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Event-based ecosystem structuring: lessons from the Volkswagen emissions scandal and the European transition to e-mobility.

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ABSTRACT

In the era we are living in, characterised by dynamism, organisations cannot be treated anymore as single entities, operating separately from their surrounding environment. In a market that is changing rapidly, businesses, to foresee and adapt to external changes, need to collaborate and interact with other actors. Nowadays, theorists recognise that firms are embedded in "ecosystems", as this structure better picture the co-evolutionary process happening between firms and the environment. In order to explain this concept, which is the backbone of the whole thesis, theories are analysed following an escalation in the complexity of the relationship of interdependence among systems and their external environment: open system theory, open polity perspective, complex adaptive systems, and the Triple Embeddedness Framework.

In complex and dynamic environments, in which ever more actors interact, events with the power to affect firms, industries, sectors or entire ecosystems emerge at an increasing extent. It became important for scholars to theorise what occurrences should be considered significant or not by firms-in-industries. Through this elaborate, the characteristics and the mechanisms that make an event salient, both for industry's insiders and outsiders, are highlighted in order to understand why some events are more attended than others.

The aim of this thesis is to study the effect of salient events in the continuous structuring and restructuring of businesses' ecosystems. This phenomenon is analysed through the study of the Volkswagen emissions scandal, in order to demonstrate the link between the emergence of the scandal and the recent turn towards electrification of the transport system. Through the analysis of the automotive ecosystem, its history, its surrounding environment and the latest trends, it is evident that the industry was not prepared, and therefore did not pushed, towards e-mobility. Moreover, the Original Equipment Manufacturers (OEMs)'s agency and structure permitted leading automakers to maintain a position of dominance in the ecosystem and to redirect changes according to their own interest. Therefore, why the transformation of the transport system is actually happening? If the scandal pushed toward this change, then the event analysed could have had an effect on the structure of the entire automotive ecosystem and on the evolution of mobility's history.

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I. Literature Review

Through this entire first chapter, theories, essential for the interpretation and analysis of our case study, are presented and explained in depth. The aim of the first part is to present the idea that systems, and accordingly firms-in-industries, are embedded into a wider set of environments, exerting numerous and continuous pressures on them. Across the thesis, the analysis is presented through an escalation in the complexity of this basic concept's interpretations: open system theory, open polity perspective, complex adaptive systems, and, finally, the Triple Embeddedness Framework. During the last decades, theorists started to recognise that firms, in order to survive in present-day marketplaces, necessitate to maintain relentlessly a process of co-evolution with their surrounding environment. To delineate in detail this viewpoint is essential to understand, later, the automotive ecosystem, and how its incumbent firms are no longer leading the direction of strategic decisions but are rather subject to variations, dictated by entities' interactions.

In the second part, instead, the academic discourse over events is presented. The world's complexity has intensified, not only increasing the interdependence between firms and its environment, but also multiplying the number of emerging occurrences and the chance that they affect firms and their relationships. To better understand why some events become more meaningful than others, the model of industry attention to events, theorised by Hoffman and Ocasio in 2001, and the Event System Theory of Morgeson et al. (2015), are presented though the course of this chapter. These theories are necessary to provide a frame to the VW emissions scandal and to evaluate its salience for the general public and for the automotive industry.

1. Organisations are part of the environment

During the twentieth century, different scholars gave various definitions of what an organisation is. The dominant perspective during the 1930s was the "rational system" idea of organisations. Companies were perceived as necessary instruments, with defined roles and social structures, for the realisation of goals and objectives. Examples are Simon's model of rational decision-making hierarchies (March and Simon, 1958) and F. W. Taylor's scientific management approach.

In the 1940s and 1950s organisations were considered foremost social entities made up by people, giving rise to the so-called “natural system” model. Members may have different needs, cultures and educational background but they interact with one another in order to pursue the organisation’s objectives and to sustain its survival. Less attention was put in formality in favour of interpersonal ties.

During the 1960s, the perception of an “open system” model of organisation became dominant. The main idea was that companies are part of a greater external context and are influenced by it in their pursue of goal attainment. Previous models never focused on external factors, but they put attention only towards what resides inside the system boundaries. The boundaries of an organisation need to be defined and clearly stated to comprise the internal factors that the company can design and alter to its advantage, like the firm’s day-to-day operations and decisions. But despite this, the success of a company depends also on the extent these factors are kept dynamic and adjustable to upcoming external forces. Environmental conditions, indeed, are beyond the control of the firm and still have the ability to impact its actions and survival. Methods of external analysis consider macro-environmental areas to delineate a reliable scenario of the business’ surrounding context: the most common is PESTEL which considers political, economic, socio-cultural, technological, environmental and legal factors, while other frameworks like DESTEP add demographic and ecological factors to the evaluation. These first-layer conditions (Figure 1), comprising the macro or general environment, are constantly changing, creating a unique set of challenges and chances to which the organisation, not being a sole entity, needs to adapt accordingly.

On the other hand, customers, competitors, distributors and suppliers make up the specific environment, a second layer of factors (Figure 1) influencing the performance and competitive advantages of companies. These actors are directly related to the firm’s business, and can affect, with different degrees, all the firms in the same industry.
Harvard professor Michael Porter conceived an analysis tool to evaluate the organisation’s specific environment. He developed five forces that have the strongest impact on industries: industry rivalry, bargaining power of buyers, bargaining power of suppliers, threat of new entrants and threat of substitutes. This model perfectly captures the influences exerted by the components of the second layer of a firm’s external environment. It also helps firms to

understand what are the predominant forces that shape their industry. The resulting insights are then employed to define the industry's structure, and, consequently, build a suitable corporate strategy for the achievement of long-term profitability. The strategy needs to be updated regularly, according to the current trends affecting the industry. Through the Porter's model organisations are also able to determine their (and their competitors') weaknesses and strengths, in order to frame what should be avoided and what, instead, exploited.

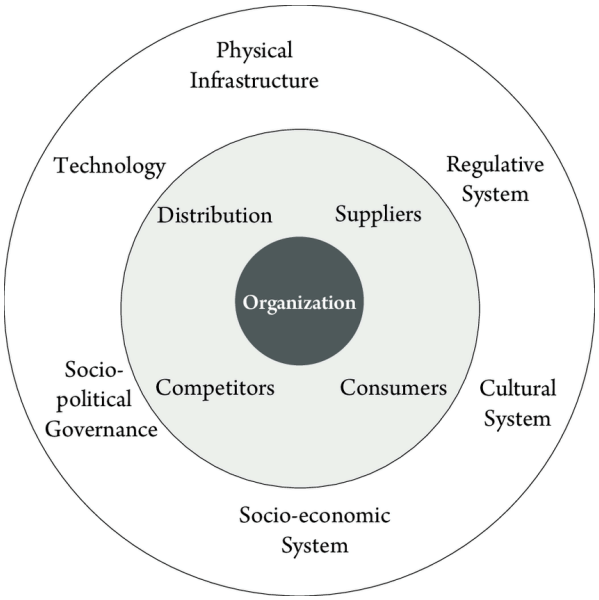

Figure 1: The organisation's environment (Pels & Kidd, 2012)

As we have seen, techniques have been generated to define what stands outside the boundaries of an organisation and which external forces influence its functioning. These factors may generate both opportunities and threats. SWOT analysis is a valuable tool that managers use in order to tackle and match internal strength and weaknesses with opportunities and threats that the surrounding environment offers. The strategic fit is the extent to which internal strength and external opportunities align.

Managers need to scan continuously the business environment in order to predict rapid and uncertain changes and transform them into foreseeable events. This helps the business to react to external forces and use them as opportunities.

The influential relationship between businesses and their environment, and also among the environmental forces themselves, is called symbiotic (Hafford-Letchfield, 2010). This means that internal factors can mutually affect and be affected by their external context, even

though with different degrees of influential strength. At the same time, the environmental factors have also the potential to influence one another.
Even if a single firm is unlikely able to change its environment, as the number of firms increases and join forces the possibility to favourably shape some factors amplifies.

We have already distinguished between general and specific environments surrounding organisations. However, business environments can also be characterised by their static or dynamic nature. Static environments have an higher degree of predictability and a lower degree of variation, while dynamic environments are constantly mutating and evolving. Due to the high level of technological advancements and the daily rate of new innovations launched in the marketplace, more and more environments are turning from static into dynamic.

Finally, as said, during the years researchers and professors have felt the urge to develop frameworks for analysing the growing bi-directional interdependencies between the company and its general and specific environment. Therefore, an organisation should not be seen as a single entity working detached towards its goals, but rather as a product of the environment, which shapes its decisions and functioning.

1.1. Open system theory

The synergies happening between the internal and external factors of an organisation leads to the creation of a system, “a group of interacting or interrelated elements that act according to a set of rules to form a unified whole” (Merriam-Webster).

Even though the term is broadly defined due to its wide use in different subject matters, it is possible to establish three characteristics common to all systems (Edquist, 2006), in order to extrapolate a tentative (and mainly theoretic) definition:

- it consists of two types of elements that form an integrated whole: the components and the relations among them;
- it has always a function which leads the group to achieve some predefined goals;
- It has defined boundaries that enable to distinguish between what is inside or outside the system.

System theory is studied across multiple disciplines. In economics, system theory views organisations as open social systems that depend on their business environment for vital resources.

Systems can be either open or closed. In reality, even if no system is completely closed or open, the difference is still dictated by the amount of responsiveness to external stimuli. Open systems are more sensitive to deviations in the environment, with which they trade knowledge, capital, or natural and human resources (Saylor Foundation, 2012). Closed systems, instead, since they are isolated, remain unchanged when something happen in their surroundings. The marketing department of an organisation needs to be extremely open to capture the new trends and customers' preferences. On the contrary, the R&D department is relatively closed as it does not interact with the external environment.

The open systems theory (OST) explains that "an organisation does not operate in isolation but in context with its social environment" (Aughton and Brien, 1999).

Katz & Kahn (1978) have developed an open system model, a framework composed by four phases, in order to delineate the organisations' interdependency with their social environments:

- Energetic inputs: e.g. employees, raw materials, capital but also intangible external influences like education, culture, status;
- The process of transformation;
- Energetic outputs;
- Recycling.

Businesses import inputs from the outside, transform them in different forms, and export outputs back to the environment (Katz and Kahn, 1978).

The process of transformation of positive and negative inputs, also said "throughput", consists in an analysis, carried out by organisations, in order to obtain clearer and precise information of environmental changes. These acquired knowledge is essential in leading strategic planning decisions.

Finally, outputs are indirectly recycled back into the organisation in other forms.

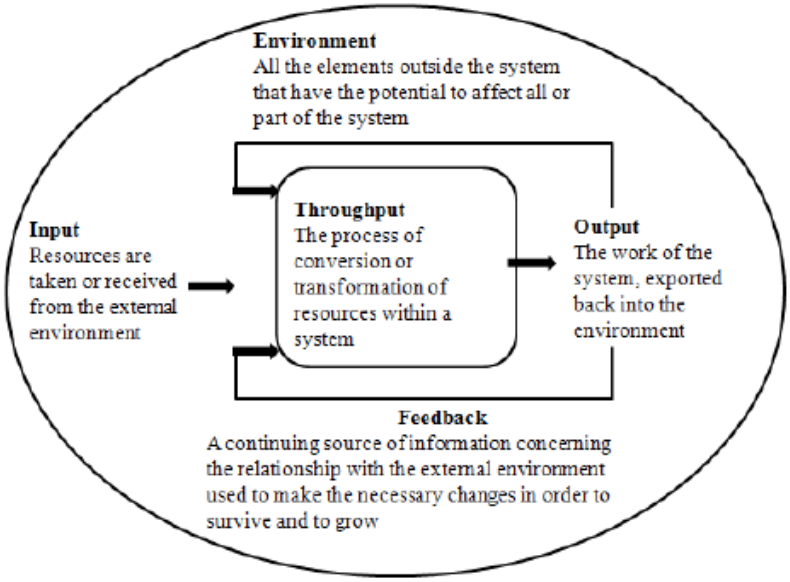

Figure 2: Open system model of Katz & Kahn (1978)

As we said, all systems have established boundaries, however, in reality, they can be blurred and complicated to define due to the systems' dynamism. Useful feedbacks are pushed in open system organisations through its permeable boundaries, but they are also pulled by the organisational willingness to understand its environment through market research and environmental scanning techniques.

Sometimes, as we will see later in this chapter, organisations have the possibility to partially affect the external environment using promotional tools (PR, advertising, advocacy) or other strategic moves (lobbying).

Organisations exist both in static and dynamic environments. When in dynamic environments, the open system strategy is, for organisations, an imperative if they want to pursue homeostasis, a principle of equilibrium (Katz and Kahn, 1978).

Homeostasis is the constant state of equilibrium maintained by organisations by balancing positive and negative entropy, through the continuous inflow and outflow of energy. In fact, while the system spontaneously tend towards positive entropy, which increases disorder, the continuous acquisition of energy from the environment creates negative entropy, therefore counterbalancing the initial effect and restoring the equilibrium. Moreover, homeostasis enables organisations to not only survive, but to grow over time. Effective organisations grow and evolve not just following a goal-attainment approach, but by maintaining homeostasis in their organisational functioning, and therefore keeping their system open and dynamic to

respond to external shocks. In summary, in this view, successful businesses are those that actively keep a balance between the internal subsystems and their surroundings.
Another organisational characteristic of open system is equifinality. This term holds that there are multiple processes and paths to achieve the same or similar result. For example, internal and external influences may change the course of action by making available or not some inputs. In this way, the open system model is not fixed but rather adapts and evolves continuously according to environmental stimuli and forces. This characteristic is essential to escape the universal law of entropy, according to which all organisations have a tendency toward disorganisation or death. Open systems avoid chaos thanks to the endless and dynamic flow of energy across systems and their surroundings, finally arriving to a status of negative entropy by collecting more energy than needed.

Many modern organisational theories and schools of thought are based on the open system perspective. Even if there are differences among them, they all agree on the idea that the firm's enduring relationship with the environment is a valuable contributor to its success and failure (or survival and death): contingency theory, for example, expresses that efficient businesses need to adapt accordingly to the environment they exist in; Weick's theory of organising theorises that organisations' aim is to reduce unpredictability thanks to information's flows and communication processes; resource dependency theory asserts that firms are engaged in continuous negotiations with actors in the environment for the procurement of resources.

1.2. Open polity perspective

Many scholars have integrated the perspectives of open systems with the idea of organisations as polities. Polities are clusters of subgroups with different interests, values, goals and resources, all embedded within a formal system (Weber and Waeger, 2017).
In this view, organisations are political entities with distinctive goals. These goals are defined by the individuality of sub-groups' interests, roles and actions, which, in turn, are set by bargainings, compromise and coalitions among members (Weber and Waeger, 2017). Accordingly, organisational interest groups engage in debates around possible decisions and directions, trying to make their interests and rationalities prevail. Also the distribution of

authority, the resolution of conflicts and the structure of the firm, are not defined by the rationality but by the willingnesses and preferences of dominant groups.
The two different positions (open system theory and organisations as polities) merge in a model, in which internal political processes combine with elements in the external environment through boundary processes (Weber and Waeger, 2017). Specifically, the surrounding dynamics influence and delineate the internal politics, affecting the way in which organisations respond to the external pressures.

According to the degree of openness of boundaries, external political actors can permeate inside organisations and influence their decision making process. Open policy theorists studied different processes through which societal forces affect interest groups' goals and power. These processes vary according to the degree of independence between the environment and organisations.
When the organisation is relatively closed to external influence, it is assumed that the internal groups' interests emerges and change independently from the external environment. However a first branch of theories argues that, regardless of the boundary closeness, an indirect influential pressure from the environment occurs to the internal policy. This may happen, for example, through opportunity structures driven by external political dynamics. These comprises all those conditions, rules and opportunities that facilitates or hider the achievement of a group's aims and interests, but without actually altering the goals' content (Weber and Waeger, 2017). Political mobilisation is able, even in closed systems, to change the social characteristics of the group in a way that increases the probability to reach its interests (Weber and Waeger, 2017).
For other theories, instead, the external political environment can directly penetrate organisational boundaries, however through few, selected entry points. These channels may be created by privileged actors with formal or informal authority over the decision-making processes or other internal dynamics of the organisational polity (e.g. regulatory bodies), (Weber and Waeger, 2017). Therefore, these external actors have the ability to shape the internal goals and interests. Selective coupling can also occur through network ties, across which information and influence flow, and internal organisational structures with the exact purpose to link organisations with audiences in the environment (e.g. compliance officers, CSR units). In both cases, the entity provides knowledge and information regarding environmental complexity, in a way that is better understandable for the organisation.

A third branch of open policy theories argues that clear boundaries between external and internal polities are absent. In this case, social aspects like gender, class, age, nationality, political or religious ideology, affect the organisational members' personal experience, which, in turn, becomes the direct influence of organisational structures, culture and dynamics (Weber and Waeger, 2017). Therefore, the individuals working inside the organisation act as the primary source of influence.

Fourthly, some scholars consider organisations as completely absorbed in their external systems (Sitkin and Bies (1994), Banerjee (2008), Thomas and Davies (2005)). According to them, organisational members' interests, identities and roles are defined by macro-level discourses, which in the long-term are internalised and become taken-for-granted social facts. Members re-enact them unintentionally, shaping internal policy.

The open polity perspective comes from a long tradition of theories on organisational politics, which agree on the idea that firms have politic-alike structures and functioning. The starting point of this tradition was March (1962)'s theory of the firm as a "political coalition". He argued that both the firm's composition and goals are the result of negotiations between coalitions within the firm. Kaplan (2008) developed the theory by focusing on how actors in a coalition share frames, or taken-for-granted interpretative models of the environment, and on how they pursue to turn them into dominant frames, generally-accepted by the other coalitions and by the whole organisation. Whitford & Zirpoli (2016) pushed these concepts further by recognising that, in a context of porous organisational boundaries like that of the network organisation, political coalitions can be internal and external to the single organisation in the network, with a direct impact on the network battlefield and that of the organisation itself. The evolution of the theory of the firm as a political coalition responds to the logic of expanding and blurring the boundaries of firms and culminates in the open polity perspective.

1.3. Complex adaptive systems

Complexity theory, in general, examines situations of uncertainty and non-linearity. It is a multidisciplinary theory that serves as a starting point for the development of numerous other doctrines. One of the most renown is the complex adaptive system theory (CAS).

A complex adaptive system is an open system “in which complex behaviour of the system as a whole emerges from the interaction of large numbers of simple components, and in which the system is able to adapt, to automatically improve its performance (according to some measure) over time, in response to what has been encountered previously” (Waldrop, 1992). As in open systems, CAS enacts processes motivated by a willingness of survival.
The system’s complexity is determined by the dynamic network of relations. Moreover, starting from the behaviour of one member is not possible to predict the behaviour of the whole system. The system’s adaptability, instead, is given by the active evolution and mutation of a single or multiple members’ behaviours, due to environmental changes.

A complex adaptive system is made up of a network of interactive agents, which take decisions on how to behave according to a schema of past experiences and strategies. However, these decisions change and adapt over time and the schema is constantly revised, developing new strategies. The agents in a complex adaptive system try to make forecasts about forthcoming events, basing these predictions on internal environmental models and external assumptions of other agents (Waldrop, 1992). Through the implementation of this mechanism CAS reacts to events, careless of the resulting effects in the environment (Waldrop, 1992).
Even if the process seems chaotic, without this adaptability, the system may not be able to survive in dynamic environments. In fact, CAS theory diverges from chaotic systems theories due to the emergence of relationships between systems and the members that are in them (Berreby, 1996). Complex adaptive systems co-evolve with their agents, who constantly modify the system by means of interactions, evolving fluctuations and feedback loops. Moreover, the heterogeneous agents interact with one another to reach a common goal, which may be difficult to achieve independently.
In summary, CAS’s ability to adapt to external pressures is determined by its self-organisation, which occurs thanks to its members’ mutual dependence. This is an essential characteristic of this system type.

Self-organisation, through learning, adaptation and co-evolution, occurs near the edge of chaos. “Poised” systems, to which CAS belongs, are able to maintain a balance between chaos and equilibrium by operating at the edge of chaos, which empowers them of a “special relevance to evolution because they seem to have the optimal capacity for

evolving" (Kauffman, 1991). On the contrary, chaotic systems, having few stable components and almost no ability to adapt, can be rapidly disrupted even by small forces (e.g. the butterfly effect). The difference lies in the pursuit of survival of complex adaptive systems, which push them to consciously evolve and adapt.

From the complexity of interactions and evolutions, the whole system becomes greater than the sum of its components. The property of emergence states that new system behaviour occurs not only due to environmental forces, but also from the combinations of agents' behaviour. Over time, interactions between agents create unpredictably new behaviours and traits that cannot be found in any single agent in the system. This leads to the result that is not possible to understand the entire system behaviour, only by disaggregating and analysing the individual parts. New opportunities arise thanks to emergence and the continuous change in agents' number and combinations.
Complex adaptive systems can be frequently found in our everyday life. Many industrial sectors, for example, are becoming increasingly more complex, having to deal with numerous external changes. Their survival is highly dependent on the relationships and interactions of internal and external agents, promoting the systems' strategy renovation.

1.4. Comparison between theories

For the purpose of this chapter, it is important to highlight the similarities and differences among the theories previously explained, the open theories and the complex adaptive system theory. In this way, it is easier to detect which theories' insights are encompassed by the Triple Embeddedness Framework (explained in the next section) and which, instead, are the novelties added in it.
To better differentiate the two theories we will begin from their main properties (Figure 3): open system's properties have been developed by Katz & Kahn (1978) while Complex Adaptive system's properties come from a research of Schneider & Somers (2006) on previous literature.

The first three properties (importation of energy, throughput, output) remain unvaried as both theories are based upon the idea that systems are part of a bigger context, the external

environment, that influences the system's behaviours and actions and activate a process of transformation and evolution.

With the fourth (cyclicality vs. Chaos) and seventh property (steady-state and dynamic homeostasis vs. adaptation) it is possible to encounter the first important diverging point: while for OST organisations adapt to external changes in a cyclical way aiming at resettling the equilibrium (or homeostasis), in CAS theory systems evolve in a non-linear way, proving to be more flexible when near the edge of chaos.

In CAS the environment and the system's functioning are indeed considered more complex and dynamic, therefore more similar to the actual conditions.

Properties of open systems		Properties of complex systems	
(1) Importation of energy	Energy is imported from the environment.	(1) Importation of energy	Energy is imported from the environment.
(2) Throughput	Inputs are converted through the use of energy.	(2) Throughput	Inputs are converted through the use of energy.
(3) Output	Produced output is exported into the environment.	(3) Output	Produced output is exported into the environment.
(4) Cyclicality	System events are structured by cycles.	(4) Chaos	CAS are poised systems that function at the edge of chaos for optimal buffering and adaptability.
(5) Negative entropy	The transformation cycle is a cycle of entropy, leading to disorganization or death. To survive, negative entropy is acquired by storing energy from the environment.	(5) Emergence	Some activity occurs that is not induced by the environment, but instead, results from the inter-dependence of system components.
(6) Information input, negative feedback, and the coding process	Inputs consist of information and signals about the environment and system functioning, as well as materials that are transformed. Negative feedback allows for necessary correction. Information must be coded appropriately to be meaningful.	(6) Information input, negative feedback, and the coding process	The interactions of system agents or elements with one another are need-based, bottom–up, and emergent, and are associated with the presence of catalysts and feedback mechanisms.
(7) Steady-state and dynamic homeostasis	The basic principle is the preservation of the character of the system. In countering entropy, systems move toward growth and expansion, as they tend to import more energy than is necessary.	(7) Adaptation	The basic principles are preservation and adaptation of the character of the system.
(8) Differentiation	There is movement toward greater differentiation, specialization, and elaboration.	(8) Differentiation	N (the number of sub-units) blends with the intra-system variables K and P and the inter-system variable C to achieve a poised system.
(9) Integration and coordination	Greater integration and coordination are necessary to counter the tendency toward greater differentiation.	(9) Integration and coordination	The intra-system variables K and P blend with N and the inter-system variable C to achieve a poised system.
(10) Equifinality	The same final state can be reached from differing conditions and a variety of paths.	(10) Path Dependence	Unique final states may be reached due to sensitivity to initial conditions.

Figure 3: Schneider & Somers (2006)

The fifth property (negative entropy vs. emergence) highlights another important difference. Keeping negative entropy, the aim of open systems, avoids companies to gradually move in a state of disorder, while the creation of emergent behaviours, the aim of CAS, leads to new opportunities, rewards and constant renovations. Therefore, both processes try to facilitate

order in the organisation, but “emergence” provides additional positive feedbacks to the system. The key point, however, is that more open the system is to external sources of energy, the easier it is to channel the forces of emergence rather than entropy (Birkinshaw, 2013).
Finally, the ideas on the end states achieved by the two systems are different. Open systems theorist agree on the achievement of homogeneous results, even when the conditions are different (equifinality), while complex adaptive system theorists support the idea that the results obtained may be heterogeneous or unique, thanks also to diverse path dependency.

In the remaining properties there are more similarities (properties six, eight, and nine). It is important to differentiate the process of feedback and exchange of inputs in the two theories. In OST inputs are information regarding the environment or the system’s functioning. Negative feedbacks are the most important opinions because they help the organisation to fix its actions and bring the homeostasis forward. In CAS the focus is on emergent and spontaneous interactions of agents, called autocatalysts. Inputs do not arrive just from sources external of the system but also from the cooperation and synergies of agents in the same system.

1.5. Triple Embeddedness Framework (TEF)

Previously, scholars have studied the consequences related to environmental influences towards industries and single firms (e.g. open systems, complex adaptive systems, evolutionary economics). However, the reversed interactions, therefore the businesses affecting the environment, has been widely overlooked. Geels (2013) has recognised this research gap by integrating in its framework the phenomenon of co-evolution. This process consists in continuous modifications and evolutions of both the business and its broader set of environments, mainly occurring thanks to the dynamic interactions and influences between multiple entities living in the environment itself.
In order to theorise this concept Geels (2013) utilises a conceptual framework, as a model that, according to Malerba (2006), permits to “move from the statement that everything is coevolving with everything else to the identification of what is coevolving with what, how intense is this process and whether indeed there is a bi-direction of causality”.

Firms-in-industries face the continuous tension between variation and similarity: on the one hand, single firms have heterogeneous strategies, competences and knowledge which increase distance between them and enhance variation at industry level, on the other hand similar selection pressures from the environment push firms towards homogeneity. Industries may be perceived as populations of firms, sharing some characteristics and offering similar goods and services, mainly because they face analogous influences from their surrounding. Various scholars (Geels, 2013; Lewin and Volberda, 1999) agree that these two types of forces should be analysed jointly into a unique system.
Accordingly, Geels (2013) coins the term "firms-in-industries", in order to consider the population of firms, with similar features, included in industries, but keeping also in mind the distinctive traits of each firm.

This section expands the idea of firms embedded in broader external environments that already open system and complex adaptive system theorists agreed upon, adding that firms are not just passive players in the system but rather actively shape their surroundings.

1.5.1. The theories behind

According to Christopher Freeman (1988: p.12), there was "the need for reintegrating economic theory with the other social sciences", as different disciplines perceive co-evolutionary interactions from different points-of-view (Lewin and Volberda, 1999). Agreeing on these assumption, Geels (2013) combined notions from various theories and literatures in a unique framework.
The theoretical background of the TEF is based on the adaptation-selection debate, which argue that there are two main perspectives that permit the comprehension of co-evolution. On the one hand, Geels (2013) takes insights from population-level selection theories (evolutionary economics, neo-institutional theory, and economic sociology) that focus on external forces and influences on businesses. On the other hand, the framework collects insights on how firms proactively aim to shape, or adapt to, environments by analysing firm-level adaptation theories, both from externally-oriented strategy approaches (economic positioning, corporate political strategy, discursive strategy and issue management) and internally-oriented strategy approaches (related to knowledge, capabilities and sense-making).

In the next sections, these theories will be more deeply explained, differentiating them according to the focus (industry vs. firm), the direction of influence they study (from the environment to the industry or firm vs. from industry or firm to the environment), and the type of force in place (selection vs. adaptation).

1.5.1.1. Population-level selection theories

In general, what these theories have in common is the study of the consequences of environmental pressures on industries as populations. For all of them, the aim of industries' internal dynamics is to find a fit with external conditions and their interest is on population of companies, therefore on the industrial level. The main difference is in the focus of their studies and research: evolutionary economics emphasise the importance of material factors (resources, capital, markets), while the neo-institutional theory and economic sociology prefer to analyse idealist factors (beliefs, values, meanings).

- *Evolutionary economics.* The underlying idea is that industries can be perceived similarly to natural ecosystems. Generally, Darwinian selection's concepts can be applied to a population of firms: if an organisation is able to propose an offer that fits perfectly with the requirements of the environment, it will be able to acquire additional resources to continue its activities.

  This theory borrows two important concepts from complex adaptive systems: self-organisation and emergence.

  The process of innovation of evolutionary economics, which permits adaptation and evolution, has analogous characteristics as the self-organising process of CAS. It is because firms' decision making process is based on routines, behavioural rules, standard procedures or, similarly to CAS, on the "schema of past experiences and strategies", to which organisational actors adhere until they bring successful outcomes (Geels, 2013). If the pre-existing conditions are not suitable anymore, the firm starts the innovation process (Geels, 2013). This process of interaction between system's components leads to new patterns and behaviours that cannot be understood only by analysing the single behaviours of individual agents (the concept of "emergence").

  The process in evolutionary economics starts with routine-based researches and incremental learning activities (Geels, 2013), triggering the innovative solution. The final

products of these activities are alterations to the schema, which is finally re-inserted in the environment. According to the market feedback, which defines the fitness of the alterations, the firm decides whether to retain the innovation or not. When the feedback is negative, the process immediately employs it for generating new alterations until one of them matches with the environmental needs. Therefore, the process can be seen as a trial-and-error learning (Geels, 2013). In most cases, the alterations are incremental as firms tend to resist radical changes that have a disruptive effect on routines (Tushman and Anderson, 1986).

There are forces, studied in evolutionary economics, that push firms towards homogeneity by clustering them into "technological regimes" (Geels, 2013: p.263). Risk-averse innovators tend to follow the constraining trajectories, creating locked-in schemas. Even if selection pressure's tendency is to prefer only some successful alterations, which are then spread to competitors through imitation (Nelson and Winter, 1982), firms try to keep a level of heterogeneity through specific capabilities and unique competitive advantage.

The co-evolution in evolutionary economics is limited to minimum as interactions are mainly one-directional: firms only adapt to environmental pressures and selection processes.

- *Neo-institutional theory.* This school of thought is considered a population-level theory as it sustains the idea that firms aggregates into populations - the industries - which "constitute a recognised area of institutional life: key suppliers, resource and product consumers, regulatory agencies, and other organisations that produce similar services or products" (DiMaggio and Powell, 1983: p.148). Scott (1995) claimed that inside the industrial area are also included all those institutions and agents that have a significant effect on businesses' activities. The focus of these theorists is in the consequences of external institutional pressures on passive industries. By adapting to these influences, firms' aim is not a high profit margin but rather the achievement of "social fitness" (Powell, 1991). The degree of social fitness is defined by legitimacy, "a generalised perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed systems of norms, values, beliefs and definitions" (Suchman, 1995: p.574).

  Legitimacy can be higher or lower according to firms' conformity to institutional selection pressures. Scott (1995) defined three types of institutional pressures: (1) regulative

institutions are written laws and regulations defining explicitly what is allowed and what is not and arranging rewards and punishments, (2) normative institutions are underlying values and norms incorporated in social practices over time, (3) cultural-cognitive institutions are core beliefs, cultural dogmas, and mindsets that define how people picture reality. The latter are generally taken for granted as they are deeply imprinted in a population's mind.

The presence of broad institutional pressures facilitates organisational isomorphism, the increasing analogy between organisations in a context. Firms, by trying to achieve an higher degree of legitimacy, and therefore trying to conform to the societal dominant understandings, structures and culture, they will increase the homogeneity among themselves (Meyer & Rowan, 1977, DiMaggio & Powell, 1983).

Also in neo-institutional theory the environmental pressures affect the industry but rarely the contrary happens.

- *Economic sociology.* Like the above mentioned theories, also economic sociology studies the environmental influences on markets. However, thanks to new economic sociology, which started with Mark Granovetter in 1985, theorists started to define also the concept of embeddedness. This embraces the idea that economic relations between agents in industries occur also under the influence of non-economic institutions (social, political and cultural patterns). In fact, agents' "attempts at purposive action are (…) embedded in concrete, ongoing systems of social relations" (Granovetter, 1985). During the years, different kinds of embeddedness have been theorised. Firstly, Granovetter (1985) emphasised the importance of trust and personal relationships in social spaces, through the conception of horizontal embeddedness. Zukin and DiMaggio (1990) continued the theorising on this matter by differentiating cognitive, cultural and political embeddedness. Cognitive embeddedness conceptualises that people have common underlying frames of reference on the functioning and meaning of things, since they share with others mental maps, beliefs, identities and preferences. At industry-level, instead, common beliefs form industry mindsets, like the conceptualisation of competition, membership, and the nature of work relationships (Phillips, 1994). Cultural embeddedness defines how an industry is perceived by the general public, by competitors and by policymakers and can have an effect on the degree of legitimacy of an industry. It may also influence aspects of extreme importance for organisations, like access to capital and government support. Political

embeddedness contains all those rules, regulations and laws, drafted by institutions of the state, that support the implementation and functioning of economies. Examples are property rights, tariffs and quotas, patents, rules on exchanges, and taxes.

Economic sociology theory recognises to industries a modest degree of willingness and power to influence external institutions, according to their own interests. It only assumes a partial bi-directionality and lacks the implementation of these notions into a dynamic and complete model (Geels, 2013).

Organisations need to remain receptive to tackle important selection forces. The three theories previously explained are necessary to understand the mechanisms that push firms-in-industries to interact with their environments, and to adapt accordingly to the direction of selection pressures.

1.5.1.2. Firm-level adaptation theories: externally-oriented approach

Adaptability is an organisation's capacity to actively adapt to changes occurring over time in its environment, striving to survive. Externally-oriented schools of thought argue that a firm's success is primarily determined by forces coming from its surrounding general and specific environment. However, these approaches argue that firms do not only undergo passively pressures and changes, but rather explain how firms are able to actively influence their environment.

These theories will be better explained in the following sections, specifically in the context of TEF, as they are necessary for the development of the bi-directionality of interactions and for the integration of the co-evolutionary attribute.

- *Economic positioning strategy.* Regards all those strategies that aim to change firms' internal factors in order to build a unique competitive advantage. Through core competences, skills, product and processes' inimitable characteristics, the firm is able to prevail over competitors and to win market share. It comprises strategies for supply chain management, operations management or changes in the marketing mix.

- *Corporate political strategy.* Firms' competitive advantage is a valuable tool that permits company to overcome competitors in the marketplace. However, value creation strategies

are structured following formal rules, policies and regulations defined by governmental and market institutions. Organisations try to influence, using corporate political strategies, the public policy process, in a way that favourably affect the achievement of a competitive advantage. Researchers found out that a strong relationship between the firm and government has a positive impact on the firm's value (Hillman et al., 1999).

- *Discursive strategy.* An approach that consists in persuading audiences with the use of linguistic tactics and procedures during communication processes. These strategies aim to shape and redirect public ideas and discourses towards the industry interest (Geels, 2013). The most covered topics, and in turn the companies directing them, shape the macro-economic field.

- *Issue management.* It is a process "to anticipate and take appropriate action on emerging trends, concerns, or issues likely to affect an organisation and its stakeholders" (Issue Management Council). Issue management practices change according to the stage of the issue lifecycle in which the issue is situated.

1.5.1.3. Firm-level adaptation theories: internally-oriented approach

Internally-oriented approach theorists argue that a firm's success is determined by its unique core competences, dynamic capabilities and interpretative skills that lead to an inimitable competitive advantage. While some schools stress the importance over internal knowledge, patents and routines as the most valuable assets for the firm, other schools recognise in interpretative processes of environmental changes and the ability of sense-making, the focal components to build competitive advantage. The first branch of theories highlights behavioural learning processes, in which firms carry on search procedures, looking for solutions, in order to release an incremental variation into the market, which, in turn, provide performance feedbacks (Geels, 2013). The second branch of approaches, instead, considers cognitive learning processes guided by planned strategies, intentionality and by environmental feedbacks' interpretations and sense making (Geels, 2013).
Internally-oriented strategies, in general, conceive the firm adapting to external pressures through a strategic process of change of the firm's identity or of other core internal elements (e.g. routines, beliefs, values and mission).

1.5.2. TEF and industry regime

The elaboration of relevant insights from the theories previously explained led Frank W. Geels (2013) to create a multi-dimensional framework for the analysis of bi-directional influential relationships between firms-in-industries and their environment.

The framework considers firms as embedded in two types of general external environments, the economic task environment and the socio-political environment. The firm performs its activities in a specific context called "industry regime", whose permeable boundaries permit the exchange of influences and feedbacks from and towards both environments. Inside the industry there are three types of firms: core firms, firms "in the middle", and peripheral firms.

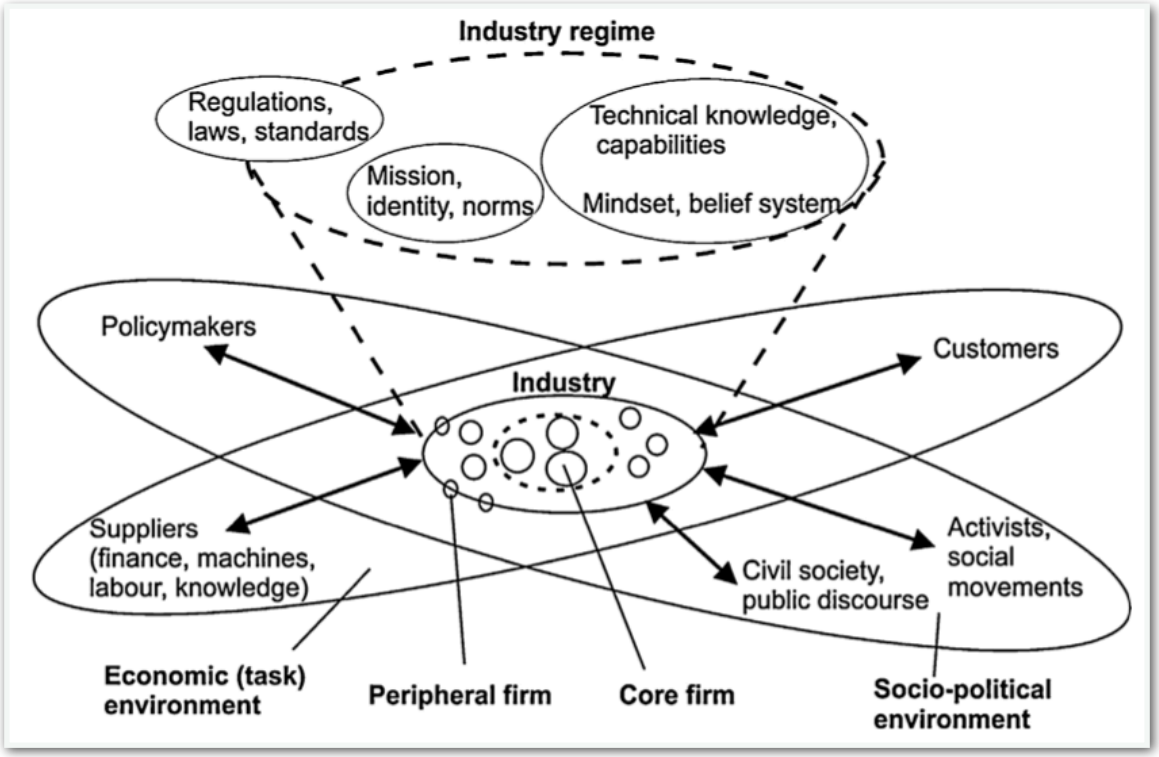

Figure 4: the Triple Embeddedness Framework (Geels, 2013)

From the selection theories previously explained, Geels (2013) borrows the main concept of selection pressures that force firms-in-industries to adapt to environmental changes. Environmental pressures may be exerted by the Economic (task) environment, mainly through customers and suppliers, whose selection criteria include financial performance, efficiency and economic competitiveness (Geels, 2013).

However, with neo-institutional theorists, we analysed also the importance of institutional environments, selecting successful firms according to the degrees of legitimacy and social fitness. A first differentiation inside institutional environments is owed to Haveman and Rao (1997), who distinguished specific (industry-level) and general (society-level) institutions. Specific institutions are defined norms, values and beliefs shared by a restricted subgroup of individuals and constituting the group's endogenous way of thinking; while general institutions are broadly ideas and models of reality agreed by all the different subgroups in a society. Robertson and Langlois (1994), instead, assumed a similar distinction of institutional environments by differentiating between exogenous institutions (of the society at large) and endogenous institutions (specific of individuals or groups). According to these distinctions, Geels (2013) proposed that pressures from "general" and "exogenous" institutions are conveyed by the socio-political environment, through the decisions and actions of the actors embedded in it (e.g. policymakers, civil society, activists). "Specific" and "endogenous" institutions, instead, exert pressures on firms throughout the industry regime.

The idea of an industry regime comes from the need of a broader concept merging technological regimes, theorised by evolutionary economists and focusing on the technical sphere, with the three institutional pillars of Scott (1995), (see above, p.16). The result is a set of "industry-specific institutions that mediate perceptions and actions of firms-in-an-industry towards external environments" (Geels, 2013: p.267). According to Geels (2013), in every industry regime it is possible to find four kinds of regime elements:

- Functional-cognitive regime elements. Similarly to technological regimes, these elements define constraining technological trajectories which dictate what firms-in-industries can or cannot do.
- Cultural-cognitive regime elements. All the firms in an industry share an endogenous industry mindset, which has the power to shape how individuals interpret and respond to external environment's threats and opportunities.
- Normative regime elements. These elements define which behaviours are considered appropriate or inappropriate by the components of the group. By sharing values, purposes and mission, a common, shared industrial identity is delineated, which is an important contributor for the achievement of a normative legitimacy.

- Formal-regulative institutions. Written standards, policies and regulations constrain the actions of firms-in-industry, affecting their profitability and competitive advantages. They may concern taxes, patents or other intellectual property protection laws, tariffs and quotas, and minimum wages. These rules may be externally imposed by governmental agencies or internally established by industry associations, through codes of conduct and guidelines. This is the reason why in Figure 4 this element is pictured across the border line of industry regime.

From economic sociology, Geels (2013) adapts the notion of embeddedness: in TEF the interactions occurring between firms and institutional groups in both economic and socio-political environments can be categorised as horizontal embeddedness, while core organisations are shaped by their industry regime through vertical embeddedness.
The Triple Embeddedness Framework adds the bi-directionality of interactions between industries and their surrounding environments to previous selection theories.

The TEF accommodates both variety and similarity, pillars of selection theories. Located at the industry's borders, peripheral firms are less influenced by the industry regime and, therefore, easily deviate from lock-in mechanisms. However, also incumbent firms, located at the centre, have the decisional power to create variety by shaping new rules to accommodate their interests. For example, individual firms may comply differently to similar regulations on sustainability. Especially for this subject matter, "organisational responses are quite idiosyncratic even within a specific industry governed by regulation that is equally applicable to all firms" (Etzion, 2007: p.646). Pressure towards similarity hits primarily incumbents and firms "in the middle", which are more influenced by industry regime elements. Because of this influence, firms evolve on predictable trajectories through incremental changes. Sometimes lock-in mechanisms and core rigidities lead to inertia, causing the firm's death.

1.5.3. Process of co-evolution (bi-directional interactions between firms-in-industries and their environment)

1.5.3.1. From the environment to industry actors

The pressures created by economic and socio-political environments may lead to challenging situations for firms. However, sometimes the interference of external forces in the everyday operations may bring opportunities and avoid firms to get locked-in into existing mechanisms. Firms-in-industries need to be equipped with forecasting techniques and interpretative processes, in order to prevent potentially problematic pressures and turn them into beneficial situations for the firm. This analytical process regards all the different environmental dimensions. The TEF is a useful tool to examine the entire range of environmental forces interacting with firms.

Some theories have been developed to explain the evolutionary path of issues, helping firms to understand and forecast their status and evolution. The issue lifecycle theory, for example, is characterised by five predictable steps along which the issue advances: (1) a restricted group of people, mainly activists or individuals affected by the issue, are the first raising complaints and showing interests to a problem, while firms may implement mechanisms to dissuade these individuals to continue; (2) thanks to their commitment to the cause, the general public acknowledges the problem generating debates and increasing coverage, forcing firms to engage in resistance activities or show "symbolic" actions (Geels, 2013); (3) policymakers start to show concern over the issue; and (4) pulled by the public opinion, introduce a new legislation, or change existing ones, to solve the problem or to exert pressure on firms to provide substantial changes; (5) markets transform due to changes in legislations or in customer preferences (when the society changes opinion over an issue, it creates new internal norms). In TEF, pressures over social issues firstly arise in socio-political environments (1-3), and than relocate to economic (task) environments (4-5), (Geels, 2013).

1.5.3.2. From industry actors to the environment

Until now, we have mainly analysed the effect of environmental pressures on firms-in-industries, overlooking the bi-directional nature of interactions in TEF. However, firms do not passively experience external changes, but rather intentionally and strategically respond to those forces, redirecting and shaping them according to their own needs. While externally-oriented responses aim at changing something in the environment, internally-oriented approaches adapt to external forces by changing core internal features. Moreover the latter, through strategic reorientation, avoids firms to stuck in lock-in mechanisms that may lead to inertia.

Response strategies (externally-oriented) in response to the external pressures

According to the different types of economic and socio-political environments, firms have various strategic responses at their disposal.

- In order to shape the economic environment and Porter's five forces, firms employ economic positioning strategies. By changing the marketing mix, supply chain management or their operations, firms are able to achieve unique competitive advantages, offering better products, at a lower price or faster than competitors. Also through innovation strategies (Dosi, 2000), firms are able to create advancements in products or processes which, when protected by intellectual property or inimitable, give influential power to firms.
- Regarding political and regulatory legal environments, corporate political strategies (CPS) argue that firms can gain various advantages in influencing policymakers or shape public debates. These activities may be carried out through individual or collective actions of firms towards a common threat. Geels (2013) recognised five types of CPS:
  - Information strategy. It is used when firms lack the expertise on the problem, so they hire research institutes to write reports or give opinions that can influence policymakers' position on the issue.
  - Financial incentive strategy. It mainly consist in paying contributions and bribes to political parties or individual politicians, in order to redirect their decisions towards firms' interests.
  - Organised pressure strategy. Firms have the possibility to create (or recruit) industry associations and representative groups ("interest groups") to put pressure on government policies, by bringing the issue in public debates.
  - Direct lobbying strategy. Industries can try to influence legislative bodies by either speaking directly with politicians or by hiring lobbyists to work as policymakers.
  - Confrontational strategies. Consists in opposing openly to laws through litigation or by intimidating policymakers.
- Matching the internal firms' ideology and culture with the general interest may bring legitimacy to the firms' practices. However, on the contrary, being able to influence the cultural environment and to direct public debates towards certain issues, according to the firm's willingness, can be an advantageous step-ahead strategy for firms. Big incumbent

organisations have also the power to shift the public interest towards favourable industry-specific discourses, while avoiding disadvantageous ones.

Discursive strategies are utilised by firms to protect corporate interests, as shifting in focus of the public discourse can threaten the firms' everyday operations and survival. These strategies can have an influence both on the recognition of the issue and on the identification of the solutions, through diagnostic and prognostic framing. Examples of diagnostic framing strategies are minimising the problem, pointing out uncertainties and research gaps, and undermining the rivals' credibility. Examples of prognostic framing strategies are complaining about costs or about the difficulties to find feasible solutions to the issue, in order to delay legislation, or the use of positive definitions for solutions' appellatives (Geels and Verhees, 2011), like "clean coal".

- Normative pressures concern the motives that lead firms to conform to society. Firms may use Corporate Social Responsibility (CSR) strategies to show active commitment to societal problems related to their performance, like sustainability, ethics, environmental issues, customers' health. CSR strategies involve corporate philanthropy initiatives like donations, contributions or support to non-profit organisations.

  During the first stages of the issue life cycle (see above, p.23), firms can employ issue management strategies, which consist in detecting early potential problems or in elaborating response strategies.

Strategic reorientation (internally-oriented) in response to the external pressures

For the strategic reorientation's conceptualisation, Geels (2013) takes insights from the two internal-approach of adaptive theories. From the routine-based behavioural learning approach, he agrees with the importance of environmental pressures, which by undermining the firm's performance, trigger local search processes for solutions and feedbacks. According to Geels (2013), this perspective alone is insufficient to explain the dynamics in TEF, as core competences, technical knowledge and search processes are not enough if the firm is unable to use them appropriately. For this reason, he stresses the need of cognitive learning processes, enacted through mental maps, strategic vision and intentionality, for the direction of search procedures. Further, information and signals from the environment are interpreted by firms through sense making.

Strategic reorientation develops through four stages, in which environmental pressures and problems challenge firms to abandon lock-in mechanisms and rigid elements of industry regime in favour of innovative variations.

- Stage 1: Firms minimise problems arising from the environment by considering them as temporary and harmless. For this reason they do not take any preemptive action. Core firms may also be overly confident by perceiving a false sense of security that leads to mis-conceptions and mistakes.
- Stage 2: Firms' recognition of performance problems triggers the local search of solutions that do not (or partially) alter the existing industry regime characteristics. The results are, in fact, incremental innovations or "symbolic" adjustments in daily procedures. Only peripheral firms and new entrants search for more radical solutions, being less attached to regime elements.

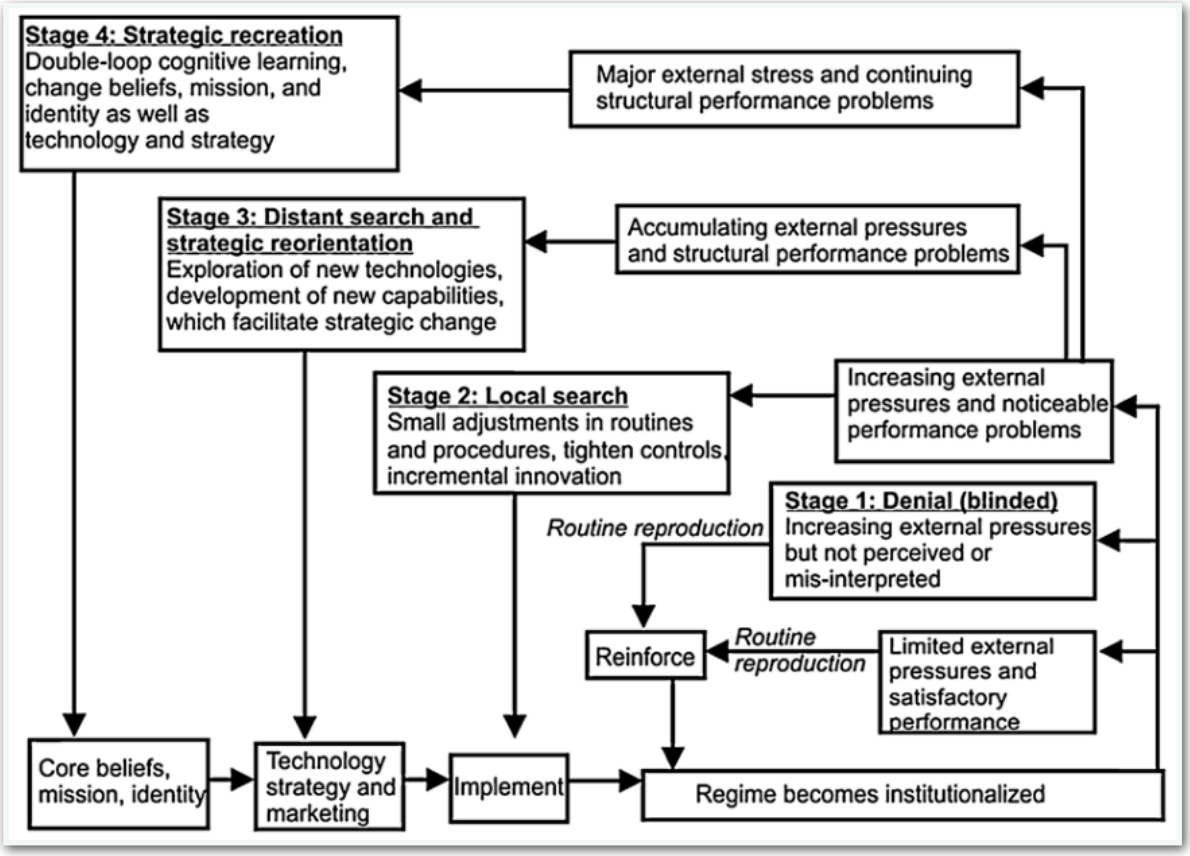

Figure 5: Strategic reorientation from Geels (2013)

- Stage 3: Having accumulated external pressure, firms start to perceive problems as structural and potentially harmful for the industry equilibrium. Therefore, firms engage in more "distant search" for solutions, whose focus shift "from the exploitation of existing technologies to the exploration of new knowledge bases and more radical alternatives" (Geels, 2013: p.271). This process requires a high sense-making capacity and interpretation, which may push the firm to overcome lock-in mechanisms and, if the interpretations are appropriate and the variations successful, to gain first-mover advantage.
- Stage 4: When problems and external forces continue to exercise pressure on the firm, it needs to consider deep-structural changes and the fundamental rethink of the company's identity, values and mission. Geels and Penna (2013) highlighted that most of the times firms engage in substantial strategic changes when they foresee economic opportunities to exploit, rather than for just solving social issues.

2. How and why events can impact industries

2.1. Definition of events

In each individuals' life, "the ongoing stream of mundane daily occurrences is punctuated by distinctive, circumscribed, highly emotional and influential episodes" (Pillemer, 2001: p.123). The circumstances that happen to us, that shape how we think, feel and act, make up our life experience.

Similarly, in the organisational life cycle, "episodes" arise at every hierarchical level, and their effects can influence entities at other levels or even the entire organisation.

Entities are independent subjects, like individuals, industries, organisations or the environment. These entities have "continuances", or enduring stable conditions (Morgeson et al., 2015). While events are discontinuous occurrences, different from the stable entities that generate them. An event happens when entities intersect (Morgeson et al., 2015). Therefore, following Allport research, Morgeson et al. (2015: p.519) define an event as "the point in space and time where entities or entity actions contact, encounter, or meet each other". Events can occur both inside or outside the organisation, but they are always

conceived as external to the entities involved. Specifically, only actions of entities, and not their internal psychological processes, can be considered events (Morgeson et al., 2015). Moreover, events need to exist in a specific time and space.

Events can have different degrees of complexity. There may be events that exert weak pressure on established routines, or more disruptive events that drastically impact an organisation, or industry, or market. Due to the dynamic environment of markets and the continuous emergence of technological innovations, disruptive events are becoming more common than in the past. Non-routine, unexpected events can include natural disasters, human health hazards, political impacts, economic crisis, technological developments, conflicts and sustainability issues. Some of these examples coincide with the list of "grand societal challenges" (Ferraro et al. 2015), or "massive social and environmental issues that transcend national borders (…) and that have potential or actual negative effects on large numbers of people, communities, and the planet as a whole" (Voegtlin et al., 2022: p.1). As driven by a common interest, to effectively implement appropriate responses to address the issue, various entities have recognised the need to collaborate and share knowledge and resources (Voegtlin et al., 2022).
The recent COVID-19 pandemic, for example, has proven the necessity that both private and public bodies join forces to generate successful solutions (e.g. to provide face masks or other medical equipment promptly, or to develop test, and administer vaccines).

Finally, not all events are negative. Positive events rarely are unexpected (e.g. World Cup, Olympiads) but still can produce unpredicted outcomes. Both kinds of events, however, can be strategically created to generate desired outcomes, which, in both cases, can be positive or negative to entities.

2.2. Industry attention to external events

After having defined what an event is from an organisational point of view, it is important, for the purpose of this research, to focus on what features and mechanisms of events trigger the attention of the organisational world.
It is easy to understand that events gain attention from the industry for two reasons: the general public holds them directly accountable for the outcomes of the event (in the case of

negative events), or the internal entities consider it a successful way in order to improve the industry image (in the case of positive events). Moreover, an event can easily become a serious issue for the firm if entities deny the accountability for the event and do not perform any solution.

Professors Hoffman A.J. and Ocasio W. developed a model in 2001 of industry attention to external events, in order to understand why some events become more salient for the industry, while others remain overlooked. Their aim was to examine the determinants of the society's concern or unconcern in the public discourse, with respect to events.

2.2.1 Theoretical background

The model brings insights from attention-based theories, which see the environment as composed by different forces and inputs affecting the organisation. Only few of these forces, however, are intercepted and deemed important by firms. In fact, these theorists consider individuals and organisations as entities capable of limited cognitive skills (Simon, 1947), that are the skills necessary to detect all the issues and opportunities coming from the environment.

Hoffman A.J. and Ocasio W. (2001) defined industry-level attention as "how industry participants, in their communications and interactions with other industry participants selectively focus their attention on a limited set of issues, situations, and activities that represent potential problems or opportunities for the industry". In this definition, industry participants comprises not only the single organisational delegates but also individuals from trade journals. In the model, both industry-level attention and the broader attention of people external to the industry are aggregated under the concept of "public attention" (Hoffman and Ocasio, 2001; Hilgartner and Bosk, 1988).

Theorised functioning per principles:

1. Entities, in general, selectively decide whether to be involved in some external events or to ignore them, through a principle of "selective attention". Industry's selective attention to certain events is determined by the degree of event's salience, which, in turn, depends on how entities enact situations in the environment. Therefore, attention is not captured by event's features but rather on its enactment in the external environment

(Weick, 1979, Ocasio, 2000), or better, the process of arranging the external context, where the event arose, through casual links and schemas.

2. Attention to events may start internal to the industry, external or both internal and external simultaneously. Sometimes, internal attention to events matches with the attention they receive externally, but not always. Social processes and interactions determine whether some events are noticed or not by internal industry participants. These processes occur throughout the channels of communication selected by the industry. External attention to issues, instead, is determined in "public arenas" (academic journals, universities, conferences, press), where events, due to the channels' limited capacity, fight for public attention and consideration (Hoffman and Ocasio, 2001). This second principle of attention-based theories is called "situated cognition".
3. A third principle can be deduced from earlier theory (Ocasio, 1997) focusing on the "structural determination of attention", highlighting that events are considered important when matched with certain social structures of attention: the core technology, the ground rules, and the status of the players (Hoffman and Ocasio, 2001).

Essential, for the comprehension of the model, is to define three wide-known business concepts: industry social identity, image and reputation. Identity comprises all the practices, values, and set of beliefs and meanings shared by industry participants. It is shaped by how the industry judges and pictures itself in the eyes of external entities, the industry image. While reputation is the actual outsiders' esteem and perception of the industry.

2.2.2. The Model

The "model of industry attention to events" developed by Hoffman A.J. and Ocasio W. (2001) not only studies whether an event receives wide public attention but also if this attention is sustained over time, becoming crucial for the industry to take appropriate actions.

Considering only industry-level phenomena, the model analyses the life of events: it delineates the two main factors (external accountability and examination of industry image) triggering industry initial attention, followed, sometimes, by contestations and re-enactments, which sustain attention over time.

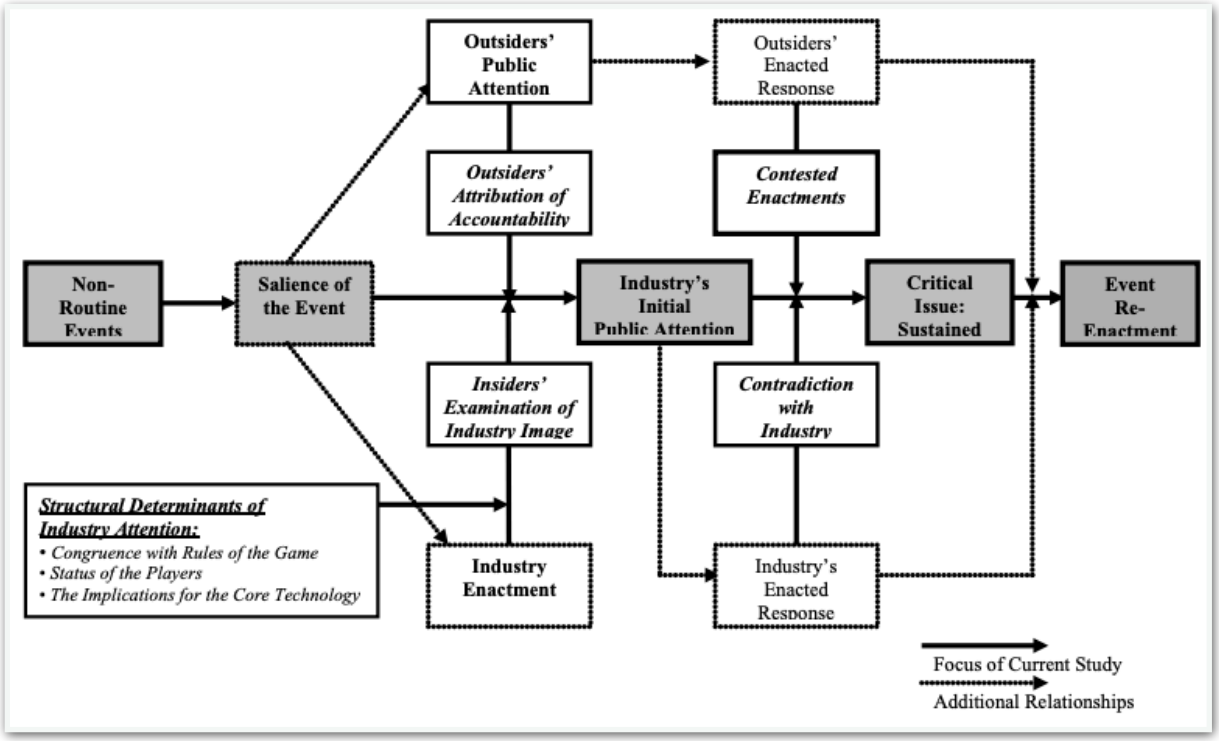

Figure 6: Model of industry attention to events (Hoffman A.J. and Ocasio W., 2001)

In the following paragraphs we will briefly describe the features and mechanisms of events that make them capture the attention of the industry.

Non-routine events. While routine events do not require additional effort and attention to overcome them, and are therefore not this model's focus, non-routine events are more complex as they arise from external environmental stimuli, disrupt the "status quo" and mutate over time. Not all of them, however, succeed in attracting the industry participants' attention.

Salience of the event. Being salience defined as the extent to which a particular issue is prominent compared to its surrounding, it follows that it is a focal attribute of those events that attract initial industry attention. In this model, both the external opinion of industry's accountability and the internal enactment of the event, by questioning the industry's image, are critical factors of an event's salience (Hoffman and Ocasio, 2001).

We will further analyse, through this thesis, the features that are considered by Event System Theory determinant for the event's salience (novelty, disruption, criticality). However, in this case, novelty is considered as a necessary, but not sufficient, condition for an event to have an impact.

Outsiders' Public Attention. More specifically, an industrial sector is sometimes forced to care about the issue when the public opinion considers it as linked, or responsible, to the problem in question.

Insider's Enactments. For an industry, the motive that makes an event attendable is how insiders enacted it (Hoffman and Ocasio, 2001). The event's features and the initial external pressures are only marginal factors that determine how an industry considers the event. It not always matches the outsiders' enactments.

Outsiders' attribution of accountability. It is the first factor that has a real effect on the initial public attention to an event. Activists, groups affected or the general public can hold the industry publicly responsible for the event, therefore affecting its reputation.
Even if the public opinion is considered a triggering factor, attention is given to events when the industry's reputation and image, and therefore long-term profitability, are threatened. However, accountability definitely makes an event more salient for the industry.

Insiders' examination of industry image. It is the second factor that have an effect on the initial public attention to an event. In this case, the industry conducts an internal analysis of its practices, and assesses whether the event may or may not influence the industry image. Usually, it is a preemptive measure as it occurs before the general public holds the industry accountable, and therefore before its reputation is affected. The attributions of accountability can be consequences of the internals' concern on image.

Social structures of attention. These factors (the core technology, the ground rules, and the status of the players) influence if an industry gives attention on the event's effects on its image and how an industry enact external events.

- Core technologies are tangible and intangible assets relative to the organisation's production process. They are necessary for the firm's goal attainment.
- Rules of the game consist of a set of written rules, unwritten norms, and standards of action that constrain the industry's decision-making process.
- The status of the players are all the individuals, public personalities or organisations that, by expressing their opinion on an event, can influence and direct the decisions and actions of industries. If their point of view is relevant for the industry, their manifestation of

interest toward an event will subsequently increase the industry attention to it (Hoffman and Ocasio, 2001). These actors usually have high social influence and authority.

Contestation and contradiction. Not all events that receive initial public and industry attention remain relevant in the long-term. An event is sustained when its enactment evolves over time. This evolution consists in continuing enactments and re-enactments of the starting event, both by outsiders and insiders. This leads to what Hoffman A.J. and Ocasio W. (2001) defines as contestation. Both the industry and the external actors engage in disputes around the meaning of the event. While industry participants try to safeguard industry's identity, outsiders battle for their own ideas and beliefs. More enduring the contestations are, more likely it is that the event will receive sustained attention over time and, therefore, will be perceived as a critical issue by the industry. Contestations and enactments are highly shaped by both cultural context, through industry identity and external values, and political context, through current rules of the game.
In general, contestations arise when there are disagreements between insiders' (industry identity) and outsiders' enactments, leading industries to start to find new answers to solve the critical issue (Hoffman and Ocasio, 2001).

Event Re-enactment. It occurs when an event, happened in the past, is re-enacted to fit the new industrial features and institutional structures. The public attention pulls again the issue out by adapting it to the current society.

2.2.3 When and why do events attain high and constant levels of industry attention?

The model of industry attention to events try to solve two important questions regarding the occurrence of non-routine events. It firstly investigates what factors differentiate events that receive public attention to those that are instead ignored. The answer is that there exist some social structures of attention that influence industry attendance or non-attendance to external events (Hoffman and Ocasio, 2001). However, social structures are considered both the cause and the outcome of the event, as they hold a critical role in triggering the event's initial attention, but they can also be shaped and altered by the event itself (Hoffman and Ocasio, 2001).

Secondly, the model seeks to evaluate what elements make an event's attention sustained over time. While some events can achieve high levels of initial attention, only a part of them will continue to hold attention in the long-term, therefore becoming a relevant issue for the industry (Hoffman A.J. and Ocasio W., 2001).
Regarding the two research questions, Hoffman A.J. and Ocasio W. (2001) have developed six hypothesis that help to understand the linkages and mechanisms of causality in their model.

As we said, two factors, outsiders' attribution of industry's accountability and the internal examination of the event's effects on the industry's image, can trigger initial attention to an event. Regardless of the initial driver (insiders or outsiders) of an event's enactments, public attention will, in most cases, presumably provoke internal analysis of industry image (Hoffman and Ocasio, 2001). As a general rule, the greater the degree of outsider's attribution of direct accountability to the industry, or of insiders' evaluation of the event's effects to the industry's image, the greater the chance that the event will attract the attention of the business press (Hoffman and Ocasio, 2001).
Moreover, an event's salience for an industry is determined by (1) the compatibility between current rules of the game and industry's level of involvement, (2) by the opinions on the event of high status players and (3) by the event's consequences on firms-in-industries' core technologies. All three determinants trigger the insiders' examination of the industry's image, therefore provoking an high-level degree of industry attention to the event.

Sometimes initial attention to events is also sustained over time, causing serious consequences to the industry. It has been recognised by Hoffman A.J. and Ocasio W. (2001) that attention is continued in the long-term due to competing enactments and debates, among internal and external actors, over the event's meaning and the accountability of the industry. In general, "the greater the contradiction between outsiders' enactment of the event and the industry's identity, the greater the contestation between insiders and outsiders over the enactment of the event. The greater the contestation over the event's enactment, the greater the likelihood the event will receive high and sustained levels of attention" (Hoffman and Ocasio, 2001).

2.3. Event System Theory (EST)

Events, in general, have been the focus of study of many theories: ranging from affective or stressful episodes in individual lives to disruptive events for organisations.
Feature-oriented theories have always explained these phenomena by linking the interactions between stable features of individuals and their work environment, with the resulting stable outcomes. However, as event-oriented theorists have argued, organisational phenomena may result also from dynamic events. The main difference between features and events is that the latter are embedded in space and time frames, and can trigger new behaviours, features or subsequent events.

In the previous section, analysing the Hoffman and Ocasio (2001)'s model of industry attention to events, we recognised the importance, for an event, to be salient to attract initial attention. Their analysis, however, was broader and mainly concentrated on the explanation of the industry's internal and external determinants of high and sustained attention towards events, overlooking which characteristics of events make them salient. In this section, we will analyse more in depth the events' salience through the EST (see paragraph 2.3.2).
The choice of these two studies over events is justified by the willingness to present a complementary view of the event's phenomenon, which, as tackled from different points of view, can trigger to the reader its complete depiction.
Differently from Hoffman and Ocasio (2001)'s model, whose focus was only at industry-level, EST analyses events arising at every organisational level. Moreover, also the way events are conceived changes from one model to the other: the attention-based model studies only events external to the industry, while EST analyses the characteristics and outcomes of events emerging inside the organisation or originating in the external environment.

Morgeson et al. (2015) have developed the EST in order to theorise what characteristics of events make them meaningful. The theory studies the interactions among three components: the event strength (quantified by novelty, criticality and disruption), the event space (the event's origin and spacial dispersion), and the event time (when the event happens and its duration).
The final propositions, written by Morgeson et al. (2015) and below reported, define what features make events impactful, contextualising them in the spatial and temporal processes, through which they cause outcomes.

2.3.1 Theoretical background: variance oriented theories and process oriented theories

Mohr (1982) theorised the presence of two major kinds of orientations for explaining scientifically organisational changes: variance and process theories.

Variance oriented theory “is the common sort of hypothesis or model, such as regression model, whose orientation is toward explaining the variance in some dependent variable” (Mohr, 1982: p.9). For theorists, when a dependent variable experiences a variation in its state, which can be statistically explained by a set of independent variables, a change occurs. The underlying goal of variance research is to find out the prerequisites necessary for the emergence of an outcome.
More in depth, Mohr called the causal relationship linking two variables, X and Y, as "push-type causality” since X makes Y to occur in a cross-sectional vein. The set of independent variables “X” is a necessary and sufficient condition that led to the creation of the outcome Y. Theorists research how stable characteristics of variables are interconnected, which in business studies have been used to explain how the amount of an organisational element is linked with the amount of another organisational element (Morgeson et al., 2015), (e.g. how a firm’s employees training program is related with its performance).

Process oriented theory, instead, “represents a series of occurrences in a sequence over time so as to explain how some phenomenon comes about” (Mohr, 1982: p.9). So, theorists may use an event-driven approach to explain how an organisation passes through patterns of events over time, pushed by directional forces, in order to determine how an outcome unfolds. In this case, Mohr calls the causal mechanisms occurring between variables X and Y as “pull-type causality”. The set of independent variables “X" is only a necessary, and not a sufficient, condition to generate an outcome Y. It is always true that the outcome is dependent on the precursor, but the reverse is not true. X do not always lead to Y, especially if some specific probabilistic processes and external forces do not occur in a homogeneous way.

Therefore, the main difference between the two theories is that the focus of study for variance-oriented theories are phenomena as static variables, while for process-oriented

theories are phenomena as events. The variance approach clearly brings with it many limitations as it overlooks the dynamics and complexities of the change process and development. Rescher (1996) argues that "natural existence consists in and is best understood in terms of processes rather than things - of modes of change rather than fixed stabilities". Things are not the ultimate indissoluble element, but rather are formed and shaped over time by set of processes.
Another divergence between the two approaches is that process theorists ask themselves how and why an entity changed, while variance theorists are more interested on what are the antecedents that led that entity to change.

Event-system theory merges insights from both approaches, but adds also important considerations to them. Firstly, contrary to variance approach, where variations can be quantified, Morgeson et al. (2015) reconsider the event as a temporary and dynamic phenomena. The change process' instability and mutability make it difficult to define precisely the characteristics of events. As, after the time needed for measurements and considerations, the previous event may have evolved into something different.
Secondly, they examine events in their entirety, distancing from the idea of process theory, which favours the study of various processes that transform separate events into outcomes. Moreover, according to Rescher (1996: p.29), "the idea of discrete "events" dissolves into a manifold of processes which themselves dissolve into further processes", generating the whole event.
In summary, EST framework studies quantifiable events as individual entities existing in space and time, but also as part of a bigger picture of interacting entities and events, developing a process over time (Morgeson et al., 2015). It mainly helps to understand the temporal dynamics and the different levels involved in organisational phenomena.

2.3.2. Event salience and characteristics in EST

EVENT STRENGTH

In society, in organisations and in our lives events occur everyday. However, we do not give attention to all of them because not all of them are remarkable and salient. Routine events are normally solved without any effort and, for this reason, ignored, while non-routine

events require different degrees of information processing and action. Researchers have distinguished between automatic and controlled information processing: while the automatic method is rapid and routine-based, the controlled method requires time, effort and is carried out intentionally.

Using a retrospective approach, research papers have described how organisational changes occur due to events and controlled information processing. However, a gap exists if we want to investigate which events' characteristics determine when events are salient and command attention or when they can be overlooked. In EST, event's novelty, disruption and criticality determine the event's degree of strength, and, accordingly, its relevance.

Event Novelty

Event's novelty is a function of how much it differentiates from current or previous processes and practices. It represents something completely new, surprising, unpredicted and unforeseen, to which the entity is ill-prepared. This lack of prior knowledge or routines on how to deal with the event, requires entities to engage in an in-depth interpretation of it through the controlled information processing approach. The final result may be a completely updated set of behaviours, procedures, factors or even subsequent events.

The novelty attribute make an event remarkable and command attention towards it. COVID-19 emergency and governments initiatives had major consequences on the every-day lives of organisations and citizens.

Proposition 1: The more novel an event, the more likely it will change or create behaviours, features, and events.

Event Disruption

Event disruption threats the entities' daily operations, preventing them to proceed in the normal way. Ongoing routines, features and processes are twisted after the emergence of a disruptive event. Entities need to adapt and evolve, not only by changing the previous behaviours and features, but also by breaking out their conventional beliefs.

Also event disruption triggers controlled information processing in order to understand what needs to be changed or developed.

Proposition 2: The more disruptive an event, the more likely it will change or create behaviours, features, and events.

Event Criticality

Critical events have the power to threaten the behaviours, goals, identity and also organisational survival. The extent to which an event is crucial, significant or a priority consists in its criticality (Morgeson and DeRue, 2006). Critical events are the central focus of the organisation until, through the activation of effortful information processing, they are resolved. Morgeson and DeRue (2006) have discovered that 20% of critical events had a strong effect on organisational performance.

Proposition 3: The more critical an event, the more likely it will change or create behaviours, features, and events.

The three characteristics previously described determine the overall event's strength, even if, in every events, these features are present in varying amounts. Clearly, events that possess high degrees of two characteristics can easily prompt controlled information processing compared to events that present only one feature.
Event strength, according to the level of presence of the different attributes, determines the impact that events trigger on behaviours, features and other events. As in TEF, entities go through a process of interpretation and sense making in order to frame the important issue and understand what actions should be implemented.

EVENT SPACE

Events need to exist in specific contexts in order to affect entities. The event space consists in the actual location in which the event emerges and in the places that the event eventually alter through its expansion. In fact, in organisations, shocks can start in a specific hierarchical level, but then it can also influence downward or upward other levels. The event overall impact is determined by how many entity's levels are affected by it, and, as a consequence, determines the event's strength and outcomes.

Event Origin

Event origin is the context in which the event emerges. As we said, this location can be internal or external to the organisation. In general, events arising in the external environment can lead to a stronger and more disruptive impact toward a wide variety of individuals and firms (e.g. stock market crash, pandemics, natural disasters).
For what concerns events taking place internally to organisations, keeping the strengths' characteristics fixed, events that originates in higher levels lead to more serious consequences, then events occurring at lower levels (Morgeson et al., 2015). This is also because top-down effects "manifest within short time frames, whereas emergent, bottom-up linkages necessitate longer time frames" (Kozłowski and Klein, 2000: p.23).

Proposition 4a: Event origin moderates the relationship between event strength and event outcomes such that novel, disruptive, and critical events originating at higher levels will be more likely to change or create behaviours, features, and events than events originating at lower levels.
Proposition 4b: Event origin moderates the relationship between event strength and event outcomes such that novel, disruptive, and critical events originating at higher levels will be more likely to moderate the relationship between lower-level behaviours, features, and events than events originating at lower levels.

Event Spatial Dispersion

Regardless of the event's location of emergence, an event effects' expansion into other levels can occur during time.

Proposition 5: Event special dispersion moderate the relationship between event strength and event outcomes such that novel, disruptive, and critical events that impact a greater number of levels will be more likely to change or create behaviours, features, and events than events that impact fewer levels.

Event Spatial Direction

As said, events can spread across different levels like individuals, teams, organisation, and environment (Figure 7).

- Single-level effects. It consists in events that originate in one hierarchical level and produce changes only in that same level, without expansion. For example, an event in the team level (event 2) can produce new rules and features, while at the organisational level an event (event 3) can produce collective new behaviours, but also lead to another event (as in the case of event 4 and 5).

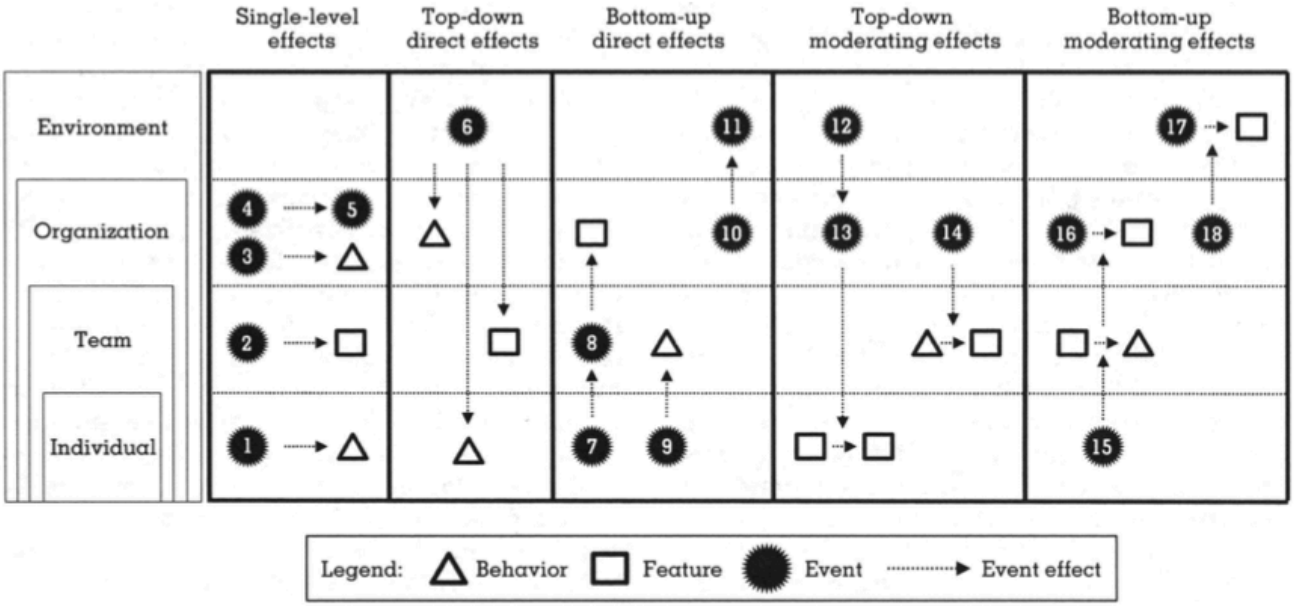

Figure 7: Events' directions across different levels (Morgeson et al., 2015)

- Top-down and bottom-up direct effects. Events occurring at higher levels of the organisational chart can directly influence lower-level behaviours, features or lead to new phenomena. When these events are generated in the external environments Tilcsik and Marquis (2013) called them "mega-events". Major shocks (e.g. natural disasters, government coup) have negative externalities at the organisational levels. However, other environmental events may be less risky and can be anticipated, leading to partial changes on selected levels. Events' effects can also diffuse in reverse, therefore having a bottom-up direct effect. It means that lower-level events can trigger the stability of organisational-level behaviours and routines, leading to collective changes in structure, values or culture.

Rarely, organisational internal events can also have an impact on the surrounding environmental forces.

- Top-down and bottom-up moderating effects. It happens when top-down (or bottom-up) effects influence and alter the relationship between two or more lower-level (or higher-level) behaviours or factors or events.

Event Spatial Proximity

Across the organisational hierarchy, units and individuals can connect vertically (when entities are in different organisational levels) or horizontally (when entities are in the same level). However, spatial distance can affect the amount of social influence, knowledge and information sharing: in case of events, the greater the distance between two entities the less the opportunity and probability that the event's effects, having origin in one entity, will affect the other entity.

Proposition 6: Event spatial proximity moderates the relationship between event strength and event outcomes such that novel, disruptive, and critical events closer to the entity location will be more likely to change or create behaviours, features, and events than events that are farther away from the entity location.

EVENT TIME

Events are enclosed in a time period. According to the timing of events it is possible to define the level of their impact. In fact, events can be temporary triggering limited effects only in the short term, but also cause long-lasting and larger consequences. Also the degree of event's strength can change according to time.

Event Duration

Events do not just "exist" in a time period, but they are also characterised by a duration, which can vary according to the event type. Event's strength and duration act and shape together the final consequences. However, duration defines the strength that events have on

outcomes. Keeping other variables fixed, events that last longer have a stronger effect on organisational entities.

Proposition 7: Event duration moderate the relationship between events strength and event outcomes such that novel, disruptive, and critical events that are longer in duration will be more likely to change or create behaviours, features and events than events that are shorter in duration.

Event Timing

Events can have different effects on organisations according to the entities' stage of development. For example, good event timing occurs when events' characteristics positively match the stage of the organisational lifecycle in which the entity is. The stage of development can also affect how entities interpret the event.
Quinn and Cameron (1983) found out that generally entities go through four stages, each characterised by unique needs: entrepreneurial, collectivity, formalisation and elaboration. For example, in the elaboration phase, where market share and capital base are already defined, it is likely that firms will search for events that bring innovative changes in order to keep their offer updated.

Proposition 8: Event timing moderates the relationship between event strength and event outcomes such that novel, disruptive, and critical events that better match the needs associated with the developmental stage of entities will be more likely to change or create behaviours, features and events than events that do not match the needs associated with the developmental stage.

Event Strength Change

Events, during time, go across a dynamic change trajectory. During this process of evolution, events can encounter and interact with entities that have the ability to influence and alter strength attributes, increasing (or lowering) events' novelty, disruption and criticality (Morgeson et al., 2015).

The impact of events' outcomes on entities is a factor of the events' average strength across time (general level) and their developmental flow (the level of strength's characteristics over time). For example, researchers found out that the average degree and development trend of job satisfaction experiences challenged important outcomes in individual and collective turnover (Liu et al., 2012).

Proposition 9: Event strength change moderates the relationship between an event's average strength and event outcomes such that in the presence of greater increment (decrement) in the event's strength over time, the event's average strength will be more (less) likely to change or create behaviours, features, and events.

2.4. Outcomes of events

As already said, entities have established routines, behaviours and features that events, according to their level of complexity, can disrupt. Events act as catalysts of change, as organisations evaluate deviations from normality only when they face salient happenings. In other words, from the perspective of event theories, when organisational habits and routines are established, they are normally maintained until the occurrence of a salient event (Gersick and Hackman, 1990).

The outcomes of events can be various, also according to the degree of complexity and influence events have on organisations or industries. In general, events preserve or originate organisational structures, which can be permanent (therefore becoming routines over time) or dynamic (leading to subsequent changes or events), (Morgeson et al., 2015).
Firstly, events can trigger a change in current behaviours or the creation of completely new ones. In this case the alteration can happen quickly, and nonetheless still have major impact on the other organisational levels. Secondly, events can affect existing features of individuals, teams or units or create entirely new features. For example, the integration of a new method or process in response of an event, after a period of time, can be endorsed in the everyday organisational practices. Thirdly, events can generate subsequent events across space and time, forming an "event chain" (Morgeson et al., 2015). Sometimes, the initial event is not directly affecting the entity itself but it triggers following events that have an impact on the entity's sphere of interest. In other cases, multiple events, bounded in a defined time and

space, merge under an “event cluster”, which has a higher potential to significantly impact entities (Morgeson et al., 2015).

The establishment of new goals is also an outcome of events. Previous goals are abandoned in favour of new ways of thinking and new directions, leading to new goals’ adoption. These changes may affect the entire goal hierarchy in different organisational levels (new subgoals are needed) or in individuals personal lives (e.g. new goals require additional work and therefore less leisure time for hobbies), (Morgeson et al., 2015).
Events can be positive or negative occurrences. In both cases, however, events may result in opportunities for the organisation. For example, entrepreneurs may experience events and turn them into new ventures.
Finally, first and foremost, before actual concrete responses are implemented, events trigger cognitive and psychological processes leading entities to action.

3. Concluding reflections

The first part of this literature review is essential to understand that industries, sectors and organisations are changing over time. The degree of interdependence with the environment increased side-by-side with the evolution of markets, and accordingly also the theoretical production. As technology advanced, competition became fiercer and customers evolved from passive to active, highly-informed individuals, organisations have unwillingly transferred their power to other external forces. Firms, but also entire industries, perceive less stability and are less certain that their business is enduring in the long term. For this reason, both theorists and managers, started to recognise in the co-evolutionary process of firms and environments a determinant of firms’ success (and survival).
Nowadays, various theorists argue that firms are embedded in “ecosystems”, as this structure better picture the real interdependencies happening on a daily basis in the environment.

In the second section, the literature on events’ attention and salience has been reviewed. The world’s complexity has escalated exponentially during the last decades, increasing interactions between firms and their surroundings and multiplying the number of emerging occurrences, in the ecosystems, affecting firms. For these reasons, it became important also to define what phenomena, triggered by external forces, are and/or should be considered

significant or not by organisations. Firstly, analysing the model of industry attention to events, theorised by Hoffman and Ocasio in 2001, and secondly focusing on the characteristics that make events salient, according to the Event System Theory by Morgeson et al. (2015) .

All in all, it is recognised that the power to select favourable and unfavourable events is not in the hands of incumbent firms anymore. Essential, and critical, is the outsiders' attribution of accountability to industries. Nowadays, public opinion and discourse can shape, voluntarily or involuntarily, the actions of organisations towards a specific issue. If firms decide to perpetuate with their own enactments of the event, the attention to it is sustained until a solution is found.

II. Automotive Industry

The automobile has been one of the biggest innovations of the latest century. From the launch of the first cars, the global automotive industry has grown exponentially during the years, becoming a leading and powerful sector, worth about 2.86 trillion U.S. dollars in 2021 (Statista, 2022).

The aim of this chapter is to provide a chronological outline of the history of the automotive sector, in order to offer to the reader some essential background information. The automotive ecosystem is then further described through the Triple Embeddedness Framework, studied in the previous chapter. The use of the TEF is focused at highlighting that both industry regime's elements and environmental factors were not compatible for a transition towards e-mobility. After having pictured the structure of the automotive industry, the chapter concludes with an analysis of the agency of Original Equipment Manufacturers (OEMs). Both factors permitted automakers to maintain a position of dominance in the ecosystem.

1. Background information

The automotive industry consists in a group of organisations dealing with the design and manufacturing of motor vehicles and their internal components (like engines, chassis, seats), (Encyclopædia Britannica). Nowadays, companies involved in the production of other important elements of autos like tires, batteries and fuels are still not considered part of it (Encyclopædia Britannica).

The core products of this sector are passenger vehicles, which comprises also sports cars, pickups, and campers. Cars are not just something useful for each individual's daily life, but they represent much more for people, like their lifestyle, status, personality and style. In fact, automakers design and manufacture cars of all types, shapes and colours to better match their customer base's preferences and, therefore, achieve an accurate segmentation (e.g. pick-ups, SUVs, minivans, sport cars, Sedans).

The history of automobile industry dates back to 1860s and '70s with the invention of the gasoline engine by France and German developers. Even if its history is not long, it is nowadays one of the most powerful and significant industries worldwide.

The prerequisites for this enormous success were various. Firstly, the high rate of population growth. From 1900s to 1990s, in less than one century, the population in the world more than tripled, moving from 1.6 billion to 5.6 billion people (McCraw, 1997). Secondly, the population's purchasing power increased exponentially in developed countries. The increased wealth, distributed to a higher number of citizens, led to more potential customers for mass-production industries. Moreover, from these phenomena which multiplied companies' profitability, continuous products and process improvements, new products developments and economies of scale and scope rapidly emerged (McCraw, 1997). As a consequence, prices dropped.

Initially, experiments and researches were conducted mainly over steam and electric powered vehicles. At the beginnings, the electric car was positively accepted by the general public for its ease of use, however, the problems related with low battery capacity put an end to its successful moment. Concurrently, in 1885, Germans Karl Benz and Gottlieb Daimler probably developed the first gasoline powered vehicle. At the start, European countries, mainly Germany, France and Britain, were the leading nations in the automobile industry.

At the dawn of this industry's evolution, around 1900s, automobile companies did not have a broad market share, a renown brand name, or large capital investments (McCraw, 1997). The reason is that each served a restricted market, located in a small geographical area. These small shops produced vehicles with unique product designs, according to the needs and preferences of the local customers. Also the manufacturing techniques and the marketing strategies were different, but all shared a tendency over low production volumes, high prices and high profits (McCraw, 1997). During these phase the market was highly fragmented.

However, with the advent, in 1908, of the Model T of Henry Ford, the market started a process of unification under a renown brand and a dominant product configuration. Ford recognised the growing number of potential customers, whose needs were not being fulfilled due to the low volumes and high waiting times for the production of a new car. Believing in the potential success of standardisation, Ford concentrated the whole manufacturing process in his company in the production of Model T only. This was the simplest vehicle, made up of few components making it light and small, but also durable and reliable thanks to the quality of materials employed. Its success resulted in continuous product and processes improvements, culminating in the advent of the assembly line in 1914. This method let the Ford Motor Company to produce larger volumes at a lower unit cost, which consequently

dropped significantly the automobile's price. In 1908, the Ford Model T was purchased for $850. The price decreased every year until, in 1924, it was sold to only $290.

Both these innovations, the assembly line and the Model T, disrupted the way automobile companies designed and produced vehicles. It was considered an event. There had been changes in behaviours (e.g. innovation processes, employee task performance), features (e.g. division of work) and the generation of subsequent events (e.g. continuous turnovers). Due to the hight turnover rate in Ford Motor Company, Ford increased the day-pay wage to 5$, decreased the daily working hours from nine to eight and the weekly working days from six to five. Although the employees' strenuous tasks, these were considered, by the general public, substantial improvements in working standards and conditions. Moreover, through these changes, Ford's own workers became also its customers.

In general, this phase was characterised by high volumes, low profit margins, low prices, national or international mass distribution, and vertical integration (McCraw, 1997).

However, even though the enormous success generated by mass-production and standardisation, during the 1920s, the Model T became outmoded. Thanks to new production techniques, more luxurious and unique cars' designs were sold to market at prices slightly higher than the Model T price. During this period, around 1930, Alfred P. Sloan Jr. recognised and exploited major changes in the automotive industry, like the shift in consumers tastes and the annual model changes. He was able to understand that the market was evolving and, by investing in styling, fashion and design, he transformed the external pressures into opportunities.

Sloan was the first attempting to implement the segmentation strategy, during his management of General Motors. At the beginning, the segmentation criteria were price and product type. However, after WW2, the customer base was segmented not only according to demographic factors (like income, age and education), but also on psychographic factors (like lifestyle), (McCraw, 1997).

In 1950, 85% of the automobiles were produced in the United States, of which nearly 90% by Ford, General Motors and Chrysler (White, 1971; Peterson, 1971).

During the same years, in Europe, cars' manufacturing companies, like Peugeot, Renault and Citroën in France, Volkswagen in Germany and Morris and Austin in UK, were growing in size and revenues.

Japanese automotive companies, however, witnessed the greatest international expansion, until 1980 when they became the world's leading manufacturers of vehicles. Contrary to U.S.

producers, who favoured aesthetics and style over safety and price, Japanese manufacturers' success was the focus on quality and fuel-efficiency. This was mainly achieved through the outsourcing strategy and the Toyota production system. The first mainly consisted in a well-organised, strategic network of suppliers' relationships, know as Keiretsu. This trust-based model permitted Japanese automakers to grow internationally by keeping prices down through economies of scale and scope, and by facilitating innovation and information sharing. The latter, instead, is what was called the "just-in-time" manufacturing, or "a framework for conserving resources by eliminating waste" (Toyota Motor Corporation, 1998) and by keeping minimal levels of inventory.

During the latest fifty years, other environmental pressures started to affect the automotive industry's growth. Numerous trends and events, initiated both inside or outside of the transport sector, have turned the tables and forced the industry to adapt and evolve.

Firstly, the establishment of unions and communities among countries (EU, NAFTA, etc.) led to the reduction (or abolition) of trade barriers. The leading national automotive firms outgrow into global enterprises, trying to acquire the largest stake of the world's market share. Following to this, an important issue emerged: the problem for firms' to deal with global level overcapacity (McCraw, 1997). Especially at the beginning of the 21st century, production plants were assembling a number of cars higher than those demanded by the market.

Secondly, in this time frame, the variety of customer tastes is transforming the business strategy from "market segmentation" towards "mass customisation". This second process consists in developing products targeted for satisfying the unique needs and tastes of individual customers. Producers are designing and manufacturing an immense variety of cars making it possible for nearly everyone to find what they desire. However, an increasing variety in products is leading to an escalation in costs and in complexity. The advent of information technology and, after, social medias, has augmented this phenomena.

Thirdly, environmental forces are highlighting two major issues. On the one hand, both most common cars' fuels, gasoline and diesel fuels, come from non-renewable natural resources, implying that their availability is going to terminate in the near future. On the other hand, the vehicles with these propulsion systems produce an extremely high amount of pollution in the atmosphere. In 2021, the U.S. department of energy collaborating with EPA has found out that "vehicles release about 1.7 billion tons (1.5 billion metric tons) of greenhouse gases

(GHGs) into the atmosphere each year — mostly in the form of carbon dioxide (CO2) — contributing to global climate change" (U.S. Department of Energy, 2021).
Both implications stress the importance to find alternative (and sustainable) solutions.
Even if 99% of vehicles' engines are powered by gasoline or diesel, nowadays a larger number of cars using alternative solutions, especially electricity, are sold in the market (EPA, 2021). The most popular alternative solutions are: flexible fuel vehicles (FFVs), electric vehicles (EVs), plug-in hybrid electric vehicles (PHEVs), compressed natural gas (CNG), fuel cell vehicles (FCVs). Even though the possibilities for alternative solutions are wide, their limitations had a strong effect on their success in the automotive sector. In the recent history, however, the world population has witnessed the increase in production of EVs and PHEVs. Moreover, recently, some countries have announced their plan to end the sale of internal combustion engines and to shift the production towards a sustainable mobility. An example, is the recent meeting of the European Parliament in which it approved to stop the sale of vehicles with combustion engines in Europe by 2035. The 2020 Climate Action Tracker report, has estimated, that in order to limit the increase of global temperatures at 1.5°C, 75-95% of global annual automobile sales should be fully electric vehicles by 2030 and 100% by 2035. As a consequence, leading automotive companies like GM, VW, Audi, Nissan, BMW, announced significant investments in EVs' design and manufacturing.

However, major improvements have not concerned vehicles' engines only. During the last decades, the automotive industry has witnessed several technological developments. Various features have been introduced, and continuously improved, to make automobiles safer, easy to use and aesthetically pleasing. Self driving systems, connectivity with other devices, sensors and cameras, smart car technology and augmented reality screens are all changing the driving experience.

2. The automotive ecosystem

The automotive industry is only a tile of the entire value chain, whose players, together, make up the automotive ecosystem. The notion of ecosystem explains the complexity of all the interdependencies occurring among sectors and organisations (ECCP). The ecosystem is, in turn, fully embedded in an even wider environment. Many internal and external conditions may affect the interactions among the players operating in the value chain. In

order to better understand the entire automotive ecosystem we will analyse it through the Triple Embeddedness Framework of Geels (2014), studied in the first chapter of this thesis. In TEF there are two main environments, the Economic and the Socio-political environments, co-evolving with firms-in-industries.
Through this section, we will go deeper in understanding the actual forces that influence the automotive ecosystem.

2.1. Socio-political environment

Political factors exerting pressures in the automotive industry regard mainly governmental decisions over safety requirements and procedures. Policymakers, during the years, have drafted and updated laws over safety measures over the production of automobile parts. Automakers are then eligible of certifications and approvals if they comply with national and international standards.
Governments can also affect the internal market of automobiles by defining the levels of imports and exports through the imposition of advantageous or disadvantageous tariffs, quotas or similar measures. If a company can import high-quality components but at a competitive price, then it will be able to gain a better profit margin compared to competitors. This factor may have influenced the market uptake of EVs and PHEVs worldwide, as the global battery technology market is controlled by Asian companies. Both EU and US automakers rely on the availability and the cost of batteries, imposed by other countries' political calculations. Moreover, even though the automotive industry and Member States governments were aware of the fact that Asian suppliers could favour their domestic customers, by providing them with the latest and premium technology first, measures and investments to enter in the battery cell market have been delayed for years. Therefore, due to the challenges that a turn of the transport system towards electrification could have carry with, governmental agencies, automakers and suppliers have always lobbied against this event to happen.
At the same time, Member States governments could have favoured cars with internal combustion engines, manufactured by domestic automakers, by imposing higher duties on EVs produced by foreign manufacturers, therefore making them a more expensive alternative.

Especially in the last decades, legislation on emission limits have been redacted by policymakers in order to protect the environmental and people's wellbeing. These standards have increasingly been upgraded into more stringent ones, affecting the automakers' business. The testing process during the time-to-market period is getting longer and more costly due to the numerous standards, procedures and regulations, coming from different fields (e.g. safety, environmental protection, property rights).

Ecological issues are for all industries on the daily agenda. Auto manufacturers are investing in research and development facilities to come up with alternative fuels solutions, different from the polluting fossil fuels. Governments incentivise and sustain these projects both at firm-level, by offering financial subsidies to increase investments in new ideas and competition among companies, and at customer-level by partially contributing to the purchase of alternative fuels' cars (and therefore lowering the final price). Moreover, activists and environmentalists are gaining increasingly attention from governments and from the general public, especially over environmental issues related to cars. Governmental agencies, like ICCT (International Council on Clean Transportation), EPA (Environmental Protection Agency) in US or EEA (European Environment Agency) in EU, have been established in order to answer to the complaints and protests of the general public, which is increasingly involved in taking care of its environment. These initiatives have favoured the promotion of alternative powertrains, especially EVs. However, the lobby of automakers, suppliers, and refineries have counteract the proposals of environmental groups by influencing governments' policies and actions to mitigate climate change and pollution.

2.2. Economic (task) environment

Exchange rates fluctuations can be risky for companies operating in international marketplaces. A firm's value, calculated as the present value of all the future cash flows, is influenced by changes in exchange rates (Mall et al., 2011). The competitive situation between firms may change over time following to the appreciation or depreciation of currencies. For example, the value of a domestic firm exporting internationally can fall if its state's currency appreciates, while at the same time an importing firm's value rises due to the same appreciation. The price of high-end electric vehicles, which initially were produced mainly by automakers outside of EU, were subject to the fluctuation of exchange rates, making them less favoured in comparison to vehicles produced by national automakers.

Different players are embedded in the economic environment: customers, suppliers, dealers and substitutes. They are the micro forces affecting the industry regime.
In the automotive industry there is a large quantity of potential buyers and actual customers. Moreover, in rich, developed countries it is easy to find two, three or even more cars per family. A country's level of development, GDP, determines the cars' demand not only for the financial wellbeing of its citizens, but also for higher customer confidence. The lifestyles and spending habits of individuals are also determined by the country's economy.
The bargaining power of buyers in the automotive industry is strong, as the switching costs for changing brands and products are low. Customers can easily switch from one automaker, dealer or model of car easily and inexpensively. Their evaluation is often based on the level of their price sensitivity, therefore selecting the car that offer them the best quality-price ratio in the price rage they can afford. Nowadays, elements such as driving performance and vehicle reliability are basic features that all cars should have and, therefore, automakers try to attract customers through differences in comfort, customer experience, and high-tech. The trends of the market were mainly focused on new designs and on technological innovations like connected cars and AR, and not in developing new, alternative engines. Customers choices were still addressed towards digitalisation of cars and fuel efficiency, while sustainability was not the primary criteria of selection. Moreover, the purchase price of EVs, risen by exchange rates, duties and political calculations, has been a barrier to their adoption, especially for price sensitive customers, which often favoured cheaper but more polluting cars. Another considerable limit for EVs was the battery autonomy, which did not match the lifestyles of citizens, typically travelling by car for all their daily necessities.
Customers are also highly sensitive towards complementary products prices, such as fossil fuels. A recent phenomena, the war between Ukraine and Russia, has exponentially increased the price of both petrol and diesel fuels, stressing the importance of cars' fuel economy and of alternative engines. In many markets, this situation has activated plans to reduce the dependency from oil, therefore facilitating the transition towards electromobility (King, 2022). As a result, compared to 2021, in Q1 2022 sales of new fully electric cars more than doubled (+102%), (Deloitte, 2022).

On the contrary, the bargaining power of suppliers is quite moderate in the automotive industry. On the one hand, the costs of switching between one supplier to another are high,

due to the heavy initial investments on parts' design and specific characteristics. OEMs have numerous advantages in maintaining a long-term relationship with suppliers. On the other hand, automakers often choose to demonstrate their purchasing power and control by switching suppliers, or threatening to do it (Jacobides et al., 2015). In the marketplace, there is a large number of small and medium-sized companies supplying directly or indirectly to OEMs. Few automotive suppliers are large corporations, like Bosh or Continental. In general, the automotive supply chain can be represented by a pyramid-like vertical network that defines the hierarchical place each supplier occupies in the pyramid. The automakers are at the top of it. Level one suppliers, system/module suppliers, have direct contacts with OEMs. However, also level two and level three suppliers can skip other levels and sell directly to manufacturers.

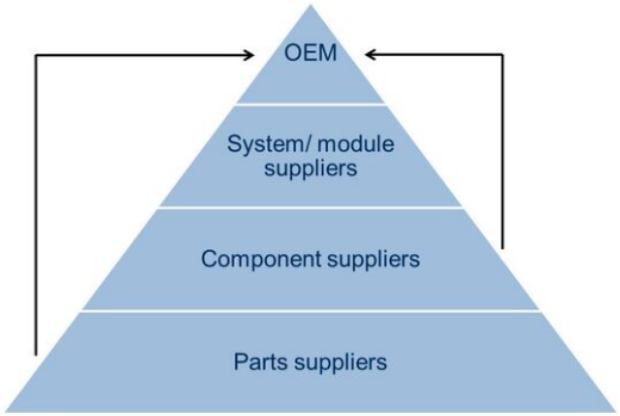

Figure 8: Pyramid of automotive suppliers

During the last two years, suppliers have been affected by various events happening in both the micro and macro environment: lockdowns and labour shortages due to the pandemic situation, the global semiconductor deficiency and the shift in preferences toward electrification and autonomous driving. Automotive suppliers are highly influenced by leading OEMs' expectations and requests imposed by industry's trends. Especially because, with international expansion, automakers started to outsource more to suppliers.

Even though large automotive suppliers have made substantial investments in EVs technologies, to remain competitive in the future of the transport system, the majority of suppliers are small and medium enterprises which will perish due to the radical turn towards e-mobility. For this reason, during the years, suppliers have used a strong lobbying strategy to deter, or delay, electrification. Moreover, especially in EU, it was not profitable for

suppliers to invest in the production of EVs parts, like battery cell production facilities, as the European automakers were not keen to put effort in adding attractive EVs in their portfolio.
The latest shortage of automotive semiconductors is forcing manufacturers to temporary stop production facilities or to remove some car's features (e.g. heated seats, pack assistant) from their packages (Burkacky, 2022). The implication for the automotive industry has been severe. This situation has largely decreased automotive revenues due to suppliers inability to find enough chips. This is a clear example of how suppliers' challenges and practices may influence the entire automotive ecosystem.

Normally, car manufacturers produce and assemble vehicles, which are then sold by dealers. The only exception is Tesla, which manufactures and sells cars directly to its customers. Dealers are, in most cases, the automakers' direct customers. They are separately owned companies that stipulate a contract to represent one or more automakers. However, dealers have low bargaining power, as, due to contracts' constraints, they are forced to buy everything from the carmaker they represent (e.g. components, tools, brand logo and sign, catalogues). Also in the case in which a manufacturer builds a car that is not successful, then dealers sometimes still need to buy them and try to sell them. There was a similar problem with electric vehicles, as dealers, and consequently customers, lacked of knowledge over the functioning, benefits and disadvantages of EVs and PHEVs, which made these technologies, in practice, difficult to sell.

2.3. Industry Regime

Industry architectures' studies focused on the ways in which companies shape their sectors in order to capture the most value.
Historically, the common structural features of automotive industry were vertical integration, economies of scale and an high amount of capital. These characteristics permitted leading OEMs to maintain their dominant position and to deter the entrance of rivals. Initially, vehicles' parts were produced inside OEMs, however, over time, they started to outsource the manufacturing of components to suppliers. Nowadays, automakers are responsible mostly of R&D and of projecting and designing cars' models and their parts. OEMs maintained the proprietary rights over their designs and specifications, which helped them to keep the control over the entire supply chain. Suppliers, in particular, remained under the

closed hierarchical control of automakers. The sector is therefore favoured by proprietary designs, hierarchical arrangements, and the avoidance of modularity (Jacobides et al., 2015). OEMs, then, supervise the final assembly procedure of vehicles, before selling them to dealers. The power of automakers in the supply chain comes also from the almost-exclusive control over franchised dealer model (Jacobides et al., 2015), which permits them to have direct and exclusive information regarding customers' product customisation. For years, OEMs have driven change in the entire value chain according to their interests, redirecting the decisions of the whole automotive ecosystem. Especially in EU, OEMs were able to maintain the dominance of their internal combustion engines, while their lobbying strategies have successfully influenced policymakers to delay the turn to electrification for decades. The relationship of power that OEMs had with governments and the other players of the ecosystem do not explain how the shift towards e-mobility is actually happening, at the end.

For various governments, OEMs are accountable for cars' defects or malfunctions, attributing to manufacturers (and not to components' suppliers) the principal legal and regulatory responsibility (Jacobides et al., 2015). Therefore, automakers are willing to preserve the control over the supply chain due to the high amount of sector's regulations and policies on customers' safety, environmental protection, and technology, over which they have legal liability.

Along with environmental issues, automotive invest in R&D to discover, as quickly as possible, new technological disruptions that can attract customers or competitive gains in general. Technological innovations have always had an important role in the automotive industry. From the first model of car, the world witnessed several developments and advancements. During the years, technology has improved the cars' safety, ease-of-use, comfort, fuel efficiency and pollution reduction or control. These developments had changed completely how cars are perceived and employed by customers. Also, improvements in the supply chain and manufacturing processes helped companies to reduce production costs and time-to-market.

Technology advances rapidly in all industrial sectors, and, nowadays, individuals feel the need to acquire the latest innovative versions. Of course, this may bring both advantages and disadvantages to automotive companies. Automakers are forced to be informed on the

latests technological advancements or, better, to lead the research towards disruptive novelties.

Nowadays, the recent technological trends are ride-sharing, electrical mobility, connected cars, self driving systems and AR. Cars are getting “smarter” thanks to their connection to intelligent technologies and the internet. In order to reduce accidents and improve cars’ safety, automakers are trying to gradually implement autonomous pilots that are capable of recognising the surrounding environment and move through it with little human help. Moreover, in order to produce environmentally friendly cars, engineers are putting much of their efforts in improving batteries of EVs, in order to make them long-lasting and efficient, or in finding new ways to reduce air pollution. Until now, regardless of R&D departments’ endeavours, electric cars still present some of the problems that were considered a barrier years ago. For example, the technology of the battery, and its high cost, are still a limit for some customers, making EV a solution for few enthusiasts and for early adopters.

2.4. Firms-in-industries

According to Geels (2014), firms-in-industries are of three types: core firms, which have the power to trigger changes in the industry regime, firms ‘in the middle’, and peripheral firms, which are entities at the border or new entrants.

In general, rivalry in the automotive industry is quite intense. The sector is in the maturity stage, leading to some companies, with similar market shares, to fight for customers’ attention fiercely. Nowadays, they compete both on price and non-price elements, like comfort, safety, technology and fuel efficiency. Since exit barriers are significant, automakers are keener to remain in the market and to battle to reduce prices. Therefore, Japanese companies may be favoured over time due to their cost leadership advantages.

There are, however, also high barriers to entry in the automotive industry, making the threat of new entrants very low for incumbents. The core requirements in this marketplace are high capital investments, technical expertise and knowledge, and an established good reputation over safety, reliability and efficiency. These three key points act as deterrents for new entrants. Especially for the latter, as gaining enough market acceptance to be competitive is a long-term objective. Moreover, dominant firms manufacture and sell cars benefitting from economies of scale and scope, which do not allow new entrants to offer competitive prices compared to those of OEMs.

In this sector, there are continuously new opportunities offered by emerging socio-cultural trends, technological developments and new potential markets (e.g. developing countries with increasing disposable income), that can help firms-in-industries to conquer an higher market share.

3. Agency of OEMs

In the automotive industry, leading manufacturing companies have been extremely active in their purpose to change the rules and roles on the division of labour, and as a consequence, of profit (Jacobides et al., 2015). In fact, during the years, OEMs have demonstrated high proactivity in reshaping their industry and low dependence on routines and lock-in mechanisms. Jacobides, MacDuffie, and Tae (2015) have studied the structural change that occurred in the automotive sector from 1997 to 2007. In this period, due to the pressures coming from the Japanese more-efficient "lean production", OEMs decided to collaborate with suppliers to alter their sector's architecture, towards modularity and outsourcing. However, when OEMs recognised the risks of letting suppliers the power over components' design and production, they were also able to reverse the change and conquer again their hierarchical control.

The structural characteristics of Industry Architecture, and the agency of OEMs, permitted leading companies to restructure their sector. Therefore the ownership of legal accountability, the regulatory responsibility and the willingness to maintain control over distribution and customers' experience persuaded OEMs to preserve the vertical nature of hierarchical arrangements and their "system-integrator" role. The OEMs core competence is, in fact, to bring component subsystems together in a way that they operate as an interconnected whole. The hierarchical control is maintained by OEMs through the proprietary rights over designs, features and components, in order to keep the distinctiveness of each model and brand. Through this capability, carmakers were able to preserve the control over quality, value creation, and the locus of differentiability (Jacobides et al., 2015).

Structural changes in the automotive industry may be triggered by exogenous shocks, but also by the initiative of key leading actors (as in the research example of Jacobides (2015). The internal dynamics leading change in the automotive industry are similar to the

mechanisms of the open polity perspective, studied in the first chapter of this thesis: the coalitions, negotiations and debates between powerful subgroups, with specific interests, preferences, and goals, drive firm-level decisions and, consequentially, sector-level changes. In order to understand the agency of OEMs, it is important to research dominant groups within automakers, which, through their internal agendas, determine the organisations' actions and responses.

If incumbent coalitions have been able to nurture and implement change, on the contrary, it is not difficult to presume that powerful industrial regimes are also capable of exerting political resistance to change. In general, it can be asserted that in open political systems it is probable that industrial actors exert influence and pressure in the political sphere through corruption, financial incentives and direct lobbying strategies, especially in the event of potentially unfavourable political decisions (Hess, 2014). In case of the presence of powerful established industry incumbents it is likely that they mobilise a strong and persuasive opposition to the political field, if it threatens their advantageous status-quo. In order to safeguard their profitability, automotive companies have always organised themselves against governmental decisions over sustainability, by redirecting the trajectory of the problematic green-energy transition at their own interest.
In summary, since the improvements in the EV technology have not been disruptive, the majority of customers remain doubtful or uninformed and OEMs agency endure, there is a shortage of factors explaining why the turn towards e-mobility is actually happening.

Even if during the years OEMs showed stringent control over backward and foreword actors of the supply chain, paired with strong coalitions of core companies against common threats, these strategies may not be the useful solution for all disruptive events. More and more powerful industrial incumbents are attributed accountable of societal issues by informed outsiders, and none of them can escape the public judgement.

III. The Research

"Scandals can be highly consequential events for the organisations involved in the wrongdoing, their affiliations, and can even lead to broader institutional change at the societal level" (Clemente and Gabbioneta, 2017: p.1). This final chapter analyses our case study, the Dieselgate scandal, by initially illustrating what happened after it hit the headlines in September 2015 and explaining how the situation unfolded over time.

The research is conducted by investigating the official documents of advocacy groups, where delegates share the opinions and represent the interests of the main actors involved in the automotive ecosystem. The idea is to search for a change in the interest groups' viewpoints and beliefs around the hot topics linked with the VW emissions scandal. The aim is to answer the research question by demonstrating the probable link between the emergence of the scandal and the recent turn towards electrification of the transport system.

1. The case study: the Volkswagen emissions scandal as an event

In September 2015, the world assisted to the discovery, by a pool of US authorities led by the Environmental Protection Agency (EPA), of significant violations of the Clean Air Act by the Volkswagen Group. The discovery was followed by the uncovering of VW Group related misbehaviour, that was prosecuted in civil and criminal procedures known as "Dieselgate", and judged by the public opinion as a major scandal in the automotive field and, more in general, in the business world.

Firm-level element of the cheating scheme: the technology

During the first decade of the XXI century, Volkswagen planned to become the world's leading carmaker by expanding in the United States. Since the US pollution standards were stricter than the European ones, from 2005, VW engineers started to design a diesel engine to be installed on "fast, green and cheap" cars, in order to take over the U.S. market. One possible technological way to reach the goal was to buy the rights of the "selective catalytic reduction" (SCR), or BlueTec treatment system, used by Mercedes for lowering their diesel engines' poisonous emissions. This direction was finally not pursued, as executives in VW preferred to start the so-called "US 07 Clean Diesel" plan, involving the production of a new diesel engine with a "lean NOx trap", a less expensive alternative compared to SCR.

Even though some VW employees expressed doubts regarding the new engine capability to comply with the US-0-07 standard (that was in force at the time), the EA 189 was used for mass production.

Being aware of the inability of EA 189 to reach the required emission levels, engineers proposed the use of a software that could detect when the vehicles were undergoing emissions tests. Originally, the software was programmed to be operative only in the first six months after the launch, but it rather became a permanent feature. Over many years, between 2009 and 2015, 11 million cars, accessorised with the defeat device, were produced and sold all over the world.

Industry-level element: certification tests

Tests are normally based on three elements: acceleration, speed and time. When the software installed on the EA 189 detected from these parameters that a certification test was under way, it reduced the general performance of the car, therefore decreasing also the nitrogen oxide output. In this way, VW vehicles were able to pass the bench tests and prove to meet the emission standards during physical tests with examiners. In fact, when involved in normal driving on roads, cars emitted a much greater volume of nitrogen oxides. Practically, the "lean NOx trap" system consisted in a container, similar to the catalytic converter, where a chemical reaction occurs transforming the NOx into plain nitrogen and carbon dioxide, before emitting it into the atmosphere. Since the amount of fuel required by the conversion was high, and as a consequence also the potential loss of customer satisfaction in terms of fuel efficiency, VW engineers considered the solution to eject a lower amount of fuel into the container than that actually needed for the NOx transformation. In this way they maintained fuel economy at the expense of cleaner emissions. The cheating scheme was that, during the tests, the right quantity of fuel was injected in the container for the conversion, only to return to an insufficient amount during on-road driving.

In 2014, the ICCT carried out a study investigating the differences in emissions between European and U.S. models of cars. The sample was made up of 15 cars' type, tested by three different sources.

Researchers at the University of Virginia Centre for Alternative Fuels Engines and Emissions (CAFEE) started to use a different testing method, a Japanese on-board emission testing system, which calculated emissions' volume from vehicles during normal driving conditions

on roads. Their conclusions were that VW diesel engine's levels of NOx output were, in some cases, 35 times higher than allowed. Comparing the unmatched results of lab and highway tests, the engineers concluded that the car was exhibiting different behavioural patterns.
Even if the ICCT and other relevant authorities did not proceed immediately through legal actions but rather informed VW of their recent discoveries and asked inquiries on the matter, VW's explanations were elusive and not paired with actual resolving actions. They claimed that the discrepancies were attributable only to technical problems.

The discovery
Only on September 18th, 2015 the US environmental agency published the truth over the Volkswagen's "EA 189" diesel engine under a "Notice of Violation", triggering a massive public debate. The publication of the EPA's official statement was the central event that publicly disclosed to the world VW's illegal behaviour. After that, Volkswagen executive managers were forced to acknowledge the real facts and take actions.
By the end of September, VW announced a plan to fix around 11 million vehicles, equipped with the EA 189 engine. In agreement with the US authorities, the plan undertaken by the VW Group entailed more options based on a case-by-case basis, like product's recall, or product's buyback, or a substantial compensations to affected customers. VW offered also a free cars' repair, consisting of a software update that, according to VW's engineers, permitted to lower emissions under the EU limit, but without altering the engine's performance and fuel economy. Years later, in 2017, a research of a Swedish automobile journal proved that, based on a sample of ten cars' models with the software update, the majority showed a reduction in performance and an increase in fuel consumption (Teknikens Värld, 2017), contrary to what previously stated by the VW Group.

Anyway, the event of the disclosure had such a resonance to bring to civil and criminal cases all over the world. Everything together highly affected Volkswagen, and the whole car industry, reputation and life. The day after the publication of EPA's Notice of Violation, Volkswagen share prices fell of 20% on the Frankfurt Stock Exchange (Cremer, 2015). And, even a year after the scandal, VW stock reached a value of 30% lower than pre-scam value (Chu, 2016).
In order to overcome the problematic situation, Volkswagen offered warranties for new vehicles purchased, declared an increase in production of electric cars, and changed the

internal hierarchical structure (Jung and Sharon, 2019). In fact, it announced to produce 80 models of cars with electric engines by 2025 and planned to invest $62 billion to improve batteries technology (Petroff, 2018).

After the emergence of the Volkswagen scam, other carmakers were also investigated (Mercedes-Benz, Chrysler-Fiat). The result was that many companies were fined, since they were not enforcing the laws on emissions. Oliver Krischer, Deputy Chair of the EU Emissions Inquiry Committee (the so-called EMIS Committee), argued that it was not only, as often described, "the VW scandal" but rather a scandal that involved the automotive industry in general, as many carmakers used illegal practices to elude environmental regulations. This was also proved in the CAFEE research of 2014, where engineers found out discrepancies in emissions' levels during lab and live road tests on two out of three diesel cars.
Therefore, Volkswagen, foremost, rose awareness over the high levels of NOx emitted by diesel vehicles in the automotive industry.

1.1. Underlying U.S. and EU emission standards around the Dieselgate scandal

US legislation on cars' emissions was, in general, more stringent than EU standards. Specifically, the US imposed the same emissions limits to both petrol and diesel cars, while EU granted higher levels of NOx to diesel vehicles (Figure 9).
The EU limits, during the years of the scandal, were regulated by the Directive 2007/46/EC, defining the type approval of light vehicles, and the Regulation 715/2007 (EC) on emission's limits of passenger vehicles. After 2014, the standard applicable for cars and vans was the Euro 6. These standards set the limits for the emissions of NOx at 80mg/km for diesel and 60mg/km for petrol vehicles.
US legislation on this matter was, instead, composed by federal laws and, when applied by the states, by stricter standards redacted by the California state. After 2014, the standard was the Federal Tier 3 (Bin 160), which limited the cumulative maximum amount at 0.099 g/km (NMOG + NOx), for both diesel and petrol cars.

Emissions standards for pollutants (g/km)	US	EU
Nitrogen oxides (NOx)	0.04	0.06/0.08*
Non-methane organic gases (NMOG)	0.06	0.07/na*
Carbon Monoxide (CO)	2.61	1.0/0.5*
Carbon Dioxide (CO2, in 2016)	155	130
Carbon Dioxide (CO2, in 2020)	132	95
Form of vehicle emission testing	FTP	NEDC
*Petrol/diesel standards Federal Test Procedure (FTP) New European Driving Cycle (NEDC)		

Figure 9: Comparison of emissions standards between US and EU (European Parliament, 2016)

These differences affected also the rigidity in test regimes. After the scandal, the recognition of an increasing gap between in-lab tests and on-the-road emissions, stressed the urge to apply a Worldwide Harmonised Light Vehicles Procedure, similar to US measurement methods. This procedure consisted in tests reflecting better real-life driving conditions (both in lab and in highways via PEMS).

In US, there was a standardised testing procedure, called Federal Test Procedure (FTP), which could be integrated by additional tests trying to picture different driving scenarios.

Moreover, another difference, laid in the approval authority releasing the necessary certificates of compliance. Type approval, in general, certifies when a vehicle type meets all the requirements necessary for the launch in the market. In US there was one single regulator (EPA) authorised to approve vehicles and carry out tests, working for the protection of the environment and of human safety. While in EU, there were multiple testing facilities and approval authorities, so that producers could choose the one with less ambitious emissions limits. Moreover, EU addressed limited control over the operations of Type Approval authorities (TAAs). The result is lower transparency on testing procedures and results, and an increased possibility of bias and conflicts of interest during evaluations.

The ban on defeat devices was also more rigid in US, and the legislation on this matter more complete and comprehensive. US authorities, differently from European ones, demand for the entire list of emissions control devices and an appropriate explanation of their usage.

Mainly for the stringency of the US regulations, but also for other motives that will be further analysed during the research's analysis of results, the VW emission scandal had an immediate impact in US, which can be found in prompt governmental actions. In fact, US citizens and governmental agencies required a strong punishment for Volkswagen Group's wrongdoing, which was implemented through fines, products' recall and buybacks, and financial compensation to offended customers. VW accepted the US's Court of Justice's resolution and it admitted the illegality of the actions undertaken to reduce NOx emissions. At the same time, VW refused to declare the same in EU, claiming that, for the European law, it was just unethical.

2. Research question

Even though it is clear how the situation unfolded, it is puzzling to figure out what are the VW emissions scandal's concrete consequences in EU, both in the short and long term. Despite the challenging operation, it is in our interest to research if and how the event gained a high and sustained level of attention from the general public and the automotive industry.

All previous studies on the automotive ecosystem sustain that leading automakers' agency permitted them to maintain the control over the industry's structure and division of profits. However, the situation has changed and the event's occurrence may prove that automakers do not have the full control over all focal decisions around industry structuring. After 2015, in fact, the pyramid of the industry's vertical network (figure 8), has soften becoming less steep. The Dieselgate scandal may have played a part in the transformation of the automotive industry into an ecosystem. Moreover, it is known that, after that event, the world has witnessed a change in how the diesel technology and e-mobility are perceived by people. If the scandal pushed toward this change, then the event analysed could have had an effect on the structure of the entire automotive ecosystem and on the evolution of mobility's history.

Therefore, this thesis intends to understand the degree of implication of the Dieselgate scandal on the turn towards the electrification of the transport system that is currently happening and on the restructuring of the whole automotive ecosystem.

3. Research methodology

In order to investigate the consequences of the Dieselgate event on the European automotive ecosystem, and, with it, to answer the above mentioned research question, we decided to employ a qualitative research method. The idea is to use the change in opinion and topics discussed in the automotive field, which has possibly occurred due to a reaction to the scandal, as a proxy for the impact of the event itself on the EU automotive ecosystem. The timeframe selected goes from the 1st September 2014 to the 30th September 2016, namely one year before and one year after the event. The topics, beliefs and viewpoints were found in the official documents published by European interest groups, associations or organisations which have, at their core, to express their opinion in order to influence public debate and policy-making. The main reason why I decided to analyse the interest groups' official documents, in order to answer to the research question, is that these organisations represents the interests, opinions and beliefs of all the different actors involved in the European automotive ecosystem.
In this way, the aim is to provide the most complete picture as possible of the situation around the VW scandal and to research if there has been a change, during the timeframe selected, in how these actors perceived some topics related to the scandal in the automotive industry.

The first step was to search for as many representative groups as possible in the field of the European automotive industry. Initially, the focus of the research was broad and, in this way, it was possible to identify a large number of advocacy groups, active in Europe and debating over topics related to the transport sector. In order to facilitate the next steps, I also divided the interest groups in categories, such as customers' groups, dealers and repairers' groups, representatives of producers and suppliers, automotive R&D groups, and associations of refineries and of clean energy and transport, so groups related to the automotive industry supply chain of raw material.

This pool of organisations was then filtered, and therefore reduced, according to two criteria. In the first place, by including only those interest groups founded before 2014, that were therefore active for the whole timeframe selected for the research. Secondly, by going more in-depth in the interest groups' websites to find the presence of official documents (position papers, reports, white papers, briefing papers) and selecting only those representatives with papers dealing with topics related to the research and published during the highlighted timeframe. In the case the advocacy group was operative during the timespan, but no more functioning or merged with other associations under a different name, the Internet Archive has been used to trace back the old websites and find pertinent information. For these motives, for example, the E-fuels alliance and CECRA (European vehicle dealers and repairers) were removed from the list because founded in 2018, ECTRI (European Conference of Transport Research Institutes), POLIS and ANEC (European Association for the Co-ordination of Consumer Representation in Standardisation), instead, were deselected because they did not publish any relevant paper for the research during the chosen period. On the contrary, even though it is an international organisation, ICCT was included because it was the agency responsible for the emergence of the VW emissions scandal. Moreover, it is frequently cited in the official documents of many of the interest groups selected.

The second step was to point out, in a file excel, the title and date of the relevant official documents, found in the websites of the ten interest groups finally selected (more widely described in the next section, 4). All the documents were then read in detail and carefully analysed to detect the interest groups' positions and opinions, regarding the hot topics around the Dieselgate. After the in-depth reading, some papers have been categorised as "too technical" (when they just described technicalities, for example, of testing procedures without exposing any opinion) or "not relevant" (when they did not approach any topic of our interest). An operation of coding was then employed to note the sentences, paragraphs and words in which an opinion was detected. In general, I decoded more rather than less, in order to facilitate the work of comparison between the opinions given before and after the scandal broke. Often, aside of citations, comments and additional information have been annotated to determine the importance of the sentence or to give the personal interpretation in terms of the case analysed. Finally, when the operation of coding was concluded, the resulting sentences were than grouped in five categories of recurrent hot topics: (1) The automotive industry's NOx emissions, (2) The automotive industry

certification testing, (3) EU strategic actions over the automotive industry, (4) Diesel vehicles, and (5) Alternative solutions. Following this distinction, in the section of the results' analysis, 5, the opinions of the interest groups have been analysed by trying to delineate, if possible, a change in the viewpoints throughout the temporal dimension selected.

4. Final sample

The final list of interest groups analysed comprises ten associations, operating in different fields. T&E and ICCT has been chosen as representative of civil protection in relation to the transport sector, BEUC as the umbrella group for customers' organisations, ACEA and CLEPA as associations of cars' producers and suppliers respectively, EARPA and EUCAR are the organisations which embody the interests of the automotive R&D facilities, EGVI represents green mobility, and lastly the European Fuel Manufacturers Association (composed by FuelsEurope and Concawe) as the interest group for refineries in EU. For the extended version of the interest groups' names, see *infra*.

Transport & Environment (T&E): It is a European umbrella group representing non-governmental organisations, targeting, in tandem, environment and transport. Founded in Brussels more than 30 years ago, its mission has always been the development of a zero-emission mobility, promoting a clean, affordable and secure transport system. Its members count 61 organisations (52 members and 9 supporters) coming from 24 different EU countries. T&E, in the current financial year, is receiving funds from the Climate Imperative Foundation, The European Climate Foundation, Schwab Charitable Fund, the European Commission, Quadrature Climate Foundation, The Norwegian Agency for Development Cooperation, amongst other organisations. As a lobbyist group, it has shaped the decisions of the EU over many environmental laws, especially pushing for the introduction of ambitious standards for the reduction of CO2 levels in the atmosphere, with a focus on those emitted by passenger cars and trucks. The papers of T&E, analysed by this thesis, include publications, opinions and press releases.

International Council on Clean Transportation (ICCT): It is the only international not-for-profit organisation analysed by this thesis. It was founded in 2001 in order to provide professional, unbiased research data to environmental regulators. Their mission is to tackle climate change

and to protect public health by trying to improve the impact of road, marine, and air transportation. ICCT was the entity that commissioned the research on VW diesel cars emissions, and therefore helped to uncover the subsequent discoveries over cheating techniques and the discrepancies between lab and on-the-road NOx emissions levels. This thesis has analysed ICCT's reports, white papers and briefings.

Bureau Européen des Unions de Consommateurs (BEUC): Founded in 1962 by national consumer organisations of six member states of the then called European Economic Community (EEC). Nowadays, the independent customers groups represented by BEUC are 46, coming from 32 European countries. Its role is to speak and act in behalf of European customers, bringing their interests to the attention of EU institutions. In this way, they are committed in affecting the policy plans of EU decision-makers, in a way that improves the life conditions of citizens. The area of work of BEUC ranges across different fields, like food, safety, sustainability, health, energy, consumer and digital rights. Its mission is to ensure the protection of customers' rights, to provide citizens with impartial information and to promote EU actions to solve current and future challenges, especially those with the potential to affect people's quality of life. For the purpose of this research, we have analysed BEUC's position papers, reports and letters, and a joint publication with ANEC, another association working for the protection of European consumers' interests.

European Automobile Manufacturers' Association (ACEA): From 1991, the year of its foundation, it considers itself the voice of the European automotive industry. Its members include 16 leading automakers, BMW, DAF, Daimler AG, Ford Europe, Ferrari, Honda, Hyundai Europe, Iveco, Jaguar Land Rover, Opel Group, Renault, Stellantis, Toyota Europe, Volkswagen Group, Volvo Cars and Volvo Group. Nowadays, its purpose is to promote a zero-emission and zero-fatality transport system. In order to achieve this, it is helping its members to address the changing customers' mobility needs and to tackle it with continuous technological developments. Moreover, through its expertise, it informs and influences EU policy makers, in order to represent the interests of its members. From ACEA, it has been examined both position papers and reports.

European Association of Automotive Suppliers (CLEPA): It is the non-governmental association that operates at the European level to represent suppliers of cars' parts, systems

and modules. It involves 3000 companies which provide all sort of goods and services along the whole automotive supply chain. Moreover, its membership counts also 20 national trade associations and European sector associations. CLEPA's vision is to guarantee an efficient and sustainable mobility in the EU and in the world. To protect the automotive suppliers' interests and achieve its goals, CLEPA tries to shape the EU legislation that can affect the automotive business.

European Automotive Research Partners Association (EARPA): This group was founded in 2002, with the aim of bringing together the leading independent R&D facilities for the automotive sector in Europe. Nowadays, its membership counts 53 members varying across universities, national institutes, research centres and commercial organisations. EARPA's mission is to protect the interest of its members by spreading awareness over the importance of the role played by R&D organisations in the automotive sector. It argues that these centres and institutions provide automakers with the ability to continuously innovate and exploit new opportunities. It provides its members with a greater visibility and a better representation, at the EU level, of their challenges and opinions. Regardless of its independence from the automotive industry, it highly cooperates with automotive suppliers, carmakers, the oil industry, and European and national institutions.

European Council for Automotive R&D (EUCAR): It is another R&D institutes' association for the leading passenger car and commercial vehicle producers in Europe. EUCAR's vision is to promote a sustainable, efficient and safe transport system, that benefits the automotive sector, users and society at large. It is less independent from the automotive industry compared to EARPA, as EUCAR is legally part of ACEA. Its mission is to commit for maintaining the competitiveness of the European automotive industry worldwide. Moreover, EUCAR members are BMW Group, DAF Trucks, Ford of Europe, Honda R&D Europe, Hyundai Motor Europe, Iveco Group, Renault Group, Stellantis, Toyota Motor Europe, Volkswagen Group, Volvo Cars and Volvo Group. During its work, EUCAR has involved and coordinated its members during European R&D projects and programmes.

European Green Vehicle Initiative (EGVI): It was a private-public partnership with the aim of promoting alternative-powered vehicles, which have the potential to solve current and future environmental and societal challenges. In collaboration with its partners, it worked on

the identification and acceleration of innovation activities with the aim of encouraging the efficient use of clean vehicles in road transport. In 2015, its members were 64, including automotive OEMs, suppliers and other associations. Nowadays, the association has been incorporated into the Towards zero emission road transport (2Zero) partnership. Its objective remains the zero tailpipe emissions in road transport, contributing to this transition by facilitating the research and innovation in mobility.

FuelsEurope: It was founded in 1989 to represent the European refineries in front of EU institutions. It is part of the European Fuel Manufacturers Association, which comprises 40 companies that own petroleum refineries in EU, together with Concawe. The two branches have, however, different functions and expertises but are administratively merged into a unique association for cost effectiveness. FuelsEurope has a representative role as, by sharing its expertise, it proactively develops regulations and standards with EU institutions. Through its work, it promotes economically and environmentally sustainable refining across Member States. From FuelsEurope, this thesis takes into consideration position papers, publications, press releases and joint statements.

Concawe: This branch of the European Fuel Manufacturers Association is engaged in continuous studies and research over environmental, societal, health and safety challenges, affecting the oil industry. Its mission is to carry out research programs in order to provide scientific evidence over important issues. Concawe does this by following three principles: sound science, transparency and cost-effectiveness. It also assists the EU institutions and Member States in the formulation of technical legislation and cost-effective policies, within the scope of the oil industry.

5. Results' analysis

In this section, the results of the coding activity are presented. A picture of the whole situation, in the European automotive ecosystem and during the timespan selected, is provided also to better contextualise the interest groups' opinions, in a unique narrative. The aim of the section is to compare the beliefs, viewpoints, and statements that advocacy groups expressed in their official documents, in order to find a change in opinions

attributable to the scandal. The statements are grouped into five main topics, which are listed below.

5.1. The automotive industry NOx emissions

In 2014, the test used by type approval authorities in Europe was the New European Driving Cycle (NEDC). The test was originally created in the 1970s as a means to test NOx emissions in urban areas. Even if it was updated in 1997, in order to assess the fuel efficiency and emission levels of passenger cars, it was not adapted to the changes occurred in driving behaviour and in technological advancements of the automotive sector during the recent decades. Moreover, although it was targeted for petrol-based cars, it was then employed to estimate the compliance of diesel and electric vehicles too. Therefore, many loopholes existed in the European fuel consumption testing procedure. Before the Dieselgate, the carmakers' manipulation of laboratories tests was already renown, mainly by interest groups specialised in this area. In particular BEUC, already in 2014, declared that "car manufacturers are grossly exploiting the loopholes in official testing protocols in order to provide completely unrealistic and misleading fuel consumption claims" (BEUC, 2014a). In their position paper of September 2014, BEUC reported a research conducted by one of its members, Altroconsumo, exploring the methods used by carmakers to influence tests' results in order to achieve fuel economy and low emission values for their vehicles. The resulting values achieved by the customers' group were far different from the official claims of the carmakers tested (Volkswagen and Fiat). For example, in the case of the VW Golf, the officially declared values were 50% lower than what obtained by Altroconsumo.

It was also widely recognised that car manufacturers used special vehicles for the official lab tests, the so-called "golden vehicles", which were different from the cars launched in the market and bought by customers. As argued by T&E (2015o), these customised vehicles are then tested in unrepresentative laboratories, conducted by specialised authorities, endowed by carmakers. On top of this, producers could employ other strategies, such as overinflate the tyres, employ special motor oils, switch off all optionals and accessories, or use tape to cover gaps around doors and windows. The result was that automotive producers were cheating their own customers and putting their health at risk by emitting a higher amount of poisonous gases in the air and by leaving them the burden to pay much more for the

everyday usage of the car than what was officially declared on the fuel consumption labels at the point of sale.

Regardless of the over mentioned situation, T&E, in its report “How clean are Europe’s cars 2015”, has declared that most automakers have overachieved the 130g/km target for 2015, portraying it as a successful result. At the same time, however, it recognised that “this progress on paper was accompanied by a marked and rapid increase in the size of the gap between test and real-world emissions” (T&E, 2015o). The progress in reducing NOx emission during real driving conditions was, therefore, much lower and much slower. At the moment of the explosion of the VW scandal, the average gap generated exploiting NEDC loopholes was of 40%, and only in the two preceding years it grew by 9 percentage points (T&E, 2015o). T&E (2015h) has ultimately asserted that, since 2012, none of the improvements registered in tests have turned into real-world advancements. The fault is (almost) unanimously assigned to the carmakers’ exploitation of NEDC weaknesses. The exceptions are producers’ and refineries’ interest groups (ACEA, 2016b; FuelsEurope, 2015), which, although they admitted the presence of a gap between lab and real-world emission results, they criticised the effectiveness of Euro 5 standards to deliver realistic improvements. They both agree that with Euro 6, the real-world emissions values are “on a downward trend” (ACEA, 2016b). On the contrary, T&E (2015o) claimed, in accordance with an ICCT study, that the gap will keep growing due to the increasing share of hybrid and full electric cars on the market, which showed a greater discrepancy between lab and real-world values compared to conventionally-engined cars.

Even before the VW scandal, most of the interest groups analysed stressed the importance of the new WLTP, Worldwide harmonised Light vehicles Test Procedure, planned to overcome the older NEDC in 2017. The entire procedure was subject to a critical rethinking, in order to solve the majority of problems and loopholes. The main goal was to reduce the difference between laboratory and real-world emissions. However, by approving the WLTP as the official test procedure, EU was making an important step forward but not solving all the loopholes and problems related with lab tests (T&E, 2014f). In fact, "major carmakers and the countries that house them are trying to ensure this new tool contains the same loopholes and manipulations that made the NEDC such a flawed test” (T&E, 2015j). BEUC was concerned about the continuous strategies used by the automotive lobbyists to delay

the implementation of the new protocol after the 2019. T&E too argued that, in 2014, the lobbying by carmakers was trying to obstacle the finalisation and to weaken the effectiveness of the new test procedure. In the carmakers' opinion, "the Commission has overreached its powers" (T&E, 2014d) by introducing a different test.

Another test type which was already promoted by environmental interest groups before the Dieselgate, and which, after the scandal, became more popular and fostered by almost all the other associations, is the real-world driving emission (RDE) test. The European Commission agreed to introduce Portable Emissions Monitoring System (PEMS) to measure gaseous emissions in roads. Also in this case the carmakers successfully employed lobbying strategies to delay the introduction of RDE, which was originally scheduled in 2012, then postponed in 2014, and finally implemented in 2017.

The implementation of both tests, highly requested by environmental and customers groups, were delayed successfully for years due to the lobbying activity of automakers. However, EU was able to introduce both WLTP and RDE in the years immediately after the scandal.

After the Dieselgate the situation changed, even if slightly. With the scandal, the whole problem related to the growing discrepancy between labelled fuel economy and what happened on the road emerged simultaneously, making medias and drivers globally aware of the situation (T&E, 2015o). Not only the European automotive industry, but also the regulatory system, lost its credibility and partially ruined its reputation. The media coverage gained by the Dieselgate helped to inform the general public about the problematic situation and to trigger the public discourse over the matter. Interest groups (T&E, BEUC) started to recognise not only that what was declared and guaranteed by automakers (and their interest group ACEA) was actually an exaggeration, but also that producers employed defeat devices to reduce, even further, emissions. Therefore, it became clear that the main causes for the failure to meet the emissions limits, in real-world driving conditions, were mainly two. Not only the entire laboratory test procedure was unrealistic and unrepresentative of the on-the-road conditions and permitted to carmakers many flexibilities, which was a problem already widely discussed and agreed among interest groups and the European Commission, but also due to the "widespread practice of disabling emission control technologies" (T&E, 2016y) in many on-the-road conditions.

Later, it was discovered that the cheating techniques used by manufacturers were different, but all causing emissions to raise when the vehicle was on the highway. The majority of dirty

cars tested showed the presence of the “thermal window" defeat device, which switched on the emissions control system only at temperatures similar to those used during laboratories tests (23-29°C), switching it off otherwise. Even though manufacturers claimed that these practices were essential to protect the engine, after Dieselgate, some producers, e.g. Renault, decided to extend the operating range of the exhaust treatment system to between 5°C and 40°C. Another type of defat device discovered was the one related with “hot restarts”, which consists in allowing higher emissions with restarts when the engine is hot. However, the effectiveness of the after-treatment system should be better functioning with hotter engine temperatures (as tested by ICCT in 2016). Finally, in May 2016, it was found out by the German type approval authority (KBA) that some Fiat’s models showed that their exhaust treatment system switched off after 22 minutes, just 2 minutes after the end of a standard lab test (therefore lasting in average 20 minutes).
In summary, through the media coverage obtained by the scandal, drivers and policymakers worldwide were informed about the illegality of automakers’ practices and about their non-ethical decisions. The complaints and opinions of the advocacy groups started to be more secure, powerful and based on reliable datas. More and more information was uncovered and shared, which reduced the credibility of the entire automotive ecosystem.

Still after the Dieselgate, ACEA asserted that the automotive industry is not able to guarantee, in the long-term, lower emissions “at the current pace on an ongoing annual basis” (ACEA, 2016c). However, for T&E, the reality is that new cars’ efficiency, in real-driving conditions, remained unaltered in the previous four years (T&E, 2016j). Therefore, in T&E’s opinion, the claims of carmakers regarding the extra efforts that the sector is contributing for reducing emissions compared to others are a “fiction” (T&E, 2015o). Even though the results have been achieved only “on paper”, an ICCT research has demonstrated that it is possible to meet, in real-world conditions, the Euro 6 emission limits with the technologies available (e.g. SCR). However, only one third of Euro 6 passenger vehicles are equipped with SCR, the rest are fitted with lower quality and less efficient exhaust treatment systems (T&E, 2015k).

5.2. The automotive industry certification testing

The VW emission scandal has been perceived differently by the analysed interest groups. All of the associations agreed on the fact that the Dieselgate uncovered some major problems of

the automotive industry: the type approval system, the difference between lab and real-driving tests, and the presence of defeat devices in cars. Some of these issues were already partially known by specialists, pundits and researchers of the sector. However, with the scandal, also the media and the public were informed, transforming it into a worldwide discourse.

According to T&E (2016c), the Volkswagen scandal was mainly caused by the lack of independence between type approval authorities (TAAs) and carmakers, more specifically it argued that "the regulatory capture of the system of type approval is at the heart of Dieselgate" (T&E, 2016y). These national authorities failed to detect the defeat devices in VW cars, overlooked the continuous manipulation of lab tests, and issued authorisations for vehicles in breach of the law (T&E, 2016c). Especially due to the high level of competition that exists among them, the main issue related with EU type approval system is that these organisations do not act as independent regulators, but rather they focus on satisfying the will of their customers. In fact, some TAAs like VCA in UK, SNCH in Luxembourg and RDW in the Netherlands see their activities as a lucrative business that yields constant revenues. For this reason, in order to maintain the inflow of profits, these TAAs avoid to be rigorous with automakers to hold on tight their customers. Others, like KBA in Germany, CNRV in France and MIT in Italy, shield their national producers by dodging strict and in-depth examinations. Some public administrations even own shares in their national carmaker company.

The European Commission was already planning to modify the European type-approval scheme before the VW emission scandal occurred, however "that scandal and subsequent events, by highlighting the severity of the problem of excess pollutant emissions, accelerated the pace and broadened the scope of the review" (ICCT, 2016b). Therefore, the EU was already aware of the problematic situation related to the dependence between carmakers and their TAAs, however, they were subject to the continuous influence of the automotive industry's lobbyists. Probably, after Dieselgate, a wider stake of the world population was aware of the carmakers' practices to improve the lab tests results, therefore pushing the EU to take a remedy quicker.

Finally, on 27 January 2016, the European Commission submitted a proposal to amend the old and inadequate vehicle testing system in Europe, the new type approval framework regulation (TAFR). It identified and tried to solve the majority of weaknesses of the previous system, trying to propose a high-quality type approval process. It can be asserted that, with the new TAFR, the European Union tried to restore customer trust and the competitive

position of the European automotive industry. It was an urgent maneuver to solve the chaos generated by the VW scandal and subsequently recover the EU economy. However, some national authorities did not completely agree with the new proposal, for example Germany, which approved most of the guilty VW vehicles, was reluctant to share their authority over TAAs with the European Commission (T&E, 2016p). Even so, for T&E (2016p), their complaint "lacks credibility" since they turned a blind eye over carmakers' non-compliance with EU rules.

The carmakers' association, ACEA (2016a), when tackling the at-the-time recent debate over the proposal for a new Framework Regulation on the European type approval system, recognised the triggering factor into "several irregularities occurred over the last years". Therefore, also carmakers were forced to admit that the VW scandal uncovered the European systems' deficiencies and the differences in interpretation and stringency between TAAs across Member States. Also the customers' association BEUC (2016a) argued that, to reduce the risk that scandals like Dieselgate occur, the EU should release an harmonised system able to discourage manufacturers to manipulate lab tests results and reduce dependency between carmakers and TAAs.

It can be claimed that the VW initial scandal, and the subsequent revelations over the entire automotive ecosystem, ruined the sector's credibility and consequently weakened the position of automakers in front of the general public. EU institutions were also influenced by this event, as it was uncovered the abetment of EU policymakers in favour of manufacturers' interests. Therefore, they were unable to succumb to the pressures of carmakers and take the sides of the automotive industry anymore. For this reason, after the occurrence of the VW scandal, EU and Member States authorities have been forced, for restoring their reputation, to present proposals for TAFR and RDE, even though such actions have been previously requested by other advocacy groups for several years, but without any successful result.

It seemed that EPA revelations came as a surprise to the whole automotive industry, including TAAs (T&E, 2016q). Even though before the scandal the fact that "hardly anyone could believe" the difference between lab and on the roads values could be attributable to carmakers' manipulations, after the Dieselgate broke, this turned into quite the opposite (BEUC, 2015c). Afterwards it was even discovered that the VW emissions scandal was just the

tip of the iceberg. It was not just the 11 million grossly polluting vehicles released by the VW Group, but, according to a study of T&E (2016y), the number of dirty diesel cars on EU's roads was much bigger, more specifically around 29 million vehicles. Therefore, the list of automakers and car models involved in the systematic manipulation of lab tests is long. Nonetheless, FuelsEurope tried to move the burden away from automakers, explaining that "in EU the VW vehicles affected were Euro 5, not the latest technologies" (2016c), implying that Euro 6 targets have the ability to solve the automotive industry's issues and force automakers and TAAs to comply with EU standards.

It was also highlighted the strong differences between US and EU legislation on different fields, especially regarding the non-compliance of the automotive industry with standards (T&E, 2015n). This reached the peak point after the scandal, with the stark contrast between actions undertaken by EU and US to force VW to comply with the law. While in Europe national governments, politicians and European authorities behaved like the scandal never occurred (T&E, 2016k), the US government took severe decisions against the automakers presenting fake figures. The issue was also related with the legal language defining and regulating defeat devices in US and EU, which is nearly the same except for some minimal differences. In this case, it was possible for the VW group to assert that the software, added in some vehicles to control the levels of polluting emissions, released in the atmosphere, was illegal under the US regulation, while not under EU.

5.3. EU strategic actions over the automotive industry

ETS strategy

Some Member States are the house of some of the largest car manufacturers worldwide, handling a large stake of the global production of vehicles. The European Union has regulated various aspects of the automotive industry during the past decades. First of all, EU has decided to categorise the automotive industry as a non-ETS (Emissions Trading System) sector. In this case, each Member State is responsible to redact policies for the transport sector, according to the guidelines provided by a European climate policy framework and to the greenhouse gas reduction target allocated to each country. ETS sectors methodology, instead, consists in a number of shares assigned to each company which equates to the amount of greenhouse gases that can be emitted by each singular company. Together, it

should determine the maximum greenhouse gas reduction target set by EU for ETS sectors. If a company's manufacturing process produces a level of emissions exceeding the permissions assigned to it, then the company can choose to optimise the production process or to buy additional 'shares' to cover the extra emissions produced. In the past 20 years, the automakers employed lobbying strategies in order to influence EU's decisions: they "argued that fuel costs naturally drive the required efficiency improvements (they don't); then it argued a voluntary agreement would be sufficient (it wasn't); and finally, when regulation was proposed, it should be delayed and weakened (it was)" (T&E, 2014a). Moreover, in order to avoid to comply with post-2020 targets they proposed the inclusion of the transport sector in ETS (T&E, 2014a). German manufacturers were the biggest proponents of this proposal, as it eventually shifted the struggles to reduce emissions to other sectors. However, the major interest groups opposed to it, as it could lead to a failure to reach the EU's climate targets. Before the VW emissions scandal broke, in fact, their opinion was that EU's CO2 standards were effective in reducing transport's emissions (T&E, 2015h). BEUC even argued that Member States were doing a good job in reducing greenhouse emissions in non-ETS sectors (BEUC, 2014c). Moreover, also ICCT agreed with this line, back in 2014b, asserting that Europe's efficiency regulation for transport sector "has very effectively driven down the official average CO2 emissions and fuel consumption" of cars, considering it as a successful measure. And, finally, automakers agreed that the EU CO2 legislation has favourably encouraged the transport sector to lower emissions and to foster innovation.

Approaching September 2015, when the VW emission scandal broke, interest groups started to recognise that the progresses achieved thanks to EU standards, while accurate, they were only "on paper" (ICCT, 2015c). The degree of cars' emissions, as previously explained, differ widely between on-the-road and lab tests results. T&E (2015o) recognised that, even though there has been a great amount of effort from institutions and interest groups, still a lot of critical issues and challenges of the transport sector were unsolved. At this time, it was also widely renown and accepted that the transport sector was quite resistant to whatever effort towards decarbonisation.

After the scandal, T&E group showed a change in opinion over EU standards and policies, defining them disappointing or a failure (T&E, 2016t). Subsequently, the enforcement of EU emissions standards by national governments was called "non-existent" and the regulation

for cars “feeble”, as authorities were more focused on safeguarding their domestic carmakers’ interests (T&E, 2016y). Moreover, also national governments, especially those whose TAAs inadequately enforced EU regulations (e.g. Germany), held accountable EU for its mismanagement and blamed the ambiguity of the European policies (T&E, 2016r).

Lobbying and regulatory capture strategy

The carmakers’ lobbying was extremely powerful in EU, and was openly directing the decisions taken by European and Member States’ politicians. Civil interest groups were worried about the potential influence of manufacturers over EU’s strategies aimed at tackling the environmental pollution produced by the transport sector. T&E commented over this issue, arguing that in EU the interests of vehicles manufacturers were “prioritised” over those of people (T&E, 2016y). Moreover, T&E (2016f) declared the existence, in the EU territory, of a “culture of perverting rather than complying with environmental rules”, which prospered due to regulators’ long-lasting activity of “cushioning” the automotive industry. In criticising authorities siding with industry, T&E (2016e) defined the European Commission as “weak”, as it agreed to decrease the power of regulations at the expense of the environment and drivers’ health.

The maximum level of protection, from the EU to shield automakers, was achieved after the VW scandal. On 28 October 2015, therefore a month after the VW emission scandal broke, EU governments agreed to weaken the NOx emissions limits for diesel cars and to postpone the application of new limits until 2019 (T&E, 2015q). Cars were allowed to emit 50% more NOx compared to the Euro 6 limit of 80 mg/km, which was the air pollution standard previously in force (T&E, 2015q). Afterwords, also the European Parliament fell under the pressure exerted by car-producing countries and favourably allowed to weaken the limits of NOx for diesel-powered vehicles. National governments, like UK, Germany, France and Italy, decided to bias for their carmakers by pushing for this proposal, despite the infringement procedures enacted by EU and the risk of paying substantial fines for failing to meet NO2 standards (T&E, 2015q). In this way, Europe decided to favour diesel cars, something that no other regions did.

The position of environmental and customers’ interest groups was of criticism against the decisions of EU. T&E wrote numerous position papers and letters to MEPs (Member of the European Parliament) or the TCMV (Technical Committee on Motor Vehicles) trying to persuade politicians to make public health and the environment their priority. The same

group has defined the decision as “disgraceful and legally questionable” (T&E, 2015). BEUC (2015d) found the resolution negatively “astonishing”, as it was not supported by scientific evidence, but, rather, it was taken to shield automakers.
According to T&E (2016s), almost a year after the scandal, national governments started to pay attention to EU authorities and to accept the “EU red tape”, despite the continuous resistance to regulations by the car industry.

Low carbon strategy
The European Union has also the responsibility to boost the development of a low-carbon transport system. T&E (2014c) argued that the EU failed to provide a strategy for a clean e-mobility, as it did not guarantee a fair competition between alternative fuels and oil. Environmental and customers’ alliances have criticised the EU decision to not set targets for renewable energy in the transport system after 2020, which inevitably slowed down progresses and market penetration of low-carbon alternatives. On the contrary, FuelsEurope, ACEA and CLEPA (2015) agreed that political measures, whose aim is to limit the introduction of up-to-date diesel technologies, would compromise the possibility to cut CO2 emissions. They also commented that diesel-hostile policies “make no sense from an environmental point of view” (FuelsEurope, 2015).

After VW emission scandal, T&E (2016u) argued that the plan proposed by the EU for transport sector’s emissions was “going in the right direction”. Not only the institutions recognised the key role that electro-mobility would play in reducing the addiction to oil of the automotive industry, but it also proposed the compulsory supply of ultra-low emission vehicles by automakers (T&E, 2016t). National governments started to share plans and timelines to reduce emissions: Norway decided to release a plan aiming at removing internal combustion engines from new cars sold by 2025, Germany proposed a three per cent sales quota for EVs, and UK voted that all cars must be zero-emissions by 2050 (T&E, 2016i). In general, it can be asserted that the attention of the EU towards alternative fuels changed, even if slightly, over the two years analysed.
Nonetheless, after the scandal, there were still some criticisms to EU’s decisions over alternative fuels. T&E (2016d), in fact, was completely unsatisfied about the absence of “electric cars” as one of the main topics discussed during GEAR2030, a group created by the European Commission to boost the competitiveness of the European car industry. T&E’s

motive is that the European automotive industry was already been superseded in EV technologies by foreign competitors, therefore, in order to protect their own economy, EU should have not wasted time over less important subjects.

5.4. Diesel vehicles

Initially, in Europe, there was no principle of technology neutrality among the available engine type. Diesel was favoured by the EU through lower fuel taxes and less stringency of emission standards, which made these cars more economically attractive to European citizens. Most of the interest groups analysed were proponents of the neutrality principle, in order to avoid to favour one fuel against the others. Environmental associations, on the one side, have heavily demanded to end the policy biases that favoured the EU diesel car market, but, on the other side, they proposed to incentivise and promote alternative energy sources. FuelsEurope, instead, claimed that it is not fair for the EU to guarantee a special treatment to "zero-emission" vehicles, however, without considering that the diesel technology, in order to account for 53% of vehicle's sold in Europe (in 2014), has been highly supported by the Member States' governments.

As we could observe, the opinions on diesel, found in the associations' position papers, follow two strands: on the one side highly critical by the environmental groups and on the other side defensive for producers and energy groups.
T&E has always been against diesel, claiming that "the only solution left to cities will be to ban all diesel vehicles" (T&E, 2014d). Also, when analysing the reasons why there are high levels of pollution in the air, the fault, for T&E (2014d), must be given to diesel cars, since, mainly due to carmakers' manipulations of tests, they emit much more than permitted. The group suggests that the industry is exaggerating the real-world advantages of diesel engines, claiming that "on a lifecycle basis the benefits of diesel are non-existent" (T&E, 2015l). In their opinion, the European automotive industry was greenwashing polluting diesel and was avoiding to admit that a common diesel car emit ten times more NOx than a similar gasoline car, in order to desperately maintain the market for diesel (T&E, 2015m). In this way, in the long-term, by being trapped in a diesel lock-in mechanism, the sector was losing competitiveness against other nations, which were investing in electrifying vehicles through hybridisation, plug-in and battery electric models. In fact, Europe, since one in every two new

cars sold used a diesel engine, compared to the rest of the world where the share is just 1 in 20 (T&E, 2016d), was already defined as a "diesel island". However, the environmental association predicted that the over-mentioned figures, especially after Dieselgate, are more likely to go down than up (T&E, 2016y), pointing out that, in 2015, they were witnessing the "peak of diesel" (T&E, 2015h). To support their viewpoint, they also reported the words of Continental's CEO commenting that "diesel passenger car could sooner or later disappear from these markets" (T&E, 2016i) and a Bloomberg's study forecasting in 2020s a "Kodak moment" for internal combustion vehicles (T&E, 2016t).
Moreover, after the VW emissions scandal, their tone of voice and the appellatives used to refer to diesel have changed, becoming graver and disparaging. They started to blame diesel vehicles, due to the high level of hazardous NOx emitted by them, to be the primary cause for 475,000 premature deaths, accordingly to a study of EEA (T&E, 2016w). They referred to diesel as "the monster" (T&E, 2016u), to "clean diesel" as a "myth" (T&E, 2016q) and used the term "diesel addiction" (T&E, 2016y) to define the continents' perseverance to treat diesel as its prime technology, even after the evidence brought by the VW scandal.
Therefore, as T&E explained, they never shared the belief that diesel engines were vital to reach the CO2 targets, especially when their benefits for climate are confronted with those of petrol cars. In their opinion, the success of the diesel technology in Europe is only to be attributed to "tax and regulatory bias" (T&E, 2016w). ICCT (2015e) agreed by claiming that if technology neutrality was not promptly achieved, then no choice was left to local authorities but to release disincentive programs for diesel cars.

ACEA (2015a), instead, claimed that "the internal combustion engine using conventional fuels will remain the dominant source of power for at least the coming decade". In their opinion, the emissions of CO2 per kilometre are up to 20% less from a diesel-fuelled car than from a petrol one, thanks to the engine efficiency (ACEA, 2015b). The new diesel technology was, according to the producers' association, both reducing considerably emissions and successfully meeting worldwide stringent standards. Therefore, a strategy that required the replacement of diesel with petrol-driven cars would have spoiled the emissions targets achieved until then (ACEA, 2015b). Even after the VW emissions scandal, ACEA (2016c) continued to point out that "Europe´s success in reducing CO2 emissions has also been largely a result of its high share of diesel-fuelled vehicles". They, instead, referred to diesel as

a “key enabler for cutting emissions”, without which, the additional CO2 reduction, would be significantly lower.
When confronted to the problem with discrepancies between lab and real-world emissions, CLEPA (2014) did not point fingers at a specific powertrain engine but rather blamed the wrong application of specific emissions control technologies on vehicles and models. For CLEPA’s members, the diesel technology was going to remain a key solution for meeting CO2 limits.

FuelsEurope generally agreed with producers’ and suppliers’ associations regarding the importance of new generations of diesel technology in cutting CO2 emissions and in meeting targets. In an open letter from ACEA, CLEPA, AECC and FuelsEurope (2015) they asked for the collaboration and support of EU policy makers “to ensure modern diesel remains one of the key pillars in the portfolio of low CO2 technologies for delivering clean, economical and affordable transport for future generations”.
After Dieselgate, however, the group declared that “efficient internal combustion engines and liquid fuels will still be needed during the transition to alternative technologies” (FuelsEurope, 2016a). Therefore, diesel was not anymore essential to meet targets but rather as a shifting powertrain towards e-mobility. However, analysing other reports (FuelsEurope, 2016e), it is possible to infer that their belief is that “refined petroleum fuels are - and will remain for many years - the prominent energy source”, since, for them, there are still numerous possibilities for a further increase in carbon efficiency. According to a study conducted by FuelsEurope (2016e), the practical removal of all diesel-fuelled vehicles from the urban environment would bring advantages only in the short term, in comparison to the scenario of continuous feet turnover of new and more advanced diesel technologies. In the long term, instead, the incremental benefits of the “zero diesel scenario” decreases.

Around the diesel technology two parties face each other: opponents and supporters. Those against the diesel powertrain argue that this engine type is responsible of high levels of polluting NOx emissions, which is extremely dangerous for human health. Those in favour, instead, assert that the diesel technology has a higher potential, compared to alternatives, to reduce CO2 in the atmosphere, and therefore safeguarding the environment. Nonetheless, they are both claiming accurate opinions. The focal point in the discourse around diesel is the social framing of the matter-at-stake. In Europe, before the scandal, the reduction of CO2

to protect the environment was prioritised, however, post Dieselgate, also the cut of NOx emerged as a first-oder issue.

5.5. Alternative solutions

All the interest groups analysed have suggested, in their official documents, alternative solutions, which, in their opinion, could have the chance in the future to reduce the emissions of the transport system.

E-mobility has not been considered by all advocacy groups as their first-choice. European automobile producers, for example, stressed the importance of continuous vehicles fleet renewal in order to replace older - and more poisonous - cars in roads. For them, this strategy is essential as it could reduce significantly the emission levels (ACEA, 2015a). Also after the scandal broke, they continued to argue that the harmonisation of incentives for fleet renewal across EU is a “key tool” for fulfilling CO2 regulations, since it is the "most cost-efficient and quickest way to reduce emissions” (ACEA, 2016b). Also FuelsEurope presented the same opinion over the effectiveness of fleet renewal for the improvement of air quality (FuelsEurope, 2015), and called for policymakers to incentivise the introduction and acquisition of latest emission-reducing technologies.

The representatives of the automotive sector were the only group that argued the importance of connected vehicles and intelligent transport system (ITS) as a solution to mobility challenges, including the high levels of pollution.

Of course, fleet renewal is a valuable strategy, however, it requires the frequent substitution of old models with new and improved ones. Even though it brings advantages for the environment and it stimulates consumption, which is a main driver of European GDP growth (ACEA, 2016c), it brings also numerous disadvantages and limitations that are not mentioned by their advocates. ACEA, for example, even though it insisted over the importance of fleet renewal, also recognised that “there are limits to how much more change can be brought to the internal combustion engine and how much further cars can be refined” (ACEA, 2015b).

It was already before the VW emission scandal that manufacturers’ associations mention alternative fuels as a key “part in the jigsaw puzzle of sustainable urban mobility” in the future (ACEA, 2015a). Their support and investments went to a wide range of renewable energy sources and low carbon technologies (biofuels, CNG, LNG, ethanol, clean diesel,

electricity and hydrogen), because they argued that technological developments are unpredictable and for this reason no “winning technology” should be prematurely selected (ACEA, 2015a). They also believed that freedom to choose any technology should be guaranteed to customers (ACEA, 2015a). In my opinion, however, the way how electric vehicles and hybrids have been treated by ACEA changed approaching to September 2015 and after it. While initially they refer at the importance for the future of transport of “alternative technologies”, as a wide category, and only labelling electrification as a “no silver bullet solution” (ACEA, 2015a), in some following papers the term “alternative powertrains” has partially been replaced by “electrically-chargeable vehicles”, however maintaining the same meaning.

Not surprisingly, there is no change in the opinion of FuelsEurope over alternative fuels and electrification. Their idea, in fact, is that, in order to reduce air quality problems in Europe, there is no need of a “wide-scale electrification as best-in class Euro 6 ICE-based vehicles including hybrids already can achieve extremely low emissions levels” (FuelsEurope, 2016b). The refineries’ association judges the electric vehicle with a critical eye, highlighting the disadvantages of it (like the cost of batteries), the non-availability of infrastructures, and the absence of a customer base ready to purchase EVs. Finally, they argue that any EU incentive for the alternative solutions’ advancement should be based on a “well-to-wheel assessment of the GHG emission” (FuelsEurope, 2016e), therefore evaluating the emissions during the entire life cycle of the fuel.

Even though there is no wonder over these FuelsEurope’s statements, I have noticed that remarks against alternative powertrains are almost absent the year before the scandal, while they become numerous, intense and highly critical immediately after the break out of EPA’s “Notice of Violation”, and continued with the same strength the year after. FuelsEurope may have felt the pressures generated by the scandal over diesel engines and the growing push for alternative solutions from the public and from other associations.

Also questionable is the absence of official documents from EGVI in the timeframe selected, more precisely between 2013 and 2017. It is reasonable to expect the opinions of an association pushing for green vehicles, especially when a scandal is shaking the credibility of the automotive industry and of its dirty diesel cars. However, as mentioned before (section 4), it is important to point out that EGVI was an organisation founded and managed by automotive’s suppliers and OEMs.

Customers' group BEUC agrees with manufacturers' association ACEA by arguing that the replacement of conventional engines in favour of electric cars should not be depicted as a "silver bullet solution" for the future of the European transport system (BEUC, 2014b). They considered extremely "challenging" the shift from the fossil fuels transport system to one based on renewable resources, nonetheless "fundamental" for a low carbon future (BEUC, 2014a). In general, however, they remained with the idea that a mass uptake of electric vehicles "will be unlikely" (BEUC, 2014b, 2015b), at least until EVs' infancy problems are not solved. A BEUC research offers the public opinion over electric vehicles in 2014(b), revealing that 44% of answerers strongly agreed with the remark that EV are safe, while 17% strongly disagreed with it. More than 43% of respondents, instead, were unable to give an answer due to lack of information on the matter. This research shows that, even before the scandal, a large stake of citizens were in favour of the alternative technology, however, it additionally proves that public discourse over this topic was uncommon and mainly misinformed.

Also the viewpoint of T&E over alternative solutions, especially electric powertrains, is not surprising. Already in 2014 (c), T&E considered e-mobility as a key solution for the transition towards a low carbon transport, for its potential to downsize both air and noise pollution. It has therefore stressed for the intervention of the European authorities for the provision of incentives with the aim to stimulate innovation and investments in sustainable technologies across all member states (T&E, 2014e). The association has always kept a positive consideration over the electrification of vehicles: "is the only credible solution left for decarbonation" (2015b) of the transport sector, "should be a key EU political priority" (2015a) to maintain the European automotive industry competitiveness, promoting a "clean electricity revolution" (2016m) and arguing that "the future will be electric, and Europe has no time to lose" (2016i). Therefore, during the years, the association maintained the same opinions and confidence over the potential of EVs, battling for the recognition of these beliefs also at EU level. T&E also rejected the opinion of carmakers and fuels' producers which argued that there is no interest from customers to purchase electric cars and that this trend will continue in the future. For T&E, however, the reality is completely different, almost the opposite.

Regarding the other alternative solutions, T&E has been highly critical. It claimed that there is no GHG savings in shifting from diesel vehicles to compressed or liquefied natural gas

(CNG, LNG), (T&E, 2016h). Moreover, it argued that “natural gas is not a ‘bridge fuel’, but an expensive dead-end on the road to decarbonising transport” (T&E, 2016h), forecasting that it will become another EU “fuels mistake” after diesel. Biofuels used in Europe were considered even worse than fossil fuels.
The only attainable, safe and efficient solution for T&E was the electric vehicle powered by clean energy.

Even though ICCT has always made clear its preference over a greener transport system, achieved through alternative powertrains, its official documents show a slight change in confidence over the turn towards e-mobility. In a report of 2014(c) ICCT argued that “electric-drive vehicles (…) could contribute substantially to long-term GHG reductions”. In December 2015(d), after the scandal broke, the association demands Member States governments to “include electric vehicles as a core component” of their climate actions. And finally, in 2016(c), ICCT sustains that “electrifying passenger cars is seen as a key measure to reduce pollutant and greenhouse gas emissions from road transportation”. In my opinion, from these statements it is possible to highlight an escalation in the importance given to electrification in the clean mobility strategy by ICCT, and a positively growing conviction and confidence in the words asserted.
It is also possible to note that the first two sentences are just ICCT proposals to push policymakers to increase incentives towards e-mobility, while the third implies that it is not just the environmental interest groups believing in the power of e-mobility to reduce emissions, but that the statement is shared among a larger group of individuals and sources.

6. Discussion

The VW emissions scandal has accelerated the implementation of some European decisions connected to mobility, such us the new testing systems and the type approval framework regulation, which, without the emergence of the scandal and the consequent loss of reliability of the automotive sector and EU institutions, would have probably been further delayed, as it used to happened before. What resulted was that the lobbying strategies of the automotive industry started to lose power in front of policymakers, which were more interested in gaining back their authority and trustworthiness among the general public. In fact, this resulted from a high level of attention from medias, and consequently from people,

worldwide. New findings about automakers dodging tests and providing misleading information, about the presence of defeat devices in cars, and about the inaction of EU actors were published regularly. Customers felt offended by automakers' actions and lost trust towards them too. Legal class actions were settled by customers' groups in many countries, in order to seek a compensation from the carmakers to their clients.

Through the analysis of the VW diesel scandal with the model developed by Hoffman A.J. and Ocasio W. in 2001, we are able to infer if the event attained a high and sustained level of attention, both from insiders and outsiders.
The model takes into consideration only non-routine events. Our case study, the VW scandal can be definitely categorised as a non-routine event, due to its unexpectedness, complexity and unusual disruption of the status quo. Initially, the automotive industry did not know how to tackle the issues generated by the scandal, because it was a phenomenon never witnessed before. Therefore, the leakage of information regarding the employment of defeat devices on cars was a completely new problematic situation for the automotive sector. Moreover, according to the definition of Ferraro et al. (2015), the VW diesel scandal can also be inserted in the context of a "grand societal challenge", as it was a social and environmental issue which negatively affected people, markets, ecosystems and climate change across national borders.

The first level of analysis: the event's features.
The main characteristic that triggers a high level of attention is the event's *salience*. Morgeson et al. (2015), though the event system theory (EST), have theorised what features of events make them meaningful, and therefore salient. In EST, event's novelty, disruption and criticality determine the event's degree of strength, and, accordingly, its relevance. The more novel, unpredicted and unforeseen an event is, the more likely entities will be unprepared to deal with the situation. Although some unethical practices of carmakers were already acknowledged, the power of environmentalists and customers' groups, which were engaged in prohibit this behaviour, was minimal compared to carmakers' influence to EU authorities. Moreover, the wider public was not aware of how polluting and fuel-inefficient their cars were in real driving conditions. Even if the cheating techniques, employed by carmakers during laboratory tests, were already renown by experts, the VW emissions scandal has exposed the issue to society and uncovered the installation of illegal defeat

devices in vehicles, in order to manipulate the evaluation of pollutant emissions. The European automotive industry found itself in an unprecedented situation because, altogether, their primary technology, diesel, was placed for the first time in a negative light, the illegality of carmakers' actions was unveiled and the automakers' implication in the European testing system malfunctioning was uncovered. Moreover, as we have analysed in the chapter on the automotive industry (chapter II), the entire ecosystem was unprepared to a shift to electrification. Both the automotive industry and its environment were not ready, and therefore did not push, for the replacement of ICEs with EVs. Therefore, for the first time, the society's emphasis over both the disadvantages of the diesel technology and the need of clean alternatives increased the event's salience, influencing the turn towards e-mobility.

When an event is *disruptive*, it means that it has the potential to alter the entities' routines, operations and activities. In case of a disruptive event, entities need to adapt and evolve, not only by replacing previous behaviour and features with new ones, but also by breaking out their conventional beliefs. The VW diesel scandal, and the work of environmental agencies, has encouraged the EU authorities to overcome the automakers lobbyist pressures and approve the final implementation of new testing procedures, WLTP and RDE, and the new type approval framework regulation. Automakers, which were able to achieve the European emissions limits only thanks to unethical techniques and cheating devices, were forced to stop their previous activities and conceive alternative ways to reach the targets. Through the advocacy groups' official documents we inferred that, after the scandal, representatives of refineries were increasingly worried about the negative judgements on diesel and the growing importance of e-mobility, while environmental groups opinions on EVs were becoming more confident and EU actions more concrete and addressed towards the electrification of the transport system. My conclusion is that, in the year after the emergence of the VW scandal, a disruptive transformation was already taking place, even though quietly, at least in the people's perception and beliefs on the two technologies. It is also possible to assert that the Dieselgate scandal, thanks to its remarkable salience, has accelerated this change in perceptions.

An event is *critical* when it is a central focus for the industry. A critical event, like the VW diesel scandal has been, has the potential to threaten the entities' goals, identity and survival. VW goal was to become the leading automotive company by entering the American market with its "clean diesel" cars. However, after the scandal, they were forced to recall all

diesel vehicles from US. The criticality of the event for the VW Group, but also for the entire automotive industry, is determined by the degree of deterioration of the companies' image as a consequence of the scandal, and of subsequent discoveries. Moreover, relevant stakeholders lost trust in carmakers as it was uncovered that the industry's declared identity and ideals were unmatched with the actions, processes and operations carried out by automakers and their suppliers.

The event's impact is determined also by the amount of entities affected by it. VW scandal originated in the external environment of the automotive industry, through the EPA's Notice of Violation, an external and autonomous agency. Events arising in the external environment lead to a stronger impact, within a shorter time period, and have the potential to affect a wide variety of entities. The scandal, and the subsequent events generated by it, have influenced the decisions of EU policymakers, automotive manufacturers, suppliers, refineries and customers worldwide, therefore affecting the majority of actors in the automotive ecosystem.

The second level of analysis: the outsiders' public attention and attribution of accountability. For Hoffman and Ocasio (2001) the external opinion of industry's accountability and the internal enactment of the event, by questioning the industry's image, are critical factors of an event's salience.

An industry is forced to consider an event salient if the public opinion judges it as linked, or responsible, to the issue. Before the scandal, activists, environmentalists and experts held the industry publicly responsible for the growing discrepancy between labelled emissions and fuel efficiency during lab tests and the real-world driving values. However, after the scandal, a wider group of people was informed, which included all the customers that were affected by the discovery of the presence of illegal devices in the vehicles they bought. Also T&E (2015o) argued that drivers and the media were increasingly aware of the unethical, and sometimes illegal, actions of leading carmakers.

External attention to issues is delineated in "public arenas", like the press, academic journals, or conferences. In these occasions, events conquer for public attention, due to the channels' limited capacity. According to Clemente and Gabbioneta (2017), the media has the power to influence the public perception of the organisational wrongdoing by providing negative frames over the transgression. It has the potential to shape the social construction of the scandal as it can act as the main publicizer and the direct source of information for citizens.

The media is “the discriminating variable that discerns between a transgression that progresses into a scandal and the many transgressions that remain buried in the mass of daily news” (Clemente and Gabbioneta, 2017: p.2), especially if it portrays the scandal as something that disrupt the current practices and routines and if it demands for a remedy from the responsible parts. In their research about how German newspapers framed the VW scandal, Clemente and Gabbioneta (2017) found out that the media, through its articles, had defined and debated over the locus of responsibility, identifying as the principal guilty party either the firm’s executives or the industry. Especially in the second case, the articles argued that the responsibility of the scandal needs to be attributed to the context in which the VW Group operated and competed, and therefore the automotive ecosystem. Most of them reported that other carmakers were under inspection, since the testing system in force at the time, the NEDC, incentivised the automobile manufacturers to cheat.
Surprisingly, few of them, however, recognised the environmental and health implications of the companies’ wrongdoing.

In general, the greater the degree of outsiders’ attribution of direct accountability to the industry, the greater the chance that the event will attract the attention of the business press (Hoffman A.J. and Ocasio W., 2001). As we have seen, a wide number of entities, like the media, environmental groups and customers groups, agreed that the burden of this scandal needed to be attributed to the automotive industry. Probably, the clarity of who was, in general, the culprit responsible for the wrongdoing had facilitated the direction of outsiders’ attribution of accountability, therefore blaming automakers and the TAAs already from the beginning. It is clear that the concern demonstrated by the press for the VW scandal has been essential for informing and updating the general public about who was responsible.
Finally, regardless of the initial driver (insiders or outsiders) of an event’s enactments, public attention will, in most cases, presumably provoke internal analysis of industry image (Hoffman and Ocasio, 2001)

The third level of analysis: the insiders’ enactments and examination of industry image.
The public attention and the outsiders’ attribution of accountability make an event more salient. However, the motive that makes an event attendable also for the industry is how insiders enacted it, or, in other words, how insiders arranged the context where the event arose using casual links and schemas. Also the event’s characteristics analysed before, if

present, can trigger industry enactments as they require an in-depth interpretation of the issue through the controlled information processing approach. Consequently, industries carry out a process of interpretation and sense making in order to frame the relevant issue and understand what actions should be put into effect. After the external analysis of the situation, where the industry enacts the environment, the industry conducts the internal analysis of its practices. During this process, an assessment of the events' probable consequences on the industry image is carried out. T&E (2015o) testified that the growing public awareness of the automakers' illegalities led "to a loss of credibility for the whole of the EU's car labelling and regulatory system". For example, for VW, the evidence that the company has lost trust from its shareholders and stakeholders is the decline of the share price by more than 20% the day after the emergence of the scandal.

Analysing the research of Clemente and Gabbioneta (2017), it emerges that newspapers reviewed also the reputational costs linked to the scandal. The media mentioned the deterioration of the company's image, defining it an "image disaster" (Clemente and Gabbioneta, 2017: p.7). Moreover, the press recognised that it was not an issue for VW only, but that the scandal could have affected the whole automotive industry, of which "image loss could be lethal" (Clemente and Gabbioneta, 2017: p.7). The press analysed also the damage occurred at the relationship of trust between the company and its stakeholders. They all agreed that the automotive industry's wrongdoing betrayed its customers confidence. Mercedes lawyers, in order to avoid the emergence of its illegal practices and the consequent damage to its reputation, tried to cover the emissions discrepancies by intimidating and threatening the environmental organisation that commissioned the tests (T&E, 2016f). What emerges is that the VW emissions scandal had a negative influence to the industry's image, triggering its actors to find a quick remedy to solve the problem. At the time, in the customers' mindset, the cleaner alternative to the diesel powertrain was the electrification of the transport system, a solution already in place in some leading countries outside EU (e.g. China).

In the model of industry attention to events, there are some factors (the core technology, the rules of the game, the status of the players), called the social structures of attention, which affect how the industry enacts external events and whether it pays attention to the event's consequences on its image. In other words, the presence of these factors pushes the industry to be concerned about the event.

Firstly, an event's salience is determined by its effects on the industry' core technologies. The diesel engine was, at the time of the scandal, the automotive ecosystem's most used powertrain in Europe. From the analysis it is clear that, with the emergence of the VW emissions scandal, the perception over diesel was increasingly negative, especially because it was discovered that the technology was not as efficient and clean as declared. Therefore, what happened triggered the European automotive ecosystem's status quo, over which it was based its profitability and its goal's attainment strategies. The shift towards electrification may have also been influenced by the increasing importance attributed to sustainability and the environment's wellbeing. High status players, public personalities and organisations are expressing their opinion over favouring a more environmentally-friendly transport system. The growing number of individuals sharing this mindset may have increased the attention of the automotive industry towards e-mobility. Finally, the rules of the game, especially with the introduction of new testing systems and a new type approval framework, constrained the automotive industry's decision-making process towards alternative solutions that could permit automakers to achieve EU emissions limits.

Has the VW diesel scandal achieved a high initial public attention?

As we mentioned during the course of this thesis, events gain the industry's attention in two cases: when the general public holds the industry accountable for the consequences generated by the event, or when the industry foresee an opportunity to improve its image by exploiting the event. In the second case, in general, the event is positive. Instead, the VW diesel scandal has been a negative event, not only for the VW Group but for the whole industry.

For our case study, we have analysed the two main factors driving industry initial attention, the external accountability and examination of industry image, plus the presence of the features that makes an event salient. It is possible to conclude that the VW emissions scandal received a high level of public attention. In fact, the event had a degree of criticality, disruption and novelty high enough to spark the interest of drivers and the media. Moreover, we can also infer that as the event studied was highly attended both by the industry and by the general public, an appropriate remedy for the wrongdoings discovered must have been solicited by a long list of outsiders, until the request was satisfied by the culprits. The guilty party, in our case the automotive industry, on its part, urged the need to fulfil the request of the outsiders, in order to recover the image and trust loss. Even though a shift towards

electrification was not in program at the time as the entire ecosystem was unprepared, the VW emissions scandal created the prerequisites for its turn. The main reason is that the automotive sector, and the EU institutions, to restore the credibility and to guarantee the survival of the industry, needed a valuable solution that could convince outsiders of their commitment to the environment and human health.

Contestation and contradiction leading to a sustained attention to the VW scandal.

It is not a foregone conclusion that those events that achieve a high initial attention remain in the spotlight also in the long-term. Some events may not maintain the outsiders and insiders' high attention over time. The general rule, according to Hoffman and Ocasio (2001), is that an event is sustained when its enactment evolves over time, and especially, if there are contestations and disputes carried out by outsiders and insiders around the meaning of the event. At the time of the Dieselgate scandal, there was a long list of actors involved in the discourse which provided their opinion on the matter, like engineers, managers, policymakers, interest groups, journalists, automakers' public relations, suppliers, environmentalists, etc.

On the one side, industry participants tried to protect the industry identity and their core technology. In the case of VW, the company admitted its responsibility for its wrongdoings, but implemented different strategies in US and EU. As we said, in Europe, the affirmations and the remedy actions were minor compared to those applied in US, defining its transgression as "unethical" in EU and "illegal" in US. Nonetheless the VW's unfair actions, EU institutions and member states' governments voted to weaken the limits of nitrogen oxide (NOx) emissions for diesel cars, doubling the 'Euro 6' levels agreed in 2007. The European Commission decided for cushioning the automotive industry, regardless of its misbehaviour. These occurrences have unchained a sequence of complaints and contestations, triggering an even wider discourse over the matter-at-stake. Initially, ACEA and FuelsEurope, as we have seen, implemented lobbying strategies to protect the perpetuation of the diesel legacy in Europe and to prevent the emergence and supersede of e-mobility.

On the other side, outsiders battle for their own beliefs and ideas. Environmental and customers' advocacy groups pushed for the electrification of the transport sector, therefore opposing to the willingness of the automotive ecosystem. They argued that e-mobility was the only solution left to safeguard the environment and people's heath.

Moreover, during the years, many lawsuits have been carried out to compensate the offended customers and to guarantee the payment of monetary sanctions for the automakers' infringements. In some cases, the trials lasted for years, which protracted the contestations and contradictions.
The media, according to Clemente and Gabbioneta (2017), affirmed that, in order to recover their reputation, automakers should fully cooperate with EU authorities, which, some months after the scandal, started to manifest a growing interest towards EVs.

In general, contestations arises when there are disagreements between insiders' (industry identity) and outsiders' enactments, leading industries to start to find new answers to solve the critical issue (Hoffman and Ocasio, 2001). The VW emissions scandal, and the subsequent discoveries over the transgressions of the automotive industry, produced enduring and competing disagreements between the two opponent sides analysed. For this reason, and due to the image deterioration, the event was perceived as critical by the industry. In turn, the continuous contestations and re-enactments required the automotive industry to find an alternative solution with the potential to satisfy both outsiders and insiders.

CONCLUSION

Firms are part of industries, which in turn are embedded in ecosystems. Ecosystems encompasses all the entities operating and interacting in a value chain. The concept of ecosystem is widely used nowadays due to its capability to capture the complexity of players' interlinkages and interdependences (ECCP). Organisations, to survive in the current dynamic environment, feel the urge to collaborate in order to overcome the challenges prompt by the external environments. Ecosystems facilitate these operations thanks to their blurred boundaries and the bi-directional flow of information and resources circulating among actors and the environment.

The theories that are analysed in the literature review of this elaborate are necessary to understand the evolution of the academic studies, which followed the changes in marketplaces, culminating in the notion of ecosystem. The Open-system theory argues that systems evolve through a routinised, linear process, triggered by the environment, which exerts both initial pressures and final feedbacks on outputs. For scholars considering organisations as polities, the surrounding dynamics delineate, through different kinds of boundary processes, the internal politics (subgroups' interests and goals), which, in turn, define organisational responses to external pressures. Instead, in Complex Adaptive Systems, the non-linear adaptation process produces unique, not-planned, heterogeneous consequences. Finally, the Triple Embeddedness Framework is the most complete model, as it theorises the bi-directionality of interactions: not only it pictures the adaptation process happening in firms due to environmental influences, but it also considers "firms-in-industries" as active entities capable of cognitive processes, interpretative capabilities, and response mechanisms in order to strategically alter the external environment, at their own interest.

The complexity of interdependencies occurring in today ecosystems lead to the emergence of a growing number of events. Some, may require only partial and effortless changes to established routines, however, due to the current environment's dynamism and the ongoing advent of technological innovations, the number of non-routine events disrupting organisations, industries or ecosystems is growing. All in all, what features and mechanisms make an event salient and why some events receive public attention while others remain overlooked? Through the elaborate, two theories have been selected to answer to these

questions. Event's salience is the subject of study of the Event System Theory, elaborated by Morgeson et al. (2015), which defines the characteristics of events that make them meaningful. The theory studies the interactions among three factors: the event strength (quantified by novelty, criticality and disruption), the event space (the event's origin and spacial dispersion), and the event time (when the event occurs and its duration).
The model of industry attention to events, developed by Hoffman and Ocasio in 2001, depicts that two main reasons trigger events to gain attention: the public holds the industry directly accountable for the event's consequences, or the internal actors consider the event's effects as troubling for the industry image. However, the high initial attention to an event is sustained over time only due to competing enactments and contestations, among insiders and outsiders, over the event's meaning and the industry's accountability.

The purpose of the thesis is to determine the event-based influence on the ongoing structuring and restructuring of ecosystems. This phenomenon has been analysed through an investigation of the VW emissions scandal in order to prove a connection between the scandal's emergence and the recent turn towards e-mobility. Through the analysis of the automotive ecosystem using the TEF, it emerged that the prerequisites necessary for this shift towards electrification were absent. Neither the history of the transport system, or the external context, or the latest trends, or the structure of the automotive industry and the agency of OEMs could explain the turn in mobility that is actually happening.
The reason of this change has been researched in the Dieselgate scandal by analysing the European advocacy groups' official documents to detect the presence of a variation in their opinions, viewpoints and perceptions over some topics related to the scandal in the automotive industry. From the analysis of the case study we inferred that the VW emissions scandal can be categorised as a salient event, as it attracted both the public attention, which held the industry directly accountable for the event's outcomes, and the industry attention, which was highly worried for the consequences of the event for its image. Moreover, it is demonstrated that the event analysed can be defined as novel, disruptive and critical, whose features conferred to the scandal a remarkable degree of strength. Also, it is possible to claim that, in the timespan analysed, it was detected a change, even if feeble, in the perception of the two technology involved, diesel and electric engines. Therefore, we can assert that the Dieselgate scandal, thanks to its saliency, had an impact in the history of

mobility, by uncovering the illegal practices of automakers and by weakening the OEMs' and their "clean diesel" reputation and credibility.

The limitation of this thesis, however, can be found in the time period analysed. The timespan of two years may be too narrow to find an evident and clear transformation of the interest groups' opinions.

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