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Theoretical Elements: A Multidisciplinary Framework between Sociology and Management of Innovation

In line with the aim of this handbook, which is to allow a realistic explanation of the innovation processes at work in the field of sport, we shall develop in this theoretical part the main contributions of several approaches from sociology and, to a lesser extent, from socioeconomics and management sciences. The description of these theoretical currents is coupled with another intention: to reflect on how they are structured.

In this regard, a clarification is needed now as to the respective projects of management sciences and economics, on the one hand, and of sociology and anthropology, on the other. If not clearly stated, this sometimes leads to misunderstanding, which can make interdisciplinary dialog difficult. Sociologists and anthropologists have essentially focused on understanding the spread of innovations (whether social, cultural, industrial, political, etc.), their adoption in different cultural milieus, which is synonymous with the transformation of practices and uses. Less concerned with cultural dimensions than with organizational and industrial issues, specialists in management science and economics seek to identify (and, to a certain extent, prescribe) the best way to successfully commercialize a novelty, with a singular focus on technological innovation. From then on, the innovative company, its stakes and the expected return in terms of added value are central (Godin 2017). Appropriation on the one hand, commercialization on the other; although this division is often schematic, it is nonetheless rooted in

a certain epistemological reality, even if several theoretical approaches propose going beyond it.

1.1. Classical approaches to innovation

Schumpeter's thinking has already been mentioned, and it is of great importance in the work on innovation, since the economist has contributed to highlighting the driving role of innovation in economic evolution, including through its paradoxes (Schumpeter 1935). In particular, we owe him the famous "creative destruction" achieved by the novelty that competes with the old to the point of harming it. He drew up categories that are still used today, including that of typology (product innovation, organizational innovation, process innovation, etc.) and degree (difference between major and minor innovation). Above all, he highlighted the decisive action of an economic agent: the entrepreneur. The latter is not necessarily an inventor (or even a company founder), but a creative and persevering actor, capable of reconfiguring both the resources of the organization and the economic circuits (Munier 2013).

This classical approach has the advantage of highlighting the centrality of innovation in the creation of value in the sports sector (see for example (Chantelat 1992)). It allows us to account for the long time span between invention and innovation in many cases. In this respect, it is interesting to note that recommendations from management science and economics generally encourage the acceleration of processes, in order to increase the pace of innovation and, in so doing, the chances of success (Segercrantz *et al.* 2017). This acceleration, which aims to prevent competition from taking advantage of innovations, is not without ambiguity: the multiplication of destruction cycles can lead to the lasting destabilization of markets.

Above all, it is important to avoid focusing on providential entrepreneurs, on the one hand because the exceptional figure of the enlightened entrepreneur can be criticized as a chimera (Mustar 1994), but also, as we shall see, because it obscures many other actors and factors. This perspective is not self-evident, since we have been used to seeing innovation as essentially the work of avant-garde individuals capable of recombining productive systems. A recent history (Schutt 2012) of the manufacturer Petzl (technical outdoor sports equipment) describes the founder (Fernand Petzl) and especially his son (Paul Petzl) as visionary, determined and driven by a desire to innovate and

capable of anticipating new needs and practices in order to reconfigure outdoor markets. While the career paths and sociological or personal characteristics of innovators must certainly be taken into account in innovation trajectories, they cannot be an exclusive explanatory factor for the fate of new products.

This caution is all the more necessary as we sometimes see the individual figure being substituted by that of the organization in studies. Following the example of the visionary entrepreneur, companies with exceptional characteristics (decompartmentalized, learning, hybrid, etc.) are designated as the driving force behind successful innovations. The Salomon company thus appears to be an ideal type of creative, even intuitive, organization, capable of managing uncertainty in order to regularly bring about innovations (Moingeon and Métais 1999; Puthod and Thévenard 1999; Desbordes 2001; Deroy 2004; Bueno Mérino *et al.* 2010). The Décathlon group – and one of its private labels, Quechua – are in turn analyzed as a hybrid organization capable of combining rational and turbulent processes in the service of effective innovations (Hillairet *et al.* 2010), in a description that seems somewhat idealized.

Moreover, Schumpeter's brainwave leaves the concrete conditions of the success of innovations in the dark (aside from a mechanism of imitation of the innovator by follower companies). The work of Rogers (1995) would deepen the study of diffusion mechanisms, characterizing the way in which a novelty, more or less easily adoptable, spreads in a context (historical, social, technological, etc.) that is more or less favorable. The progressive adoption of an innovation by a growing number of users is done by persuasion and imitation, via a "trickle-down" movement (from the producer to the consumer, from the pioneers to the laggards, from the upper classes to other social circles). The success of an innovation is described as being linked to a double movement between certain endogenous factors which favor (or don't favor) its progressive spread towards a market which is variably favorable (thus exogenous factors).

Several favorable characteristics of innovation can be singled out:

– the relative advantage over previous solutions;

– compatibility with existing values and practices;

– simplicity and ease of use;

– trialability or possibility of testing the innovation;

– finally, the observability of the results obtained.

Salomon's arrival on the ski market in the 1990s, through a strategy of innovation (Desbordes 1998, 2001), is thus interpreted in the light of an organized rationality, centered on these factors of success: advantageous technological breakthrough for the skier, compatibility with the current practice of skiing, "visibilization" of the innovation, progressive marketing to validate the trialability, etc. The widespread uptake of the monocoque ski was described as a "snowball" effect, with users confined to the role of successive adopters, starting with champions, expert skiers, high-end customers and then regular skiers. Conversely, Trabal (2008) reveals the effects of social resistance to innovation within the French canoeing federation: a new form of competition kayak, technically optimal, was not taken up because it was not compatible with what certain key actors in the system (the first adopters: coaches, elite athletes) perceived as technical progress.

Classical approaches in sociology are therefore interested in the intrinsic properties of objects in order to deduce their advantages and disadvantages in relation to the social or cultural context in which they are received. Innovation spreads (or doesn't spread) in a more or less receptive environment and makes it evolve or transforms itself to respond to major trends. This is how the relatively rapid adoption of the fiberglass pole vault in the 1960s was analyzed (Defrance 1984). However, in spite of obvious relative advantages compared to the previous solutions (bamboo or metal poles), it is again the compatibility with the traditional definition of the activity (body techniques, the spectacle on show, the validity of records) that is debated. For Defrance, the context (ideology of progress) and the adoption of the fiber in other countries obliged the French athletes to imitate. But if the contextual dimension of an acceptance or rejection is undeniable, the mechanisms of adoption (or rejection) are not always made explicit.

Thus, Martha's (2006) account of technological innovations modifying BASE jump practices only partially describes how practitioners became interested in the invention. As a result, she hardly discusses how the invention was not only adopted, but adapted to a physical environment (take-off site, air) and social environment (uses, techniques, conceptions), which were both evolving together.

KEY POINTS – The studies included in this first set of theories have the merit of highlighting the role of social factors and the influence of the global innovation environment. They sometimes deal with cases of resistance or failure to spread, which can be considered as failures. From this point of view, innovation appears less as a result than as a process; it is not limited to the emergence of a novelty, however ingenious it may be, and only succeeds when it is adopted by an environment and goes hand in hand with the renewal of social practices as much as of productive systems. Such works have thus made it possible to anchor technical constraints in their social, economic and cultural contexts, in order to underline the complexity and the progressiveness of the processes of sports innovations (Vigarello 1988; Chantelat 1993; Pociello 1995). The five factors that facilitate diffusion (relative advantage, compatibility, simplicity, trialability and observability) also constitute a solid basis for analyzing the downstream phase of innovation trajectories.

THE LIMITS OF THESE APPROACHES – Schumpeterian thinking remains marked by a conception of innovation centered on the suppliers and their products[1], with the adopters appearing as relatively passive agents. Boullier (1989) in turn underlines the imprint of these reductions in the diffusionist theory. Focusing on the acceptance of the novelty, the analysis neglects what happens upstream, as well as the influence that users can have on the genesis of the innovation. More broadly, this point of view is in some ways linear and unidirectional (top down, from the producer to the consumers, from the elites to the ordinary users, from the center to the periphery). It does not completely escape determinism, obscuring certain contingency effects, uncertainties and the sinuosity of real innovation stories. Finally, the focus on a main actor (whether an entrepreneur or a pioneering organization) seems in some cases excessive (falling under the "myth of origins" pointed out by Callon (1994)), whereas stakeholders with multiple roles generally take part in innovation processes. Bauer (2017) also questions certain diffusionist assumptions: the anchoring of the novelty in a single, specific place; the need for rapid spread; the only temporary nature of possible rejections; or the absence of evolution (or only at the margin) of innovations during the diffusion process. Rogers (1995) also recognized the unrealistic nature of most diffusionist assumptions, especially since they are based on the study of a carefully selected set of success stories.

1 "Production educates consumers, as it were, and creates new needs, so that initiative is on its side" (Schumpeter 1935, p. 94).

1.2. Approaches based on uses and users

Sportsmen and women (whether experts or "ordinary" sportsmen and women) are not the subject of much attention by the authors mentioned so far: "second roles": they often appear as simple recipients who accept or don't accept an innovation, either as a trailblazer or a follower. Innovation is still thought of as a closed process, carried out by organizations (generally companies). In this sense, the main role attributed to the user is to have needs that the manufacturer tries to identify, to fill or even to transform by designing new products.

However, it has now been proven that consumers are not passive: they appropriate goods (even the most standardized ones) through their "arts of doing" (de Certeau 1990), and they are creative through their "techniques of use" (Julien and Rosselin 2005). For their part, the management sciences have clearly shown how much the consumer participates in the processes of servuction, and even production (Vernette and Tissier-Desbordes 2012).

Moreover, it is possible to consider users as actors in innovation, given their capacity to move, adapt, extend, divert and transform novelties and their prescribed uses (Akrich 1998). This is by no means to postulate an absolute symmetry between designer and consumer (Flichy 2003), but simply to note that there is no watertight barrier between design, production and use – which are all sources of creativity.

1.2.1. *The lead-user theory: the user-innovator*

The consumer may seem to be nothing more than a tactician, capable of playing with innovations designed by market professionals. By developing the lead-user theory (LUT), Von Hippel (2005) pushes the consideration of the user to the point of affording him or her a "lead role" in the innovation process. More so than the early adopter, according to Rogers, who approves or diverts manufacturers' innovations, the lead user is a developer of specific products or services that the market does not yet know how to use or does not yet want to use. Von Hippel was interested in lead users (or "pioneer users") in the creation of "informational goods" (such as software), but also in the manufacture of "material goods", with a particular focus on the sports sector, which is teeming with creativity carried by these user-innovators.

The lead user is generally an expert in the activity concerned, but he is also characterized by a willingness to tinker. He may even rationalize the process to the point of creating a "mock laboratory" to test and compare different solutions. He also sometimes seizes the opportunity to use his close circle and/or custom manufacturers to obtain resources. Although important compromises are made at this stage (due to time, money, etc.), this low-cost innovation niche is likely to produce prototypes with novel functionalities. The solutions thus generated are generally shared with other users who will examine them, comment on them, imitate them, test them and eventually appropriate them (modifying and enriching them in the process, in many cases). This sharing, based on a free and generalized free access opposed to intellectual protection (close to the open-source movements (Von Hippel 2013)), is very frequent among most lead users[2]. Favoring the dissemination and circulation of knowledge, their approach is not necessarily disinterested because it is the source of symbolic benefits (recognition, notoriety, status) within communities of practice.

By definition, the number of user-innovators is greater than the number of people working in the R&D departments of companies in the sports sector. Beyond the diversity of needs expressed by this mass of sportsmen and women, another element that explains the effectiveness of these communities, in terms of innovation, can be evoked: technical expertise and cognitive diversity are a source of creativity. Von Hippel supports the idea that innovation is all the more effective when it is elaborated collectively; on the one hand, through the successive addition of improvements and transformations made by others; on the other hand, because of the heterogeneity of needs and the capacity of users to imagine solutions to lead to a stable (and generalizable) form of progress. The collective activity of lead users, especially when mediated by structured communities of practice, offers manufacturers a large amount of information about the stated needs, envisaged solutions, and, indirectly, potential markets. This information is all the more useful to manufacturers because it is either unavailable or extremely costly to obtain. Sometimes, companies only have to reproduce

2 Faced with an unfulfilled need, some of these user-inventors nevertheless aspire to take advantage of their inventive capacity, and create companies (Shah and Tripsas 2016) or even file patents for this purpose. But ultimately, a very small percentage of such patented products reach the market phase (Dulakakhoria and Jana 2013), and the eventual transition to commercialization often involves the use of traditional manufacturers.

prototypes developed and progressively optimized in this way, thanks to the virtues of this "distributed innovation".

Von Hippel, and a growing number of researchers with him, were particularly interested in sport. The invention and spectacular spread of the mountain bike is an example. In the United States, in the early 1970s, elite sportsmen who wanted to ride off-road and were dissatisfied with the existing bicycles decided to build their own equipment. To get around on rough terrain, they cobbled together bicycles by assembling pre-existing elements (old solid frames, wide tires, motorcycle brakes, etc.). Gradually, these prototypes were taken up, perfected and developed by user-manufacturers, and only then were they recovered and generalized by the bicycle industry (Büenstorf 2003). Subsequently, users have continued to invent new equipment due to the diversification of mountain bike practice (subspecialties according to terrain, practice conditions, modalities – touring, downhill, etc.), giving rise to other unmet needs (Lüthje *et al.* 2005). In the development of kitesurfing, Franke *et al.* (2006) have also highlighted the essential role of kite surfers in the improvement (incremental innovation) of equipment, by adapting and diverting equipment, in an iterative and collective way. These authors underline the efficiency of this bottom-up mode of innovation (open innovation, user-centered innovation, or community-based innovation), which is confirmed by the safety improvements obtained in this way in the field of wing safety releases (Hillairet 2012). A study of innovation practices in four sports communities – canyoning, gliding, boardercross and cycling – suggests that, on average, 20–30% of practitioners have already modified or created their equipment (Franke and Shah 2003).

Lead users are sometimes the source of radical innovations, but most often they bring about incremental innovations that are likely, through accumulation and enrichment, to modify products and techniques to a greater or lesser extent. Take, for example, the development of materials and expert gestures in windsurfing in Hawaii (Shah 2000), and the adaptation and stylization of kayaking materials (Hienerth 2006; Hyysalo 2009). Analyzing the emergence and growth of Nordic walking, Pantzar and Shove (2010) also mention the need to take into account, alongside lead users, ordinary users whose role is somewhat underestimated. In this respect, the description of food techniques in different forms of sports itinerancy illustrates the great creativity of even the most ordinary sportsmen and women: repackaging,

using things for different purposes, fashioning things themselves, etc. (Boutroy and Vignal 2018).

Beyond the questioning of the monopoly of innovation capacities held by industrialists alone and the demonstration of the specific functioning of lead user communities, the essential contribution of the LUT is to show how companies can be inspired and fed by users' achievements. Cases of co-production with lead users are not rare. This process of open innovation provides manufacturers with a wealth of information on the contexts of use, which would be difficult to access by other means (for example, a series of formal tests). In this respect, user creativity is a positive externality for the commercial world, which may have an interest in developing processes of innovation through use.

1.2.2. *Innovation through use: user participation*

Making the user a partner in innovation is not a new idea. The approach is the result of the observation that 80 to 90% of innovation attempts (whether they be products or services) end in failure. There are many different approaches to innovation that implicate users (innovation through use, user-centered approach, etc.). Whatever the favored one, innovation is thought of as an iterative and whirlwind-like process, during which a good, a service or a process encounters users, or not. The challenge is, of course, to encourage this adoption.

Faced with the order to innovate, recourse to the sociology of uses (Akrich and Méadel 2004) makes it possible to accompany the action, particularly in the case of disruptive innovations (Cardon 1997). The user then becomes a kind of useful resource for innovation actors (designers, marketers, etc.), as they can reduce risks by testing and validating ergonomic or technological choices as early as possible, for example. Ultimately, it is a matter of optimizing the creation of value and ensuring its perception. Any reusability is only possible if the user is interested in the object or service, and if we can verify that its use makes sense in his daily life. This perspective reflects renunciation into technical determinism, whereby the user is no longer considered a passive being nor a docile absorber of an innovative proposal.

Research on usage shows that usage does not exist in a desert of use and that the adoption of a good, in particular, is built around previous techniques and practices (Mallein and Toussaint 1994). Use is also social, since it develops over time and often comes up against the resistance of the social body and the weight of habits and tradition, which regularly thwart the diffusion of innovation (Perriault 1989). The value of the innovation is thus constructed by the meaning of favorable uses.

Depending on the approach, the question of usage can be raised at certain key points (usage-based approach) or during each of the major phases of the innovation process, that is anticipation, design, adaptation and adoption (user-centered approach). For each of these phases, specific tools from the human and social sciences and dedicated devices (places of interaction, co-creation platforms, test prototypes and usage analyses) are deployed in order to anticipate the technical requirements of users and their social and cultural anchoring. Finally, these methods allow for concrete tests, within the ordinary environment of practice, in order to study the ways of doing things, the resistances, and also the new configurations employed (appropriations, other uses or "misuses").

1.2.3. *Co-creating value: the consumer at the heart of innovation*

The participation of users in innovative processes is an important factor in the success of an innovation, particularly during the ideation, testing (concept, prototype) and marketing phases (Gatignon *et al.* 2016). The various forms of open innovation that we have just described also refer to a certain heterogeneity of terms: depending on the case, we speak of involvement, participation or even co-production.

A more recent paradigm – value co-creation (VCC) – is also interested in these interactions between companies and consumers but goes further in recognizing the active role of the latter (Vargo and Lusch 2004, 2008). This approach reverses the classical perspectives to postulate that value is generated not by companies (which only make value propositions), but by consumers during their participation and then use. An organization therefore becomes co-creative if it reinforces its interactions with users, in order to foster the iterative emergence of value-generating propositions for end users (Grönroos 2011). Interactions do not aim to change the consumer, but on the contrary to transform the company.

Although VCC is receiving increasing attention in sports, it has not been used in the context of innovation case studies. However, in an indirect way, most of the work focuses on the co-creation of value around novelties. Kolyperas *et al.* (2019) synthesized how fans (understood as engaged consumers) determine the value of propositions (e.g. "GoPro Be a Hero", through users' productions, narratives and broadcasts). According to them, this is done through operations of evaluation (role of assimilator), creation (role of adapter) and positioning (role of authenticator). These mechanisms very often move value propositions "in directions that were not foreseen or explored by the brand itself" (Kolyperas *et al.* 2019, p. 213). These elements confirm, if necessary, that the value of an innovation cannot be defined *a priori* by the providers but is constantly redefined *a posteriori* and in a contextualized manner by consumers.

Fostering consumer-centric interactive approaches should not be idealized as it does not protect against a symmetrical phenomenon of value co-destruction through misuse (Plé and Chumpitaz Cáceres 2010), resistance (fan protests in sports shows, see (Stieler *et al.* 2014)), or loss of value for other stakeholders. Boutroy and Bodet (2017) showed, for example, how an innovation process based on a strong co-creative approach adopted by a sports goods manufacturer (relying on its fan community) failed to succeed owing to the co-destruction of value for ordinary consumers as much as for intermediaries. Focusing on the *Nike Run Club* mobile sports app, Charitsis *et al.* (2018) also show that the co-creator of value can be somewhat unknowingly co-creative, as the data harvested on their physical activity is subject to secondary use by the producers of these apps.

In this respect, it remains important to move beyond the company-consumer dyad to take into account all interacting stakeholders (Woratschek *et al.* 2014), relying in particular on the notion of stakeholder network, as Grohs *et al.* (2020)[3] did in the case of sports events.

KEY POINTS – The contrast with classical approaches to innovation is significant. Von Hippel and his colleagues take the opposite stance on the still widespread view that innovation comes exclusively from industry and its entrepreneurs, from the identification of markets to the propagation of novelty. The LUT makes it possible to highlight the importance of more

3 It is surprising that this original work in sports management does not rely on the actor-network theories that we will see in section 1.3.

ordinary actors on the periphery of productive systems by taking into account the role of users (described as growing, to the point of evoking a "democratization of innovation"). However, it is important not to misunderstand the main interest of this inverted model of innovation: it is true that lead users occasionally take the place of industrialists; but in a more structural way, they provide them with valuable information about expert uses, without which many industrially produced innovations would not see the light of day or would prove to be out of step with the needs emerging from the field. Finally, one may wonder whether the LUT does not stimulate more reflection on ideation and invention than on innovation as a whole. The increasing attention paid to different forms of open innovation signals a desire on the part of companies to integrate consumers as actors of creativity. This may involve encouraging interactions with different categories of users (user-driven approach), or even making the company a simple facilitator of the co-creation of value by consumers (VCC). These elements open up the possibility of substituting the top-down innovation scheme with a more bottom-up conception with the LUT, or even more horizontal and whirling in other cases (Gaglio 2011).

THE LIMITS OF THESE APPROACHES – While this approach has led to decisive advances, it leaves some questions unanswered. By emphasizing the primary role of lead users, the proponents of the LUT sometimes come to underestimate the structuring role of the traditional actors of innovation (companies, laboratories, etc.). In a way, they reactivate a new incarnation of the heroic figure (the lead users, the communities of practitioners resemble the "disinterested enthusiast" of the mythology of innovation analyzed by (Callon 1994)), which displaces, rather than overcomes, the emphasis placed on a central actor in the innovation process. The role and objectives of the users appear to be quite heterogeneous, just like the forms of relations that are established with the manufacturers and their representatives. Some of the innovations described are in fact similar to "simple" customizations, which are, after all, quite classic in the phase of appropriation of serial equipment or material. Open innovation is certainly part of a more egalitarian dyadic relationship between companies and users, but it is not a miracle solution. There are many consumers and their needs are evolving. What's more, listening too much to certain users can destroy value for other users and even other stakeholders. Innovation is a collective activity that requires going beyond the organization-consumer dyad to take into account the wider network of actors who will support it, as well as the many material and technical elements that will influence the fate of a new product.

1.3. The socio-technical approach to innovation: networks and attachment

The socio-technical analysis of innovations makes it possible to enrich the previous contributions, in particular by going beyond the overly pronounced focus on certain components of the systems: the entrepreneur, the technical object, the user, etc. According to this relational approach, the success of an innovation depends above all on the progressive construction of a network of stakeholders who will support it and give it substance. It is therefore understandable that the central issue becomes recruiting allies, identifying their expectations and translating the project in such a way as to interest them (Akrich *et al.* 1988a, 2006). The originality of this point of view is summed up in the following statement, which is rather iconoclastic with regard to the usual sacralization of the inventor: the fate of an innovation does not depend so much on the intrinsic qualities of the idea or the object conceived as on the solidity and breadth of the chain that will support it. Innovating therefore consists of building and maintaining a chain of association that is increasingly extended, solid and stable, by attracting and recruiting new actors. Kline and Rosenberg (1986) develop a vision of innovation as an interactive process, or chain-linked model, compatible with the socio-technical approach. The consensus that has gradually taken hold in the academic sphere around this collective and systemic understanding of innovation has not prevented institutions responsible for innovation policies from maintaining approaches that are too linear and/or focused on a few key actors (Joly 2019).

In order to develop and strengthen the innovation network, one must regularly agree to transform the project into a new form acceptable to new entrants. The adoption of an innovation thus goes hand in hand with an adaptation, or even a reinvention of the "product" (which (Gaglio 2011) summarized through the neologism "adaptation"). Moreover, recruiting or losing an actor leads to a new network, which is likely to reconfigure the project. At each stage, "the innovation is transformed, redefining its properties and its public" (Akrich *et al.* 1988b, p. 31). This approach does not prejudge the decisive role of any one actor (who may be quite ordinary: a prototypist, a salesperson, a supplier, a client, etc.), especially since his or her influence may vary considerably from one stage to another. Moreover, many innovation trajectories develop despite the exit of the inventor's network or of a key player from the beginning.

It is thus necessary to avoid the trap of reconstruction in the form of a success story, with its classic ingredients: passionate and determined

innovators; their promising intuitions stubbornly propagated toward a demand (initially reticent, then benevolent); a concept or product that is "already there" that only needs to be refined to overcome technical difficulties or customer reticence, etc. However, even to understand *a posteriori* a success story, one must try to refuse a finalistic explanation: the receiving society, the convinced market, the controlled efficiency or profitability. "It is impossible to use the end of the story to explain its beginning and its course" (Latour *et al.* 1991, p. 462). It is therefore a question of starting again from the beginning of the story, in a pragmatic way, in order to describe and understand its extensions, its reversals and its adhesions; that is to say, "to explain its elaboration without assuming it to be acquired" (Latour and Callon 1990, p. 23). A first principle of symmetry follows from this: to consider the innovation under construction, without prejudging its success or failure (which must be explained in the same way), which Trabal (1999) has underlined the importance of in the sports sector. Hence the interest of innovation narratives in process studies (innovation in the making) (Hoholm and Araujo 2011), a trend that invites us to look at trajectories that are still unstable, or in the process of stabilization, rather than at the already stabilized products and the formalized collectives that underlie them. Hence the importance of works that are interested in this way in innovations that have not met their market or penetrated society (Latour 1992). This perspective can be compared with the contributions of Latour (1989), who very early on was sensitive to science in action, that is to say in the process of being made. It is indeed a way of capturing and then showing the experiences and actions of all stakeholders in the face of opportunities, uncertainties, disagreements and trade-offs to be made (Hoholm and Araujo 2011).

In innovation studies, materiality is generally taken into account, but in a somewhat reductive way. To put it simply, technical determinism makes it an obstacle (to be overcome or bypassed), the techno-centric approach focuses on functionality (to be domesticated), and diffusionism considers material elements as static and malleable entities. A second symmetry, embodied in the very notion of sociotechnics, allows the theory we are interested in to go further: the material or technical dimensions cannot be separated from the social dimensions. An innovation network is thus conceived as an assembly of human actors and non-human elements: materials, objects, prototypes, workshops, environments of use or diffusion, plans, regulatory texts, etc. On both sides, interests or constraints are redefined according to the context and concrete uses. Such a conception can seem destabilizing, but it allows us "to take the non-humans out of a status oscillating between the docile resource,

mobilizable without effort by the social actors, and the absolute constraint, over which they would have no control" (Grossetti 2006).

Non-human elements are not static. They are constantly evolving (Ingold 2012): they change according to the transformations of the socio-technical network. First, because they are manipulated and transformed by the other actors of the innovation. Second, and more subtly, because their very properties are redefined according to the uses and other entities. For example, according to the phases of the innovation trajectory of kitesurfing (Boutroy *et al.* 2014), waves were initially "reliefs" that slowed down and disrupted an unmanageable glide, focused on speed; whereas later, new users with modified gear perceived them as "tremors", or means of making them allies that they could collaborate with to reinvent the practice in an acrobatic mode. Symmetrically, human actors and their behaviors can thus be modified in return by the non-human elements with, or through which, they associate in the innovation.

Put another way, objects can have agentivity, that is, they have capacities to make humans act: they obstruct, incite, enable, associate, mediate (Latour 2006; Quéré 2015). For example, the Joëlette is a single-wheel supported-traction chair that allows severely disabled people to access hiking trails. Because of its shape and weight, it mobilizes and associates several conveyors and accompaniers who must be one with each other to move. The socio-technical choices stabilized in this innovation (in particular the absence of motorization) make the machine a hybrid between man and things that creates interdependence, and therefore attachment (in all senses of the term: material, social, sensory and affective) between disabled and able-bodied actors (Kasprzak and Perrin 2017).

A third principle of symmetry forces us to consider both associations (additions of functionalities, materials, actors in a network) and dissociations. Indeed, in some cases, "the structuring element is simply the removal of one of the elements" of the network (Goulet and Vinck 2012, p. 197). This is what has been observed, for example, in the sports domain, with regard to the trajectories of objects that are innovative because of their lightness, the simplification of use allowed, etc. (Hallé *et al.* 2014; Soulé and Lefèvre 2016). We then speak of "withdrawal" innovations, which are structured by detachment, which in fact implies reconfigurations of the network. Withdrawal or reduction is the very objective of innovation, which Kimberly (1981), in the organizational context, calls exnovation (abandoning

a practice or a product, such as the use of paper in a company). Innovation therefore amounts to opting out of something that is no longer deemed useful or sustainable (Goulet and Vinck 2017). Detachment can even concern a human actor, as in the case of exclusively female mountaineering groups (Ottogalli-Mazzacavallo and Boutroy 2020). This innovation of practice is indeed based on the progressive dissociation of men, especially in the high mountains, to enable an emancipatory and autonomous mountaineering experience, which is not without controversy or compromise.

Take, for example, the stormy history of kitesurfing. This is not one of a brilliant intuition and first prototypes progressively perfected to the point of performance for a public captive to this invention (Boutroy *et al.* 2014). From the elaboration of the first inventions by lead users to an undeniable commercial success, it took two decades of reversals, failures and transformations to laboriously extend, through translations of heterogeneous interests, a socio-technical network associating pioneer users, capricious wind, fickle journalists, patents, tourist actors (agencies, service providers), irreducible waves, board and sail manufacturers, fickle sports federations, political elected officials and Kevlar threads, among other factors. Rech and Paget (2018) pointed out that the socio-technical approach allowed for a consolidated understanding of innovation networks in the outdoor sports sector, for example the difficult territorial innovation and practices in a small winter sports resort (Rech *et al.* 2009); or the creation of a company and the uncertain launch of innovative services (Paget *et al.* 2010). The success of these innovations is each time linked to the consolidation of an extended chain of human actors (managers, supervisors, elected officials, athletes, etc.) and non-human elements (slope, wall, snow, wind, etc.). This work also reminds us that innovation often goes hand in hand with the emergence of controversies that need to be resolved (see, for example, the case of the development of motorized recreation in a natural park (Haye and Mounet 2014)).

A comparison between the manufacture of ultra-light mountaineering equipment (backpack or harness, see (Soulé and Lefèvre 2015)) and that of a new adjustable kayak seat within two different very small businesses (VSBs) shows varying levels of success. Yet failure or success can be explained symmetrically according to similar principles: growing interest and attachment (or not) of multiple allies, strength or fragility of ties (likely to produce continuous reconfigurations of the network), and ability (or not) to compromise – especially on technical perfectionism (Soulé *et al.* 2014). If, in all cases, contingency and unpredictability are prevalent, the question of

the capacity of the innovation's project owners to compromise on their initial project or program appears essential. It is in particular with regard to this aspect that it is possible to understand the contrasting fates of innovations carried by a pole manufacturing company, whose different ages testify to very different abilities to compromise (technical, commercial, entrepreneurial) in order to achieve a successful operation (Hallé *et al.* 2016; Vignal *et al.* 2018).

The socio-technical approach nevertheless sometimes struggles to shed light on what, from a normative point of view, makes possible (favors, hinders, weakens, etc.) the associations between actors in innovation. Quéré (1989) was quick to point out this limit on the clearance of regulations (collective norms, interpersonal relations) and regularities (structure). However, innovation activities can be considered as dependent on and determined by different kinds of social characteristics.

For example, in line with the sociology of networks developed by the new economic sociology (Cochoy and Grossetti 2008), it is possible to take better account of the dynamics of pairing between actors. Grossetti (2006) suggests strengthening "the explicitness of what makes up the network, the relationships", including in innovative activities (innovation networks, business creation) (Grossetti 2008a, 2008b; Grossetti and Barthe 2008). The first phases of innovation are thus characterized by a strong dependence on prior interpersonal relationships (we speak of social embedding). However, the expansion of the network will inevitably (and sometimes abruptly) involve enrolling new actors by escaping from personal relationships, sometimes by detaching oneself from one's "close friends" (known as decoupling). This allows us to understand the difficulties in making a success of switching between the exploration and exploitation of an innovation, or the importance of the many mediation mechanisms (objects and professionals involved in putting people in touch with each other) that proliferate around innovation activities: clusters, incubators, economic agencies, directories, etc. This interpretive framework thus is drawn upon to understand the role and changing weight of interpersonal relationships in an innovation trajectory of a novel sliding device (Hallé and Boutroy 2017).

KEY POINTS – At first sight difficult to access, particularly due to its innovative and radical character, the socio-technical analysis of innovations has the merit of "hammering the nail in" by breaking down most of the commonplaces that are frequently trotted out about innovation. It invites us

to study failures as well as successes; to avoid focusing on the inventor and to substitute a collective or even systemic interpretation; and to avoid isolating the social and technical dimensions of the processes being studied. Indeed, innovation implies dealing with complex material elements (technologies, practice spaces, materials, objects, production systems, etc.) that will have a determining influence on the future of an invention. Three principles of symmetry summarize the foundations of this approach: "equal attention paid to successes and failures, to humans and non-humans, but also to associations and dissociations" (Goulet and Vinck 2012, p. 219). This reticular interpretive framework allowing detailed and realistic accounts of innovation dynamics will constitute the central approach mobilized in this handbook. Innovation – whether it starts in an R&D office or in a lead user's garage – is never a solitary process. From the invention phase onwards, it is important to surround oneself with support and resources in order to make an idea or a prototype exist, evolve and become more reliable. An innovation trajectory is a collective journey involving human and non-human actors, because to succeed, the invention must be socialized and appropriated by increasingly large and heterogeneous groups.

THE LIMITS OF THESE APPROACHES – By enriching, almost infinitely, the parameters and entities to be taken into consideration, this model undeniably makes the analysis more complex. It provides a valuable "education of the eye" that helps us to avoid many simplifying traps, but at the same time requires adjustments. Without questioning the status of material elements as "acting entities", there are obviously differentiated properties between the domain of humans and non-humans, which this theory tends, if applied unqualifiedly, to level out excessively (Quéré 2015). Moreover, because of its anchoring in actor-network theory (Akrich *et al.* 2006), socio-technical analysis proposes a theory of action (what moves actors) that risks being reduced to strategic rationality; it is indeed largely about tactics, enrolments, interest, etc. (Quéré 1989). The danger is then that we cut ourselves off from certain contributions of the classical social sciences, which are nonetheless capable of taking into account the external determinants that precede innovation activities. By giving them their rightful place, it is possible to better understand how actors link or associate (types of social relations, structures), or – by mobilizing the achievements of more traditional sociologies (lifestyle, dispositions, cultures, etc.) – the phenomena of attraction or resistance to a particular enlistment or innovation (Gaglio 2012).

In this respect, the recent revivals of economic sociology around attachments (Cochoy 2012a) and market arrangements (Callon *et al.* 2013) provide promising support for understanding the establishment of links in innovation processes. Above all, it is important to remember "that these positions and programs complement and enrich each other more than they contradict each other" (Cochoy 2012b, p. 37).

1.4. Critical innovation studies

In recent years, a still heterogeneous set of approaches originating essentially from sociology has renewed the call for caution for anyone intending to develop research on innovation. The collective study coordinated by Godin and Vinck (2017) offers a synthesis of this research: a statement of the various biases faced by researchers who primarily study innovation; a call for enhanced reflexivity; and a desire to identify innovation processes in a comprehensive manner. These critical analyses aim to avoid the reinforcement of a particularly prevalent "ready-made thinking", whose concrete repercussions go beyond the academic sphere (Sveiby 2017). It is in fact a call for a less enthusiastic, more balanced and nuanced approach. We propose below a synthesis of these approaches, in the form of advice and calls for vigilance, which for the most part echo aspects developed earlier.

Several biases orient the study of innovation in a sometimes very marked direction. In some ways, they also shape managerial practices and political decisions in favor of innovation. The purpose of this section is to identify the factors that prevent us, in a certain way, from considering and analyzing innovation "as it is done", in as realistic a manner as possible.

These biases are problematic insofar as they contribute to forming excessive confidence in the benefits of innovation, to exaggerating the control exercised over processes and to trivializing disruptive innovations, while strongly orienting towards techno-push proposals. All this is to the detriment of understanding complex, contingent and risky processes that require anticipation and preparation. Derived from or associated with a certain number of myths, they are at the origin of innovation models (Joly 2019). These interpretive frameworks generate shared representations and interpretations of how innovation is produced, then acting performatively, they guide our collective way of seeing innovation. Jasanoff and Kim (2015) speak of socio-technical imaginaries, imbued with values that impact both discourse and practice, more or less consciously.

Type of bias	Explanations and effects on the study of innovations
Pro-innovation bias	Taking for granted that innovation is positive, insisting on its virtues and neglecting the study of collateral effects and negative externalities. Understanding it less as a phenomenon to be studied than as a remedy to social and economic problems.
Pro-success bias	Drawing optimistic conclusions (feeding the pro-innovation bias) from the analysis of success (studying what worked). Leaving aside the analysis of unsuccessful projects and semi-failures, which are nevertheless in the majority and rich in lessons learned.
Pro-disruptive innovation bias	Associating innovation with disruption and exaggerating its "disruptive" character. Most often focusing on radical innovations while supporting and incremental innovations (recycling, maintenance are the majority).
Originality bias	Putting creativity and inventiveness on a pedestal. Associating innovation with the pioneering dimension of the precursor. Badmouthing imitation, considered the antithesis of innovation, although it is an integral part of the innovation process. Underestimating the rigidity and caution of most companies which are actually quicker to imitate and draw inspiration from others than to invent.
Short-term bias	Compressing the duration of innovation projects (being the first to market, introducing the novelty to the market and benefiting from a return on investment, keeping followers at bay). Accelerating innovation when real processes often take a long time. Overestimating the control that can be exerted on innovation processes.
Pro-technological innovation bias	Sanctifying technology as the main provider of solutions ("technological solutionism"), to the detriment of a detailed understanding of the problems to be solved. Approach sold as a technological fix to remedy the difficulties generated by the new solutions, thanks to other technological advances. Focusing on high-tech solutions (new technologies) and adding functionalities to the point of forgetting the low-tech possibilities (simplification, minimalism, removal, use or improvement of already proven technologies, continuity, etc.). Relegating service, organizational, process and social innovations to a secondary role.
Pro-business bias	Considering the enterprise, and in particular start-ups, as the natural cradle of innovations. Minimizing or even ignoring innovations coming from the third sector (associations, foundations), public actors or communities of practice (escaping at least temporarily from market-oriented rationale).

Table 1.1. *Summary of biases in innovation studies*

1.5. Lessons learned from resistance to innovation and unsuccessful processes

Often described as irrational, transient and related to the lack of knowledge of positive effects or anxiety about new things ("neophobia") (Bauer 2017), resistance to innovation can take on many other meanings. There is indeed rationality in the arguments of actors who do not adhere to innovation (Godin and Vinck 2017), which Cañibano *et al.* (2017) state very simply through the concept of "novation": some actors formulate non-innovative strategies and succeed in implementing them. They therefore have "good reasons", entirely rational, for not adhering to, not using, and ultimately not appropriating an innovation. The conception of rationality is here open to the pursuit of goals and to the engagement of plural actions, including those that push to innovate, and those that lead to the absence of innovation, even if this clashes with the contemporary call to innovate permanently and in every respect.

Provided that the choices that led to non-adoption are considered to be sensible and well-founded, resistance can be considered an asset that can contribute to the innovation process (Bauer 2017). Not adopting an innovation is indeed an adaptive strategy that it is important to understand as such (Kimberly 1981) in order to be able to alter the trajectory in question, or to energize other projects. Studies on this subject are few and far between (Thomas *et al.* 2017) and do not sufficiently reveal the actions of resistance. However, an in-depth analysis of resistance to innovation, also known as "re-innovation", allows us to make sense of it (*ibid*.). The rejection of certain technologies, for example, carries messages, identifications and meanings in relation to hegemony or domination-based rationale. It is not only an act of non-consumption, to be approached from a strictly economic angle, but also a question of alignment and coherence compared to a vision of the world and a set of values.

In the same way, the unsuccessful trajectories of innovations (a term that is preferable to that of failure) are rich in teachings. Vinck (2017) approaches them as collective learning processes (learning by failing). In fact, organizations learn more effectively from their failures (and the failures of others) than from their successes (Cyert and March 1992), which are often analyzed in a simplistic and superficial manner. Conversely, when things do not go as planned, there is fertile ground for an in-depth study to identify the causes of the failure. This is not only about transparency, but also about the

search for long-term efficiency. Learning in this way implies accepting to testify about one's professional activity in a way that is *a priori* devaluing, in a culture marked by the call to succeed, to excel and to promote oneself. Although it is an integral part of professional life, failure is rarely openly discussed (Vinck 2017), which is another effect of the pro-success bias mentioned above.

KEY POINT – Not all research on innovation escapes the shortcomings mentioned above (excessive rationalization, emphasis on disruptive innovations to the detriment of imitation and incremental innovations, poor integration of resistance and failures, etc.). The whole point of critical studies of innovation is to provide hindsight to oppose these unthoughts, which are at the origin of a form of partial blindness (Godin and Vinck 2017). To remedy this, Bauer (2017) recommends observing innovations in progress, rather than retrospectively; studying failures in order to understand, by contrast, the origins of success; analyzing abandonments following adoptions; taking into account feedback from users (re-innovation); or even considering the reasons for rejecting an innovation.

1.6. Conclusion

At the end of this brief overview, it should be pointed out that there is no *a priori* more or less true (or false) reading of innovation processes, nor is there a neutral reading; the statements produced from these different theoretical perspectives constitute, as it were, "pieces of the truth", each with its own grey areas. There are therefore different ways of understanding sports innovations, which are sometimes difficult to reconcile. Diffusionism, inspired by Rogers, focuses on the properties of an innovation in order to highlight its relative qualities (within a given context) and thus explain its spread. For some, the context (organizational, historical, social, cultural) will appear to be more decisive in understanding the success or failure of inventions. For others, it is the users (lead users, users involved in the innovation process) who are the main drivers of value creation. Finally, a current of socio-technical inspiration will reverse the gaze to address the dynamic and reciprocal co-construction of the innovation and the environment that will judge it... These different perspectives are not mutually exclusive but correspond to distinct questions that focus on different scales or periods of the innovation.

At a time when innovation processes are becoming more complex (if only because of the acceleration of the circulation of information and the growing influence of users, or even of communities of use), and when innovations become increasingly intertwined (as in the case of the development of service innovations in conjunction with product innovations), it seems desirable that research in social and management sciences applied to sport should be based more voluntarily and systematically on these different theoretical achievements. The specificity of the sociology of innovation lies, on the one hand, in its empirical anchoring, which gives pride of place to field studies, and, on the other hand, in its descriptive dimension, which is particularly relevant to account for emerging and unstable processes.

With regard to the surveys and research mentioned, it is important to remember that the innovation process often appears to be less linear and centralized than common sense would suggest. A reticular phenomenon, subject to continuity and sometimes swirling, it eludes categories that are too closed, as well as attempts to identify the key stages of any innovative process (identification of a need, prototyping, testing, successive lifting of technical constraints, marketing, etc.), tending toward a form of idealization of real innovation trajectories (Gaglio 2011). In principle, while some approaches value one actor or another (be it an entrepreneur, lead user, open enterprise, socio-technical network, etc.) as a source and catalyst of innovation, it is probably less the characteristics of a hypothetical typical innovator that should be tracked down than, more modestly, the key competences that are recurrently implemented in the innovative processes (Gaglio 2011).