

Sustainability management in the global automotive industry: A theoretical model and survey study

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ABSTRACT

In the past decade, several publicized issues have revealed that the environmental and social performance of major automotive companies does not always conform to regulations or expectations. The purpose of this paper is to explore the sustainability behavior of automotive companies. Based on a systematic literature review, it is found that previous studies (a) offer only partial explanations for the behavior of automotive companies related to sustainability issues, and (b) both case studies and survey-based papers use inconsistent measurements. To address these gaps and inconsistencies, we propose a comprehensive theoretical model that describes the behavior of automotive companies along the relationships between “external pressures – strategy – practices – operational performance – financial performance”. To empirically validate our model, we apply structural equation modeling in SmartPLS using data on 142 automotive units from 22 countries. The results of the analysis suggest that pressure from external stakeholders has a positive impact on the inclusion of sustainability in the strategic agenda of automotive companies, which, in turn, increases the effort undertaken by these companies to implement sustainability practices. The implementation of such practices has a positive influence on operational performance in terms of environmental and social sustainability. Surprisingly, however, our findings do not indicate any significant effect on the financial performance of these firms.

1. Introduction

The automotive industry is one of the largest and most complex industries around the world (Orsato and Wells, 2007; Kannegiesser et al., 2014). Although the automotive industry is a key industrial sector influencing the sustainability of the global economic system, the environmental and social performance of major car manufacturers and other companies in the automotive supply network does not always conform to regulations or expectations (Koplin et al., 2007; Orsato and Wells, 2007).

In response to this practical challenge, sustainability has gained significant attention in the management literature in the past couple of decades, and the operations management literature is no exception in this respect. Several authors have investigated sustainability issues specifically in the automotive sector (e.g., González et al., 2008; Nunes et al., 2016; Held et al., 2018). Nevertheless, their findings are rather scattered, and to the best of our knowledge, no previous attempt has been made to align and generalize different results. More specifically, previous studies offer only fragmented evidence focusing on narrow segments of the sustainability behavior of automotive firms, and there

are no holistic models that can explain these behaviors, including their antecedents and performance outcomes. Furthermore, previous studies use diverse and inconsistent measurements of the main constructs, which poses an important barrier to generalizing their findings. Given these gaps and inconsistencies in the current literature, this study proposes the use of operations strategy theory as a conceptual lens to review and extend the current literature on sustainability management and introduces a comprehensive theoretical model to answer the following research question: *how can the sustainability behavior of firms in the automotive sector be described?*

Operations strategy theorists argue that any action on the level of operations (including sustainability practices) has to be aligned through the operations strategy with the general business strategy of the firm, which, in turn, is shaped by the pressures and requirements of the external environment (Ward and Duray, 2000; Koufteros et al., 2002; Szász and Seer, 2018). Operations that are well aligned with the external environment are meant to implement practices and actions to create operations capabilities that lead to superior operational and business performance (Bendoly et al., 2007; Szász and Demeter, 2014; Nair et al.,

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2020). From this perspective, operations strategy theory offers an appropriate lens to investigate sustainability management, the latter being defined as “the formulation, implementation, and evaluation of both environmental and socioeconomic sustainability-related decisions and actions” (Starik and Kanashiro, 2013: 12). The formulation-implementation-evaluation triad of this definition is compatible with the logic behind operations strategy theory: the formulation of sustainability-related decisions and actions is analogous to external pressures and operations strategy formulation, implementation is connected to operations practices, and evaluation is related to the performance outcomes of operations practices.

Thus, the aims of our paper are twofold: (1) to apply the operations strategy framework to systematically review and structure the literature related to sustainability management in the automotive industry and (2) to introduce and empirically validate, based on a large-scale survey, a holistic model of sustainability management that extends and generalizes previous findings in the literature, including antecedents (external pressures, operations strategies) and consequences (performance outcomes) related to the sustainability actions of automotive firms.

From a practical perspective, our study offers relevant insights into the implementation and performance implications of sustainability actions for practitioners working in an industry that has been largely affected by sustainability scandals in the last couple of decades. While there are some positive signs as well (e.g., the growing use of green supply chain management practices, Thun and Müller, 2010), the industry is still dominated by the echo of major sustainability issues. We identify four major scandals in the last 20 years that caught global attention, showing that the environmental and/or social performance of major car manufacturers does not always conform to regulations or expectations (Fig. 1). The first major issue involved Ford in 2000 and 2001. Several accidents due to improper tires were registered, and the faulty tires caused 103 deaths in total. As a result, Ford recalled 14.4 million tires (NHTSA, 2001; Noggle and Palmer, 2005). The second issue started in 2005 and brought about the largest recall in history until the present: General Motors (GM) recalled 30 million vehicles over a ten-year period due to a faulty ignition switch that stopped the engine during driving (Eifler and Howard, 2018). The accidents caused by this issue were severe in most of the cases, and a total of 124 deaths were registered. The third case is Toyota, whose trustworthiness was severely damaged between 2007 and 2011 because of the accelerator pedals that could get stuck in 7.5 million Toyota vehicles. Due to this faulty

component, 89 deaths were registered (The Economist, 2012; Szász and Demeter, 2014). In the current decade, the most recent automotive issue was Volkswagen's emissions scandal. Excessively high emissions of Volkswagen diesel engines were discovered in 2015, affecting a total of 11 million cars worldwide (Rhodes, 2016). These scandals also point towards the fact that the automotive industry should face a turning point in terms of sustainability, with car production being one of the least sustainable activities in the world (Nieuwenhuis and Katsifou, 2015; Orsato and Wells, 2007).

The paper is organized as follows: section 2 systematically reviews previous findings in the literature as a basis for construction of the hypotheses of a holistic model, section 3 presents the dataset and methods, section 4 summarizes the results of the analysis, and in the last section, we discuss our findings by comparing them with previous results and formulate the conclusions of our paper.

2. Literature review

Following the recommendations of Durach et al. (2017), we conducted a systematic literature review to identify and summarize relevant findings in the literature.

The first step of this process is to define a theoretical framework to guide the review process. As argued in the introduction, we use operations strategy theory to define the main constructs of interest in our topic. The operations strategy framework that is generally accepted in the literature argues that the external environment shapes the business strategy of firms, which is transposed to the level of operations through competitive priorities (Ward and Duray, 2000; Szász and Demeter, 2014; Nair et al., 2020). Then, operations practices are aligned with these strategic priorities and create competitive capabilities that lead to higher operational and financial performance (Koufteros et al., 2002; Bendoly et al., 2007; Rosenzweig and Easton, 2010). The theoretical framework defining the “environment – strategy – practices – performance” relationship structure has also been applied in the sustainability literature (e.g., Huang et al., 2012; Zailani et al., 2012; Nunes et al., 2016; Szász and Seer, 2018). To apply this theoretical framework to our subject, we investigate sustainability management in the automotive sector by including the following constructs and the relationships between them: external environment, sustainability strategy, sustainability practices, sustainability and business-related performance.

In the second step, to create an initial set of relevant papers, we

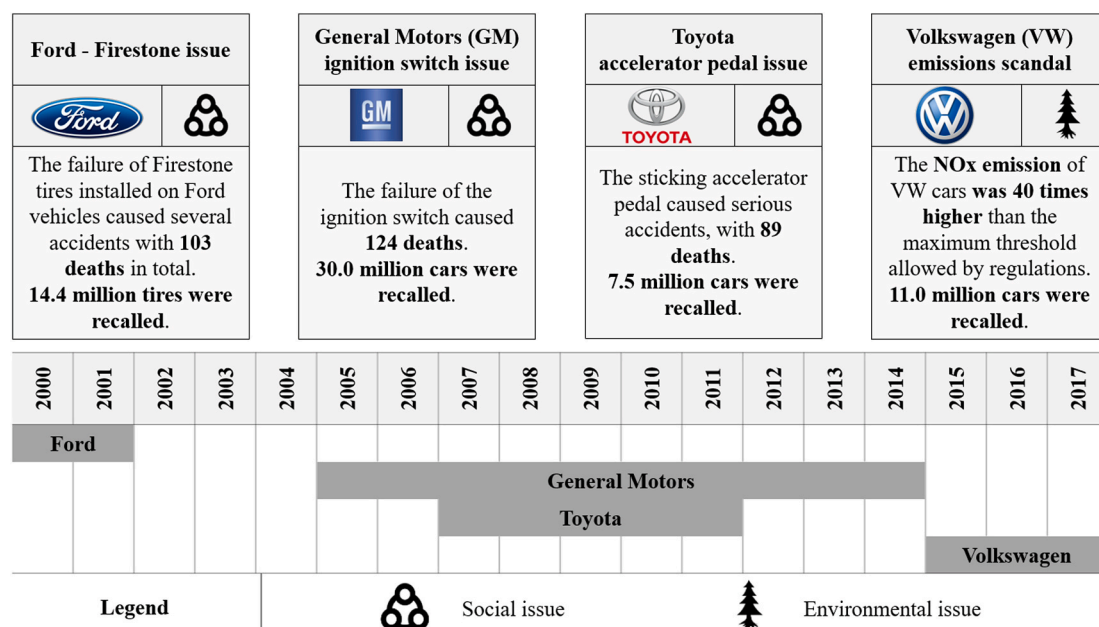


Fig. 1. Major sustainability scandals in the automotive industry in the last two decades.

identify five inclusion criteria: (a) articles are published in leading journals in business- and/or sustainability-related domains, (b) articles are published after 2000, (c) articles written in English, (d) the primary focus of the articles is automotive companies, but we also include other relevant manufacturing industries, and (e) the articles study relationships between relevant constructs (Table 1).

As a third step, we defined several combinations of keywords to retrieve a sample of potentially relevant literature (Table 2). The search was performed in the Clarivate Web of Science database on June 9, 2020. The keyword-based search resulted in an initial pool of 1089 articles. After the elimination of duplicates, all abstracts were read to restrict our sample to relevant topics, complemented by a full-text analysis, which yielded 22 relevant articles. To avoid missing any further relevant studies, we used the “snowballing” technique to analyze the reference list of the 22 articles and included another 27 articles that fulfilled all inclusion criteria and addressed industrial compositions relevant to the automotive industry.

The final sample contains 49 relevant journal articles published in 24 different journals (Table 3).

The results of the analysis of these papers are presented in the following sections and summarized in Table 4 and Table 5.

2.1. The effect of external pressures on sustainability strategies and practices

Companies face three main types of external pressures: normative, imitative and regulative pressures (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Lo and Shiah, 2016). Normative pressures come from the market in the form of customers', suppliers' and partners'

Table 1
Inclusion criteria.

Inclusion criteria	Detailed argument
(a) Business and/or sustainability related scientific articles in leading journals	We focus exclusively on scientific articles indexed in the Clarivate Web of Science database, excluding conference proceedings, book chapters and other nonarticle publications, to review the most reliable sources that have undergone a rigorous review process. Journals must be indexed in at least one of the business, economics or sustainability domains.
(b) Articles published after 2000	We focus on scientific publications after 2000, as major car manufacturers started to embrace sustainability in their strategic agendas mainly in the new century (Sukitsch et al., 2015), and the largest environmental and social scandals in history all occurred after 2000.
(c) Articles written in English.	The use of English, as the dominant research language in business studies, ensures the accessibility and comparability of our results.
(d) Articles focusing on automotive units or other manufacturing companies	We primarily search for findings related to the automotive industry (d1), but given the diverse industrial composition of global automotive supply chains and the restricted amount of literature focusing solely on the automotive industry, we complemented our search by including sustainability studies using mixed industrial samples (d2), thereby allowing the inclusion of all manufacturing industries that might yield analogies for automotive companies.
(e) Articles focusing on relationships	Articles must explore relationships between at least two constructs relevant to our study (i.e., external pressure, sustainability strategy, sustainability practices, environmental performance, social performance and financial performance).

Table 2
Article selection process.

1. Retrieval of articles based on keywords and inclusion criteria (a), (b) and (c)		
“sustainability, automotive industry”	333	1089 articles
“environmental performance, automotive industry”	405	
“social performance, automotive industry”	146	
“environmental practices, automotive industry”	134	
“social practices, automotive industry”	71	
2. Elimination of duplicates		
The elimination of duplicate articles from the search results		769 articles
3. Article selection based on inclusion criteria (d1) and (e)		
The selection of the articles that meet all of the inclusion criteria		22 articles
4. Search for complementary articles based on inclusion criteria (d2), fulfilling (a–e)		
The addition of further relevant articles with more diverse industrial compositions		27 articles
FINAL SAMPLE		49 articles

expectations (Scott, 1995). Imitative pressures come from competitors, as every company strives to gain competitive advantages (Scott, 1995). Regulative pressure refers to the legal responsibilities and requirements that must be met (Scott, 1995). Being heavily resource-dependent, the automotive industry must face all these pressures that drive automotive companies to become more sustainable (Zhu et al., 2007).

Focusing on *normative pressures*, authors argue that one important stakeholder group that drives automotive firms to adopt sustainability-focused strategies is represented by customers (Held et al., 2018). For example, Hetterich et al. (2012) argue that car customers are demanding more ecologically sustainable products and are even willing to pay extra to have renewable materials in their cars. In a survey study of 35 German automotive suppliers, Thun and Müller (2010) also find that customers are the most important driving force behind ecological initiatives. In a B2B setting, supply chain pressures usually also take the form of customers pressing suppliers to comply with sustainability requirements (González et al., 2008; Baden et al., 2009; Awaysheh and Klassen, 2010). Simpson et al. (2007), however, argue that the relationship between customer requirements and suppliers' strategic commitment towards sustainability holds only if there is a high relationship-specific investment between the customer and the supplier.

Regarding *imitative pressures*, several articles emphasize that the actions of competitors are also an important external driver of sustainability-related strategies and practices. Thun and Müller (2010), for example, find that in addition to customers, competitors are the second most significant driving force pressuring German automotive companies to implement green supply chain practices. Several other authors argue that firms seeking to gain competitive advantage cannot lag behind their competitors and should try to overcome them in terms of implementing sustainability policies and actions (Walker et al., 2008; Huang et al., 2012).

In terms of *regulative pressures*, the laws and regulations faced by automotive companies have become stricter in recent years, and companies that are discovered not to conform are fined. These legal restrictions, including higher prospective fines, force automotive companies to strive for more sustainable operations. Several authors argue that legal and regulatory pressures are the primary external drivers of a sustainability-focused business strategy (Hall, 2000; Zhu et al., 2007; Kehbilla et al., 2009; Lin and Ho, 2016; Vanalle et al., 2017; Held et al., 2018). Zhu et al. (2005) also find that regulatory factors represent the most important driver of the implementation of green supply chain practices in Chinese manufacturing firms. Furthermore, Nakamura et al. (2001) use a large-scale survey study to show that in addition to governmental regulations, pressures from civic society (nongovernmental organizations) can drive automotive companies to adopt sustainability strategies and practices. Zailani et al. (2012) argue that both governmental and customer pressures have a significant

Table 3
Relevant articles by year of publication and journal.

Year of publication	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Name of journal																						
International Journal of Operations & Production Management	1	1	1			2		1	1		1		1				1					10
Journal of Cleaner Production						1		1					1		1	1		1	1	1		8
Business Strategy and the Environment											1				1	1		1	1			4
European Management Journal	1									1												2
Journal of Operations Management					1						1											2
International Journal of Production Economics													2									2
Supply Chain Management: An International Journal													1				1					2
Corporate Social Responsibility and Environmental Management										1										1		2
Sustainability																2						2
Journal of Environmental Economics and Management		1																				1
Administrative Science Quarterly				1																		1
Organization Studies				1																		1
Business Process Management Journal							1															1
Journal of Purchasing and Supply Management									1													1
Journal of Supply Chain Management Resources, Conservation and Recycling										1												1
Transportation Research Part E: Logistics and Transportation Review												1										1
IEEE Transactions on Engineering Management													1									1
Journal of Environmental Planning and Management													1									1
Journal of World Business													1									1
Production Planning & Control													1									1
Industrial Management & Data System														1								1
International Journal of Sustainable Transportation																1						1
Long Range Planning																	1					1
Total	2	2	1	2	1	3	1	2	2	3	3	2	9	1	1	5	3	2	2	1	1	49

Table 4

Summary of the literature on the external pressure – strategy – practice relation chain.

Reference	Industry (country)	Sample	Method	Effect(s)*
Adebanjo et al. (2016)	Various industries, including automotive (China, India, Malaysia)	159 companies	Survey +SEM	EXTPRES → SUSPRAC (+)
Awaysheh & Klassen (2010)	Various industries, including automotive (Canada)	307 companies	Survey + factor analysis, discriminant analysis	EXTPRES → SUSPRAC (+)
Baden et al. (2009)	Various industries (UK)	Interviews + survey of 103 SMEs	25 semi-structured interviews and online surveys	EXTPRES → SUSPRAC (+) → SOCPERF (+)
Böttcher & Müller (2015)	Automotive industry (Germany)	159 companies	Survey +SEM	EXTPRES → SUSPRAC (+) → ENVPERF (+) → FINPERF (+)
Diaz-Garrido et al. (2016)	Automotive industry (Spain)	228 companies	Survey + category analysis	EXTPRES → SUSSTRAT (+)
González et al. (2008)	Automotive industry (Spain)	157 personal interviews with automotive suppliers	Binary logistic regression	EXTPRES → SUSPRAC (+)
Green et al. (2012)	Various industries, including automotive (USA)	159 companies	Survey +SEM	SUSSTRAT → SUSPRAC (+)
Held et al. (2018)	Automotive industry (Germany)	14 pilot survey and 37 online survey with automotive industry experts	Survey + descriptive statistics	EXTPRES → SUSSTRAT (+), SUSSTRAT → SUSPRAC (+)
Hetterich et al. (2012)	Automotive industry (Germany)	15 semi-structured interviews and 106 potential car buyers	Interview and survey + PCA	EXTPRES → SUSPRAC (+)
Huang et al. (2012)	Hi-tech industries (Taiwan)	349 companies	Surveys +SEM	EXTPRES → SUSPRAC (+) → ENVPERF (+) → FINPERF (+)
Kehbila et al. (2009)	Automotive industry (South Africa)	81 companies	Survey	EXTPRES → SUSPRAC (+)
Lin & Ho (2016)	Automotive industry (global)	74 companies	Secondary data + regression	EXTPRES → ENVPERF (indirect, +)
Lo & Shiah (2016)	Hi-tech industries (Taiwan)	174 companies	Survey + regression	EXTPRES → SUSPRAC (+)
Nakamura et al. (2001)	Various industries, including automotive (Japan)	193 companies	Survey + factor analysis and OLS regression	EXTPRES → SUSSTRAT (+), EXTPRES → SUSPRAC (+)
Sarkis (2001)	Manufacturing units (USA)	–	Conceptual	EXTPRES → SUSSTRAT (+) → SUSPRAC (+)
Sarkis et al. (2010)	Automotive industry (Spain)	157 companies	Survey +SEM	EXTPRES → SUSPRAC (+)
Seitz & Wells (2006)	Automotive industry (Europe)	1 company	Case study (one European OEM)	SUSSTRAT → SUSPRAC (0) SUSPRAC → FINPERF (0), SUSPRAC → ENVPERF (0)
Severo et al. (2015)	Automotive industry (Brazil)	298 companies	Survey +SEM	SUSPRAC → SUSSTRAT (+)
Simpson et al. (2007)	Automotive industry (Australia)	6 interviews, 55 companies	Semi-structured interviews and survey + linear regression	EXTPRES → SUSSTRAT (+)
Shinkle & Spencer (2012)	Automotive industry (global)	3 OEMs	Critical discourse analysis	EXTPRES → SUSSTRAT (+)
Sukitsch et al. (2015)	Automotive industry (global)	14 OEMs	Case study	EXTPRES → SUSSTRAT (+)
Thun & Müller (2010)	Automotive industry (Germany)	35 companies	Survey + cluster analysis, discriminant analysis	EXTPRES → SUSPRAC (+) → ENVPERF (+)
Vanalle et al. (2017)	Automotive industry (Brazil)	83 companies	Survey +SEM	EXTPRES → SUSPRAC (+) → ENVPERF (+)
Walker et al. (2008)	Various industries (UK)	Interviews with 7 economic entities	Surveys	EXTPRES → SUSPRAC (+)
Zailani et al. (2012)	Various industries (Malaysia)	132 companies	Survey +SEM	EXTPRES → SUSSTRAT (+) → ENVPERF (+), EXTPRES → ENVPERF (+)
Zhu et al. (2005)	Various industries, including automotive (China)	314 manufacturing units	Survey + exploratory factor analysis, <i>t</i> -test	EXTPRES → SUSPRAC (+), SUSSTRAT → SUSPRAC (+), SUSPRAC → ENVPERF (+)
Zhu et al. (2007)	Automotive industry (China)	89 car manufacturers + 1 case study at an engine manufacturer	Case study and survey + regression analysis	EXTPRES → SUSPRAC (case study: +/survey:0);

*EXTPRES – external pressure, SUSSTRAT – sustainability strategy, SUSPRAC – sustainability practices, SOCPERF – social performance, ENVPERF – environmental performance, FINPERF – financial performance, (+) positive relation, (–) negative relation, (0) no relation.

impact on the environmental performance of firms, both directly and indirectly, through sustainability-focused strategies.

The findings are not always conclusive, however. In a single case study of a European vehicle manufacturer, [Seitz and Wells \(2006\)](#) found that remanufacturing practices, i.e., a category of methods that are supposed to improve the environmental and social performance of companies, do not result from a sustainability-focused strategic approach or lead to higher environmental or financial performance. Similarly, [Zhu et al. \(2007\)](#) found no relationship between external (regulatory and supply chain) pressures and green supply chain management practices implemented by Chinese automotive firms. While these results are not generalizable and do not reflect recent developments, they still show that exceptions exist.

In summary:

- The majority of authors agree that external pressures, which may be normative, imitative or regulative, represent the most important driving force for companies to adopt sustainability-focused strategies and practices, although some exceptions exist.
- Studies generally include only one or a limited set of stakeholder groups that can exercise pressure on automotive firms. From this perspective, [Huang et al. \(2012\)](#) and [Lo and Shiah \(2016\)](#) offer the most comprehensive assessment of external stakeholder pressures, including customers, suppliers, competitors and the government in their measurement model. Some authors further add to the list of relevant stakeholders, including categories such as nongovernmental organizations and internal stakeholders (shareholders and employees) (e.g., [Sarkis et al., 2010](#); [Böttcher and Müller, 2015](#); [Diaz-Garrido et al., 2015](#)). From a more practice-oriented perspective, [Shinkle and Spencer \(2012\)](#) and [Sukitsch et al. \(2015\)](#) analyze the corporate sustainability reports of major car manufacturers and

Table 5

Summary of the literature on practices – performance relations.

Reference	Industry (country)	Sample	Method	Effect(s)*
Adebajo et al. (2016)	Various industries, including automotive (China, India, Malaysia)	159 companies	Survey +SEM	EXTPRES → ENVPERF (+), EXTPRES → SUSPRAC → ENVPERF (+)
Azevedo et al. (2011)	Automotive industry (Portugal)	5 companies	Case studies	SUSPRAC → ENVPERF (+), SUSPRAC → FINPERF (+)
Azevedo et al. (2012)	Automotive industry (Portugal)	1 company	Case study	SUSPRAC → ENVPERF (+), SUSPRAC → SOCPERF (+), SUSPRAC → FINPERF (0)
Baden et al. (2009)	Various industries (UK)	Interviews + survey of 103 SMEs	25 semi-structured interviews and online surveys	EXTPRES → SUSPRAC (+) → SOCPERF (+)
Böttcher & Müller (2015)	Automotive industry (Germany)	159 companies	Survey +SEM	EXTPRES → SUSPRAC (+) → ENVPERF (+) → FINPERF (+)
Comoglio & Botta (2012)	Automotive industry (Italy)	45 companies	Survey + descriptive statistics	SUSPRAC → ENVPERF (+)
De Giovanni & Vinzi (2012)	Various industries (Italy)	138 companies	Survey +SEM	SUSPRAC → ENVPERF (+), SUSPRAC → FINPERF (+)
Eltayeb et al. (2011)	Various industries (Malaysia)	569 companies	Survey + regression analysis	SUSPRAC → ENVPERF (0/+), SUSPRAC → FINPERF (0/+)
Feng et al. (2018)	Automotive industry (China)	126 companies	Survey +SEM	SUSPRAC → ENVPERF (+) → FINPERF (+)
Gimenez et al. (2012)	Various industries, including automotive (19 countries)	519 assembly plants	Survey +SEM	SUSPRAC → ENVPERF (+), SUSPRAC → SOCPERF (+), SUSPRAC → FINPERF (0/+)
Govindan et al. (2014)	Automotive industry (Portugal)	5 companies	Case study	SUSPRAC → ENVPERF (+), SUSPRAC → SOCPERF (+), SUSPRAC → FINPERF (+)
Green et al. (2012)	Various industries, including automotive (USA)	159 companies	Survey +SEM	SUSPRAC → ENVPERF (+) → FINPERF (0)
Hartmann and Vachon (2018)	Various industries, including automotive (Europe)	336 companies	Secondary database + regression	SUSPRAC → ENVPERF (+)
Huang et al. (2012)	High-tech industries (Taiwan)	349 companies	Surveys +SEM	EXTPRES → SUSPRAC (+) → ENVPERF (+) → FINPERF (+)
Kehbilla et al. (2009)	Automotive industry (South-Africa)	81 companies	Survey	SUSPRAC → SOCPERF (+)
Laosirihongthong et al. (2013)	Various industries, including automotive (Thailand)	190 companies	Survey + regression analysis	SUSPRAC → ENVPERF (+), SUSPRAC → FINPERF (+)
Lin et al. (2019)	Automotive industry (global)	163 companies	Secondary data + regression	ENVPERF → FINPERF (+)
Lin et al. (2020)	Automotive industry (global)	132 companies	Secondary data + regression	ENVPERF, SOCPERF → FINPERF (±)
Margolis & Walsh (2003)	–	–	Literature review	SUSPRAC → FINPERF (+), SOCPERF → FINPERF (+)
Orlitzky et al. (2003)	Various industries (global)	33,878 observations based on 52 articles	Meta-analysis of literature	SUSPRAC → FINPERF (+), SOCPERF → FINPERF (+)
Pullman et al. (2009)	Food industry (USA)	117 companies	Survey + factor analysis	SUSPRAC → ENVPERF (+)
Rao & Holt (2005)	Various industries (South-East-Asia)	52 companies	Survey +SEM	SUSPRAC → FINPERF (+)
Rao (2002)	Various industries (South-East-Asia)	52 companies	Survey +SEM	SUSPRAC → ENVPERF (+) → FINPERF (+)
Rondinelli & Vastag (2000)	Aluminum (USA)	1 company	Case study	SUSPRAC → ENVPERF (+)
Seitz & Wells (2006)	Automotive industry (Europe)	1 company	Case study (one European OEM)	SUSSTRAT → SUSPRAC (0) SUSPRAC → FINPERF (0), SUSPRAC → ENVPERF (0)
Tan (2005)	Various industries (Malaysia)	18 companies	Survey	SUSPRAC → ENVPERF (+), SUSPRAC → SOCPERF (+), SUSPRAC → FINPERF (+)
Theyel (2000)	Chemicals (USA)	188 companies	Interviews and survey + regression analysis	SUSPRAC → ENVPERF (+)
Wu et al. (2015)	Automotive industry (China)	3 companies	Case study	SUSPRAC → ENVPERF (+), SUSPRAC → SOCPERF (+), SUSPRAC → FINPERF (+)
Zailani et al. (2012)	Various industries (Malaysia)	132 companies	Survey +SEM	EXTPRES → SUSSTRAT (+) → ENVPERF (+), EXTPRES → ENVPERF (+)
Zhu & Sarkis (2004)	Various industries, including automotive (China)	186 companies	Survey + regression analysis	SUSPRAC → ENVPERF (+), SUSPRAC → FINPERF (+)
Zhu et al. (2005)	Various industries, including automotive (China)	314 manufacturing units	Survey + EFA (Exploratory Factor Analysis), t-test	EXTPRES → SUSPRAC (+), SUSSTRAT → SUSPRAC (+), SUSPRAC → ENVPERF (+)
Zhu et al. (2007)	Automotive industry (China)	89 car manufacturers + 1 case study at an engine manufacturer	Case study and survey + regression analysis	SUSPRAC → ENVPERF (+), SUSPRAC → FINPERF (0)

*EXTPRES – external pressure, SUSSTRAT – sustainable strategy, SUSPRAC – sustainable practices, SOCPERF – social performance, ENVPERF – environmental performance, FINPERF – financial performance, (+) positive relation, (–) negative relation, (0) no relation.

find that the vast majority of them rely on an active dialogue with a diverse group of key stakeholders in shaping their sustainability strategy.

- Research findings are inconclusive regarding the dependent variable related to external pressures: some studies investigate the direct impact of external pressures on sustainability practices (e.g., Walker et al., 2008; Sarkis et al., 2010; Böttcher and Müller, 2015; Adebajo et al., 2016; Lo and Shiah, 2016; Vanalle et al., 2017), while others create a direct link between external pressures and sustainability strategy (e.g., Simpson et al., 2007; Zailani et al., 2012; Diaz-Garrido et al., 2015). Nakamura et al. (2001) include both relationships simultaneously. One study introduces a research model in which practices drive company-level environmental policies, and not vice versa (Severo et al., 2015). Another paper fully omits sustainability strategies and practices, creating an indirect link through organizational ambidexterity between external pressures and environmental performance (Lin and Ho, 2016). Based on operations strategy theory, we argue that the complete link between these constructs should follow the logical order of pressures – strategy – practices. The conceptual paper of Sarkis (2001) and the empirical paper of Green et al. (2012) also support this idea.

Starting from a summary of the shortcomings and arguments above, we intend to provide a literature-based holistic model of sustainable management in the automotive industry. Therefore, using operations strategy theory, we formulate the following two hypotheses:

H1. External stakeholder pressures have a positive impact on sustainability-focused strategies.

H2. A sustainability-focused strategy has a positive impact on the implementation of (environmental and social) sustainability practices.

The literature on the “external pressure – strategy – practice” relation chain is summarized in Table 4.

2.2. Performance effects

The performance impact of sustainability initiatives in the automotive industry has always been at the center of researchers' attention, and the number of articles from our sample dealing with performance implications (Table 5) clearly supports this statement. Furthermore, in some instances, automotive examples are used to formulate sustainability-related performance hypotheses in other industrial sectors (e.g., Pullman et al., 2009). The social and environmental scandals that strike the automotive industry continue to drive companies to intensify their pursuit towards improving their sustainability performance. This motivation is complemented by tightening regulatory pressures, such as the most recent emission targets of the EU, which leave no choice for automotive companies but to further improve their environmental and social performance or face the financial burden of fines due to failure to comply (Morgadinho et al., 2015).

Given the sharp theoretical and practical focus on performance improvement opportunities, the literature offers several conceptual and empirical studies that investigate the relationship between sustainability management and company performance. While most studies advocate a positive performance effect, there are several discordances in the literature, especially in terms of performance operationalization and measurement, an issue pointed out in earlier literature reviews as well (Margolis and Walsh, 2003; Orlitzky et al., 2003). We summarize this stream of literature as follows:

- In line with the triple bottom line concept as a systemic approach towards sustainability (Nunes and Bennett, 2010), the three performance dimensions found in the literature are the environmental, social and economic/financial dimensions.

- Most of the studies include one (e.g., Theyel, 2000; Kehbila et al., 2009; Comoglio and Botta, 2012; Hartmann and Vachon, 2018) or two (e.g., Azevedo et al., 2011; De Giovanni and Vinzi, 2012; Laosirihongthong et al., 2013; Feng et al., 2018) of the three performance dimensions. There are only a few papers that strive towards a more holistic assessment of performance effects, involving all three performance dimensions (Tan, 2005; Azevedo et al., 2012; Gimenez et al., 2012; Govindan et al., 2014; Wu et al., 2015). With a few exceptions, the majority of the articles, including the meta-analysis of Orlitzky et al. (2003), offer support for the positive impact of sustainability practices on one or more of the performance dimensions. One notable exception is Lin et al. (2020), who also find a positive relationship between the environmental/social performance and financial performance of automotive firms but argue that in the presence of a moderator (market differentiation), this relationship can become an inverted V-shaped relationship.
- There is a large inconsistency in the way the three performance dimensions are measured (cf. Margolis and Walsh, 2003). In several cases, the different performance dimensions are mixed together in the same construct (e.g., Severo et al., 2015). There are also differences in how the same performance dimensions are measured. For example, using different versions of the same survey, Gimenez et al. (2012) measure environmental performance as the percentage change in performance over the last three years, while Adebajo et al. (2016) measure the same construct as the importance of order winner priorities. While this is a problematic issue in several cases, given the diversity of research instruments, countries and companies with different strategies involved in the studies, it might be a natural consequence as well (Orlitzky et al., 2003).
- More importantly, studies model the impact of sustainability practices on the three performance dimensions in an inconsistent manner. Several articles measure the impact of these practices on environmental/social and financial performance directly and simultaneously: Zhu and Sarkis (2004) and Eltayeb et al. (2011), for example, show that green supply chain practices have a positive impact on both environmental and financial performance; Azevedo et al. (2012) investigate the simultaneous impact of these practices on environmental, social and financial (cost) performance; Wu et al. (2015) also take environmental, social and financial performance into consideration, mixing these indicators together in aggregated performance constructs. However, according to operations management theory, environmental and social performance are more immediate performance outcomes of sustainability practices, which can be regarded as operational performance indicators. Financial performance, on the other hand, is a business-level performance indicator that is directly influenced by the operational performance of the company. Thus, we argue that such a model should follow the “practices – operational performance – financial performance” logic. Essentially, we argue that operational performance (in our case, environmental and social performance) mediates the impact of sustainability practices on the financial performance of a firm. This approach is also in line with the recommendations of Rao (2002), Green et al. (2012), Huang et al. (2012), Böttcher and Müller (2015) and Feng et al. (2018).

Based on the summary above, we formulate the following hypotheses related to the performance impact of sustainability practices, where environmental and social performance (as operational performance indicators) mediate the relationship between practices and financial performance.

H3. Sustainability practices have a positive impact on environmental performance.

H4. Sustainability practices have a positive impact on social performance.

H5. High environmental performance has a positive effect on financial performance.

H6. High social performance has a positive effect on financial performance.

The literature on the “practices – operational performance – financial performance” relation chain is summarized in Table 5.

In summary, the 49 articles found to be relevant in our systematic literature review show that much effort has been made to map sustainability-related issues in the automotive and related manufacturing sectors. Nevertheless, as our analysis points out, (a) none of these articles provide a comprehensive framework explaining the implementation of sustainability practices, their antecedents and their performance implications, and (b) the measurement of the main constructs of interest is largely inconsistent across studies.

Two papers that use a similar dataset to ours but with a different set of industries and different timeframes (Adebanjo et al., 2016; Gimenez et al., 2012) are also relevant to exemplify the gaps and inconsistencies in the current literature. Given two similar datasets, external stakeholder pressures are considered only by Adebanjo et al. (2016), while sustainability strategy is present only in the Gimenez et al. (2012) study, albeit only as a control variable. Furthermore, while both studies include sustainability practices in their analysis, Gimenez et al. (2012) focus on external (i.e., supply chain-level) practices as well beside internal practices. Last, there are significant inconsistencies in the way performance outcomes are operationalized by the two papers. On the one hand, Gimenez et al. (2012) use a single construct that includes environmental, social and financial performance as well, which does not enable the assessment of distinct performance impacts of sustainability practices. On the other hand, Adebanjo et al. (2016) include separate measures for environmental (including environmental and social performance items) and economic performance (cost and time efficiency) but measure environmental performance as strategic objectives and not as actual performance outcomes. Given the discrepancies in the reviewed literature, exemplified by the two papers above, we construct a holistic model of sustainability management in the automotive sector, which is presented in Fig. 2.

3. Data and methodology

3.1. Research sample

To measure external pressures, sustainability strategy, sustainability practices, and environmental, social and financial performance of automotive firms, we use the most recent database of the International Manufacturing Strategy Survey (IMSS VI).

Since its launch in 1992, coordinated originally by the London Business School and Chalmers University of Technology, data collection in the IMSS has been carried out every 4–5 years, with 6 rounds of data collection until the present (www.manufacturingstrategy.net). The most recent edition was carried out during 2013 and 2014. The IMSS VI contains data on 915 manufacturing companies from 22 countries, among which 142 automotive firms with complete data on all our variables of interest are selected (Table 6). Questions were answered by

manufacturing/operations managers or the person in an equivalent position, who are the most knowledgeable about issues related to company operations, including strategy, practices and performance. The same rigorous data collection procedure was applied in each participating country, with final data quality checks being performed by the central coordination team at Politecnico di Milano.

3.2. Measures

The external pressure construct measures stakeholder expectations related to sustainable operations and consists of two main variables, namely, environmental pressure (Sarkis et al., 2010) and social pressure (Porter and Kramer, 2002). Each item was measured on a 5-point Likert scale ranging from very weak perceived pressure (1) to very strong external pressure (5).

To measure the role of sustainability goals in the manufacturing strategy of firms, we used the following three items: environmentally sound products and processes (Gimenez et al., 2012), contribution to the development and welfare of society (Maxwell and van der Vorst, 2003) and safe and health respectful processes (Maxwell and van der Vorst, 2003). All items were measured on a 5-point scale to assess the order winner importance of these factors in the manufacturing strategy of the respondents, ranging from not important (1) to very important (5).

Table 6

The composition of the research sample by country and ISIC code.

Country	Frequency (number of firms)	Relative frequency (%)	Frequency of ISIC codes*		Relative frequency of ISIC codes* (%)	
			29	30	29	30
Belgium	10	7,04%	9	1	9,68%	2,04%
Brazil	7	4,93%	5	2	5,38%	4,08%
Finland	3	2,11%	3	0	3,23%	0,00%
Netherlands	5	3,52%	2	3	2,15%	6,12%
India	20	14,08%	13	7	13,98%	14,29%
Japan	17	11,97%	7	10	7,53%	20,41%
Canada	1	0,70%	1	0	1,08%	0,00%
China	27	19,01%	20	7	21,51%	14,29%
Hungary	7	4,93%	6	1	6,45%	2,04%
Malaysia	1	0,70%	1	0	1,08%	0,00%
Germany	1	0,70%	1	0	1,08%	0,00%
Norway	1	0,70%	0	1	0,00%	2,04%
Italy	5	3,52%	2	3	2,15%	6,12%
Portugal	4	2,82%	3	1	3,23%	2,04%
Romania	2	1,41%	2	0	2,15%	0,00%
Spain	3	2,11%	2	1	2,15%	2,04%
Switzerland	2	1,41%	2	0	2,15%	0,00%
Sweden	11	7,75%	8	3	8,60%	6,12%
Taiwan	3	2,11%	2	1	2,15%	2,04%
USA	12	8,45%	4	8	4,30%	16,33%
Total	142	100,00%	93	49	100,00%	100,00%

*ISIC code - 29: Manufacture of motor vehicles, trailers and semitrailers; 30: Manufacture of other transport equipment.

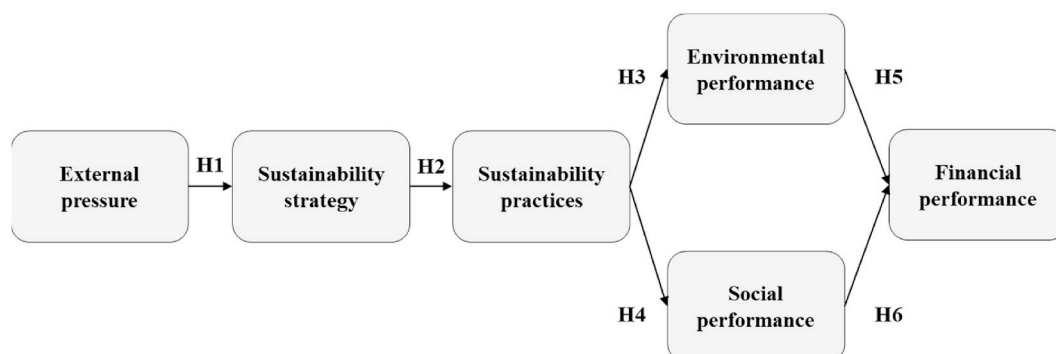


Fig. 2. Sustainability management – research framework.

Table 7

Description and descriptive statistics of the variables adopted from the questionnaire.

Variable codes	Latent variable	Manifest variables	Reference	Min	Max	Avg.	St. dev.
A2j	External pressure	Environmental pressure (e.g., stakeholders call for environmentally friendly products and processes)	Sarkis et al. (2010)	1	5	3.48	1.06
A2k		Social pressure (e.g., stakeholders pay attention to companies' commitment to ethical issues, human rights respect, labor conditions)	Porter & Kramer (2002)	1	5	3.33	1.12
A3m	Sustainability strategy	More environmentally sound products and processes	Gimenez et al. (2012)	1	5	3.30	0.95
A3n		Higher contribution to the development and welfare of society	Maxwell & van der Vorst (2003)	1	5	3.25	1.06
A3o		More safe and health respectful processes	Maxwell & van der Vorst (2003)	1	5	3.56	1.16
SM1a1	Sustainability practices	Environmental certificates (e.g., EMAS or ISO 14001)	Kitazawa & Sarkis (2000)	1	5	3.59	1.29
SM1d1		Energy and water consumption reduction programs	Sarkis (1998)	1	5	3.35	1.12
SM1e1		Pollution emission reduction and waste recycling programs	Klassen & Whybark (1999)	1	5	3.27	1.13
SM1b1		Social certificates (e.g., SA8000 or OHSAS, 18000)	Longo et al. (2005)	1	5	2.93	1.44
SM1c1		Formal sustainability-oriented communication, training programs and involvement	Daily & Huang (2001)	1	5	3.09	1.13
B6q1	Environmental performance	Materials, water and/or energy consumption	Rao (2002)	1	5	2.65	0.92
B6r1		Pollution emission and waste production levels	Zhu and Sarkis (2004); Zhu et al. (2005); Rao and Holt (2005)	1	5	2.83	0.98
B6k1	Social performance	Workers' motivation and satisfaction	Gimenez et al. (2012)	1	5	2.94	0.92
B6l1		Health and safety conditions	Maxwell et al. (2006)	2	5	3.46	0.99
A4b	Financial	Sales	–	1	5	3.62	0.94
A4d	performance	Return on Sales	–	1	5	3.24	0.97

The construct assessing sustainable practices contains five items measuring both environmental and social practices: environmental certifications ([Kitazawa and Sarkis, 2000](#)), energy and water consumption reduction ([Sarkis, 1998](#)), pollution emission reduction and waste recycling programs ([Klassen and Whybark, 1999](#)), social certificates ([Longo et al., 2005](#)), formal sustainability-oriented communication, training programs and involvement ([Daily and Huang, 2001](#)). All five items were measured on a 1–5 Likert scale ranging from no effort (1) to high effort (5) undertaken in the last three years to implement these practices.

In concordance with the triple bottom line perspective, we include three performance indicators in our study: environmental, social and financial performance (e.g., [Gimenez et al., 2012](#)). The environmental performance construct consists of materials, water and/or energy consumption ([Rao, 2002](#)), and pollution emission and waste production levels ([Zhu and Sarkis, 2004](#); [Zhu et al., 2005](#); [Rao and Holt, 2005](#)). We measure the change in performance levels over the past three years on a 5-point scale. Given that these performance indicators denote harmful environmental effects, a reverse scale is used, ranging from “increased by 5% or more” (1) to “strongly decreased by 25% or more” (5). The scale is asymmetric to enable a more fine-grained assessment of performance improvement (as opposed to performance decline). The social performance construct also includes two variables, namely, workers' motivation and satisfaction ([Gimenez et al., 2012](#)) and health and safety conditions ([Maxwell et al., 2006](#)). A similar 5-point scale is used ranging from “decreased by 5% or more” (1) to “strongly increased by 25% or

more” (5). Last, the change in financial performance is measured in terms of sales and profitability compared to the same indicators three years before. A 5-point Likert scale ranging from “much lower” (1) to “much higher” (5) is used. Literature support and descriptive statistics for the constructs used are presented in [Table 7](#).

4. Data analysis and results

To test the hypotheses, we use partial least squares structural equation modeling (PLS-SEM). PLS-SEM can handle complex interrelations between constructs even on smaller datasets ([Henseler et al., 2016](#)), assessing direct, indirect and total effects on the constructs of interest ([Hair et al., 2017](#)). In addition, the PLS-SEM method can handle nonnormally distributed data, which is an important feature, as skewed distribution of variables is typical for the survey data we use in our study ([Hair et al., 2017](#)).

Altogether, 6 constructs are developed based on 16 manifest variables (indicators). The 6 latent constructs are developed as part of a reflective model, where all constructs are the cause and not the consequence of manifest variables ([Henseler et al., 2016](#)). To run the PLS algorithm, we used the default path weighting scheme: the data were standardized before the estimation of latent constructs, the tolerance level was set to 1e-5, the maximum number of iterations was set to 300, and the algorithm was run to create 5000 bootstrap samples. All analysis procedures are based on the recommendations and best practices in [Hair et al. \(2017\)](#).

Table 8

Measurement model estimates for the constructs and variables used.

Latent variable	Manifest variable	Weights	Factor loadings	Standard error	AVE	Cronbach Alpha	CR	pA
External pressure	A2j	0.667	0.895	0.061	0.723	0.624	0.839	0.658
	A2k	0.501	0.804	0.055				
Sustainable strategy	A3m	0.413	0.880	0.035	0.762	0.845	0.906	0.849
	A3n	0.351	0.862	0.027				
	A3o	0.380	0.877	0.023				
Financial performance	A4b	0.628	0.892	0.243	0.752	0.672	0.858	0.687
	A4d	0.523	0.841	0.274				
Environmental performance	B6k1	0.590	0.902	0.072	0.792	0.738	0.884	0.743
	B6l1	0.533	0.878	0.071				
Social performance	B6q1	0.511	0.859	0.121	0.780	0.720	0.876	0.738
	B6r1	0.619	0.906	0.100				
Sustainability practices	SM1a1	0.177	0.738	0.029	0.663	0.873	0.907	0.890
	SM1b1	0.241	0.795	0.025				
	SM1c1	0.303	0.859	0.028				
	SM1d1	0.241	0.845	0.020				
	SM1e1	0.258	0.829	0.027				

4.1. Measurement model

In the first stage of our analysis, we used the PLS algorithm to assess the reliability and validity of our measurement model. First, we examined the outer model by assessing the following metrics: indicator reliability, internal consistency reliability, and convergent reliability. The indicator reliability was assessed by calculating the path loadings between the constructs and their indicators. Internal consistency was measured with three indicators, namely, Cronbach's alpha, composite reliability (CR) and Dijkstra-Henesler's ρ_A . Finally, average variance extracted (AVE) scores were computed to measure the convergent reliability of each latent construct. Second, the inner model was assessed based on two main categories: discriminant validity between constructs and overall model fit assessment. Discriminant validity was assessed by using the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT). Overall model fit assessment was carried out by computing the square root mean residual (SRMR) metric.

The outer model assessment is presented in Table 8. All factor loadings exceed 0.7, supporting high indicator reliability. In terms of the internal consistency of constructs, all CR values are above the 0.7 threshold. Cronbach's alpha and ρ_A values indicate that two constructs (external pressure and sustainability practices) are slightly below the 0.7 threshold. However, given that all other reliability and validity measures are acceptable for these two constructs and the problematic values are close to the minimum thresholds, we decided to keep them unchanged to remain consistent with the measurement models used by previous authors in a similar context (Adebanjo et al., 2016). Finally, the AVE values are well over the 0.5 threshold, indicating good convergent reliability.

For the inner model, we first assessed the discriminant validity of the constructs. Using the Fornell-Larcker criterion, we compared the square roots of the AVE values with the pairwise correlations between the 6 latent constructs. Discriminant validity can be established if the square root of the AVE is higher than the pairwise correlations for each construct of the measurement model (Henseler et al., 2016). Table 9 shows that this criterion of discriminant validity is fulfilled, indicating that latent constructs truly measure different phenomena.

To use a more robust discriminant validity assessment than the Fornell-Larcker criterion, heterotrait-monotrait ratios (HTMTs) were also computed (Table 10). HTMT values close to 1 indicate the lack of discriminant validity (Henseler et al., 2016). In our case, all values are significantly below 1, indicating that discriminant validity is acceptable.

The overall model fit is also acceptable, with an SRMR value of 0.075, which is below the commonly accepted threshold of 0.08 (Henseler et al., 2016).

4.2. The structural model

To test the structural model, we used the bootstrapping method offered by the SmartPLS software. The predictive capability of the model was assessed by the R-squared values. The explanatory power of the model ranged from moderate to weak. Looking at the endogenous constructs, the strongest effects were registered for sustainability strategy (0.315) and sustainability practices (0.258), suggesting that the proposed "external pressure – sustainability strategy – sustainability practices" relation chain has moderate explanatory power. The explanatory power is lower for environmental (0.085), social (0.162) and financial performance (0.031). This result is, however, not surprising since it confirms that both operational and financial performance measures are influenced by a great number of factors outside the scope of this study.

To test the individual hypotheses, we applied the bootstrapping method. We used the t-values to determine the significance of the relationships between the constructs (Hair et al., 2017). The results of the test suggest that four hypotheses can be accepted, while the last two hypotheses are rejected (Fig. 3).

In line with previous literature, our results suggest that external pressure has a strong positive effect on the role of sustainability goals in

Table 9
Discriminant validity assessment based on the Fornell-Larcker criterion.

	Sustainability practices	Environmental performance	External pressure	Financial performance	Social performance	Sustainable strategy
Sustainability practices	0.814					
Environmental performance	0.292	0.883				
External pressure	0.313	0.233	0.851			
Financial performance	0.165	0.053	0.040	0.867		
Social performance	0.402	0.376	0.238	0.176	0.890	
Sustainable strategy	0.508	0.223	0.561	0.148	0.329	0.873

Table 10
HTMT ratios estimated for each pair of constructs.

	Sustainability practices	Environmental performance	External pressure	Financial performance	Social performance	Sustainability strategy
Sustainability practices						
Environmental performance	0.359					
External pressure	0.395	0.339				
Financial performance	0.208	0.086	0.081			
Social performance	0.491	0.521	0.344	0.245		
Sustainability strategy	0.574	0.282	0.759	0.208	0.414	

the strategy of automotive firms (+0.561, $p = 0.000$), thus supporting [H1](#). Sustainability-based strategies have a strong impact on (environmental and social) sustainability practices in the automotive industry (+0.508, $p = 0.000$), which confirms [H2](#). In terms of [H3](#) and [H4](#), our model demonstrates that sustainability practices implemented by automotive companies lead to higher environmental and social performance (+0.292 and +0.402, $p < 0.001$). Surprisingly, however, [H5](#) and [H6](#) are not supported. The path coefficients connecting environmental and social performance with the financial performance of automotive firms are not significantly different from zero, indicating that higher environmental and social performance is not (immediately) transposed into better financial performance. The final structural model is summarized in [Fig. 3](#). Indirect effects are presented in the Appendix.

5. Discussion

5.1. Theoretical implications

We contribute to the existing literature on sustainability in the automotive industry by both confirming and extending current findings in this stream. First, the finding that the pressure of external stakeholders on automotive firms plays an important role in adopting a sustainability-based perspective is well aligned with previous findings (e.g., [Sarkis et al., 2010](#); [Zailani et al., 2012](#); [Böttcher and Müller, 2015](#)). However, we argue that, in line with operations strategy theory ([Koufteros et al., 2002](#); [Rosenzweig and Easton, 2010](#); [Szász and Seer, 2018](#)), external pressures first shape the strategy of automotive companies, driving them to adopt strategic sustainability goals, which in turn leads to a more intensive implementation of sustainability practices. While the literature provides evidence for the impact of external pressures on both sustainability strategies (e.g., [Diaz-Garrido et al., 2015](#)) and practices (e.g., [Lo and Shiah, 2016](#)), none of the papers reviewed include all three constructs. Thus, our results add to the literature by showing that sustainability strategy mediates the impact of external pressures on sustainability practices (see Appendix).

Second, our study confirms the many findings in the literature that the implementation of sustainability-oriented practices, such as waste reduction programs, green supply management or environmental and social certifications, improves the environmental and social performance of automotive companies (e.g., [Azevedo et al., 2012](#); [Govindan et al., 2014](#); [Hartmann and Vachon, 2018](#)). Given that the main purpose of such practices is to strengthen the environmental and social capabilities of companies, this is not a surprising finding. However, when adding the economic/financial performance dimension to the model, the literature is fairly inconsistent in assessing the impact of sustainability practices on this dimension. A great number of articles measure the direct impact of sustainability practices on financial performance, many of them handling environmental/social performance indicators together with financial indicators ([Zhu and Sarkis, 2004](#); [Zhu et al., 2005](#); [Azevedo et al., 2011](#); [Eltayeb et al., 2011](#); [De Giovanni and Vinzi, 2012](#); [Govindan et al., 2014](#); [Severo et al., 2015](#)). Building on operations strategy theory, in this paper, we argue that environmental and social performance are operational-level performance dimensions, measuring the operational capability of firms to be environmentally and socially responsible. Financial performance, on the other hand, is a higher-level performance indicator that is influenced by a great number of factors, including operational performance, such as environmental and social performance. Our theoretical approach is backed up by several recent sustainability-related studies in the literature (e.g., [Feng et al., 2018](#); [Lin et al., 2019](#); [Lin et al., 2020](#)). Thus, we propose that environmental and social performance are a prerequisite for achieving an impact of sustainability practices on financial performance (see Appendix).

Third, our study finds no positive influence on financial performance. This is actually in line with several previous studies that also do not confirm a clear positive impact on financial performance ([Azevedo et al., 2012](#); [Green et al., 2012](#)) or that obtain mixed results ([Zhu et al., 2007](#);

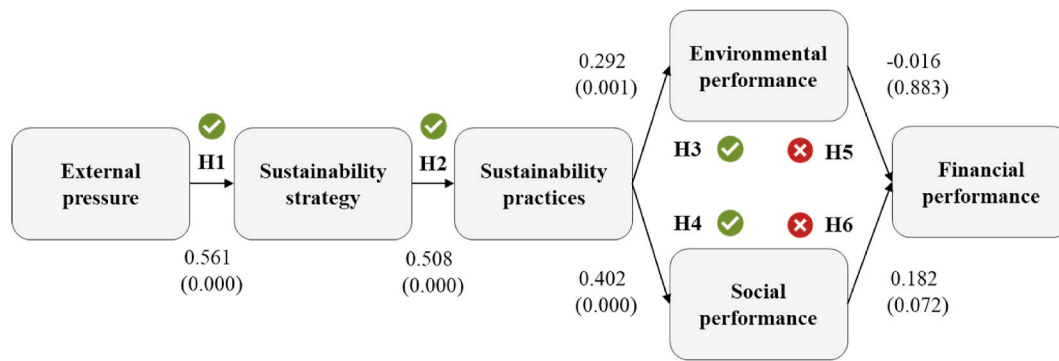


Fig. 3. Path diagram of the hypothesized model with path coefficients and significance levels.

Eltayeb et al., 2011; Gimenez et al., 2012; Lin et al., 2020). Nevertheless, numerous other researchers have linked sustainability to better financial performance (e.g., Rao, 2002; Orlitzky et al., 2003; Zhu and Sarkis, 2004; Rao and Holt, 2005; Huang et al., 2012; Wu et al., 2015; Lin et al., 2019). The explanation we suggest for our findings, which partially contradict the existing literature, is that the financial performance of an automotive firm is influenced by a great variety of other, nonsustainability-related factors, which makes it difficult to single out the impact of sustainability on financial performance. It still has to be noted that our study considered current financial performance improvement, meaning that a positive effect may still appear with a time lag.

Fourth, to the best of our knowledge, supported by our systematic review of the literature as well, the theoretical model proposed and tested in this paper is the first comprehensive model to explain the implementation and performance implications of sustainability strategies and practices in automotive firms. The model is based on operations strategy theory and proposes a chain of relations along the “external pressures – strategy – practices – performance” continuum. Such a model can also explain some of the inconsistent findings in the literature. For example, Zhu et al. (2007) obtain mixed findings concerning the direct impact of green supply chain management practices on environmental and financial performance. A research model treating environmental performance as a mediator of the impact of green practices on financial performance might yield more enlightening results.

5.2. Practical implications

Although the primary objective of our study was to create a theoretical model to generalize and extend current knowledge on sustainability in the automotive industry, two practical implications can also be formulated. First, company managers facing external pressures to become more sustainable should first raise the strategic importance of sustainability goals in the operations strategy of the firm to support a more intensive implementation of sustainability-related practices. The implementation of such practices without a strong strategic driver might not lead to the expected results (cf. Zhu et al., 2007).

Second, our results suggest that even if strategy-driven sustainability practices lead to improved environmental and social performance, these improvements are not reflected in the short-term financial performance of automotive firms. Thus, a strategic focus on sustainability has to be viewed as a long-term investment that does not necessarily offer immediate financial payoffs. Nevertheless, whether these strategies offer high enough financial returns in the long run to cover implementation costs remains an issue for further research (cf. Lin et al., 2020).

Third, to make the entire automotive industry more environmentally and socially sustainable, our results indicate that external pressure is a key driver of increasing the true strategic role of sustainability. Thus, we propose that external stakeholders, including industry-external entities, such as governmental policy makers, nongovernmental organizations and customers, should further increase their regulative power and social

influence to push the automotive industry towards a positive contribution to global sustainability.

6. Conclusion

In summary, based on a systematic review of the literature on sustainability in automotive and connected industries, this paper proposes a holistic model of sustainability management constructed through the lens of operations strategy theory. The model is tested using a global sample of automotive firms. Our results confirm that pressure from external stakeholders has a strong and positive effect leading automotive companies to include sustainability goals in their strategies. Once sustainability gains an important place in the operations strategy of the firm, higher efforts are made to implement (environmental and social) sustainability-related practices. These practices, in turn, improve the environmental and social performance of automotive companies. Nevertheless, our study is unable to confirm that higher environmental and social performance can contribute to better financial performance.

One important limitation is related to the nature of the survey study, which enables the collection of larger amounts of data but does not offer deep insight into the reasons behind the relationships confirmed by our study. For example, future case studies could explore specific sustainability practices, especially those enabled by the digitalization of manufacturing, and the extent to which these practices contribute to the improvement in environmental and social performance. Another issue related to the survey is the timeframe of data collection, which preceded the most recent sustainability scandal in the automotive industry, Volkswagen’s “dieselgate”. A new round of data collection in the global automotive industry could investigate more specifically how the most recent scandal has changed the behavior of firms in terms of sustainability.

Last, given that we cannot confirm H5 and H6, the most important future research avenue we propose is to investigate, on a large-scale dataset, preferably with longitudinal data, whether high sustainability performance leads to higher financial performance in the long run. This might well be the case, as with properly implemented sustainability practices, the reputation of the firm and the efficiency gains from sustainable operations can reach a critical mass that significantly improves financial performance as well.

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Appendix. indirect effects

Sustainability practices	Environmental performance	External pressure	Financial performance	Social performance	Sustainable strategy
Environmental performance			0.069		
External pressure	0.083**		0.020	0.115***	
Financial performance					
Social performance					
Sustainable strategy	0.148**		0.035	0.205***	

***p < 0.000; **p < 0.010; *p < 0.050.

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