signal is identified concerning a particular technology component, this signal can give rise to the search for weak and strong signals on alternatives related to this component, or simply its elimination.

## **Routine signals and multi-criteria incremental innovation**

In the current context of my research, I am trying to identify the routines that can be related to: the product design (continual improvement with the same method), marketing (promotion and sale of products always follows, or almost always, the same model), strategic choices (the strategy of the company is always the same) etc. In this paper, I focus on design routines. The principle of routine identification is the same whatever the object of observation, but a priori it seems that design routines are easier to spot than others, because we can more easily compare products than sales practices or business strategies.

One methodological assumption considers that the more there are strong routines for the same product (i.e. some elements are repeated in time or are used by many competitors), the easier the next generation of products will be to anticipate and the more risk there will be to be confronted with a disruptive innovation or a multi-criteria incremental innovation. For example, in the case of the gamepads (or game controllers) considered, we can talk about disruptive innovation with the introduction of the Microsoft Kinect technology; as the slogan says: "You are the controller!". There is no longer a question of improving the gamepad, because the paradigm has been changed. But the routine signals, if they can possibly alert a company to the risk of disruptive innovation (e.g. from stagnation of proposed improvements to the new generation of a type of product), can more easily highlight elements from which a multi-criteria incremental innovation can be developed. Indeed, in the context of design considered in isolation the routine signal can orientate the thinking only to a single improvement or innovation, while a set of routine signals will be able to stimulate multiple possibilities for innovation. This may lead to various possibilities of multi-criteria incremental innovations corresponding to a potential strategic advantage over the competing products of the next generation. In the design of video game controllers that I have considered in this paper, it is particularly the gamepads of the Vectrex console and the Wii that best represent this type of innovation.

## **Experimental framework**

I wanted to find a simple way to assess routine signals. From two cases of innovation, I tested the implementation of the recognition and analysis of routine signals, by a group of 12 people aged 21-37 years. The question was to determine whether an analysis method based on descriptions of photographs and the indexing of these descriptions allowed people to identify some routine signals and detect an opportunity or a risk of

innovation. To this end, I sought what might be a routine signal for the design of video game console controllers. Moreover, I took the opportunity to identify the maximum number of changes accepted by the users of this type of product.

## The gamepad evolution of video game consoles



Figure 1. From left to right, top to bottom illustration in the chronological order of gamepads: Magnavox Odyssey, Radofin, Atari 2600, Intellivision, Vectrex, NES, Mega drive, Super NES, N64, Ps2, Xbox 360, Wii.

The history of the video game consoles really began with the marketing of the Magnavox Odyssey console in 1972 ([42], p 54). The gamepad of this console was quite primitive, but new consoles were rapidly available. Initially, merely different lever designs were proposed, until the appearance of the Radofin console in 1976 which had a directional lever or stick. This idea was repeated the following year by the Atari 2600 console that changed its gamepad with a disk for a game controller with a stick linked to a button. For several years, gamepads with directional disks (Mattel Intellivision, Colecovision) co-existed as an alternative to those with a stick (VideoPack, Emmerson Arcadia). However, in 1982, the Vectrex console appeared. This brought many changes to the design of the gamepad. Its constructor, Smith Engineering, wanted to propose a gamepad which could realize the equivalent of what is feasible with an arcade interface, but it disappeared in the video game crash of 1983 ([42], p 94). After a similar thinking and / or the adoption of key elements of its design, Nintendo offered a smaller gamepad for its console known as NES (Nintendo Entertainment System) in 1983, with a design that matched the reference models of video game controllers for over 20 years. During this time, other manufacturers were involved in a slow evolution of the gamepad design with a few fundamental additions such as replacing the directional lever by a directional cross by Nintendo in 1983, the appearance of a more ergonomic croissant shape proposed by Sega in 1988, the presence of 4 circle buttons with four different colours on the right side of the main face of the gamepad and the addition of trigger buttons on the north face of the controller of the Super Nintendo (SNES) in 1990, the return of a directional lever (the return of the stick of the Vectrex) with the Nintendo 64 (or N64) in 1995, and the emergence of a second stick with the Playstation 2 (PS2) in 1999. Hence, we arrived in 2006, when Nintendo unveiled the Wii that challenged the global design of gamepads ([42], p 215).

## Methodology and data analysis

The analysed innovation cases mainly concern two gamepads that have brought great changes by their design: the gamepad of the Vectrex console developed by Smith Engineering and the nunchaku for the Nintendo Wii. I am interested in the standard gamepads of video game consoles, i.e. those supplied with the console. I have listed most of the gamepads that have been produced and placed on the market between 1972 (date of release of the Magnavox Odyssey console) and the end of 2006 (date of the arrived of the Wii and the Playstation 3). The starting interest of this work was to understand the changes that had occurred in the design of video game controllers from the beginning to the Wii controller.

For the period 1972-2006, I identified 47 different gamepads (see Appendix Table 1), all of which were provided with the console and did not correspond to an annex accessory like a gun or the Wii balance board, for example. I invited 12 people to identify the apparent components of the different gamepads and to recognize those that were repeated and linked to design routines. A file of photographs of 47 game controllers had been developed for this purpose. Then, restricted interviews were conducted with these people to expose to them the outline of

the method used, which they were free to change if they wanted to. We explained the purpose of the exercise, i.e. to identify what had become banal in the design of gamepads between 1972 and 2005. We did not expect them to imagine the console of the following year, but hoped that they could recognize what it would not be surprising to find in the gamepad design during this period. We questioned these people showing them photographs. In the context of semi-oriented interviews, we started by showing them how we proposed to analyse the game controllers from their photographs. Any distinctive element of the gamepad should be recognized, starting from the shell, and by shape analogy a name was given to these elements. It was also necessary to count and locate the elements.

To facilitate this analysis, the gamepad photographs were oriented according to their different faces (see Figure 2). The game controller is examined in the same direction as we are supposed hold it to play. The main face is the one that we see in totality when we play. Only the bottom facade of the gamepad could not be analysed. In fact, the left and right faces were often called simply left and right sides. Then, we asked for confirmation that it was indeed the left face and not the left side of the main face. The person questioned could also point his finger to what was identified, which limited discussions and ambiguities. To help people to name the elements and forms, we had already listed some (rectangle, circle, triangle, cross, croissant, pushbutton, trigger button, cable, axial symmetry, etc.).



Figure 2. The different faces considered for a game controller like the Xbox 360.

As people analysed the photographs, we enriched our lexicon with new words and expressions. We also asked the members of the interview group to sort the results to eliminate rare words and to regroup synonyms that were most often used to describe the same thing. The final total of expressions listed is 31. During the interviews, these words were recorded in a file using a spread-sheet. The lines correspond to the expressions describing the gamepads while the columns were initially associated with the gamepads analysed and then each gamepad was associated with a year of production. Each cell in the table was associated with each expression and gamepad, being given a "1" or "0" depending on whether the gamepad corresponded or not to the description. In a second step, another table was created. This had for rows the words describing the consoles and for columns the periods encompassing the set of gamepads of the same generation (5 or 6 years for each period). These periods were calculated based on the average time to onset of a new gamepad from the same company (rounded in function of the choice of the interview group). The cells were thus given the percentages of gamepads of the same period that were described by the same word.

## General remarks

Over the period from 1972 to 2006, two gamepads with many innovations emerge from the crowd (Chapter 4.1), they are recognized by the analysis of changes vis-à-vis the routine signals (Figure 3): these are the game controller of the Vectrex console of Smith Engineering (released in 1982) and the Nintendo Wii (released in 2006). If we consider all the comments made concerning the Vectrex gamepad and the words used by the interview panel, we find, for its release in 1982, the following routines:

- (1) A shell composed of 1 part,
- (2) the shell is cuboid-shaped,
- (3) the main face is oriented by height,
- (4) there is an axial symmetry (main face),
- (5) there is a digital keyboard (main face),
- (6) there are 10 to 12 buttons (main face),
- (7) there is a wheel or a steering lever (main face),



- (8) there is 1 push button or trigger on each side (left and right front sides),
- (9) there is a cable connecting the gamepad to the console (upper face).

When the Vectrex console appeared at the end of 1982, its gamepad no longer followed the routines (3), (4), (5), (6) and (8). The Vectrex game controller proposed in total 55% of innovation in its design.

Similarly for 2005, the routine signals identified by all respondents were:

- (1) A shell composed of 1 part,
- (2) the shell is croissant-shaped,
- (3) the main surface is in width,
- (4) there is a cross-shape directional pad on the left (main face),
- (5) there are pushbuttons, most of them in circle-shape (main face),
- (6) there are 4 circle-shape buttons of 4 different colours on the right (main face),
- (7) there are 6 to 7 pushbuttons on the main face,
- (8) there are two directional levers, 1 on the right and 1 on the left (main face),
- (9) there are 4 trigger buttons (upper face),
- (10) there is a cable connecting the gamepad to the console (upper face).

Only one redundant attribute (10) is not found on any gamepad proposed in 2005 and 2006 (the seventh generation consoles: Xbox 360, PlayStation 3 and Wii). Concerning the Wii Nunchuk controller, while remaining functional and appreciated by the players, it does not respond to routine attributes (1), (2), (6), (7), (8) and (9). There are therefore 60% of efforts made on routine signals of the Wii gamepad. For their part, the Xbox 360 and PlayStation 3 have changed about 10% of the routine signals of the previous generation (PlayStation 2, GameCube and Xbox).

## Specific observations

If one is interested in the identification of the routine signals by each person considered individually, different things are remarked. One person recognised 29 of 31 routines. The person who identified the least routine signals noted only 16. The first two people tested identified 23 and 27 of the routine signals, respectively. Thus, the order of questioning did not greatly influence the panel members. The interviews lasted an average of 1hr30, which could pose concentration problems for those who were not implicated in this research. We also realized that if we regroup randomly the routines identified by 3 people (there are 22 possible combinations), the total number of routine signals identified by these trinomials different varies between 23 and 31. Thus, without special training, any group of three people can identify a priori at least 75% of all routine signals recognised by the most performant group. In this manner, in the context of a real creative competitive intelligence with a professional challenge, we can assume that 90% to 100% of the routines would be identified. Concerning the time-scale chosen for recognition of the game controllers of a same generation, we did not notice any significant impact on routine signal recognition. The number of gamepads analysed, may have compensated some potential side effects. Interestingly, one person wanted to double the importance of the design elements of the gamepads of the market leaders. This was not problematic for the study and did not affect the results. This criterion merely amplified some routine signals and made sense only in the case of the Vectrex gamepad. Indeed, the only leader identified by that person for that period was the Atari and this is only 1 manufacturer faced by at least 7 others. In 2006, with the Wii, the situation changed radically. The leaders, Nintendo and Sony, have a single competitor: Microsoft. In both cases, the accepted routines remain the same.

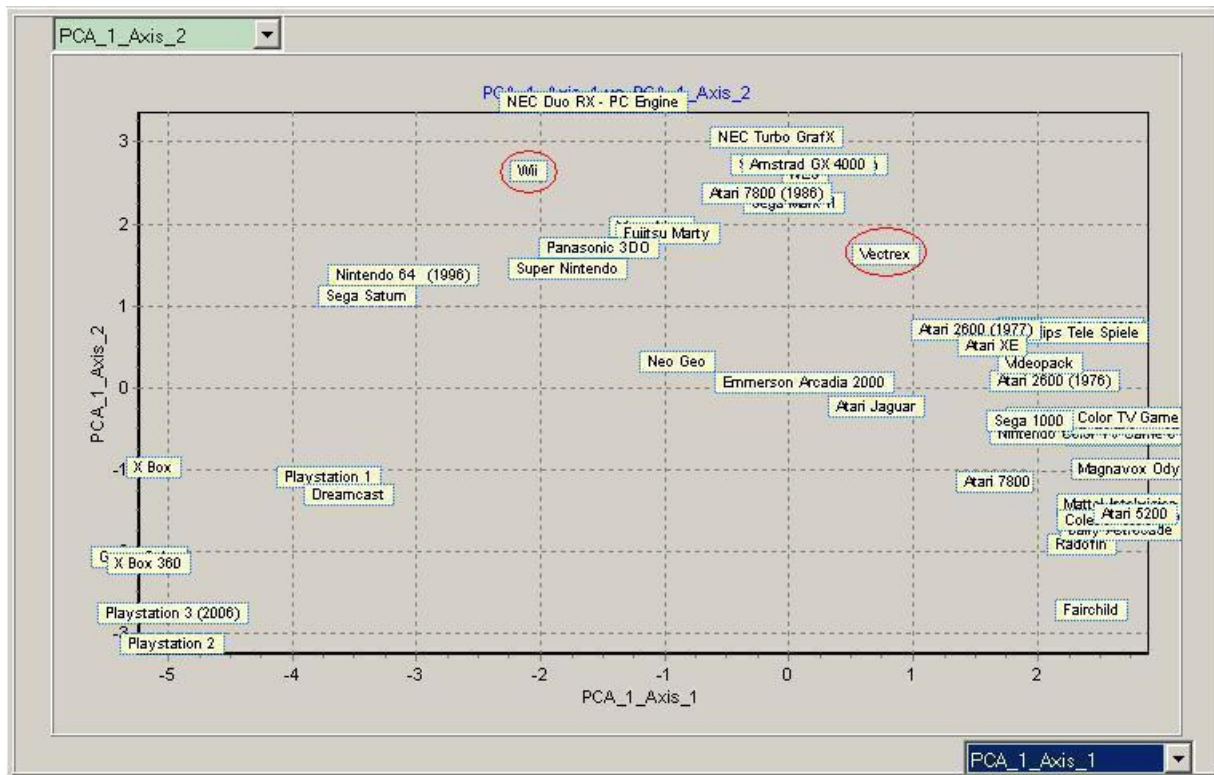


Figure 3. Example of results of a principal component analysis applied to the elements identified on all 47 gamepads considered.

This accounts for the identification of the various routine signals associated with gamepad consoles when these latter are considered independently. The identification of several routine signals is thus possible without too much difficulty. What matters is the time and attention devoted to observations and their association with a variable to create a signal. Depending upon the game controller, the "0" or "1" parameter provides a very convenient binary matrix to identify the importance of signals. Concerning the multi-criteria incremental innovation discussed above, we can justify its interest from a principal component analysis performed using the values recorded for each of the 31 expressions considered as variables. Whatever the main axes of projections used, it can be noted that the Wii gamepad lies well-isolated from its competitors: Xbox 360 and Playstation 3 (e.g. the projection shown in Figure 3). Similarly, to a somewhat lesser extent, the gamepad of the Vectrex console is isolated from its competitors: Colecovision, Emerson Arcadia 2000, Atari 5200 and even 1000 Sega appeared the following year. The importance of risk of multi-innovation that can highlight the routine signal analysis is also reflected in the curve that describes the positions of the game controllers via the principal component analysis performed (Figure 3). Indeed, in the direction of left-right reading, we have a quasi-chronological succession of the different gamepads (with the notable exception of the Wii), but no variable is associated with a year. This also highlights the fact that during the past 40 years, the design of the gamepad has evolved by successive small changes except the Vectrex controller that allowed an important development in one step.

## Conclusion

I have been interested in creative competitive intelligence, which is a competitive intelligence with a main objective of providing relevant information to stimulate and strengthen the process of creation and innovation. I hypothesized that the routine signal search corresponds to this aim. I assumed that routine signals are the result of psychological barriers that limit the ability of companies to innovate. To highlight these barriers, it suffices to note the repetitions in a strategy or a design in time and by different organizations. My choice for this experimentation concerned the analysis of the video game controller design between 1972 and 2006. The results are encouraging, especially as some testing with automated image analysis tools have been particularly disappointing. Therefore, the human specialist of competitive intelligence still has much progress to make to contribute to the competitiveness of the company. We also note vis-à-vis the MAYA principle [14] that, in the

limited context of the gamepad design, the Vectrex gamepad provides 55% of new features compared to previous game controllers. Similarly, the gamepad of the Nintendo Wii brings 60% of changes. We can therefore make the assumption, to be checked later, that the multi-criteria innovations with 50% to 60% of changes for this type of product (as long as it does not change the size) may be accepted. From creative competitive intelligence using a routine signal monitoring, we are now able to show how a product deviates from the others and thus can promptly report this one as a potential carrier of a large number of new ideas.



Figure 4. Prototype of what could have been a routine board feasible at the end of 2001 on the design of a console gamepad.

The establishment of a creative competitive intelligence based on the collection and analysis of the routine signals therefore requires a retrospective analysis of past routines to identify the percentage of multi-criteria innovations that are acceptable and capable of giving an advantage to designers. Of course, we must link this percentage with the number of changes associated with it (for the design of the gamepad 10% of change is linked to about one design change). Depending upon the decision context associated and its implications, the routine signals have several advantages. For example, at an operational level, in addition to boards or trend books [3], a person in charge of the creative competitive intelligence can draw boards (Figure 4) or routine books to stimulate the creativity of designers. At the strategic and competitive levels, routine signals can highlight weaknesses in the products of competitors. Part of their product strategy can then be easily decrypted and anticipated. From the cross-referencing of these signals with other signals such as weak signals linked to investments and patents, a few major strategic decisions can then be taken.

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## Appendix

*Summary table of the gamepads studied in this experimentation*

Console	Company	Year released
Magnavox Odyssey	Magnavox	1972
Video Sport MK 2	Henry's	1974
Atari Double Pong	Atari	1975
Interton Video 2000	Interton	1975
Philips Tele Spiel	Philips	1975
Atari 2600 (first gamepad)	Atari	1976
Fairchild	Fairchild Semiconductor	1976
Radofin Supersport	Radofin	1976
Bally Astrocad	Bally	1977
Atari 2600 (second gamepad)	Atari	1977
Nintendo Color TV Game 6	Nintendo	1977
Palladium TV Match	Palladium	1977
Nintendo Color TV Game 15	Nintendo	1978
Videopac	Magnavox - Philips	1978
Intellivision	Mattel	1980
Creativision	V Tech	1981
Colecovision	Connecticut Leather Company	1982
Emerson Arcadia 2000	Emerson Radio Corp	1982
Atari 5200	Atari	1982
Vectrex	Smith Engineering	1982
Sega 1000 (Sega Mark I)	Sega	1982
NES	Nintendo	1983
Atari 7200	Atari	1984
Sega Mark II	Sega	1984
Sega Master System	Sega	1985
Atari 7800	Atari	1986
Turbo Grafx (PC Engine)	Nippon Electronic Company (NEC)	1987
Atari XE	Atari	1987
Megadrive	Sega	1988
Amstrad GX 4000	Amstrad	1990
Super Nintendo	Nintendo	1990
Fujitsu Marty	Fujitsu	1991
Philips CDi	Philips	1992
NEC Super GraphX (PC Engine)	Nippon Electronic Company (NEC)	1992
Panasonic 3DO	Panasonic	1993
Jaguar	Atari	1993
Neo Geo	SNK Corporation	1994
Playstation	Sony	1994
Sega Saturn	Sega	1995

N64	Nintendo	1996
Dreamcast	Sega	1998
Playstation 2	Sony	1999
Xbox	Microsoft	2001
GameCube	Nintendo	2001
Xbox 360	Microsoft	2005
Wii	Nintendo	2005
Playstation 3	Sony	2006