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Towards a Sociology of Innovation Ecosystems: Decision-Making under Uncertainty between Social Construction and Bounded Rationality

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Abstract

Starting from the Schumpeterian approach and arriving at the most recent anti-mainstream theories on Innovation Ecosystems, the research examines, through theories, models and business cases, the problematic relationships between Innovation, Invention, and Creative Processes in an attempt to understand, from a sociological perspective, the decision-making processes induced by expectations and uncertainties.

Different schools of thought in economics, agree that innovation is the main driver of growth. Disagreement arises when economists attempt to explain how innovation occurs, as there is a lack of shared understanding about the expectations of its decision-makers and implementers. There is also a lack of understanding about the social and cultural constructions of decision-makers, which are influenced by conditions of uncertainty, error and "non-knowledge" (Gross, McGoey, 2015).

The imagined innovation may be considered feasible in the start-up phase but fail during its development. The innovator, in an ex-ante phase, cannot predict how a new hypothesis will evolve. In many cases, as we shall see, he will remove the observation of obstacles, because he is influenced by beliefs and convictions that disregard rational choices, even bounded ones.

Keywords: social construction, uncertainty, innovation ecosystem.

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1. Introduction: research questions and methodological aspects

What are Innovation Ecosystems and how do they operate?

Do Ecosystems accelerate the introduction of innovations more easily than other networks of relationships?

Do Ecosystems direct the strategies of decision-makers, or do they increase perverse effects and self-deception?

In order to rigorously answer the questions posed, this research paper starts with Schumpeter's reflections and arrives at the current definitions of the Innovation Ecosystem (I.E.). Schumpeter was the first economist to examine the dynamics of innovation. He was also the first to put the behaviour of the entrepreneur at the centre of the capitalist system.

In doing so, Schumpeter went against the orthodox (mainstream) classical theories of economics, inaugurating a heterodox (anti-mainstream) perspective that influenced scholars who later came up with the definitions of the National Innovation System (N.I.S.) and the Innovation Ecosystem (I.E.).

Schumpeter (anticipated only by Pareto[1]) was also among the first to combine economic observation with sociological understanding, with reference to behaviour characterised by uncertainty and risk, but with a particular focus on entrepreneurs and inventors[2]. The famous definition of "creative destruction" (Schumpeter, 1947a) and the identification of the four levers of innovation processes (Schumpeter, 1961) influenced economists and sociologists who investigated the relationships between Creativity and Innovation. From 1982 (the year of the first definition of a National Innovation System accepted by international organisations such as the OECD) to the present day[3], the standard definitions of 'National Innovation System' and

[1] Pareto (1916) believed that the main impetus for action came from what he called 'residues'. Residues are biologically inherited instincts that determine the human inclination to make combinations, to assemble and live in society, to manifest one's feelings through behaviour. Surrounding the residues are the principles of justification that Pareto calls derivations. This, according to Pareto, is the formation mechanism of the non-logical actions that characterise most human actions. As Garzia (2011) shows, residue theory predates behavioural economics and social neuroscience by 70 years.

[2] This peculiarity differentiates Schumpeter from the Pareto perspective.

[3] The most significant definitions of N.I.S. and E.I. were elaborated between 1982 and 2004, as emerges in the second paragraph. For an in-depth examination of the subject in a chronological sense see: Den Hartigh, E., & Tol, M. (2008); Fransman, M. (2018b); Clevenger, M.R., Fortunato, M.W. (2022).

'Innovation Ecosystem' come from economists influenced by the Schumpeterian approach[4].

Methodologically, the researcher examined all the definitions of N.I.S. and I.E., introduced by economists and sociologists of innovation. In addition, the researcher selected paradigmatic case studies, the result of desk analyses. The intention of the research is to highlight the contradictions between academic definitions of Innovation Ecosystems and the behaviour of decision-makers.

Philosophers and sociologists of science have recognised the importance of heuristic reasoning strategies for theory building (Nersessian, 2008), but their significance is underestimated by Innovation Ecosystem Decision-Makers. Decision-Makers believe they are acting in a risky (hence calculable) context when in fact they are operating in an uncertain (hence non-calculable) context that hinders classical rational behaviour. Failing to recognise this abysmal difference, ecosystem decision-makers put in place mechanisms to remove and justify a posteriori a decision made a priori.

Although there is research that emphasises the difference between risk and uncertainty[5], innovation decision-makers make choices thinking they can govern and calculate the problematic relationships between creative initiation, invention, and the innovation process. This gap between theory and behavioural practices has not been highlighted by any research to date.

The imagined innovation is deemed feasible in the start-up phase, but the innovator cannot predict how a new hypothesis will evolve in an ex-ante phase. Yet, in all the cases examined, the innovation decision-maker removes the observation of even obvious obstacles, because he is influenced by beliefs and convictions that disregard rational choices, even heuristic and limited ones (Simon, 1955).

While ecosystem scholars have emphasised the vicious circle brought about by uncertain environments where it is impossible to construct optimality, measurability and equilibrium, real-world decision-makers seem to act 'believing' that they can measure and find equilibrium.

If uncertainty, inhomogeneity, non-knowledge, and error influence decision-making in the real world (making optimal decision-making impossible by definition), ecosystem actors make decisions as if these huge factors were irrelevant. The set of rational decisions - from value-oriented to heuristic decisions, from non-calculable to calculable decisions (Giere, 2006; Nersessian, 2008) - are less evident in everyday practices. This gap between the false perception generated by the social construction of the ecosystem and everyday

[4] The research does not consider 'social' innovation ecosystems for which there are totally different approaches and authors.

[5] The most famous of which is that of Knight and dates back to 1921.

practice is rejected by the real actors who remove the problem by self-deception.

Decision makers are convinced of their nose for business (some call it intuition, others vision, others sixth sense). The entrepreneurial stories examined (both success and failure) are the result of behaviours that go beyond heuristic reasoning.

Entrepreneur Dyson, for example, was successful with a patented 'cyclonic suction' model after prototype variation number 5127[6], because previous prototypes had not met market expectations. But there are entrepreneurs who have abandoned a project after the third prototype variation.

How can we define Dyson's choice and that of other decision-makers examined in the research (see section 3)? Certainly, we cannot call it a rationally calculable decision; nor a risky choice that is measurable. Can we call it a strong conviction that evolves into stubbornness?

But obstinacy does not fall within the sphere of rationality. Is it part of a process of a posteriori justification (which Pareto calls 'derivation') triggered by an instinct for combinations (which Pareto calls residual)?

This research consists of five paragraphs.

In the first paragraph, the researcher examines the definitions and organisational models of National Innovation Systems (N.I.S.) and Innovation Ecosystems (I.E.) used by leading experts on the topic. This section concludes that N.I.S. and I.E. are 'abstract entities' that allow the analyst to observe, but also to 'construct' the relationship between the expectations of various innovation actors.

In the second paragraph, the differences and commonalities between the N.I.S. model and the I.E. model are emphasised.

In the third paragraph, eight international case studies[7] are examined to highlight the gap between academic theories and decision-makers' behaviour.

The fourth section details the problematic relationships between creativity, invention, and innovation (both incremental and radical) in order to corroborate the thesis about the self-deception of decision-makers and the contradictions brought about by uncertainty.

The fifth paragraph attempts to answer the research questions posed at the beginning, arriving at the following conclusions:

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[6] See the interview: "James Dyson si racconta", published in *Corriere della Sera Login* 24/04/2022, p. 14.

[7] The cases examined are a) Apple Ecosystem; b) Huawei-BT-University Ecosystem; c) Concorde N.I.S.; d) Ericsson/Nokia/Symbian/Scandinavian Research Community; e) Intel Research Community; f) Laser Research Community; g) Fiber Optics ICT Ecosystem; h) Transistor Research Community.

- Ecosystems and National Innovation Systems are non-directly observable abstract entities that foster social and cultural constructions about how to innovate, but which do not necessarily determine the success of an innovation. On the contrary, they can create cognitive traps and self-deceptions.
- The Innovation Ecosystem creates a context in which an uncritical acceptance of the inevitability of innovation is fostered, while the observation of obstacles and perverse effects brought about by ex-ante uncertainty is downplayed.

2. From the mythicisation of the entrepreneur to the systemic construction of the innovation process

In societies characterised by a capitalist system, the ability to introduce something new is the driving force behind the development of organisations. Schumpeter was one of the first economists to view capitalism from the perspective of the inevitability of perpetual innovation. For Schumpeter, the characteristic of capitalism is the 'restlessness' dictated by a system in a constant process of change.

What causes this restlessness?

Schumpeter's answer to this question is that the cause of restlessness is the permanent injection of novelty in a circular process between cause and effect. The introduction of novelty creates new possibilities and opportunities to which some actors in the system respond.

But at the same time novelty destroys old practices, making them obsolete and creating other problems that need further novelty. In pre-capitalist societies, the relationship between innovation, creativity, invention, and economic processes was not driven by this logic, nor by the constant increase in profit, nor by the speed of implementation of innovation.

Schumpeter identifies four types of innovation that - individually or in combination - constitute the levers of creative-destructive change in the capitalist system: a) product and service innovation; b) process and technology innovation; c) organisational innovation; d) the ability to create new markets or regenerate them by finding new business models or new forms of commercialisation[8].

But who makes innovation happen in this context?

[8] Schumpeter, J. A. (1961). *The Theory of Economic Development*. New York, NY: Oxford University Press; Schumpeter, J. A. (1943). *Capitalism, Socialism, and Democracy*. London: Unwin.

Schumpeter's answer is that this function is performed by the entrepreneur (Schumpeter, 1961). The Entrepreneur is not necessarily the inventor who introduces the new, but the facilitator of the diffusion of the novelty and the generator of the economic impact. He/She is not necessarily the provider of capital and is also clearly distinct from the manager.

But is the Entrepreneur rational when he/she decides to become an entrepreneur?

If studies concerning the entrepreneur are largely absent from traditional economic theories, the reason is that entrepreneurship is incompatible with the (explicit and implicit) assumptions of optimisation, maximisation, and equilibrium. The world of the Entrepreneur is characterised by uncertainty, which, unlike risk, is not measurable (Knight, 1921). This is why entrepreneurial failure is more likely than success. In such a scenario there is no optimal entrepreneurial start-up decision because it cannot be defined a priori.

Traditional economists have not developed a realistic theory of how innovation is produced. Without such a theory, traditional economics is confined to data. It is the injection of novelty that changes the data, making it different from what it was. Schumpeter is called an anti-mainstream economist because he inaugurated a heterodox line of research based on understanding decisions under conditions of uncertainty that is close to sociological and psychological analyses focusing on the relationship between actions, decisions, and expectations.

Schumpeter has influenced many researchers in the social sciences who, in various disciplines (psychology, sociobiology, social neuroscience, behavioural economics, anthropology) have introduced the concept of the "Innovation Ecosystem" (I.E.). In his research, Schumpeter shows that if the novelty introduced by the entrepreneur takes root over a period of time, it leads to a change in the system itself. But the subject of entrepreneurial action cannot know ex-ante (predict) the nature of these changes.

Ex-ante decisions are, therefore, dominated by uncertainty, where probability distributions cannot be defined and cannot facilitate decisions. How, then, do entrepreneurs decide?

The answer is: by building subjective expectations that may turn out to be wrong. This creates an additional problem that may trigger perverse effects: different innovation decision-makers, under the same circumstances, may build up inconsistent expectations. These expectations will, over time, turn out to be right or wrong. If some entrepreneurs (actors in the system) realise that they were wrong later, they may not have been in equilibrium earlier, when they made their decisions based on wrong expectations. Under these circumstances, equilibrium, over time, is meaningless.

This is why Schumpeter found the notion of general economic equilibrium unacceptable. Not only is the notion inherently unacceptable, but it is also misleading. The introduction of an innovation increases the state of uncertainty, upsetting the expectations of decision makers operating within the capitalist market. Innovation is an integral part of the capitalist system which produces both problems and solutions. Innovation feeds the system and at the same time puts it in crisis.

Such a process is incompatible with the assumption of a state of rest in which the actors and decision-makers in the system reach their preferred positions. Consequently, the concept of ideal equilibrium distorts the reality of decision-making in the uncertain, unstable, fast-paced, and turbulent world.

Paradoxically, those who are culturally influenced by the concept of 'balance' may fail in their decision-making process, because they may 'believe' in the (unrealistic and idealistic) hypothesis that balance will be achieved sooner or later. The sociologist Boudon defines this phenomenon as a "perverse effect of social action" (Boudon, 1981) that can result from unintentional processes or from individual rational action that does not synchronise with the rationalities of others. Under conditions of uncertainty, the perverse effect is not an exceptional phenomenon, but a frequent one.

Sociologists, psychologists, and economists following rational choice theory explain action, whether individual or collective, "as the result of the orientation of individual actors towards the efficient achievement of a goal" (Coleman, 1986). They regard intentions as the sole cause of behaviour.

But this perspective is reductionist because it excludes behaviour determined by impulses, self-deception, or the ambiguity of information. Rational choice theory is inadequate because it reduces choices to the paradigm of methodological individualism and analyses perverse effects as phenomena that are determined unintentionally by the misalignment of individual rational intentions.

This excludes the perverse effects produced by other behaviors that make the failure of the set goals much more frequent than one might think. Innovation occurs through the ex-ante generation of a hypothesis about how value will be created and can, at any time, be hampered by another innovation.

A hypothesis about what adds value for consumers-users compared to what is already offered by competitors involves the imagined possible.

This hypothesis of value has to be tested, passing through several selection processes, to be finally submitted to the market test. The testing process provides feedback that can transform the original hypothesis. For this reason, the hypothesis must be conceived as a process that evolves over time.

Actual innovation refers to the complex result that emerges from these evolutionary processes, through trial and error. The attempts are, moreover,

carried out through stubbornness and resilience rather than through rational choices: factors that have nothing to do with balance, maximisation, and measurability[9].

Herbert Simon, in proposing his theory of 'bounded rationality', observed human beings as information processors limited by their short attention span. Simon argues that people do not make optimal decisions based on a complete set of information, but rather decide on the basis of the information they have selected, within the limits of their short attention span.

Their decisions would be rational not in absolute terms, but in relation to the selected set of information. So, they would be boundedly rational. But Simon's insistence on the 'rational' part of bounded rationality is in itself a 'limitation'. For it means seeing the whole decision-making process as rational with respect to constraints. To give an example: what set of information does the Simonian-Boudonian decision-maker use when deciding whether it is worth investing in telecommunications without having knowledge of which innovation will stand out among those tested?

Simon's answer to this question is: "it depends on the information the decision maker has selected". But our decision maker is not only influenced by verifiable information. He is also influenced by intuitions and beliefs. Simon's theory of bounded rationality starts from a rational action-oriented paradigm. For Simon, the subject selects to save time, but always using logical criteria.

Simon does not include unintentional selective actions induced by obstinacy, performance anxiety, unconscious desires to assert one's ideas. Simon and Boudon underestimate the mechanisms of repression and self-deception.

Often the focus on certain aspects is a way of accelerating a decision that the subject had already made unconsciously. There are impulsive decisions, decisions dictated by a belief system, halo effects (Kahneman, 2011) and a natural orientation towards shared trust that go beyond even the concept of bounded rationality. It makes no sense to logically evaluate a subject's belief system (Wittgenstein, 1999).

All the more so, common analytical tools are inadequate, as they treat the innovation process as a 'black box' with the result that the output becomes an ex-post datum, devoid of any credible causal antecedent. In response to these shortcomings, Schumpeterian and post-Schumpeterian economists have

[9] The Schumpeterian approach, with its emphasis on concepts such as Knight's uncertainty, the likelihood of inconsistent subjective expectations, the ambiguity of errors, implies a degree of unpredictability that mainstream economic thinking is unwilling to accept.

developed the concept of 'National or Global Innovation Systems' (a term also used by international organisations such as the OECD).

National or global innovation systems are 'abstract entities' that allow the researcher and analyst to observe the complex relationship between the expectations of various innovation actors: institutional representatives, entrepreneurs, researchers, inventors, financiers, start uppers and end-users.

The innovation system is, therefore, a social construction that should allow us to understand how the actors of innovation processes interact to facilitate or hinder innovation in a given context.

But can the innovation system (national or ecosystemic according to the approaches we will see in the following paragraphs) mitigate degrees of uncertainty? Can it be an attempt to restore the misleading idea of equilibrium? Or does it risk being yet another self-deception of researchers?

3. N.I.S and I.E.: social constructions useful for analysis

Christopher Freeman was a leading thinker in innovation economics. He observed innovation processes, dividing innovation into incremental and radical (Freeman, 1987). According to Freeman, radical innovation emerges periodically through wave-driven cluster explosions that characterise specific long-term economic activities, also referred to as Kondratieff[10] waves.

Since the Industrial Revolution, which began in Britain in 1770, there have been five long waves: a) Textiles; b) Steam and Railways; c) Steel and Heavy Engineering; d) Oil and Automobiles; e) Information and Communication Technologies.

According to Freeman, the network of institutions in the public and private sectors whose interactions initiate, import, modify and disseminate new technologies can be described as the 'National Innovation System' (N.I.S.). The Japanese National Innovation System has inspired other countries.

In this model it counts:

- The role of the Ministry of International Trade and Industry[11].
- The research and development strategy of companies.
- Reverse engineering.

[10] Name of the Russian statistician who studied the phenomenon.

[11] As Mazzucato (2014) demonstrated, in the most advanced economies it is the national state that bears the investment risk at the origin of the new technologies. Often the state finances research that produces the most revolutionary technologies in the fields of the green economy, telecommunications, nanotechnologies, and pharmaceuticals. This fundamental role is not adequately perceived by public opinion, because it is not promoted by the mass media.

- The role of education and training with related social innovations.
- Relations between companies.

Richard Nelson and Sidney Winter (1982), exponents of the modern Schumpeterian-evolutionary economy, better articulate the definition of the Innovation System where the following are involved: a) Universities; b) Government laboratories; c) Education, training, and retraining system of a nation; d) Models of labour-management relations; e) Financial institutions; f) Enterprises and companies; g) Users of the system.

But there are other definitions by well-known economists. From 1982 to 1995, the National Innovation System was defined as: "a network of institutions/subjects in the public and private sectors whose activities and interactions initiate, import, modify and diffuse new technologies" (Freeman, 1987: 12); "a set of elements and relationships that interact in the production, diffusion and use of new economically useful knowledge, located or rooted within the boundaries of a nation state" (Lundvall, 1992: 35); "a set of institutions whose interactions determine the innovative performance of national firms" (Nelson, 1993: 27); "national institutions, incentive structures and competencies that determine the rate and direction of technological learning (or the volume and composition of change-generating activities) in a country" (Patel, Pavitt, 1994: 42); "a set of distinct institutions that jointly and individually contribute to the development and diffusion of new technologies, providing the framework within which governments form and implement policies to influence innovation processes; a system of interconnected institutions for creating, preserving, and transferring the knowledge, skills, and artifacts that define new technologies" (Metcalfe, 1995: 8).

From 1993 onwards, a new approach called "Ecosystemic" was born. Pioneering the concept of the Innovation Ecosystem was James Moore (1993, 1996) who used the analogy of biological ecosystems where species and organisms cooperate and compete, co-evolving.

He finds the analogy of biological ecosystems useful in providing insights, but also recognises its limitations. While biological species and organisms are constrained by their genes, and the length of their lives limits the rate at which advantageous characteristics can be reproduced within populations, this is not the case for companies. Companies, on the other hand, can make rapid changes from their standard behaviour. Moore began his professional life as a business consultant with a primary interest in corporate strategy. He was influenced by the ideas of an anthropologist, Gregory Bateson, who describes co-evolution as a process in which interdependent species evolve in a never-ending reciprocal cycle, where changes in species A prepare the ground for natural selection of changes in species B and vice versa.

According to Moore, an Innovation Ecosystem (I.E.) is a community supported by a base of interacting organisations and individuals. This economic community produces goods and services of value to the members of the ecosystem. Member organisations also include a) suppliers; b) manufacturers; c) competitors; d) market intermediaries; e) government agencies; f) customers; g) trade associations.

Over time they co-evolve their capabilities and tend to align with the directions set by one or more central companies. Companies in leadership roles may change over time, but the function of ecosystem leader is valued by the community because it allows members to share visions, align investments and support each other. The Innovation Ecosystem (I.E.) is defined as the set of actors and processes that, through their cooperative and competitive interactions, enable innovation and, in so doing, co-evolve.

As is evident from these metaphors, the Innovation Ecosystem is not an empirical entity that can be seen, measured, and analysed. It is an entity dependent on the expectations of the observer, to put it in sociological terms. It is a cultural and social construct that exists in the minds of analysts. This means that different analysts will conceive of different constructs while referring to the same research object.

For example, researchers Iansiti and Levien (2004a, 2004b) rework Moore's reasoning, focusing on the behaviour of individual business units that, while operating within the same company, may belong to different Business Ecosystems. Rather than dealing with firms as a whole, the interest in managers' decisions leads the two authors to disaggregate these entities, focusing on the strategy of specific business units. In contrast to Moore, Iansiti and Levien think it is problematic to define the boundaries of a Business Ecosystem. In an Ecosystem there are: a) Key Actors; b) Dominators; c) Niche Players.

Key Actors make the strategic decision to create a Business Ecosystem, while Dominators seek to capture most of the collective value created by the Ecosystem (Apple is a classic example of a Dominator). But Niche Players survive by moving in and out of boundaries, differentiating themselves through specialisation and innovation. Iansiti and Levien argue that niche players are the real drivers of innovation in Ecosystems. They are often located at the margins of the Ecosystem and are difficult to control by external actors. Since 2004, nothing has changed in the standard definitions of the Innovation Ecosystem. Based on what has been said so far, we could briefly compare the two approaches as follows:

- Both the *Ecosystem* and *National Innovation System* models explain competitiveness over time, recognising that innovation is a systemic phenomenon and that it increases competitiveness.

- The National Innovation System (N.I.S.) model attempts to explain the performance of countries and industries from a comparative perspective.
- The Innovation Ecosystem (I.E.) model puts more emphasis on key decision-makers strategies to improve competitiveness.
- Those who follow the N.I.S. approach come mainly from the world of academic research and are influenced by the Schumpeterian and post-Schumpeterian paradigm.
- Those who follow the I.E. approach use integrated approaches and work predominantly as business consultants.

We must not forget, when analysing, that we are talking about ideal-typical entities that are useful to those analysing the processes, but difficult to use to describe concretely how innovation happens.

4. Ecosystem practices observed through exemplary case histories

In this section we will try to understand, through descriptions of concrete cases, the relationships that exist between specific actors that are inserted within innovation systems and ecosystems.

For such concrete actors we basically speak of relationships that can be vertical and horizontal, weak, or symbiotic. Let us start with an innovation ecosystem of a specific sector: ICT Information and Communication Technology. First of all, we can start with the identification of the specific actors of the sector that are: a) ICT equipment suppliers; b) Network operators that use the equipment to build their networks; c) Providers of platforms, contents, and applications whose products and services are on the networks; d) End-users of the production of ICT goods and services of the ecosystem.

Each group of actors interacts with all the others. This results in symbiotic relationships between different actors. ICT equipment suppliers are the main driver of product innovations, while network operators mainly provide capital, steering the thematic paths of research and development.

But is there a clear distinction about the roles of innovation? Everyone in an Ecosystem can be useful in building innovation. The distinction between creators and users of knowledge is flexible. In some cases, users become creators of further new knowledge, by acquiring new knowledge through their use. In addition, creators and users can 'co-create' new products or improve innovation hypotheses and prototypes.

Apple provides an articulated example of overlapping relationships; it is, in some respects, a supplier of ICT equipment (as a manufacturer of smartphones,

iPads, watches), but it is also a provider of platforms, content and applications through iTunes and the iPhone application platform.

As a product supplier, it has in turn established stable relationships with some 2,000 suppliers of iPhone components, most of which come from Japan, Korea, Taiwan, and China. Foxconn, one of the world's largest assemblers of electronic products, owned by Taiwanese company Hon Hai, assembles iPhones in China. Fundamental to Apple is its symbiotic relationship with its customers around the world. Also important is its relationship with content and application providers, such as those who create content available on iTunes and app developers who produce applications for the iPhone, increasing value for iPhone users.

Apple's relationship with telecommunications operators is also central. It is these operators who provide the networks needed by iPhone users. In addition, agreements with operators have facilitated Apple's entry into the mobile phone market. Apple has succeeded in creating an innovation ecosystem where the R&D-intensive elements included in Apple products are provided by other companies in the ecosystem. This includes, for example, the microprocessors in Apple's iPhone manufactured and supplied by Samsung which, ironically, is Apple's main competitor in the smartphone market.

Apple invests less than other competitors in research and development yet dominates in terms of relationships with other players in the ecosystem, marketing, community building, and customer loyalty. A different story is that of Huawei and BT (the UK's historic telecommunications operator).

BT and Huawei are involved in a symbiotic cooperative relationship: they are co-innovators.

Their cooperation includes the joint creation of new innovation hypotheses that are tested, developed, and brought to market together. Some of this innovation takes place at BT's Adastral Park in Ipswich, England, where the two companies have established a joint innovation and collaboration programme. Huawei occupies two entire floors, with 40 engineers working alongside BT staff. Nigel Abraham, Solutions Director at Huawei, sums up the relationship in these words: "Our commitment to BT is total, which is why we have our engineers permanently based at Adastral Park. Together, we work from the inception of an idea, through development and testing, to market launch" [12].

A third example is the relationship between Ericsson, Nokia, Public Institutions, and the Scandinavian Research Community. In the past, Ericsson

[12] The full description of the Huawei case history can be found in Fransman, M. (2018b). *Innovation Ecosystem. Increasing Competitiveness*. Cambridge: Cambridge University Press.

and Nokia have achieved European leadership in 2G mobile technology. They have become the leading European telecom operators capable of introducing 2G mobile infrastructure and services. At the same time, they also became the leading European suppliers of mobile equipment. Why did this happen? Because of public institutions that regulated mobile systems to facilitate international communications within Scandinavia, enabling the emergence of GSM standards. This example could also be observed by the researcher as evidence of co-evolution and ecosystem collaboration.

But ecosystems are not permanent, nor suitable for every context. Above all, they are not sufficient for innovation triggers. A relevant example in this respect is the disappearance of Nokia, one of the main pioneers and leaders of the global mobile industry.

Nokia was penalised over time by its historical dependence on a supplier that was unable to evolve. The company was hampered by the Symbian operating system (a system Nokia had been using since it was a pre-computer smartphone). This operating system had flaws from the point of view of application development, a key requirement for competitiveness. In this case, Nokia's membership of an overly stable ecosystem did not allow it to evolve. Even within ecosystems, therefore, we have uncertainty and a very high risk of failure.

If we want to make a comparison between different sectors, we can say that both Concorde and the iPhone were considered innovative and creative from the beginning. Both represented progress in their respective fields. But in the case of Concorde the assumption of innovation turned out to be wrong. Concorde was a failure, while the iPhone was a global success, reifying emerging innovation.

Non-knowledge (Gross, 2007; Gross and McGoey, 2015), mistakes, and errors are part of the evolutionary innovation process. Those who bring forward innovative products make decisions based on subjective expectations that depend on judgements, intuitions, and consensus. In this ex-ante phase, there are no right answers.

We are back to square one, the Schumpeterian approach, which is also useful within ecosystem dynamics. The process of how innovation happens is neither mechanical nor deterministic.

From an ex-post point of view, some will have made a mistake. But it is not possible to determine, ex ante, the optimal decision. The decision-maker brings his or her past experience (including knowledge and learning) and current beliefs. Experience and beliefs influence the way he/she understands his/her environment.

The innovator imagines innovation on the basis of experience and beliefs. Brian Loasby states that innovation is the imagined deemed possible or as

Fransman further clarifies the imagined deemed feasible (Fransman, 2018b). A revolutionary idea is often a solution to a problem.

What do the transistor, the microprocessor, the laser, and fiber optics have in common? They started out as solutions in search of a problem. Then they changed the world irreversibly. Townes (inventor of the laser) notes in telling his story: "For several years after the invention of the laser, colleagues would tease me, telling me that this was a solution in search of a problem!" (Townes, 1999: 12).

Andy Grove, one of the founders of Intel, the company where the microprocessor was invented, confessed that he initially thought that the use of this device would be limited to simple traffic light applications. Thomas Watson, the founder of IBM, originally believed that there would be very little demand for mainframe computers in the United States. There are many other similar stories that confirm the ex-ante uncertainty and undecidability.

The problem is that the imagined innovation may be considered feasible in the course of research, but unsuccessful in development. The innovator decides to remove this uncertainty in an ex-ante phase. He removes observation of the obstacles because he is blinded by his beliefs. He decides to emphasise the emotional side and binds himself to a strong belief system that makes him sure of what he is doing. We can say that there is a Sociology of shared social construction of innovation decisions that drives the innovation economy.

From the cases considered, we deduce that uncertainty is related to the idea of innovation from the beginning.

This uncertainty must be distinguished from risk. In the case of risk, it is possible to derive probability distributions from existing data that will facilitate decision making, as is the case in the insurance industry, for example. In the case of the ex-ante idea of innovation, probability distributions cannot be deduced, since innovation only exists in the imagination and in the cultural system that revolves around it, generating consensus or dissent.

5. Problematic relations between creativity, invention, and innovation

How is it possible for the analyst to concretely understand and explain the interactive decisions made by a particular leading company in an Ecosystem? What is the appropriate unit of analysis to do this? Is it the board of the company, the CEO, the shareholders (and which shareholders?), the employees, the unions, some of them or all of them? Given the complexity, is it possible to provide an explanation of the decisions taken or should one limit oneself to simply observing the end result?

If the approaches described so far are constructed conceptual entities, how does innovation actually take place? The analysis of economic processes generated by innovation appears culturally imprisoned by the straitjacket of microeconomics, through which it is assumed that firms always make optimal profit-maximising decisions. Such firms are analysed as if they were homogeneous and in equilibrium. Surprisingly absent from classical research is uncertainty and continuous diversification between firms.

Furthermore, the following categories are absent: non-knowledge and error. However, uncertainty, inconsistency and error affect business decision making in the real world, making the optimal decision impossible by definition. The set of rational decisions (from value-oriented to heuristic decisions, from non-calculable to calculable decision) are less evident in the daily practices of the company.

This gap between the false perception of an ecosystem that acts rationally and daily practice that contradicts classical theories is recorded by anti-mainstream research but rejected by the ecosystem actors who remove the problem by deceiving themselves. The decision occurs because at some point in time, a decision has to be made even in the absence of information. The indicators that are supposed to allow decisions are misleading and insufficient to decide the future strategies of any organisation.

Investment in R&D, the number of patents and the abundance of citations are useful, but incomplete indicators. "More R&D expenditure does not necessarily mean more innovation and value creation" (Fransman, 2018b; 94). The total number of patents granted tells us little about the values generated. Weighing patents against generated income is difficult. Because of these shortcomings, organisations such as the OECD have tried to include other elements such as the percentage of income from new products. Another blind spot in traditional economics is the sector. The sector creates problems with respect to the conventional binary observation of knowledge in economics.

The primary distinction in the discipline is between macroeconomics, the study of the economy as a whole, and microeconomics, which studies individual decision-making units such as the firm and the consumer. The sector is in a 'meso' point that could be called 'blind'. Standard microeconomics begins by referring to the representative enterprise. Yet, one of the key characteristics of every enterprise is that it is different from all others. The reason is that to survive and thrive in competitive markets, each must differentiate itself in order to make profit margins.

It is the variation between firms that, together with selection processes, drives the evolution of the whole system. Thus, there is no representative firm in reality, but only in the head of a researcher/observer. How, then, is it possible to reason in terms of the sector? And how in terms of an ecosystem made up

of homogeneous companies belonging to the same sector? Does this make sense? These considerations feed into the theme of the ecosystem as a shared social construction that stimulates an imaginary capable of generating expectations and prophecies in the hope that they will fulfil themselves (Thomas, 1928; Merton, 1948). Schumpeter (1947a) drew the important distinction between adaptive and creative responses, stating: "Creative response means, in the economic sphere, the combination of productive resources in new ways or for new purposes, and this function defines the economic type we call the entrepreneur" (1947a, 10).

The creative response is, in fact, an essential component for all actors in an Ecosystem (Entrepreneur, Inventor, Researcher, Manager, Supplier, Marketing Manager, etc.). But the relationships between creative response, inventive output and innovation processes are problematic.

In Western culture, the word "creativity" is a term that contains many connotations and cultural nuances. It is the result of a socio-historical symbolic negotiation that has emerged in contemporary times, beginning in the early 20th century. The pre-modern but post-medieval terms 'inventive' or 'ingenious' can be considered direct ancestors of the term 'creativity'. Creativity has been confused with Serendipity in scientific circles.

But Serendipity represents a sub-set of the creative process, determined by the complex relationships between error, chance and the researcher's preparation. By most psychosociology scholars, creativity has been interpreted as "the ability to grasp the relationships between things in a new way, formulating unconventional syntheses" (De Caroli, 2009: 34).

Today the term is applied to all fields of knowledge. The new and the useful determine the essence of the creative act of business: an overcoming of existing rules (new) that establishes a further shared and functional rule (useful) in line with the Schumpeterian vision of the restless capitalist system.

With the term creativity, a Weberian process of secularising talent is implemented. The romantic figure of the irrational fury of the man of genius (a cultural and social construction typical of the 19th century) is replaced by the man who, by means of rules, is able to guide the process that is first creative and then inventive.

This socially shared construction of the term is functional to modern organisations governed by procedures. The meaning of the term creative summarises an epochal passage that shifts the generative capacity of the human being from an artistic dimension determined by inspiration to a professional result of methodical application capable of triggering ideas to arrive at innovation.

Howard S. Becker has masterfully demonstrated that "the creative process has always been the subject of individualistic mythologies, but in reality, over

the centuries, this process has always involved rational and collective work in every sphere, from art to science and everyday life" (Becker 1982; 10).

There have been many avenues of research to define the creative phenomenon as: (a) process (Vangundy, 1987); (b) capacity to produce new methods or products (Fransman, 2018a); (c) social and collective dimension open to the new (Feuer, 1969; Montuori and Purser, 1997; De Masi, 2003); (d) cognitive system of a person (Simonton, 1999) (e) social persuasion (Simonton, 1999); (f) contrast to conformity (Munari, 1997) (g) model (De Bono, 1998).

On the other hand, the term 'Innovation' has also undergone the same hermeneutic process (D'Alessandro 2021c). Innovation has also been examined as a process and result of a series of interconnected steps. Everett Rogers (2003) divides the innovation process into five stages: a) Identification of a need or problem that requires a solution; b) Decision to do research to solve the problem; c) Development of the new solution to give form and content to those who will have to use it; d) Production and distribution of the product or service containing the innovation; e) Consequences determined by the introduction of the new solution.

These phases do not have a linear or orderly development but are 'creatively' connected, without a distinct temporal hierarchy (Kline, Rosenberg, 1986). Innovation is also observed and interpreted as a relationship that depends on a set of actors, often from different backgrounds, constantly interacting to generate value over time. Innovation is a social construction based on cohesion and trust because by strengthening networks of sharing it is possible to increase the number and quality of winning ideas (D'Alessandro, 2015b). Innovation goes beyond change because it involves doing new things or doing them in new ways (Schumpeter, 1947a). Innovation does not coincide with invention even when it is involved.

If an inventor realises he has made a 'great discovery' but cannot find anyone willing to produce it, the new solution ends up in the patent office archives. To turn an invention into an innovation there has to be an organisation capable of combining different types of knowledge, skills, competencies, and resources. In other words, inventing means conceiving a new product (or service or process) while innovating means putting new ideas into practice for the first time (Fagerberg, 2003).

Today, in some production sectors, inventive, innovative, and creative activities tend to overlap.

As Mokyr (1990) argues, innovation and invention are complementary and have a circular relationship with each other. Innovation can be 'incremental' when it improves an existing product, enriching it with solutions that do not change its substantial logic.

On the other hand, innovation can be 'radical' when it produces a paradigm shift, when it creates a new market, when it completely reconfigures the way of knowing something, generating a new category.

Innovation can come from creative thinking but also from chance. It can produce positive or negative externalities. Those who deal with innovation know that there are more failures than successes. Innovation means generating unexpected consequences, investing in capital and human resources without knowing in advance if and when the goal will be achieved. In the delicate relationship between innovation and invention, it is difficult to understand where the creative process comes and goes.

In *Capitalism, Socialism and Democracy*, Schumpeter (1943) assigns the governance of these processes to the entrepreneur. But in an Innovation Ecosystem, all the actors involved must have entrepreneurial skills: from the researcher to the manager; from the technologist to the commercial director.

All must participate in the process of creative destruction, playing a role that involves managing uncertainty and fighting cultural resistance to innovation. While theoretically the distinction between 'creating ideas' and 'realising them' appears clear-cut and defined by declared roles and functions, in the real world this is not the case.

If 'having new ideas' does not necessarily require realising them, on the contrary 'producing something' requires generating multiple new ideas about what might work. The entrepreneur as the 'absolute protagonist who makes innovation happen' no longer exists, or perhaps this figure has only existed in Schumpeterian literature, as a cultural construction of an ideal types.

There are more decision-makers who have entrepreneurial characteristics and who act within complex vertical or horizontal, rigid or flexible, occasional or symbiotic relationships. From the solitary and heroic figure of the modern 19th century entrepreneur, we have moved to the multi-identity and collaborative figure of the startupper. Eric Ries[13], for example, does not attribute the role of innovator to a specific individual: "when I use the term entrepreneur, I am referring to the entire Start-up Ecosystem" (Ries, 2011: 32).

All the actors involved in the Ecosystem will significantly influence the way the final innovation will take place. This concise description of the process demonstrates the cultural and social construction shared by all actors that are part of an innovation process, both as researchers and as decision makers.

[13] Silicon Valley entrepreneur. Co-founder and chief technology officer of a Silicon Valley software company called IMVU. Known for writing the essay *The Lean Startup: How Constant Innovation Creates Radically Successful Businesses*.

6. Conclusions. Innovation ecosystems between social construction and self-deception

In capitalist societies, the ability to introduce something new is the engine that allows the system to grow. Heterodox economists - who have also observed the phenomenon under a sociological and psychological lens - have grasped its implications in terms of uncertainty, revealing the propaganda narrative - an essential part of a social and cultural construction - of the entrepreneurial subject as a permanent lever of innovation.

In the world of innovation, theoretical postulates such as equilibrium, maximisation and optimisation make no sense; on the contrary, they are misleading and feed self-deception. Instead, innovation means deciding even in the face of the undecidable.

This means that innovation will ultimately depend on the expectations of the entrepreneur, but also on a social construction shared with other decision-makers. Decision-makers will generate ex-ante a hypothesis on how value will be created. What is imagined to be possible will depend on expectations, context, and past experience.

But the hypothesis will remain uncertain. Individual or collective individuals do not make optimal decisions when they have to innovate. The imagined innovation may be considered feasible in the course of research, but unsuccessful in development. But in many cases, the innovator removes the observation of obstacles because he is blinded by his beliefs.

As the Laser example shows, a revolutionary idea is often a solution in search of a problem. If decision-makers did not have resilience and the ability to stubbornly pursue a path, innovation would not happen. We therefore return to the considerations developed in the course of the paragraphs.

Why did analysts construct the concept of the Ecosystem? Most probably to accelerate innovation processes, in the awareness that in many specialised sectors the entrepreneurial figure could not be sufficient.

Ecosystems and National Innovation Systems are non-directly observable abstract entities that foster social and cultural constructions about how to innovate, but which do not necessarily determine the success of an innovation; on the contrary, they can create cognitive traps and self-deceptions.

The Ecosystem creates a context in which an uncritical acceptance of the inevitability of innovation is fostered, while the observation of obstacles and perverse effects brought about by ex-ante uncertainty is downplayed.

Perhaps the Ecosystem concept can create more favourable contexts for innovation. But this does not explain how innovation happens, nor does it allow for optimal measurability of assumptions. In this respect, research is still far from understanding the emerging factors of the innovation phenomenon.

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