A tobacco industry study of airline cabin air quality: dropping inconvenient findings

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Objective: To examine an industry funded and controlled study of in flight air quality (IFAQ).

Methods: Systematic search of internal tobacco industry documents available on the internet and at the British American Tobacco Guildford Depository.

Results: Individuals from several tobacco industry companies, led by Philip Morris, designed, funded, conducted, and controlled the presentation of results of a study of IFAQ for the Scandinavian airline SAS in 1988 while attempting to minimise the appearance of industry control. Industry lawyers and scientists deleted results unfavourable to the industry’s position from the study before delivering it to the airline. The published version of the study further downplayed the results, particularly with regard to respirable suspended particulates. The study ignored the health implications of the results and instead promoted the industry position that ventilation could solve problems posed by secondhand smoke.

Conclusions: Sponsoring IFAQ studies was one of several tactics the tobacco industry employed in attempts to reverse or delay implementation of in-flight smoking restrictions. As a result, airline patrons and employees, particularly flight attendants, continued to be exposed to pollution from secondhand smoke, especially particulates, which the industry’s own consultants had noted exceeded international standards. This case adds to the growing body of evidence that scientific studies associated with the tobacco industry cannot be taken at face value.
redirecting attention from secondhand smoke to the broader issue of indoor air quality (IAQ).23–25 In 1987, PM began to discuss conducting studies of in flight air quality (IFAQ) with the objective of resisting smoking restrictions and reversing “scientific and popular opinion that ETS is harmful to health”.26 We describe how PM conceived of, and the industry executed, one such study of air quality on the Scandinavian airline SAS, excised results that did not serve the industry’s interests, and eliminated statements regarding the study’s health implications.

METHODS
We analysed tobacco industry documents available on the internet as a result of tobacco litigation. We searched for documents on the following websites: Philip Morris (www.pmdocs.com), the Tobacco Institute (www.tobaccoinstitute.com), Tobacco Documents Online (www.tobaccodocuments.org), the Legacy Tobacco Documents Library (legacy.library.ucsf.edu), and the UCSF British American Tobacco documents collection (www.library.ucsf.edu/tobacco/batco). Searches were conducted from August 2002 to May 2003. We also examined paper copies of British American Tobacco Company documents from the Guildford depository identified in a manual search of the documents conducted in November 2002.

RESULTS
IFAQ study
In 1987, Philip Morris employees identified Scandinavian countries, Sweden and Finland in particular, as priority areas for action because the dangers of secondhand smoke had received extensive media coverage there and because both SAS and Finnair, the national airlines of Sweden and Finland, had contemplated or were preparing to implement smoking restrictions. Moreover, SAS’s charter airline, Scanair, planned to offer smoke-free charter flights during the winter of 1988–89. PM employees met with each airline during the summer of 1988 to discuss conducting IFAQ studies, presenting IFAQ studies as a means of addressing an issue that concerned both the tobacco industry and the airline industry: customer preference.19 20–22 Finnair declined to participate in an IFAQ study because it might publicly mark them as having an air quality problem;23 SAS showed more interest, however, perhaps because of its continuing attempts to address the issue of smoke in the cabin.

SAS had tested in-flight smoking restrictions twice, in 1981 and 1983, in response to customer and cabin crew complaints about smoke. Complaints from passengers had increased sharply after the introduction in 1981 of length-wise smoking, and complaints from cabin crew had increased sharply after the introduction in 1983 of non-smoking areas on the Airbus in an effort to separate smokers and non-smokers. Results of a passenger survey taken after the 1983 smoke-free trial indicated strong support for restrictions, especially from non-smokers. SAS analysts remained concerned, however, that SAS would lose passengers (revenue) if they implemented a permanent smoke-free policy.* 33 Due to those financial concerns and sought the help of flight attendant unions and associations in order to spread its IFAQ message.26 28 Philip Morris had established a relationship with the International Flight Attendants Association (IFAA) in 1987, when PM agreed to be a sponsor of the IFAA 7th World Congress. PM’s 1988 public relations plan included “convey[ing] the story of the broad issue of IFAQ and the minimal role of ETS at the IFAA Congress in October”.28 PM’s letter to IFAA president Peter Tronke outlined the terms of PM’s sponsorship included stipulations that PM could provide an “independent” speaker to address a plenary session on the subject of IFAQ.29 That speaker, Dr Phillip Witorsch, a Tobacco Institute consultant the tobacco industry used around the world to support its positions on a variety of issues related to secondhand smoke,30 spoke of all of the possible factors affecting IFAQ and dismissed the importance of secondhand smoke as one of those factors. Witorsch ended by noting that the 1986 SAS study’s recommendation to end smoking on all commercial flights seemed “unreasonable” and “inappropriate” in view of available data.30 The IFAA granted PM a two hour IFAQ panel discussion at the 1989 World Congress featuring tobacco industry experts ETS/IFAQ/IAQ consultants Charles Caliendi, Larry Holcomb, and Gray Robertson.31–33 PM considered the relationship with IFAA valuable enough to sponsor at least three more conferences—in 1989, 1991, and 1993—usually providing funding ranging from CHF 50 000 ($37 000) in 1987 to CHF 80 000 ($60 000) in 1993.34–36

PM’s relationship with the IFAA offered other opportunities to spread the industry message that smoking restrictions would do little to solve the problem of IFAQ. For example, in 1988 PM’s director of corporate affairs, EEMA region, discussed drafting a letter IFAA president Peter Tronke could mail to heads of airline attendant unions and organisations with a copy of a Tobacco Institute sponsored paper “Impact of ETS on Cabin Air Quality” with “the letters individually typed for his signature on his letterhead” and “postage [put] on the envelopes, etc.,” but, he warned, “PLEASE do not discuss such details in writing with Peter/IFAA” (emphasis in original).36 47 PM also planned to “encourage IFAA president to participate, perhaps host, a panel discussion on airline workplace issues, of which smoking would be a minor part.”37 In 1988 Tronke sent a letter to British Airways, at PM’s request, urging the airline to...
do IFAQ studies; British Airways declined Tronke’s offer of help. A 1990 “PM EEC Corporate Affairs Agenda 1991” suggested using Tronke to lobby the German airline Lufthansa.

The documents do not reveal any direct payments to Tronke, but PM did budget money for IFAQ in addition to the conference sponsorship—for example, a 1991 budget included under the heading “Special Projects” the item “IFAA $25,000.” A 1993 budget draft allocated IFAQ $90,000 under the heading “Support for key third parties and programs.” This $90,000 appears to be about $30,000 more than PM contributed to support the 1993 IFAQ Congress. The documents did not reveal the purpose of the additional funds.

PM saw its relationship with the IFAQ as a means to add legitimacy for the planned IFAQ study, which PM sought to fund and publish without exposing industry involvement. In a March 1987 memo to PM Europe public affairs and R&D executives, PM’s director of corporate affairs, EEMA Region, heralded the possibility of “negotiating a sponsorship agreement by which IFAQ studies could be funded through and published in the name of the IFAQ,” perhaps in order to gain legitimacy for the results. The final agreement between PM and IFAQ, spelled out in a June 1987 letter to IFAQ president Peter Tronke, specified that IFAQ would “endeavor to have a report on such study published in scientific, medical and airline journals…”

**Industry control**

PM later abandoned the idea of publishing IFAQ study results via the IFAQ, perhaps because the creation of the Center for Indoor Air Research (CIAR) by US tobacco companies in 1988 provided PM with a better mechanism for controlling such studies while obscuring industry involvement. The CIAR, while funding some independent peer reviewed research, was used as a means for paying for work that met the industry’s political, legal, and regulatory needs while maintaining the fiction that it was independent of the tobacco industry. PM eventually opted to have CIAR officially fund the SAS study so that CIAR could “correctly be named as a sponsor” of the study and thereby “diminish the effectiveness of Antis [anti-smoking] PR efforts to challenge the credibility of the research.” Efforts to obscure the study’s origins suggests concern that public knowledge of industry participation might expose the research to criticism.

In an effort to fund its portion of the IFAQ study through CIAR, PM sought other ways to obscure industry participation in the SAS IFAQ study. Final plans called for “ETS whitecoats” to publish the study in airline trade press and scientific and medical journals. (“Whitecoats” were “independent” scientists PM hired to conduct research intended to dispel concerns about the health risks of SHS as part of the industry’s secret “International ETS Consultancy Project”). As a June 1988 memo by Pottorff to Stig Carlson, director, corporate affairs, PM EEMA, noted, industry law firm Covington & Burling’s John Rupp (who managed industry scientific and regulatory responses to secondhand smoke worldwide, including the International ETS Consultancy Project) was responsible for “coordinating the selection and use of scientists to undertake the study.” Rupp oversaw the selection of toxicologist Torbjörn Malmfors, statistician Daniel Thorburn, and occupation hygienist Arne Westlin, all three of whom were already working for PM as Nordic ETS consultants. In fact, Malmfors, “Chief Expert” PM ETS consultant in the Nordic countries, had helped form and direct the EGIL group (Swedish acronym for the tobacco industry’s “Expert Group for Indoor Air”) in 1987. As in other parts of the world, Covington & Burling coordinated the consultants because PM recognised that, in general, ETS consultants should not appear to be working directly for the tobacco industry. The independence was illusionary; CIAR’s draft budget for the project indicated that CIAR paid all three scientists for their participation in the SAS study, though their status as PM ETS consultants was never disclosed.

Aided by the ETS “whitecoats” who eventually published the study, as well as by other industry scientists, PM employees designed a study to examine the air quality in passenger cabins of DC-9 and MD-80 aircraft on 48 representative flights. RJ Reynolds’ Guy Oldaker, for example, assisted with the statistical methods. Oldaker attended an August 1988 meeting to review the study design, wherein the participants “proceeded to go through the [proposed project design], asking questions, making comments and suggesting changes.” PM’s Pottorff and Helmut Gairsch, industry IAQ consultant Charles Calendi, Lorillard’s V Norman, Covington & Burling’s Rupp, and the three PM ETS consultants also attended the planning meeting. The study proposed to measure the following: respirable suspended particles (RSP), nicotine, carbon monoxide, and carbon dioxide.

PM chose an outside laboratory, the Netherlands Organization for Applied Scientific Research or Nederlandse Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek (TNO) to collect data for the study, again in an attempt to cover industry involvement and provide legitimacy. “It’s advisable,” Pottorff and Carlson wrote in a 1988 memo, “to use government and semi government laboratories to conduct IFAQ research, as this factor will enhance the credibility of the research.” According to Helmut Reif, director of science and technology, PM Europe, TNO could “carry out the IFAQ tests without tobacco industry fingerprints.” Nevertheless, PM’s Reif was charged with carefully monitoring the scientific execution of the study, and Reif and his staff supervised TNO closely.

In addition to supervising TNO’s data collection, the industry exercised complete control over explanation and presentation of the results. As Gairsch wrote in a January 1989 status report: “The interpretation and the statistics are to be made by independent experts for the CIAR.” Handwritten notes (author unknown) of a January 1989 meeting at the Washington DC offices of Covington & Burling attended by RJ Reynolds, PM, Covington & Burling, and EGIL, noted concerns about “inappropriate explanations” in a draft of TNO’s report that highlighted high levels of exposure to secondhand smoke, and indicated that TNO should delete this information before PM could deliver the results to SAS. Pottorff stressed that it was CIAR’s decision what went into TNO’s report and noted that TNO had not been asked to draw conclusions and should concentrate instead on experiment techniques. Gairsch later wrote: “All chapters of the narrative part of TNO [report], going beyond the mere description of the experimental part, should be eliminated.” The group designated CIAR executive director Max Eisenberg to approach TNO to request that the lab omit the material that concerned the industry. At CIAR’s request, TNO removed an entire 21 page section entitled “Analysis of the results.” Among the information deleted were the following conclusions...
Nicotine concentrations of 10 µg/m³ were measured in the smoking sections, the tourist non-smoking section, and the two rows in front of the smoking section in the business class. In the two rows of the tourist non-smoking class in the front of a smoking section (“worst cases”) nicotine concentrations of more than 40 µg/m³ were measured.

The respirable dust concentrations often exceeded the World Health Organization guideline of 70 µg/m³ for PM 10 particulate matter. The probability of this was about 30% in the business non-smoking section and about 95% in the other sections.

The carbon dioxide (CO₂) concentrations in the various sections did not differ significantly. The CO₂ concentrations measured in the cabin were higher than the concentrations calculated from the data on the ventilation and the numbers of passengers in the cabin.

The cumulative frequency distribution of the ETS components nicotine, respirable dust, and carbon monoxide were close to each other in the two smoking sections and in the tourist non-smoking section.

In addition, a table summarising the results was also deleted entirely from the executive summary, together with the following statement:

The industry in particular wanted TNO’s conclusions about RSP and CO₂ removed, possibly because RSP levels are one of the most reliable indicators of and damaging components of secondhand smoke, and because the high CO₂ levels may have been a result of the combustion process associated with smoking the cigarettes. The industry group considered the RSP levels “unexpectedly high” and decided to double check TNO’s numbers, having another laboratory (International Technology Corporation) reanalyse the samples; International Technology Corporation confirmed TNO’s results. The excised data demonstrate that the simple separation of smokers from non-smokers in airplanes did not protect people in the non-smoking section from secondhand smoke. Indeed, TNO observed significant migration of secondhand smoke constituents into the tourist non-smoking section. The conclusions about CO₂ concentrations also suggest that the aircraft ventilation systems were not adequate to deal with the combustion products put in the air by the burning cigarettes. Since SAS had already recognised the need to “improve the division between smokers and non-smokers”, PM may have been sensitive to releasing data that underestimated that need. The final report, when delivered to SAS, would not give a busy executive the clear view that smoking on airplanes presented a serious air quality problem on aircraft; the original version of the report, before it was revised by industry scientists and lawyers, would have.

Misleading presentation of results

In addition to managing and directing TNO’s efforts, tobacco industry interests also carefully controlled the report written and published by “ETS whitecoats” Malmfors, Thorburn, and Westlin. On 16 March 1989, Mary Potteroff circulated a draft version of the SAS study to senior industry scientists CR Green and Guy Oldaker (RJ Reynolds), Tom Osdense (PM), A Spears (Lorillard), and Covington & Burling’s Rupp. On 21 March 1989, the same group, plus the study’s authors and representatives from British American Tobacco and the Nordic National Tobacco Manufacturers Association, met in Stockholm to discuss the study further. After the March meeting in Stockholm, CIAR’s Eisenberg forwarded another draft of the study to the same group, asking for comments by 9 April. That further drafts were circulated is evident from comments on the draft received from Green and Spears in June. Industry lawyers, as well as industry scientists, participated in the revisions. A 30 May 1989 bill to CIAR from Covington & Burling contained charges for “continued work in connection with the SAS project, including consulting with Professor Malmfors and others in Washington and Stockholm concerning their research report, consulting with the Executive Director and Company scientists concerning the draft report and related matters, and editing the draft report...” A substantial difference existed between the published IFAQ study results paper “Air Quality in Passenger Cabins of DC-9 and MD-80 Aircraft” published under Malmfors’ authorship in the journal Environmental Technology Letters in 1989, and the draft report TNO had produced. While the TNO draft reported standard deviations and full ranges for recorded values (reproduced in fig 1), Malmfors et al reported standard errors of the mean and 5%/95% range in separate tables (reproduced in fig 2 and 3). This presentation, while not wrong, is misleading, since a casual reader would probably underestimate the range of exposures. The presentation in Malmfors et al is unusual, since the original presentation in the TNO report provides more information in a more compact and clearer form and is a more common way of reporting such information; compare fig 1 with fig 2 and 3. This presentation is particularly important, since it is the maximum, not the mean, levels that are generally important for regulatory purposes.

Another important difference in presentation existed between TNO’s report and the published paper. The industry group that met at Covington & Burling in January 1989 had suggested that Malmfors compare measured levels of secondhand smoke components with WHO standards. Malmfors agreed to this approach. When the paper appeared, however, it contained a table (fig 4) that omitted RSPs on the grounds that no standard “for RSP resulting from ETS” existed. This statement ignored the fact that there were standards for RSPs in general, though not for ETS in particular. Indeed, material the industry had TNO delete from the original TNO report had noted that the measured values of RSP exceeded the WHO standard of 70 µg/m³ 95% of the time in all but the business non-smoking sections.

The final industry edited paper “Air Quality in Passenger Cabins of DC-9 and MD-80 Aircraft” published in the journal Environmental Technology Letters diverged not only from TNO’s draft report but also from earlier drafts of the paper circulated within the industry. The industry was careful not only to see that the substance was presented in ways that met the industry’s needs, but also was careful in the choice of words. For example, a section title was changed from “Levels of air contaminates” to “Levels of air components.” More significant, reporting of an important result changed considerably. TNO’s results showed that secondhand smoke levels in the tourist non-smoking section, sandwiched between business and tourist smoking sections, were much closer to levels found in the smoking sections than in the business non-smoking section, located in the front of the
plane. Malmfors' first draft stated: “Any such [health effects of SHS exposure] in the tourist non-smoking section would have been closer to those in the smoking sections.” This statement was deleted from the published version of the paper. Instead, the published version noted “the levels of measured ETS-components in [the tourist nonsmoking section] is lower than in the smoking sections”, which, while true, was misleading. As clearly indicated in the original report, the levels in the non-smoking section were only slightly lower than in the smoking section.

A second significant change between the versions was in the study’s attributions and acknowledgements. The draft paper reported that the CIAR had sponsored the study and had asked the authors “to give advice about the conduct of the study and to evaluate the results”. That statement made explicit the relationship between the authors and CIAR. The

### Table 2: Concentrations per section. Nicotine and respirable dust (RSP) in µg/m³ CO and CO₂ in ppm.

<table>
<thead>
<tr>
<th>Component</th>
<th>Section</th>
<th>n</th>
<th>GM</th>
<th>GSD</th>
<th>AM</th>
<th>STD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nicotine</td>
<td>B/NS</td>
<td>47</td>
<td>3.85</td>
<td>2.72</td>
<td>6.66</td>
<td>9.11</td>
<td>0.4-50</td>
</tr>
<tr>
<td></td>
<td>B/S</td>
<td>48</td>
<td>30.8</td>
<td>1.79</td>
<td>36.1</td>
<td>20.9</td>
<td>7-104</td>
</tr>
<tr>
<td></td>
<td>T/NS</td>
<td>48</td>
<td>19.0</td>
<td>1.87</td>
<td>22.8</td>
<td>13.9</td>
<td>5-64</td>
</tr>
<tr>
<td></td>
<td>T/S</td>
<td>47</td>
<td>24.3</td>
<td>1.94</td>
<td>29.3</td>
<td>17.2</td>
<td>5-73</td>
</tr>
<tr>
<td>Respirable dust</td>
<td>B/NS</td>
<td>47</td>
<td>50</td>
<td>2.15</td>
<td>70</td>
<td>74</td>
<td>15-460</td>
</tr>
<tr>
<td></td>
<td>B/S</td>
<td>48</td>
<td>187</td>
<td>1.96</td>
<td>218</td>
<td>113</td>
<td>11-600</td>
</tr>
<tr>
<td></td>
<td>T/NS</td>
<td>48</td>
<td>155</td>
<td>1.67</td>
<td>176</td>
<td>92</td>
<td>45-560</td>
</tr>
<tr>
<td></td>
<td>T/S</td>
<td>47</td>
<td>187</td>
<td>1.71</td>
<td>213</td>
<td>165</td>
<td>45-500</td>
</tr>
<tr>
<td>CO</td>
<td>B/NS</td>
<td>45</td>
<td>0.40</td>
<td>2.46</td>
<td>0.55</td>
<td>2.46</td>
<td>0.1-1.5</td>
</tr>
<tr>
<td></td>
<td>B/S</td>
<td>47</td>
<td>0.92</td>
<td>1.62</td>
<td>1.03</td>
<td>0.50</td>
<td>0.3-2.5</td>
</tr>
<tr>
<td></td>
<td>T/NS</td>
<td>46</td>
<td>0.76</td>
<td>1.73</td>
<td>0.86</td>
<td>0.44</td>
<td>0.1-2.5</td>
</tr>
<tr>
<td></td>
<td>T/S</td>
<td>45</td>
<td>0.97</td>
<td>1.53</td>
<td>1.05</td>
<td>0.41</td>
<td>0.3-2.2</td>
</tr>
<tr>
<td>CO₂</td>
<td>B/NS</td>
<td>45</td>
<td>1213</td>
<td>1.23</td>
<td>1239</td>
<td>254</td>
<td>70-2000</td>
</tr>
<tr>
<td></td>
<td>B/S</td>
<td>47</td>
<td>1200</td>
<td>1.27</td>
<td>1232</td>
<td>282</td>
<td>700-1950</td>
</tr>
<tr>
<td></td>
<td>T/NS</td>
<td>46</td>
<td>1216</td>
<td>1.24</td>
<td>1244</td>
<td>262</td>
<td>650-1920</td>
</tr>
<tr>
<td></td>
<td>T/S</td>
<td>46</td>
<td>1357</td>
<td>1.24</td>
<td>1387</td>
<td>286</td>
<td>730-2100</td>
</tr>
</tbody>
</table>

### Table 3: Average level of air components by section

<table>
<thead>
<tr>
<th>Class and section</th>
<th>BNS (µg/m³)</th>
<th>B/S (µg/m³)</th>
<th>T/NS (µg/m³)</th>
<th>T/S (µg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RSP</td>
<td>60</td>
<td>250</td>
<td>160 (15)</td>
<td>220 (21)</td>
</tr>
<tr>
<td>TRP Average reading (µg/m³)</td>
<td>0.6 (0.1)</td>
<td>1.9 (0.1)</td>
<td>1.3 (0.1)</td>
<td>1.7 (0.2)</td>
</tr>
<tr>
<td>TRP Maximum reading (µg/m³)</td>
<td>4 (0.8)</td>
<td>29 (4.4)</td>
<td>7 (0.8)</td>
<td>16 (3.2)</td>
</tr>
<tr>
<td>Nicotine (µg/m³)</td>
<td>5 (0.9)</td>
<td>41 (3.6)</td>
<td>21 (2.5)</td>
<td>32 (3.5)</td>
</tr>
<tr>
<td>Concentration of CO (ppm)</td>
<td>0.6 (0.06)</td>
<td>1.1 (0.08)</td>
<td>0.8 (0.07)</td>
<td>1.1 (0.11)</td>
</tr>
<tr>
<td>Concentration of CO₂ (ppm)</td>
<td>1310 (41)</td>
<td>1310 (42)</td>
<td>1270 (36)</td>
<td>1430 (36)</td>
</tr>
<tr>
<td>Mean Relative Humidity (%)</td>
<td>25 (0.7)</td>
<td>25 (0.8)</td>
<td>25 (0.6)</td>
<td>25 (1.0)</td>
</tr>
</tbody>
</table>

Cell content: - Weighted mean value, all flights
- Standard error for mean value in parenthesis

Figure 1: One element of the presentation of results in the paper published by Malmfors; compare with the simpler and more compact presentation in fig 1. Note that the standard deviations have been replaced with the standard errors of the mean.

Figure 2: Summary table of results included in the original report from TNO delivered to the tobacco industry. Note that the table presents the fact that levels of several components were high and presents the range of observations.
The authors have served as consultants to CIAR. This carefully worded statement suggests that the authors had, in the past, worked with CIAR, and not that they were paid by CIAR to interpret and publish the present study. There was no mention of the role of the industry lawyers or scientists in the development and conduct of the study, much less the writing of the report and paper.

Since CIAR involvement in the study might raise questions of bias, PM attempted to deflect queries about the study’s origins. PM provided SAS with answers to questions airline management was likely to receive when announcing completion of the study. If asked who sponsored the research, for example, SAS was told to respond, CIAR, “an American-based non-profit group which sponsors research of different kinds regarding the indoor environment”. If asked...

<table>
<thead>
<tr>
<th>Table 4: Ranges in the levels of air components between flights – Business Non-Smoking (BNS), Business Smoking (BS), Tourist Non-Smoking (TNS) and Tourist Smoking (TS).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>RSP (µg/m³)</td>
</tr>
<tr>
<td>TVF-Average</td>
</tr>
<tr>
<td>TVF-Maximum</td>
</tr>
<tr>
<td>Nicotine (µg/m³)</td>
</tr>
<tr>
<td>Concentration of CO (ppm)</td>
</tr>
<tr>
<td>Concentration of CO₂ (ppm)</td>
</tr>
<tr>
<td>Mean Relative Humidity (%)</td>
</tr>
</tbody>
</table>

This table shows estimated quantities. For example 5% of the passengers in BNS were exposed to less than 12 µg/m³ RSP, and 95% of the passengers in the same section were exposed to less than 100 µg/m³ RSP.

Figure 3. One element of the presentation of results in the paper published by Malmfors; compare with the simpler and more compact presentation in fig 1. Note that the range has been replaced with the 5% and 95% points.

published version stated simply: ‘The authors have served as consultants to CIAR’. This carefully worded statement suggests that the authors had, in the past, worked with CIAR, and not that they were paid by CIAR to interpret and publish the present study. There was no mention of the role of the industry lawyers or scientists in the development and conduct of the study, much less the writing of the report and paper.

<table>
<thead>
<tr>
<th>Table 7: Air quality standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Component</strong></td>
</tr>
<tr>
<td>INDOOR AIR IN GENERAL</td>
</tr>
<tr>
<td>Nicotine</td>
</tr>
<tr>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>AIRLINE CABIN AIR</td>
</tr>
<tr>
<td>Carbon monoxide</td>
</tr>
<tr>
<td>Carbon dioxide</td>
</tr>
</tbody>
</table>

OSHA – Occupational Safety and Health Administration
ASS – Workers Protection Board
EPA – Environmental Protection Agency
ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers
FAA – Federal Aviation Administration

Figure 4. Presentation of international standards in paper published by Malmfors. Note that the standards for particulates, which had been stressed in the original TNO report, have been dropped.
about tobacco company involvement, the suggested response was “We understand that CIAR receives grants from various sources, including some from the tobacco industry". If tobacco money is involved, how can research be unbiased? “The results were analyzed by three independent Swedish scientists” and published in a peer-reviewed journal so “the scientific integrity of the research is beyond reasonable question”.27 Nowhere is it noted that the “three independent Scandinavian scientists” were also part of the tobacco industry’s International ETS Consultants project.28 29 The illusion of independence was important, since the authors promoted industry positions. Although both the abstract and the body of the paper specified that “no observation of health effects were made”, the study contained a lengthy discussion of health consequences, concluding that long term health effects of exposure to secondhand smoke on airplanes “were most likely insignificant in passengers and cabin crew with or without compromising medical conditions”24. There were no data presented in the paper to support this statement. The authors also emphasised the effectiveness of the aircraft ventilation systems, though the paper provided no data demonstrating that ventilation systems could reduce the levels of smoke pollutants to levels deemed acceptable by international health authorities such as the WHO.30 Indeed, the results on CO2 in the original TNO report31 indicated that the ventilation system was not adequate to control the combustion products from burning cigarettes. Malmfors dismissed this observation by speculating that the ventilation system “airflows, which have not been measured, are lower than intended” (emphasis added). He seemed not to consider the possibility that the ventilation system was being operated according to specification and was simply not adequate to control the levels of combustion products put into the air by burning cigarettes. Disregarding results that clearly showed secondhand smoke polluting the cabin, the paper instead pushed industry positions.

IFAQ study did not stop smoke-free policies in Scandinavia

In spite of initial enthusiasm for IFAQ studies as a means of forestalling smoking restrictions,32 PM and the rest of the industry coiled on the idea after completion of the SAS study. The dampened interest may or may not be attributable to the fact that, on the recommendation of the Nordic Council, an interparliamentary body charged with developing cooperation between Scandinavian nations, both SAS and Finnair ended smoking on all Nordic area flights effective 1 November 1989, just a few months after publication of the SAS study. News that SAS planned to host a meeting of airlines servicing the Nordic countries in an effort to secondhand smoke on airplanes “were most likely insignificant in passengers and cabin crew with or without compromising medical conditions”. There were no data presented in the paper to support this statement. The authors also emphasised the effectiveness of the aircraft ventilation systems, though the paper provided no data demonstrating that ventilation systems could reduce the levels of smoke pollutants to levels deemed acceptable by international health authorities such as the WHO.30 Indeed, the results on CO2 in the original TNO report31 indicated that the ventilation system was not adequate to control the combustion products from burning cigarettes. Malmfors dismissed this observation by speculating that the ventilation system “airflows, which have not been measured, are lower than intended” (emphasis added). He seemed not to consider the possibility that the ventilation system was being operated according to specification and was simply not adequate to control the levels of combustion products put into the air by burning cigarettes. Disregarding results that clearly showed secondhand smoke polluting the cabin, the paper instead pushed industry positions.

Smoking continued on SAS outside of the Nordic region

Although SAS implemented smoking restrictions within Scandinavia, smoking continued on SAS flights to the rest of Europe and beyond. When SAS extended its smoke-free flight policy to cover all of Europe in March 1993,33 PM reacted vigorously, applying some of the other tactics the industry deployed to resist smoking restrictions. These tactics included applying economic pressure by boycotting SAS and by attempting to create a stir in the Danish investor community (SAS is listed on the Danish stock exchange);

issuing press releases and articles calling bans “discrimina-
tion”; and mobilising Scandinavian and international smo-
kers’ rights groups.34 A Norwegian news item two months later, Ban on smoking goes up in smoke,35 reported that SAS had rescinded the expanded restrictions because “anti-smokers protest(ed).” Although SAS denied that pressure from the tobacco industry precipitated the turnaround, PM’s Matthew Winokur, manager for worldwide regulatory affairs for PM Europe, took credit for the turnaround in a July 1993 memo to senior vice president for corporate affairs Craig Fuller. “We have had mixed results combating [voluntary smoke-free policies]. However, success is possible. SAS recently overturned its decision to ban smoking on longer flights.”36

SAS went entirely smoke-free in 1997. According to an SAS press release: “We have chosen to introduce non-smoking in stages and our customer surveys show that an overwhelming majority prefer a totally smoke-free environment on board. Our surveys also show that as many as 60 percent of our passengers who smoke accept the introduction of a non-smoking policy.”

DISCUSSION

This story of the IFAQ study follows the now familiar pattern of the tobacco industry working in the shadows to fund and control studies designed and presented in a way to support industry positions on secondhand smoke. As with other secondhand smoke related issues, industry lawyers, scientists, and consultants cooperated to produce “studies” that appeared to be legitimate, unbiased scientific research but which were controlled by industry at all levels.37 38 39 40 41 42 For example, the industry generated a study to counter findings that showed an association between lung cancer and exposure to secondhand smoke.43 As in the SAS IFAQ study, several participants, including an industry scientist as well as a representative of Covington and Burling, were unacknowledged.

PM conceived of IFAQ studies as part of an overall strategy to “reverse scientific and popular opinion that ETS is harmful to health” and restore the “social acceptability of smoking”.27 IFAQ studies were to provide a means for spreading the industry’s message that secondhand smoke was an insignificant factor in air quality onboard aircraft.38 Tobacco industry funded IFAQ studies, like those funded by governments and non-governmental organisations, clearly showed that secondhand smoke polluted aircraft in which smoking was permitted.39 Four industry funded studies (including the SAS study) yielded similar concentrations of contaminants as did government and airline sponsored studies but offered different conclusions.45 In the SAS example, the industry chose to disregard the study’s implications and focused instead on propagating its message that secondhand smoke on airplanes posed no health risk to passengers and crew and that adequate ventilation would alleviate problems perceived to be created by secondhand smoke.

The industry also avoided comparing RSP and other secondhand smoke components with values collected on flights during which smoking was not permitted, despite suggestions from its own employees to do so.38 Indeed, other studies done by non-industry sources demonstrated that RSPs in smoke-free airline cabins were generally below 10 μg/m3,46 well below those observed when smoking was present and well within accepted standards of exposure.47 48 49 50 51 52

Sponsoring IFAQ studies was but one of several delaying tactics the industry employed in its efforts to reverse or delay implementation of in-flight smoking restrictions. For example, the industry fought smoking restrictions at the legislative and regulatory levels.100 101 Pressured individual airlines that instituted restrictions,36 102 103 and generated letter writing
campaigns from “consumers” challenging proposed or actual restrictions.106–114 Overall, industry tactics helped slow implementation of no-smoking policies: SAS and many other airlines permitted smoking for almost 20 years after activists first called for eliminating the practice. As a result, airline patrons and employees, particularly flight attendants, continued to be exposed to levels of pollution from secondhand smoke, particularly particulates, that the industry’s own consultants had noted exceeded international standards in the late 1980s.

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REFERENCES


33 Traylor MP. Begay ME, Glantz SA. New tobacco industry strategy to prevent local tobacco control. JAMA 1993;270:479–86.


19 Sloane MA, Glantz SA. New tobacco industry strategy to prevent local tobacco control. JAMA 1993;270:479–86.

18 Traylor MP. Begay ME, Glantz SA. New tobacco industry strategy to prevent local tobacco control. JAMA 1993;270:479–86.


15 Committee on Passive Smoking NRC. Non-smoking wives of heavy smokers have a higher risk of lung cancer: a study from Japan. BMJ 1981;281:183–5.

Airliner cabin air quality


