

**Standardizing Car Sound—Integrating Europe? International Traffic Noise Abatement and the Emergence of a European Car Identity, 1950-1975**

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<http://www.tandfonline.com/doi/abs/10.1080/07341512.2012.662332#.VP4JoeGmjOU>

CITATION: Krebs, S. (2012). Standardizing Car Sound – Integrating Europe? International Traffic Noise Abatement and the Emergence of a European Car Identity, 1950–1975. *History and Technology* 28, 1, 25–47.

Abstract: The postwar motorization boom in Western Europe implicated rising complaints about road vehicle noise. By the end of the 1960s, traffic noise abatement became an urgent topic for European regulators and automobile engineers. The article investigates how car sound, its measurement and the standardization of measurement procedures developed during the first postwar decades, and how this relates to European integration. It shows that the standardization of car noise measurement affected market integration and the harmonization of technical regulation on the European level, thus shaping the political integration process. Furthermore, standardization and harmonization stimulated the circulation of knowledge and the rise of a new field of knowledge organized around the standardized and harmonized issues. Although the standardization and harmonization efforts did not result in the homogenization of European automobile technology, they did contribute to the narrative construction of a European car identity.

Keywords: European integration, European identity, automobile engineering, car noise abatement, international standardization

In the first postwar decades, European countries, especially West Germany, Italy, France and the United Kingdom, experienced an exceptional motorization boom. During the 1950s only, the joint passenger car production of these countries almost quadrupled.<sup>1</sup> At the same time car tourism became more and more popular.<sup>2</sup> In the United States, too, every year produced a new record for vehicle-miles traveled. In 1951, the U.S. Bureau of Public Roads exclaimed helplessly, “we are being overwhelmed by a flood of traffic.”<sup>3</sup> The drawback of this automobile success story was an equally dramatic rise in environmental

pollution caused by motorized road traffic.<sup>4</sup> One of the major concerns, especially in urban areas, was traffic noise.<sup>5</sup> As a countermeasure, engineers and regulators soon considered setting noise emission limits for new passenger cars, which required standardized techniques for measuring exterior car noise. Such standards were first discussed within the domestic framework of several countries, although increasing international car trade and cross-border traffic pointed out that the car noise problem could hardly be solved on the level of individual nation states. At the end of the 1950s, the call for international regulations grew louder: in particular in Western Europe.<sup>6</sup>

Several international organizations took part in negotiating and coordinating the technical and political questions of car noise abatement: The International Organization for Standardization (ISO), which included European nations and the U.S. among its members, dealt with the definition of a common standard for setting and measuring exterior car noise. Organizations like the United Nations Economic Commission for Europe (UNECE, established in 1947) and the Organization for Economic Cooperation and Development (OECD, established in 1961) discussed limits on car noise and the mutual recognition of national regulations and procedures. Both organizations were founded to stimulate the economic reconstruction and progress in Europe after the Second World War. The UNECE, with one focus on cross-border transport, had members from both sides of the iron curtain, whereas the OECD members were limited to Western Europe. Finally, the European Economic Community (EEC, often referred to as the Common Market, had originally as members West Germany, France, Italy, Belgium, Netherlands, Luxembourg) adopted a common policy on car noise abatement. These groups requested the ISO and its experts to define an international standard method of measuring the noise produced by automobiles. Their challenges were several. ‘Noise’ and ‘loudness’ were subjective perceptions—individually, nationally, and culturally—and were politically fraught. Not surprisingly, prior efforts, in Western European nations and in the U.S, to establish noise standards used different approaches. Last, the ISO process itself was collegial and agreement on a standard did not require member nations to adopt it. Within this context, the ISO sought to address this tangle of political, technical, and cultural issues to create a international standard, resulting in ISO 362, issued in 1964.

ISO’s work, de facto, became primarily a European standard, as the U.S. chose to keep its own different, national standard. In 1968, a first political accord on maximum noise levels was reached under the auspices of the UNECE (with the U.S. the lone non-

European member), but, again, the United States chose not to join this agreement. Commenting on the lack of American participation, the OECD (which also included the U.S. as a member) concluded that ‘Europe’ alone sought a common solution to the traffic noise problem.<sup>7</sup> Still, the European situation was more complex than the OECD statement suggests because the six Common Market countries did not join the UNECE agreement either, but issued their own maximum noise limit. The history of car noise abatement shows that multiple ‘Europes’ with different political and geographical agendas were dealing with the same subject. For the six Common Market countries, for example, traffic noise abatement was part of the process of economic and political integration that was the aim of their supranational organization. In comparison, negotiations under the auspice of the UNECE, with its larger number of members, were seen primarily as technical discussions, in which Eastern and Western European countries could jointly take part. Intersecting with these perspectives was the large role that U.S. played in postwar Europe. As the OECD statement suggests, that the conduct of the United States played a crucial part in shaping the impression of a distinct ‘European’ solution to the traffic noise problem.

In recent years, historians of technology have actively studied the relationship between technology and European integration.<sup>8</sup> In an agenda-setting paper, Johan Schot and Ruth Oldenziel argued that “material networks, technical systems, and the circulation of knowledge and artefacts” significantly influenced this integration.<sup>9</sup> Because these authors felt that scholars of European integration had underestimated, if not neglected, the crucial role of design and use of technology in the shaping of Europe, its institutions and identity,<sup>10</sup> they coined the notion of Europe’s ‘hidden integration.’<sup>11</sup> Much recent scholarship sustains the claim of a co-construction of Europe, as a geographical and imaginary space, and infrastructure-related technologies.<sup>12</sup> What a large number of these publications have in common is a clear focus on network technologies and large-scale technological projects.<sup>13</sup> For example, Alexander Badenoch and Andreas Fickers have described transnational infrastructures such as roads, railways, electricity and broadcasting networks as “material links between nations and across borders in Europe.”<sup>14</sup> In this domain, transnational infrastructures serve as integrating technologies *sui generis*—as evident material links enabling a bottom-up integration of Europe. In the same line of reasoning, Johan Schot and Frank Schipper have emphasized the role of technical experts in the integration process. They draw on the epistemic community concept to explain how expert committees on the international level “technify discussions and make clear-cut

distinctions between technical and political issues, hence to arrange for decisions without any interference of politics.”<sup>15</sup> Epistemic communities can be understood as networks of experts with an authoritative voice in defining problems and identifying solutions to policy-relevant issues. As ‘hidden integrators,’ they shape standards, norms and rules, which subsequently, as a regulatory regime, affect the integration of politics and markets.<sup>16</sup>

In several ways the case of car noise abatement can be said to complement the above findings. It contributed to European integration in terms of regulatory regimes, but also stimulated the circulation of knowledge and the rise of new fields of knowledge organized around problems raised through standardization and international collaboration. A focus on the history of car noise abatement in the 1960s and 1970s allows one to identify additional forms of integration, notably in terms of identity. Among automobile engineers, car noise abatement, as the first environmental issue to be solved on a European level, triggered the emergence of a “common European consciousness” in Western Europe.<sup>17</sup> European car noise abatement also stimulated the cross-border circulation of people, knowledge and automobiles. With this turn, given the dramatic postwar rise of automobile production and consumption, this relation between the ‘European’ automobile and ‘European’ identity had a larger cultural resonance. In this sense, ISO recommendation 362 and the noise limits of EEC and UNECE can be understood as critical events that gave ‘Europe’ new importance and meaning, among engineers and policy elites and, then indirectly, a broader European public. In this process of identity formation, the United States, in its choice to pursue its own national rather international standards, acted as a catalyzing force that helped shape the notion that ‘Europe’ was seeking a common approach to traffic noise abatement.

To develop my argument below I draw on sources from automobile and noise control engineering trade journals,<sup>18</sup> conference proceedings and reports from national and international institutions. In addition, I have used archival material to describe the negotiations about ISO standard 362. In the first section I provide a brief historical overview of the postwar motorization boom and rising complaints about traffic noise in Europe and the United States. The following section focuses on the negotiations leading to international car noise measurement standard ISO 362, and its perception as a European standard. Section three covers the broader landscape of international car noise legislation, where standardization and harmonization of technical regulation served as means of market integration while simultaneously causing market fragmentation between the U.S.

and Europe. The next section addresses the circulation and appropriation of noise control knowledge, highlighting that ISO 362 stimulated the rise of the new field of (car) noise control engineering. The final section investigates the discursive construction of a European car identity. The notion of a 'European' automotive community became conjoined with the concurrent discussion on car noise control, and, in both cases, was reinforced by highlighting the differences between European and American car technology, engineering methods and noise abatement policies.

### **Postwar Motorization, International Car Trade and the Rise of the Traffic Noise Problem**

The 35th edition of the Automobile Salon in Paris, 1948, presented the first European postwar models ready for production and served as a prelude to the unprecedented motorization boom in Western Europe.<sup>19</sup> Fostered by the 'economic miracle' of the late 1950s, Europeans longed to have and were moved to purchase a car of their own.<sup>20</sup> In the four main producing countries—United Kingdom, France, Italy and West Germany<sup>21</sup>—production numbers grew steadily during the first postwar decades (see Table I).

In 1953, German manufacturers surpassed their prewar production numbers for the first time. Another three years later, Germany also became the number one automobile manufacturer of Europe. But while leading in car production, Germany was still lagging behind in postwar motorization: at the beginning of the decade, only 1.25 million passenger cars circulated on German roads, compared to 3.3 million cars in the United Kingdom, and 2.75 million cars in France. At that time, car density in Germany was as low as 13 cars per 1,000 inhabitants, compared to 47 cars in Britain, or 38 cars in France.<sup>22</sup> The difference between the high production numbers and relative low numbers of car ownership in Germany resulted from the very low starting point of car ownership after the war and the large export numbers. In 1953, 32.2 percent of the total German production was sold outside Western Germany. In Europe, only the UK had a higher export share: due to high subsidies 69.2 percent of the domestic production was exported.<sup>23</sup>

On 25 March 1957, the treaty that formalized the creation of the EEC was signed in Rome. To establish a customs union between the six member states, a gradual reduction of tariffs and quotas in intra-Community trade started as of January 1, 1959. Still in 1958, the French automobile market was protected by a 34.7 percent import tariff on foreign

vehicles. The German import policy was less strict with a tariff of 14.8 percent, while the Italian market was protected by a prohibitive import duty of up to 46.8 percent (depending on engine size). Belgium, Luxemburg and the Netherlands had tariffs between 25.9 and 27.9 percent.<sup>24</sup> In view of these tariffs it is no surprise that import shares were small: in Italy and France two percent, in Germany five percent of the total registrations. Prior to the EEC, the automobile markets in individual European countries were largely separated from each other.<sup>25</sup>

In July 1968, the transition period for the establishment of a common policy on customs was completed: all internal EEC automobile tariffs were abandoned and an import duty of 17.6 percent for all non-EEC countries was imposed. This development stimulated intra-Community trade, of course, and it transformed the European automobile market significantly. In 1959, for example, French cars were exported to traditional European markets, such as Belgium and Switzerland, and to the French overseas territories. Overall, 45.6 percent of the country's annual production was sold abroad. A decade later, the export share of French carmakers was still around 45 percent, but now, about 40 percent of these were exported to other EEC members, another 35 percent going to other European countries. This trend also was evident in the other Common Market countries.<sup>26</sup> Import shares among these countries grew considerably as well: to 22.2 percent in Germany, to 22.4 percent in France and to 15.2 percent in Italy.<sup>27</sup>

One can say that the formation of the Common Market stimulated the circulation of automobiles in Europe, both literally, on the road, and figuratively, as one of the pivotal postwar consumer goods. In everyday life, various European car makes, from and in different countries, increasingly became a familiar sight, in particular passenger cars of leading brands such as Fiat, Volkswagen, PSA and Renault.<sup>28</sup> At the same time, integration of national markets continued to be moderate because "the lion's share of intra-community trade for private motorcars had a complementary rather than a substitutive character."<sup>29</sup> Thus, European manufacturers did not compete in the same market segments and overall competition across borders was comparatively low. For example, German manufacturers like Opel, Ford and Mercedes competed in the higher middle-class and the upper price segment, while French manufacturers Citroën and Renault were strong in the lower middle-class and low-priced segment. From an economic perspective, the formation of the Common Market only transformed 'tight' national oligopolies into 'wide' supranational oligopolies.<sup>30</sup>

Compared to the European situation, the U.S. market was predominately self-contained. In 1955, American manufacturers sold a record-breaking 7.9 million cars, of which the Big Three—General Motors, Chrysler and Ford—sold 95 percent. Overall, about 99.7 percent of the cars sold that year were of domestic origin.<sup>31</sup> From 1956 onwards, the picture began to change.<sup>32</sup> While the Big Three faced, in 1958 alone, a slump of their sales by more than 45 percent, European imports soared to 11 percent in 1959. At the same time, U.S. manufacturers like American Motors successfully introduced new ‘European size’ cars.<sup>33</sup> In response to the threat of rising European imports, the Big Three introduced their 1960-compacts, which put an end to the car size and horse power race that had defined the American automobile industry after 1945.<sup>34</sup> A major difference between American and European manufacturers pertained to their export policy. Italian, French and German manufacturers were emphatically export-oriented and, in 1969, their export shares reached between 39.7 and 57.5 percent of their annual production. At the same time, the U.S. export share stood at 4.1 percent of annual production volume (see Table II). In absolute numbers, exports amounted to only 335,000 units. In comparison, more than 2.18 million European cars were sold to the United States and the rest of the world.<sup>35</sup> Because of their export orientation, European manufacturers had an economic interest in market integration and reduction of obstacles to international car trade.

In spite of differences in production numbers, export strategies and national car ownership figures, European and North-American countries all were confronted with the drawbacks of the automobile ‘success story’: a rise in environmental problems. Air pollution<sup>36</sup> and traffic noise had gradually evolved into urgent societal concerns.<sup>37</sup> A German survey, sponsored by the Medical Academy Düsseldorf and published in 1953, revealed that, in comparison to the situation in 1938, the average noise level in urban areas had increased by nine phon, which equals almost a doubling of perceived loudness.<sup>38</sup> The authors concluded that only new regulatory measurements could prevent a further rise of traffic noise. In the following year, the German *Anti-noise League* took up this line of reasoning and proposed the introduction of a noise tax for motor vehicles.<sup>39</sup> Another reaction on the institutional level was the initiative of German, French, Austrian and Suisse anti-noise societies to found an international non-governmental organization, the *Association Internationale Contre le Bruit* (AICB), in 1959. General secretary O. Schenker-Sprüngli declared that AICB’s “[g]oal is the international promotion of noise abatement, the fostering of cooperation and exchange of experiences, and the preparation of

international measures.”<sup>40</sup> Looking back at the 1960s, the editors of the journal *Transportation* summed up the urban traffic noise problem: “Although the characteristics of both urban form and the motor vehicle population, as well as community standards and values, vary widely throughout the world, the basic problem is always present, whether it is due to five liter American automobiles on the freeways of Los Angeles or the ear-splitting scream of 50-cc motorcycles reverberating through the narrow streets of an historic European town.”<sup>41</sup>

The prelude to postwar traffic noise abatement was the widely recognized Wilson Committee report, published in 1963. The report was commissioned by the British government “to examine the nature, sources and effects of noise and to advise what further measures can be taken to mitigate it.”<sup>42</sup> In regard to vehicle noise, the report highlighted that “the results at about 400 points of the survey have been analyzed, and the most important conclusion is that at 84 per cent of these points noise from road traffic predominated.”<sup>43</sup> Accordingly, the committee concluded that in large towns road traffic noise dominated all other noise sources.<sup>44</sup> The report identified “the lack of numerical definition of ‘excessive noise’”<sup>45</sup> as a major obstacle in developing recommendations for traffic noise abatement, but did note that “a satisfactory method of measuring the maximum noise which a vehicle can emit,”<sup>46</sup> did exist.<sup>47</sup> The Wilson report, together with German, French and Italian studies, was presented at the 1967 meeting of the *Permanent International Association of Road Congresses*, the international organization of road experts and authorities. With reference to these reports, the working group on urban road construction concluded that “[n]oise caused by vehicular traffic has become so great that it is now harmful to the health of residents along streets. Since most of the causes are on the automobile side, much effort should be made for automobiles of less noise.”<sup>48</sup> As a consequence, political interest grew in developing international maximum noise limits for new passenger cars.

### **ISO 362: Creating a European ‘International Standard’**

Even before these discussions were underway, the search for an accepted procedure for setting noise standards had started during the 1950s. Below I first consider national activities in Germany and France before describing the international process, which culminated in the adoption of ISO recommendation 362 in 1964.



The German Road Traffic Act, re-enacted in 1949,<sup>49</sup> described two noise measuring techniques: a stationary test, which measured exhaust noise within a 7 meter range, was used for practical, on the road enforcement of the imposed noise limit. A pass-by test, which measured the noise of a single car with wide open throttle at 40 km/h from a distance of 7 meters, was used for approval of manufacturer car-types. The latter test was rather tricky to perform, as the driver had to operate at full throttle and to break at the same time to stay within the speed limit. In 1954, the type-approval method was questioned at a meeting of the noise abatement section of the *Verein Deutscher Ingenieure*. Alfons Stadie proposed an alternative pass-by acceleration test. He argued that results of this test would be more reliable.<sup>50</sup> He further criticized that the Road Traffic Act listed another special method for diesel engines, and that the Swiss regulation used three different methods, which slightly differed from those advocated in Germany. Stadie complained about the current situation and claimed that international harmonization was needed.<sup>51</sup> By contrast, Gisbert Bobbert, from the *Physikalisch-Technische Bundesanstalt*, defended the test methods as technically sound. He argued that from an engineering perspective different vehicle types needed different measuring approaches.<sup>52</sup> He investigated the regulation in an extensive test series, conducted between 1950 and 1954. He identified four variables that were of major influence on the test results: measuring distance, engine revolutions, engine power and drive-by speed. Still, in his opinion, the actual regulation was a fair compromise between simplicity and adequacy, even though it was far from optimal.<sup>53</sup>

A parallel discussion started in France when the traffic noise legislation was amended in 1957. A first regulation introduced in 1954 lacked a practicable measuring technique.<sup>54</sup> The new regulation stipulated precise measuring conditions and noise limits for different vehicle categories. For example, the measuring distance was 10 meters, while the drive-by speed varied between 40 and 60 km/h for different vehicle categories. However, the procedures were difficult to apply in practice. In some cases, moreover, test conditions did not match real driving conditions, distorting the results. At the end of 1957, the French Ministry of Transportation entrusted the *Commission d'Etudes du Bruit des Véhicules Automobiles* to develop a new technique for car noise measurements.<sup>55</sup>

In the same time frame at ISO, the *Technical Committee for Road Vehicles* (TC 22) asked the *Committee for Acoustics* (TC 43) to develop an international car noise measuring standard. In July 1958, Working Group no. 7 (WG 7) was formed and appointed to work on a draft method of measurement of traffic noise.<sup>56</sup> The first step was to study existing

measuring techniques. The working group distinguished four principal methods: the German, the Italian and the French method, as well as that of the American Society of Automobile Engineers (SAE). In the end, the group members dismissed all four methods and decided to develop a new measuring technique: a standard which should combine a realistic driving scenario with the basic testing norms of reproducibility and simplicity, the latter also a condition to keep testing costs low.<sup>57</sup> Based on work of the *Commission d'Etudes du Bruit des Véhicules Automobiles*, the French delegation proposed a drive-by test with full throttle acceleration from a given speed, which was seen as a typical urban driving situation.<sup>58</sup> This idea was taken up and in 1961 a first draft version appeared as ISO 419 'Method of measurement of noise emitted by vehicles'; it was commented on by TC 22 and the ISO member bodies. Several editorial comments had to be taken into account, but finally, in February 1964, the second draft was accepted by the ISO Council and issued as ISO 362-1964.<sup>59</sup> The most important test regulation concerned the test site conditions, the setup of the measuring equipment (at 7.5 meters), the driving conditions (full throttle acceleration from 50 km/h) and the measuring method itself. For the latter, *International Electrotechnical Commission* approved sound level meters were prescribed, which would assure both the practicability and reproducibility of the test.

The measuring results had to be given in decibel weighting system scale 'A' (dB(A)). This system was based on frequency correction factors, which placed less emphasis on low frequency sound and provided more weight to middle and high frequency sounds between 500 and 6000 Hertz, typically perceived as the most annoying by listeners.<sup>60</sup> Up to that time, national measurement methods had preferred other units: some (USA), phon (France) and DIN-phon (Germany). Prior to the decision for dB(A), members of ad hoc Group E within WG 7 conducted several test series. Results of these tests were presented to WG 7 and, after a long discussion, a majority of the group members voted for dB(A).<sup>61</sup> It was argued that dB(A) was best suited to correlate the annoyance factor of car noise to an objective measurement.

It can be assumed that the British members in WG 7 played a key role in favor of dB(A): H.G. Mills from the *Motor Industry Research Association* and D.W. Robinson from the *National Physical Laboratory* (NPL) were leading experts in noise control research. They had conducted extensive jury tests to "establish a relationship between the subjective rating of noise emitted by motor vehicles, and objective measurements made with a sound level meter employing 'A' weighting."<sup>62</sup> NPL scientists had a long tradition

of jury testing that went back to the 1920s—a particular British practice in noise measurement described in detail by Karin Bijsterveld.<sup>63</sup> With reference to Mills and Robinson, contemporary noise control handbooks adopted the British standpoint and agreed that “practical work has indicated that numerical dB(A) values can be directly related to a subjective scale with a good measure of agreement between independent observers.”<sup>64</sup> T. Priede from the Southampton *Institute of Sound and Vibration Research* emphasized that Mills and Robinson had “shown conclusively in the investigation of subjective rating of motor vehicle noise that a linear relation exists between the pure physical measurements with sound level meter ‘A’ weighting network in dBA units and the subjective rating of the noise such as quiet, acceptable, noisy, and excessively noisy.”<sup>65</sup> Accordingly, dB(A) seemed to be the perfect compromise between simple, reliable and inexpensive measurements. Still, even ad hoc Group E had to admit certain limitations: thus “it may also be necessary at some future date to replace the A weighting network of the sound level meter with another weighting.”<sup>66</sup>

The history of ISO 362 reveals that central test conditions were derived from national measuring standards. Test site size, ambient conditions and measuring distance evolved from the German car noise regulation, driving conditions were proposed by French experts and the use of dB(A) can be traced back to British members in TC 43. American test preferences did not play a part in the consensus: neither the American measuring distance of 15 meters, nor the preferred unit of ‘sone’ became part of ISO 362. In other words, the new international standard was an integration of three European car sound measuring traditions. This European bias suggests that experts from European member bodies recognized the economic arguments and gains of integration, and that they used their majority within WG 7 to define a standard that was close to existing regulations in Europe. Historical and social studies of standardization processes have shown that political negotiations are always involved, “also when non-political matters such as technical norms and standards ... have to be decided.”<sup>67</sup> Participants of TC 43 regarded themselves as neutral technical experts that prepared expert decisions on the basis of technical arguments. One Dutch member of TC 43, though, accused the American delegation that their rejection of ISO 362 was based on political, not technical, reasons.<sup>68</sup> One, thus, may well consider ISO 362 perhaps not a mere engineering solution, but a practicable political compromise—based on European expert knowledge.

## Harmonizing the Fragmented Car Noise Legislation Landscape

The adoption of an international car sound measuring standard was only the first step; the next step was to include it in national or international traffic noise legislation. For the 1960s, existing traffic noise legislation can be divided in two principal categories. One consisted of non-technical language that prohibited, for example, “excessive objectionable noise” of vehicles on the road.<sup>69</sup> Such regulations had little impact on traffic noise abatement as they were hard to enforce: after all, how might excessive noise be objectively rated? The second type of legislation imposed numerical noise limits. Here, the specification of functional test conditions was crucial. The second category can be further divided into stationary tests for the measurements of road traffic and drive-by tests for rating and approval of various car types. The following sections will focus on the latter sub-category, because it affected the automotive industry directly. I first offer a brief sketch of the international traffic noise legislation landscape, before investigating initiatives for international harmonization of regulation.

Though Germany and France had both adopted noise control legislation with numerical limits for type-approval by the mid-1950s, car noise abatement in other countries was still in its infancy. A comparative survey, published in 1971, pointed out that 15 out of 29 countries under investigation had only general regulation without numerical limits and no specific measuring procedures.<sup>70</sup> Four nations had imposed numerical limits in combination with a stationary test,<sup>71</sup> and ten countries had laid down numerical limits and a drive-by test.<sup>72</sup> For the countries with numerical limits, current regulation for passenger cars ranged from 75 to 93 dB.<sup>73</sup> The span of 18 dB is quite remarkable, as it equals, due to the logarithmic scale of the decibel, a 3.48-fold increase of perceived loudness. Several different measuring units were used—sone, phon and DIN-phon, decibel, and decibel with ‘A’ or ‘B’ scale weightings—while the test conditions revealed a similarly scattered picture.<sup>74</sup>

The many differences in regulation posed a serious obstacle to international automobile trade and circulation, therefore manufacturers<sup>75</sup> and policymakers<sup>76</sup> demanded international harmonization of car noise regulations. Thereby they could build on existing agreements to harmonize vehicle regulation. Already in June 1952 the *Working Party on the Construction of Vehicles* (WP 29) had been established within the framework of the UNECE. Initially, nine countries and five non-governmental organizations were active. In

1956, an important step was taken, when Germany, France and Italy, as leading car exporting nations, and the Netherlands, as importing country, signed a first agreement in Rome “on the subject of adoption of uniform and harmonized requirements for headlamps emitting an asymmetrical passing beam.”<sup>77</sup> Two years later, Germany took the initiative and proposed that an agreement be established under the auspices of UNECE “in order to facilitate the adoption of uniform conditions of approval and the reciprocal recognition of approval for motor vehicle equipment and parts.”<sup>78</sup> The agreement was signed in Geneva, 20 March 1958, by several European countries.

Subsequently, WP 29 became a central market place for the circulation of knowledge in the field of international vehicle standards. UNECE also took the lead to find an agreement on international norms for vehicle noise emissions. Not surprisingly, given this history of collaboration, ISO 362 was quickly adopted by the UNECE as common test method and the ‘European compromise’ entered the policy process as non-political international standard. In the following years WP 29 and ISO TC 43 cooperated closely and tried to synchronize their working schedules.<sup>79</sup> After the test standard was adopted there was still disagreement within WP 29 on numerical noise limits. Finally, in 1968 a noise limit of 84 dB(A) for new passenger cars was accepted. As this threshold was above the current regulation in Germany and France these countries did not sign the UNECE agreement.

Instead, the EEC started to negotiate an additional agreement with stricter limits. In February 1970, Council Directive 70/157 on the approximation of the laws of the Member States relating to the permissible sound level and the exhaust system of motor vehicle was issued. It adopted the measurement technique of ISO 362, too, and imposed a noise limit of 82 dB(A) for passenger car type-approval.<sup>80</sup> The six Common Market countries had to implement this directive as part of their national regulation within 18 months. With the expansion of the Common Market in 1973, Ireland, Denmark and the United Kingdom also had to adopt the EEC directive on vehicle noise. Another four years later, Directive 77/212 lowered the noise limit for passenger cars to 80 dB(A).<sup>81</sup>

To understand the full impact of traffic noise regulation on the integration of the European automotive field, the simultaneously adopted EEC Council Directive 70/156 has to be taken into account. This directive was a precondition to establish a Community policy on car noise abatement. It declared that because “in each Member State motor

vehicles intended for the carriage of goods or passengers must comply with certain mandatory technical requirements” and because “such requirements differ from one Member State to another and consequently hinder trade within the European Economic Community,”<sup>82</sup> the introduction of a Community type-approval procedure and the reciprocal recognition of national compliance checks was necessary for the proper functioning of the Common Market. In principle, Council Directive 70/156 facilitated and accelerated the circulation of EEC-manufactured cars between the member states. The first technical directive that made use of the new Community type-approval was the one on car noise emissions—highlighting the importance of the harmonization of traffic noise abatement as a stimulus for economic and political integration of the European automotive field, because it paved the way for future EEC regulations in the automobile sector.<sup>83</sup>

Directive 70/157 and the concomitantly adopted Community type-approval procedure can be depicted as symbolic cornerstones of market integration. Marine Moguen-Toursel pointed out that “for Community institutions, it was important to show that the type-approval procedure functioned well on a product as important as a car.”<sup>84</sup> However, the practice of Community type-approval proved to be difficult. Member states used national road safety issues or other “requirements that remained applicable in respect of parts and characteristics which were not yet covered by separate Community directives” as means to protect the national car industry by denying simple recognition of foreign type-approval certificates.<sup>85</sup> It was not before January 1, 1996—when Council Directive 92/53, which amended directive 70/156, became mandatory—that all national type-approval systems got replaced by a single Community procedure.<sup>86</sup>

Besides UNECE and EEC initiatives, a third strand of international action was instigated by the OECD. In 1971, OECD’s *Consultative Group on Transportation Research* entrusted an expert group to formulate recommendations for international vehicle noise regulation. The expert committee prepared a report that was approved by OECD and published in 1972.<sup>87</sup> The report stated: “Standards for new vehicles should be expressed in terms of maximum permissible noise levels as measured by test procedures recommended by the International Standards Organisation.”<sup>88</sup> The exemplary UNECE and EEC activities were welcomed, but seen only as a first step. All countries were encouraged to support R&D efforts in the field of noise reduction, which included research on effects of noise exposure, on the development of measuring and monitoring instruments, and car noise reduction technology.<sup>89</sup> The OECD report had no direct influence on national legislation,

but it played an important role in promoting international vehicle noise regulation, as it was well-received in different automotive trade journals and conference proceedings. For example, a summary was published in the U.S. *SAE journal* under the telling title “Europe seeks common solutions to problems of emissions & noise.”<sup>90</sup>

The United States neither joined the UNECE agreement nor followed the OECD recommendations. With the enactment of the Noise Control Act (NCA) in 1972, though, the federal government launched an initiative of its own. Initially, the NCA was seen as an important step to abate vehicle noise as it explicitly aimed at surface transportation noise. However, because of the primary responsibility of states and municipalities no federal regulation on passenger car noise was issued. The Environmental Protection Agency (EPA) issued a limit of 86/90 dB(A) only for trucks. This EPA action was justified with reference to the federal responsibility for interstate commerce.<sup>91</sup> Meanwhile, states like California, Minnesota and Colorado, and individual cities, such as Chicago, imposed their own regulation. Maximum noise limits differed significantly, but all regulation referred to SAE 986a, the U.S. standard of car noise measuring for car type-approval.<sup>92</sup> The emergence of this standard will be discussed in the next section.

At the end of the 1970s, the bigger picture of international car noise regulation showed an inner circle consisting of the nine Common Market countries with one common regulation based on ISO 362. Around this core, a corona of other countries adopted the UNECE recommendation, also integrating the ISO test procedure into their national legislation. Lastly, the United States pursued an independent position with different state and city regulations, based on SAE test procedures. Compared to the U.S. situation, European harmonization of car noise standards had made great progress. This development was strengthened by the concurrent adoption of a single type-approval procedure that removed non-tariff trade barriers between Common Market countries. Moreover, the UNECE agreement also facilitated the automotive trade between the Common Market and other European countries. This development was reflected in a rising import and export trade for Italy, France, Germany and the United Kingdom.<sup>93</sup> Thus, the ‘European compromise’ inscribed in ISO 362, which became part of EEC and UNECE regulation on car noise, contributed to the economic and political integration process in Europe—even beyond the Common Market.

## The Circulation and Appropriation of Car Noise Control Knowledge

The endorsement of ISO 362 in 1964 had, at first sight, little impact on the circulation of noise control knowledge. The new test setup was occasionally discussed in trade journals, and at the 1966 conference of the *International Federation of Automotive Engineering Societies* (FISITA), British engineers presented an extensive survey on vehicle noise.<sup>94</sup> Still, it was not until the approval of EEC Council Directive 70/157 and the 1972 U.S. Noise Control Act that exterior noise control became a frequent topic for automotive engineers. A survey of trade journals and conference proceedings shows a peak in presentations and articles on noise control after 1970 (see Table III and Figure 1). In 1972 alone, 65 papers were published in the *SAE transactions* from several national and regional conferences.<sup>95</sup> And, in the same year, the FISITA conference hosted for the first time a car noise panel with 17 papers. FISITA also organized special noise panels in 1976 and 1978. Here, engineers presented their latest findings on car noise control: for example, different ways to reduce noise from specific car components such as the clutch, brakes, exhaust and intake. Overall, automotive engineers recognized car noise reduction as a priority design goal, but they also discussed target conflicts with other design goals such as safety and fuel economy.<sup>96</sup>

A close reading of the different papers reveals, however, that ISO 362 had a significant impact on the development of knowledge on noise control. For the first time, British, French, German, and even Hungarian and Japanese engineers applied the same test methods. Moreover, the common test procedure allowed automobile engineers to directly compare their research results without conversion of different measuring units. In that sense, ISO 362 created a common framework for research on car noise control, and FISITA meetings became central market places for ‘homogenized’ car noise control knowledge.<sup>97</sup> Heightened attention to standardization and regulation also stimulated the integration of noise control and automobile engineering knowledge. In other words, ISO 362 supported the rise of a new field of knowledge. Moreover, the institutionalization of noise control engineering as an emerging technical discipline established new places of knowledge exchange, which facilitated the circulation of knowledge between noise control engineers and automotive engineers. The former presented their knowledge at automotive events and the latter attended noise control engineering gatherings to share their knowledge. In 1971 the *Institute of Noise Control Engineering*, a professional society for noise control engineers, was founded in Washington, and the next year the *International*



*Institute of Noise Control Engineering* was founded as an association of several national professional organizations. Since 1973 the first organization has hosted national conferences, NOISE-CON, while since 1972 its international counterpart has hosted INTER-NOISE. With regular sessions on surface transportation noise both conference series stabilized the circulation of knowledge on car noise control.<sup>98</sup> However, this now became a global rather than primarily a European phenomenon.

The distinct American approach in car noise measurement and abatement can be interpreted as a partial appropriation, over time, of ISO 362. To understand the decision not to adopt ISO 362 as a standard, a brief look at the history of SAE 986a, the U.S. method for performing noise measurement is necessary. In the 1950s, the SAE implemented standards for trucks and buses, but it was not until July 1967 that a standard, J986a, was approved by the SAE *Vehicle Noise Committee* for passenger cars. It was generally based on ISO 362, but test site requirements, instrumentation specifications, microphone distance and procedural details drew from the prior standard for trucks and buses.<sup>99</sup> One can say that SAE engineers appropriated the ISO recommendation to their specific noise measurement tradition. As a result, “differences between the SAE and ISO methods occur in microphone distance (15 versus 7.5 m) and among the various procedures in gear selection, initial vehicle speed, and so on.”<sup>100</sup> Thereby, measuring distance is crucial: “If the same [15 m] level is legally requested, the vehicles in the United States can be made about 6 dBA noisier.”<sup>101</sup>

European engineers hoped that international agreements would lead to an alteration of SAE 986a. But Americans were more attuned to their national context. Ralph K. Hillquist, from General Motors, admitted that studies in the U.S. and Canada had shown that “a 7.5 m microphone distance may be technically acceptable, but perhaps not so politically because the levels are approximately 5 dB higher at the nearer location.”<sup>102</sup> Ford engineers, too, acknowledged that a 7.5 meter microphone distance had some advantages as signal/noise ratios improved at closer distances.<sup>103</sup> But noise tests carried out at the ‘European distance’ revealed why adoption was not wanted. A tested high-power sedan emitted 88.3 dB(A), which was 6.3 dB(A) above the EEC limit. Corrected to 15 meter, the result would be 82.3 dB(A) and comply with most U.S. regulation.<sup>104</sup>

As the above suggests, there was tension between ISO 362 and SAE 986a in their different political and economic implications. Furthermore manufacturers were eager to

question the dependability of the test results at all. General Motors, for one, pleaded for an additional two decibel allowance, pointing out, that “recent studies into test parameters ... indicate that significant variations in test results can occur.”<sup>105</sup> In another study, Ford engineers compared seven test grounds and found significant measuring differences between them: for instance, Maremont Corp. test ground was 0.94 decibel louder than Ford’s own Michigan test site.<sup>106</sup> European engineers, too, pointed out immanent reading and driving errors.<sup>107</sup> The complaints are, at first, hard to understand as nearly all production cars passed the imposed noise limits in Europe,<sup>108</sup> and the United States.<sup>109</sup> They can be conceived as an anticipation of future problems as stricter noise limits were already announced.<sup>110</sup> Yet, it is possible to draw another explanation from the example of air pollution regulation: the contestation of regulation was a habitual defense reaction of the automotive industry. Manufacturers conceived (traffic noise) regulation as economic threat, which could impose extra design and compliance costs and thereby reduce profits.<sup>111</sup>

Despite the contestation of car noise regulation, American and European automobile engineers had to integrate noise control knowledge into their automotive research practice. This can be seen by the investments of car manufacturers and research laboratories into new facilities with anechoic chambers, which were equipped with the latest electro-acoustical instruments.<sup>112</sup> Outdoor test sites and sound chambers became central sites for car noise control research. They also symbolized two distinct approaches to how acoustics knowledge could improve car noise control. The idea of the first approach was to use sound level meters with dB(A) reading during the research process, because in the end automobiles had to meet a legally-specified limit in dB(A). As one author concluded: “The noise performance of a vehicle [should be considered] in the context of the particular conditions imposed by the specified test procedure, and that observations of variations of noise with time, during the test, can be useful in the diagnosis of the predominant source of noise.”<sup>113</sup> Other engineers criticized the use of ISO pass-by procedure: “For research purposes the measurement of noise under these test conditions is difficult and time consuming and so measurements of individual vehicle sources, for example the engine, close to its surface and in a test cell are made.”<sup>114</sup> The different research approaches emphasize that there were certain limitations to the creation of a common framework for developing knowledge on controlling car noise as laboratory practices differed significantly.

## Narrative Construction of a European Car Identity

In 1967, Erik d'Ornhjelm, president of the French chamber of car manufacturers, stated that the automobile industry had been successfully Europeanized.<sup>115</sup> The customs union between the EEC members was approaching its completion and intra-Community car trade had already increased significantly. The successful harmonization of car noise regulations in Europe further strengthened that perception. What's more, the EEC legislation on maximum noise limits for new passenger cars established 'Europe' as political actor in the automotive field. However, the integration of the European automobile sector was not solely a technical, economic or political issue, but a "story ... about the construction of the European identity."<sup>116</sup> Crucial in this identity discourse—as the history of car noise abatement suggests—was the European experience that the United States pursued their own national policy instead of joining international agreements. The UNECE accord on car noise revealed that it was easier to find a technical compromise between East and West European countries than one with the U.S. car industry. It was, thus, the political abstinence of the U.S. that helped to shape the impression of a common European approach. The same discursive mechanism can be observed in other concurrent discourses on a European car identity: here, too, American car technology served as a mirror in which common European features were highlighted. One can argue that the discourse on a 'European car' helped to reach a common accord in car noise abatement, and that, at the same time, this agreement sustained the formation of a European car identity. Moreover, the EEC directives 70/156 and 70/157 stabilized and institutionalized the notion of the 'European car.' To understand the entangled history of noise abatement and identity formation we need to take a final look at the latter process.

One discursive strand on the 'European car' can be found in historical narratives, which appeared in automotive trade journals—written by engineers for their colleagues.<sup>117</sup> In 1958, the *Journal de la SIA* published an essay under the title 'How European Motor Car Design evolved.' According to this article's author, the evolution of a distinctively European automobile already had started during the interwar years, whose identifying features included the rear engine concept and the self-supporting body without chassis.<sup>118</sup> Thus, the 'European car' predated the political integration process in this author's historical narrative. In the postwar period, the author saw smallness and economy (especially as compared to American models) as further distinguishing attributes of the typical European car. These characteristics, and their causes, were critical in shaping

European discussion on the ‘European car.’ Briefly put, limited disposable income, automobile taxation, high fuel costs, and narrow roads in historical city centers motivated European engineers, despite their different national contexts, to develop small cars with small high-revving engines.<sup>119</sup> During the interwar period, however, discussions in automotive trade journals differed significantly from postwar historical reflections. In the 1920s, French and German engineers referred to American automobiles indeed, but only as a way to construct and demarcate their own national automobile cultures, and not the distinctiveness of a ‘European’ car culture. The styling of German car bodies, for example, was seen as different from American preferences.<sup>120</sup> Such critique, in part, reflected a resistance to cosmopolitan or non-indigenous influences and urged for a distinct German way of car body design.<sup>121</sup> At the same time, French commentators recognized differences in engine configuration and size between French and American automobiles, but, again, used the American example to define a particular French engine layout.<sup>122</sup>

Another related strand in the postwar discourse can be found in accounts on the state of the art of automobile technology. But this time the opposition was semantically constructed between the typical ‘European car’ and the ‘American car,’ which was configured as large, high-powered, and comfortable. Here it was the otherness of the American car that formed the European car identity. This identity-building was based on simple social and technical dichotomies between America and Europe: high versus low income, low versus high fuel prices, wide versus narrow roads—big versus small cars, high-powered versus underpowered engines, automatic versus manual transmission, and so on.<sup>123</sup> These dichotomies not only resulted from technical or economic causes; European-based engineers underlined that the differences were deeply rooted in national, respectively European, driving cultures: the American public desired large, comfortable and luxurious cars with big V-8 engines and automatic transmission as status symbols. In contrast, during the reconstruction period, Europeans longed for cheap, small and economical cars as basic means of transportation. Later, they preferred middle-size cars with manual transmissions, which were sportier than American sedans.<sup>124</sup>

By and large, the construction of the ‘European car’ was based on tendencies in American car technology different than those in Europe. During the 1950s, such differences in automotive technology were obvious: since the interwar period American cars had become larger and more powerful every year. In 1955, American manufacturers installed V-8 engines in 80 percent of all passenger cars produced, as the average

horsepower rose from 54hp in 1938 to 212 in 1955.<sup>125</sup> At the same time, some of the iconic European cars like Fiat's *500*, Citroën's *2 CV* and Volkswagen's *Beetle*, which competed in the same small car segment, were based on quite different engine technologies: a 12 hp two-cylinder rear engine, a 13 hp flat-twin front engine and a 30 hp flat-four rear engine. Between different market segments technological variations were even more obvious. For European manufacturers these product variations were a strategic strength in the competition for world export markets, in particular when their products complemented the domestic supply.<sup>126</sup>

Already at the end of the 1950s, the small 'European car' had come to serve as a collective, transnational symbol in Europe.<sup>127</sup> When American compacts were introduced in the early 1960s, such a perspective structured the comments of French and German engineers: the cars were of 'European size'<sup>128</sup> and had a 'European design.'<sup>129</sup> Concurrently, European trade journals started to subsume the national motor shows under the label of 'European motor shows.' The once separate articles on the Paris, Frankfurt or Geneva motor show were now joined into one article.<sup>130</sup> But 'Europe,' being more than just a geographic indicator, was also a leitmotif: authors used to identify converging developments in European automobile technology. This did not always seem justified, however: a German NSU *Prinz* and the luxurious French Citroën *DS*, for example, had technologically little in common but they were both subsumed under 'European car' technology.

Another Europe-building practice was the semantic construction of a contrast between American and European engineering methods. In 1969, the new Audi 100 was presented as the new 'European middle-class sedan.' Ludwig Kraus, engineer of *Auto Union*, explained to the readers of the *Automobiltechnische Zeitschrift* that there had been four possible ways to design the new Audi: according to the American, European, sporty and radical fashion. 'America' was identified with simple technology, a stylish body and the cheapest price, whereas 'Europe' was equated with more sophisticated technology, a modern yet functional body styling and a slightly higher price.<sup>131</sup> Even if this article conveyed blunt stereotypes it illustrates how the discourse on Europe had become entangled with other discourse fragments in the automotive field: here, it was no longer the German engineering genius, 'Made in Germany,' but the European engineering style that was superior to the American one.

The examples provided illustrate how historical narratives and the semantic construction of the typical ‘European car’ and of a distinct European way of engineering similarly contributed to the Europeanization of the automotive field. European engineers and representatives of manufacturers compared themselves with their American counterparts. One’s own distinct car identity seemed grounded in the alterity of the other side, but in contrast to the interwar period the national frames of reference were replaced by a European reference frame. In this respect, one may well speak of a reciprocal narrative construction of otherness. As a result, two imagined car communities emerged—the American and the European.<sup>132</sup> Certain technologies and concepts were branded as either European or American, which gave rise to an imagined Atlantic divide in car technology, driving and engineering culture.

## **Conclusions**

The history of traffic noise abatement between 1950 and 1975 shows how international standardization of measuring car sound contributed to European integration. The ‘non-political’ expert knowledge of ISO 362 was indeed a political compromise of European experts in TC 43. This standard then served as basis for the harmonization of technical regulation on the supranational level of EEC: a nice example of ‘hidden integration’ through engineering knowledge. But effects of international standardization reached beyond the Common Market, because UNECE also adopted ISO 362 as basis for international harmonization of technical regulation—opening broader European and world export markets for EEC car manufacturers. In addition, international traffic noise abatement had wider effects on knowledge integration between automobile engineering and acoustics. At the very same time, ISO 362 also fragmented the international automotive community, because the United States did not adopt it but issued a separate national standard. This step can be interpreted as a market protection strategy aimed at preserving the Atlantic divide in automobile technology—albeit one with moderate success, as import shares of European cars increased beginning in the late 1950s.

In sum, it is possible to distinguish several different forms of integration: of markets, regulation and legislation; of expert communities and engineering knowledge; as well as of identity discourses. Integration did not run in parallel at all these layers, and the degree of integration depended on actors’ perspectives: from an American perspective trans-Atlantic market integration was very much advanced, from the European perspective

competition between European car manufacturers was rather moderate. In addition, integration was sometimes a rather contradictory process as automobile culture became Europeanized at the narrative level, but continued to be national in a material sense. However, in contrast to the interwar period, where differences between American and European automobile technology were categorized within national frames of reference, Europe became the point of reference after the war. The economic and political integration process of the EEC and the active role of EEC and UNECE in the international harmonization of car noise regulations, contributed to the notion of a common European approach in automobile development.

The history of car noise control also illustrates that the emergence of a European car identity neither stimulated nor resulted in homogenization of car technology. The European automobile industry preserved a broad technological diversity.<sup>133</sup> At the level of market integration, one can even argue that until the 1990s the automobile industry was the least integrated industry in Europe.<sup>134</sup> The sense of ‘Europeanness,’ then, hardly originated in a common material basis. Rather, it was the perceived difference of American automobiles that helped to shape the idea of a shared European car identity. As a result, the automotive community in Western Europe embraced the ‘small European car’ as a collective symbol, which helped to constitute and enact ‘Europe’ as imagined automobile community—despite the fact that a great number of European cars did not fit into this stereotype.

Acknowledgement: The research for this article was funded by the Dutch Science Council *NWO* as part of the project “Selling Sound: The Standardization of Sound in the European Car Industry and the Hidden Integration of Europe,” acquired by Karin Bijsterveld (Maastricht University) and Gijs Mom (Eindhoven University of Technology). I thank my colleagues Karin Bijsterveld, Gijs Mom and Eefje Cleophas, the editor, and all others who have made helpful comments on my manuscript.

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<sup>1</sup> See table 1.

<sup>2</sup> Between 1950 and 1960 the number of miles driven for tourist purposes increased from 17 to 50 million and reached 177 million in 1970. Vidal, 'Tourism,' 480.

<sup>3</sup> Annual Report of the Bureau of Public Roads (1951), 1, quoted by Seely, 'Visions,' 271.

<sup>4</sup> For American air pollution in 1950s see McCarthy, *Auto Mania*.

<sup>5</sup> One of the earliest postwar traffic noise studies was a German survey from 1954. Meister and Ruhrberg, 'Messung der Verkehrslautstärke in einer Großstadt.'

<sup>6</sup> The facilitation of cross-border automobile traffic was one of the early 'European projects' in the interwar period, see Schipper, *Driving Europe*, 259-274.

<sup>7</sup> Anonym, 'Europe Seeks Common Solutions.'

<sup>8</sup> For more information see the Tensions of Europe website <http://www.tensionsofeurope.eu/>.

<sup>9</sup> Schot and Oldenziel, 'Tensions of Europe,' 2.

<sup>10</sup> Misa and Schot, 'Inventing Europe,' 2-7, 9.

<sup>11</sup> Schot and Oldenziel, *Tensions of Europe*, 2.

<sup>12</sup> For the notion of the co-construction of technology and Europe see Misa and Schot, 'Inventing Europe,' 3.

<sup>13</sup> Schot, 'Building Europe on Transnational Infrastructures.' For information on the Eindhoven based research project 'Transnational Infrastructures and the Rise of Contemporary Europe' go to <http://www.tie-project.nl>. First results of this project are PhD thesis Schueler, *Materialising Identity*; Lagendijk, *Electrifying Europe*; Schipper, *Driving Europe*; see also essays in Van der Vleuten and Kaijser, *Networking Europe*; Badenoch and Fickers, *Materializing Europe*. In his review essay economic historian Christian Kleinschmidt even identifies the methodological approach of the Tensions of Europe scholars with the 'large technical systems' approach affiliated with the work of Thomas P. Hughes and David E. Nye. Kleinschmidt, 'Infrastructure, Networks, (Large) Technical Systems: The 'Hidden Integration' of Europe.' See also issue 3 (2011) of *History and Technology*, a special issue on 'Infrastructural Europeanism' edited by Frank Schipper and Johan Schot. Schipper and Schot, 'Infrastructural Europeanism.'

<sup>14</sup> Badenoch and Fickers, 'Europe Materializing,' 1.

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- <sup>15</sup> Schot and Schipper, 'The role of experts,' 3-4. For the concept of epistemic communities see Haas, 'Epistemic communities.'
- <sup>16</sup> Schot and Schipper, 'The role of experts,' 11-12.
- <sup>17</sup> E. Tuchfeldt cited by Schipper, *Driving Europe*, 259.
- <sup>18</sup> The article takes German, French, British and American trade journals into account.
- <sup>19</sup> Anonym, '35. Automobilsalon in Paris.'
- <sup>20</sup> This was the observation of A. Kucher, president of the American Society of Automobile Engineers. Kucher, 'My European Impressions'; for the European motorization boom see also Laux, *The European Automobile Industry*; Spicka, *Selling the Economic Miracle*.
- <sup>21</sup> In the following I will speak of Germany meaning the Federal Republic of Germany.
- <sup>22</sup> Schmidt, 'Die deutsche Kraftfahrzeugforschung.'
- <sup>23</sup> Le Grain-Eiffel, 'L'Evolution de l'Industrie Automobile'; Cramer, *Der Welthandel mit Automobilen*, 102.
- <sup>24</sup> Berg, 'Motorcars,' 126.
- <sup>25</sup> Ibid., 125.
- <sup>26</sup> D'Ornhjelm, 'L'Industrie Automobile Française'; Cramer, *Der Welthandel mit Automobilen*, 102.
- <sup>27</sup> 'Common Market' was used as a synonym for the European Economic Community, see Diez, 'Speaking Europe,' 602.
- <sup>28</sup> These four companies became known as the European generalists. Moguen-Toursel, 'Defining a European Vehicle,' 75-76.
- <sup>29</sup> Berg, 'Motorcars,' 135.
- <sup>30</sup> Ibid., 130-133.
- <sup>31</sup> McCarthy, *Auto Mania*, 100.
- <sup>32</sup> Ibid., 147.
- <sup>33</sup> These were still larger than most European imports but with a wheel base between 100 and 108-inches much smaller than typical American cars.
- <sup>34</sup> Anonym, 'European Production Methods;' McCarthy *Auto Mania*, 130-147.
- <sup>35</sup> Le Grain-Eiffel, 'L'Evolution de l'Industrie Automobile.'
- <sup>36</sup> As early as the 1940s the Los Angeles region had to cope with heavy smog from industry and vehicle pollution (see McCarthy, *Auto Mania*), but this issue lies beyond the scope of this article.
- <sup>37</sup> For one of the earliest post-war traffic noise surveys see Meister and Ruhrberg, 'Messung der Verkehrslautstärke in einer Großstadt.'
- <sup>38</sup> Meister and Ruhrberg, 'Messung der Verkehrslautstärke,' 373.
- <sup>39</sup> Deischi, *Kampf dem Lärm!*, 2.
- <sup>40</sup> Schenker-Sprüngli, 'Vorwort,' 5.
- <sup>41</sup> Waller, Glück and Vulkan, 'Urban Traffic Noise,' 291.
- <sup>42</sup> Wilson, *Noise*, XII.
- <sup>43</sup> Ibid., 22; see also Blitz, 'Road Traffic Noise.'
- <sup>44</sup> Wilson, *Noise*, 27.
- <sup>45</sup> Ibid., 136.
- <sup>46</sup> Ibid.

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- <sup>47</sup> The report itself referred to British Standard 3435: 1961, which was virtually based on the draft version of ISO 362. Ibid., 45.
- <sup>48</sup> Saccasyn, 'General report,' 62.
- <sup>49</sup> The West German regulation originated from the 1938 Road Traffic Act.
- <sup>50</sup> Stadie, 'Messung des Kraftfahrzeuglärms,' 131.
- <sup>51</sup> Ibid., 132.
- <sup>52</sup> Bobbert, 'Zur Kritik der Kraftfahrzeuglärm-Meßverfahren.'
- <sup>53</sup> Bobbert, 'Verkehrsgeräusche.'
- <sup>54</sup> The regulation imposed a noise limit of 95 dB, measured in 10 meter distance.
- <sup>55</sup> Thiébault, 'La Lutte contre le Bruit.'
- <sup>56</sup> WG7 consisted of delegates from Czechoslovakia, Denmark, France, Switzerland, Germany, Italy, the Netherlands, United Kingdom, United States, the USSR and Scandinavia. Private Archive Leif Nielsen (ALN), H ISO TC43 Møde Rapportør, Report of the 4th meeting of ISO/TC 43, Stockholm 1959.
- <sup>57</sup> Thiry, 'Les Mesures du Bruit,' 298.
- <sup>58</sup> Ibid.
- <sup>59</sup> ALN, H ISO TC43 Møde Rapportør, Report of the 6th meeting of ISO/TC 43, Helsinki 1961; ibid. Report of the 7th meeting of ISO/TC 43, Baden-Baden 1962; ibid. Report of the 8th meeting of ISO/TC 43, Aix-les-Bains 1964.
- <sup>60</sup> Wang and Pereira, *Handbook of Environmental Engineering*, 401.
- <sup>61</sup> ALN, H ISO TC43 Møde Rapportør, Report of the 5th meeting of ISO/TC 43, Rapallo 1960.
- <sup>62</sup> Mills and Robinson, 'The Subjective Rating of Motor Vehicle Noise,' 173.
- <sup>63</sup> Bijsterveld, *Mechanical Sound*, 203-209.
- <sup>64</sup> Warring, *Handbook of Noise and Vibration Control*, 407-406.
- <sup>65</sup> Priede, 'Noise in Engineering,' 214.
- <sup>66</sup> ALN, H ISO TC43 Møde Rapportør, Report of the 5th meeting of ISO/TC 43, Rapallo 1960.
- <sup>67</sup> Pfetsch, 'Bargaining and Arguing,' 53.
- <sup>68</sup> ALN, Measurement of noise emitted by vehicles, Letter Kleinhoonte van Os to Leif Nielsen, February 2 1979.
- <sup>69</sup> Sheth and Gegesky, 'The Influence of Test Site.'
- <sup>70</sup> Argentina, Australia, Brazil, Bulgaria, Denmark, Greece, Guatemala, Israel, Yugoslavia, Madagascar, Norway, Peru, South Africa, Czechoslovakia and Portugal. Matthes, 'Nationale und internationale Gesetzgebung,' 73.
- <sup>71</sup> Finland, Luxemburg, Sweden and Suisse. Ibid.
- <sup>72</sup> West-Germany, Belgium, France, United Kingdom, Italy, Japan, the Netherlands, Austria, Spain and the United States (California and New York). Ibid.
- <sup>73</sup> This is just an estimation as limits were given in dB, dB(A) and dB(B).
- <sup>74</sup> Warring, *Handbook of Noise and Vibration Control*, 409-417.
- <sup>75</sup> See for example Stork, 'The Cost Effectiveness of International Vehicle Regulation.'
- <sup>76</sup> Buhler, 'La lutte contre lebruit,' 41.
- <sup>77</sup> United Nations Economic Commission for Europe, *World Forum*, 5.
- <sup>78</sup> Ibid.

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- <sup>79</sup> ALN, H ISO TC 43 SC 1 Møde Rapport, Report of the 3rd meeting of ISO/TC 43/SC 1, The Hague 1973; *ibid.*, Report of the 8th meeting of ISO/TC 43/SC 1, Sydney 1980.
- <sup>80</sup> Council Directive 70/157/EEC, *Permissible sound level and the exhaust system of motor vehicles.*
- <sup>81</sup> Council Directive 77/212/EEC, *Amendment of Directive 70/157/EEC.*
- <sup>82</sup> Council Directive 70/156/EEC, *Type-approval of motor vehicles and their trailers.*
- <sup>83</sup> Other directives concerned, for example, air pollution (70/220/EEC) or the mounting of rear registration plates (70/222/EEC). EEC approved 54 directives on motor vehicles during the 1970s.
- <sup>84</sup> Moguen-Toursel, 'Defining a European Vehicle,' 77.
- <sup>85</sup> Swaak, *European Community Law*, 120.
- <sup>86</sup> *Ibid.*, 119-127.
- <sup>87</sup> Anonym, 'Europe seeks Common Solution.'
- <sup>88</sup> Organisation for Economic Co-operation and Development, *Urban Traffic Noise*, 16.
- <sup>89</sup> *Ibid.*
- <sup>90</sup> Anonym, 'Europe seeks Common Solution.'
- <sup>91</sup> Anonym, 'EPA Analysis of Noise Problems'; Wang and Pereira, *Handbook of Environmental Engineering.*
- <sup>92</sup> Vargovick, 'Noise Source Definition'; Wesler, 'Traffic Noise Legislation.'
- <sup>93</sup> Laux, *The European Automobile Industry*, 192.
- <sup>94</sup> Macmillan et al., 'A Survey of the Problems of Vehicle Noise.'
- <sup>95</sup> The 1973 volume of the SAE transactions published papers from conferences that took place a year earlier. There has no distinction been made between aircraft and road vehicle noise papers.
- <sup>96</sup> Rapin, 'Introductory Lecture.'
- <sup>97</sup> See for the notion of knowledge circulation as a means of homogenization see Hård and Misa, 'Modernizing European Cities,' 10-11.
- <sup>98</sup> The founding of these organizations and conferences can be interpreted as an important step in the genesis of an independent noise control engineering discipline. Hixson, 'Noise Control.'
- <sup>99</sup> Hillquist and Bettis, 'Measurement of Automotive Passby Noise,' 1052-1053.
- <sup>100</sup> Hillquist, 'Sound Measurement Standards,' 131.
- <sup>101</sup> Priede, 'Noise in Engineering,' 228.
- <sup>102</sup> Hillquist, 'Sound Measurement Standards,' 131.
- <sup>103</sup> Vargovick, 'Noise Source Definition,' 1046.
- <sup>104</sup> Wesler, 'Traffic Noise Legislation.'
- <sup>105</sup> Hillquist and Bettis, 'Measurement of Automotive Passby Noise,' 1059.
- <sup>106</sup> Sheth and Gegesky, 'The Influence of Test Site.'
- <sup>107</sup> See for example Kihlmann, 'Traffic Noise Control'; Kolya, 'Geräuscharme und umweltfreundliche Kraftfahrzeuge.'
- <sup>108</sup> Thiry, 'Les Mesures du Bruit.'
- <sup>109</sup> Franken, 'Criteria, Standards and Limits.'
- <sup>110</sup> Alexandre, 'Traffic Noise Control.'
- <sup>111</sup> McCarthy, *Auto Mania*, 176-192, 222.
- <sup>112</sup> See for example Anonym, 'Das Opel-Konstruktions- und Entwicklungszentrum'; Wolff and Stehle, 'Das Porsche Entwicklungszentrum'; Anonym, 'Les Installations de Mesure.'



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- <sup>113</sup> Mills, 'Noise Measurement,' 113.
- <sup>114</sup> Lalor and Anderton, 'Vehicle Noise,' 619.
- <sup>115</sup> D'Ornhjelm, 'L'Industrie Automobile Française.'
- <sup>116</sup> Moguen-Toursel, 'Community Bargaining.'
- <sup>117</sup> For the importance of historical narratives see Hård and Misa, 'Modernizing European Cities,' 6.
- <sup>118</sup> Brownback, 'Comment la Voiture Européenne a évolué.'
- <sup>119</sup> Kucher, 'My European Impressions.'
- <sup>120</sup> G., 'Deutsche Karosserien.'
- <sup>121</sup> v. G., 'Allerlei neue Karosserien;' see also v. Gorrissen, 'Deutsche Karosserien 1923.'
- <sup>122</sup> Peyrelongue, 'Petits moteuts ou voitures silencieuses.'
- <sup>123</sup> Brownback, 'Why is the American Car built as it is built?'; see also McCarthy, *Auto Mania*.
- <sup>124</sup> For the example of the automatic transmission that failed in Europe see Mom, 'Translating properties into functions.'
- <sup>125</sup> McCarthy, *Auto Mania*, 107-108.
- <sup>126</sup> Womack, Jones and Rose, *The Machine that changed the World*, 46.
- <sup>127</sup> Jäger, 'Theoretical and Methodological Aspects.'
- <sup>128</sup> Le Grain-Eiffel, 'L'Evolution de l'Industrie Automobile.'
- <sup>129</sup> Rixmann, 'Entwicklungstendenzen im Personenwagenbau.'
- <sup>130</sup> Le Grain-Eiffel, 'L'Evolution de l'Industrie Automobile;' Sitterding, 'Neue europäische Personenwagen.'
- <sup>131</sup> Kraus, 'Der Audi 100, ein europäischer Mittelklassewagen.'
- <sup>132</sup> For the concept of imagined communities see Anderson, *Imagined Communities*.
- <sup>133</sup> Fridenson, 'Étendue et Limites.'
- <sup>134</sup> Swaak, *European Community Law*, 62.