

Military Noise and the Public Element: Domestic and International Issues

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MILITARY NOISE AND THE PUBLIC ELEMENT: DOMESTIC AND INTERNATIONAL ISSUES

Erik H. Ayers

September 1996

ABSTRACT

From all corners of the globe, the public has been influenced by military noise. However, what are the most common sources of concern and how has the public reacted to them? What changes and trends can we see emerging from the past twenty years? More importantly, what can they tell us about public opinion and reaction in the future?

This paper examines the major issues related to military noise and the public element (in two separate time slices) for the years 1975 to 1990 and 1991 to the present.

Evidence indicated that past concerns about military noise were relatively minor compared to complaints about commercial aviation noise. The physiological effects of such noise were uppermost in the minds of the public, at home and abroad. However, the literature indicated the public's dawning awareness of the effect of noise on the environment.

With noise control regulations being tightened on commercial aviation, public attention has swung to focus more sharply on military noise. Specifically, impulse noise and the effect of military noise on wildlife and natural habitats has increased. Action groups have been formed and are proving to be a vocal outlet for public opinion on noise issues.

In the past, the prevalent Army mindset was that a certain amount of noise was an unintended "cost of business" resulting from efforts to build a strong military. However, the Army has realized that public concerns about noise must be addressed and has taken steps to minimize noise.

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Issues on the maps are presented: **(1)** darkly outlined to indicate emerging issues, **(2)** outlined with dashes to indicate fading issues, or **(3)** normally outlined to indicate stable issues. Each issues map should be viewed in conjunction with their respective narratives.

1. Introduction

1.1 Study Background

The Aircraft Noise Pilot Study Follow-Up Programme, created under the auspices of NATO's Committee on the Challenges of Modern Society (CCMS) is concerned with issues relating to aircraft and weapons noise, both domestically and within the NATO alliance. As NATO enlarges its membership, as weapons become more powerful, as populations grow, and as training space becomes more severely constrained, the number of related noise conflicts is likely to increase. As a consequence, recent concerns of the CCMS Aircraft Noise Pilot Study Follow-Up Programme have focused on the public element of military noise. This project is intended to provide the Follow-Up Programme with an evaluation of the current state of military noise issues, both in the domestic arena and internationally, describe how these issues relate to public interests.

1.2 Research Tool

Technology Opportunities Analysis (TOA) was used to expedite secondary analyses of database searches on the topic of military noise and the public element. TOA and its unique *Knowbot* software allow for efficient and effective information processing. TOA draws on monitoring and bibliometrics to mine the wealth of information available in major public and private electronic databases.

TOA performs "value-added" data analysis, abstracting knowledge from raw information. The process entails gathering large amounts of raw information (literature abstracts), from electronic database searches, and through the use of TOA *Knowbot* software refining that information to identify key issues and where possible relationships between concepts. Key issues are displayed graphically in the form of issues maps.

The following is a list of databases used to compile raw information (abstracts) on the research topic:

NTIS: *National Technical Information Service*
PAIS: *Public Affairs Information Service*
INSP: *On-line Equivalent of Science Abstracts*
DTIC: *Defense Technical Information Center*
ACAD: *Expanded Academic Index*

BUSI: *Business Index*
WNC: *World News Connection*
WWW: *World Wide Web*
ENGI: *Engineering Index*

Appendix A provides a brief description of each of these databases.

1.3 Limitations

TOA was applied in this project as a tool to help identify issue areas. Techniques utilized in TOA are augmented by the researcher's own insights. That is, the findings of this report are based on (1) co-occurrences between keywords within the literature, and (2) the researcher's own insights into why certain co-occurrences exist. In essence, TOA was used in this project as a tool to help facilitate a type of subjective empirical analysis. Given this context, the findings in this report are generalizable and representative of the published literature available in the databases presented above.

1.4 Findings Presentation

TOA on the topic of military noise and the public element resulted in the development of nine issues maps. Each map represents a main topic (center of map), as well as major cluster issues that surround the main topic. Each cluster, where possible, was then connected to subcluster

issues. The subcluster issues maps for the “1991 - present” literature, as well as foreign literature, are presented in conjunction with the corresponding narratives.

Because TOA is dependent on large amounts of raw information, one of the first steps in conducting TOA is to determine if the information obtained on a particular topic is sufficiently large enough to warrant TOA *Knowbot* processing. Review of the topic of military noise and the public element resulted in large amounts of domestic literature. However, investigation of NATO-related information was somewhat limited. As a consequence, maps depicting the issues related to military noise in NATO countries were less developed.

Review and analysis of the topic literature focused on two time slices. Maps reflecting the major issues related to military noise and the public element for the years 1975 to 1990, and 1991 to present, are at the beginning of sections 2.1 and 3.1, respectively. Subcluster maps for the recent literature are found, along with the corresponding narratives, in chapter 3.

Because one of the focuses of this investigation was directed towards NATO-relevant literature, two maps were developed for foreign literature based on the preceding time slices. These maps are at the beginning of sections 2.6 and 3.6, respectively. General narratives were given for each of the maps, as well as narratives based on specific NATO countries and numerous NATO cooperation countries.

2. Military Noise and the Public Element: 1975 - 1990

Military training and testing have the potential to be significantly impacted by injunctions, court orders, public involvement and other influences, because of perceptions surrounding the impacts of noise. Recent literature suggests that military noise has become a significant source of public concern. However, to gain a better understanding of how issues related to military noise have evolved, and what issues might be emerging, it is necessary to review the earlier literature. From literature dated 1975 through 1990, the following key clusters and subclusters emerged.

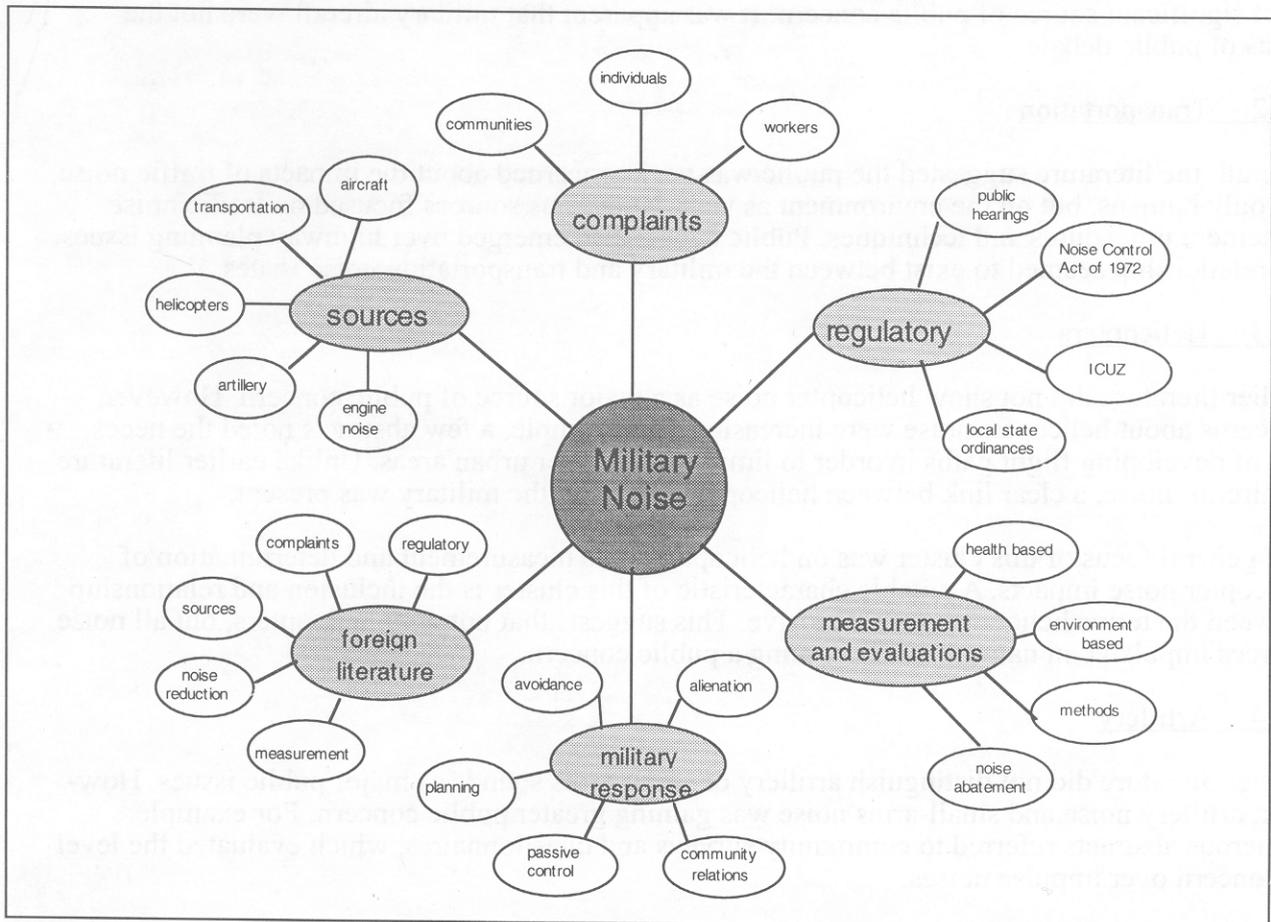


Figure 2.1: Military Noise and the Public Element, 1975 - 1990

2.1 Sources

Commercial airport and aircraft noise and transportation noise were the major sources of public concern in the earlier literature. This is especially true for the years 1975 to 1985. Concerns over military noise sources appeared to be insignificant in comparison to the public's concerns about aircraft and transportation noise.

2.1.1 Aircraft

Aircraft noise, mainly emanating from commercial aircraft and commercial airports, was the focus of public concern in the earlier literature. Although references were found from the mid to late 80s which suggested the emergence of military aircraft noise related problems (mainly associated with sonic booms), commercial aviation was clearly the major focus of public debate.

Review of the earlier literature also revealed that public concerns were focused on the perceived physiological and psychological impacts of aircraft noise. In addition, concern about the impacts of aircraft noise on habitats were emerging. However, these concerns seemed unrelated to military noise sources. Overall, the earlier literature suggested that commercial aircraft noise was the most significant source of public concern. It was apparent that military aircraft were not the focus of public debate.

2.1.2 Transportation

Overall, the literature suggested the public was very concerned about the impacts of traffic noise, not only humans, but on the environment as well. Numerous sources focused on traffic noise abatement procedures and techniques. Public debate also emerged over highway planning issues. No relationship seemed to exist between the military and transportation noise issues.

2.1.3 Helicopters

Earlier literature did not show helicopter noise as a major source of public concern. However, concerns about helicopter noise were increasing. For example, a few abstracts noted the necessity of developing flight paths in order to limit impacts over urban areas. Unlike earlier literature on aircraft noise, a clear link between helicopter noise and the military was present.

The general focus of this cluster was on helicopter noise measurement and determination of helicopter noise impacts. A notable characteristic of this cluster is the inclusion and relationship between the terms helicopter and impulsive. This suggests that not only helicopters, but all noise sources impulsive in nature were becoming a public concern.

2.1.4 Artillery

Earlier literature did not distinguish artillery or small-arms sounds as major public issues. However, artillery noise and small-arms noise was gaining greater public concern. For example, numerous abstracts referred to community surveys and questionnaires, which evaluated the level of concern over impulse noises.

Analysis of earlier literature identified an overlap in research related to artillery and helicopters. Again, the mutual characteristic was the inclusion of terms related to impulse noise.

2.1.5 Engine Noise

Engine noise also emerged as a significant cluster. Much of the focus was on aircraft engine noise, mainly from commercial testing and commercial take-offs. One engineering issue was "ship engine" noise, which was gaining recognition as a legitimate concern. However, these concerns were reflected from within the scientific community and little evidence suggested that the public was concerned about the impacts of ship engine noises.

2.2 Complaints

This cluster represented the most significant sources of noise complaints, or where concerns about the impacts of military noise might have arisen. Most complaints focused on commercial

aircraft noise and commercial airport operations. The following clusters signify the major sources of noise complaints that emerged from review of the earlier literature.

2.2.1 Communities

The literature suggested that communities were most concerned about the perceived physiological and psychological effects of aircraft noise on humans. Complaints came mostly from communities surrounding large commercial airports. Of these complaints, most notable were concerns about the auditory impacts of aircraft noise.

Although community complaints about military aircraft training were present, the most pressing concern the military addressed were the issue of sonic booms. In fact, numerous abstracts implied that community concerns over the physiological impacts of sonic booms were the most significant source of military-related public complaints.

There was also an indication that communities had become more concerned about the environmental impacts of aircraft noise. Nonetheless, physiological and psychological concerns were the driving forces behind community complaints.

A significant amount of literature suggested that communities were concerned about the physiological impacts of transportation and highway noise. However, there was no apparent relationship between the military and community concerns about transportation noise. Heavy community focus on mitigating the impacts of transportation and highway noise could have detracted from the number of complaints related to military aircraft noise.

2.2.2 Individuals

Complaints from individuals were most likely to be in response to sleep disturbance. There was some indication that Air Force overflights and sonic booms sparked such complaints. However, the focus of individual complaints was centered on commercial aviation.

It should be noted that sleep annoyance concerns were not characteristic of community complaints as might be expected. Instead, sleep annoyance complaints regarding noisy aircraft operations originated from affected individuals, not entire communities.

One explanation for this may be that some people are sounder sleepers than others. For many community residents, the impacts of nighttime aircraft noises were minimal. One might conclude that the best approach to managing sleep-related complaints was on an individual basis. Nonetheless, earlier literature suggested that individual residents were a significant source of public complaints.

2.2.3 Workers

There was a large body of literature related to occupational health and the impacts of workplace noise. Although the focus of this cluster was not on issues directly related to military operations, numerous abstracts suggested that military personnel were at risk from high noise exposures.

A great deal of literature addressed standards for workplace noise, as well as management practices and devices to limit occupational noise exposure. This may explain the limited number of references directly related to military personnel and noise exposure.

It may be that threats to military personnel of high levels of workplace noise were easily mitigated. For example, numerous abstracts identified devices that could be used to reduce the exposure of aircraft noise on military personnel. Clearly, it is much easier to supply workers with

ear mufflers than it is to distribute them to entire communities. Overall, the volume of literature reflecting complaints about occupational noise exposure was diminishing.

2.3 Regulatory

This cluster was slim. The regulatory environment surrounding military noise was vaguely defined within the literature. Earlier literature revealed little connection between regulations and military noise.

Most of the regulations found in the literature were directed at commercial aircraft and commercial airports. A majority of the commercial-related literature was focused on land use, with some suggestion of policies to curb community annoyance.

A weak relationship between land use and military noise was shown. This association, between land-use issues and military noise, may have been a suggestion that the only way the public could combat military noise was through active participation in land-use planning.

In the commercial arena, the public had considerable success in limiting the expansion of commercial airports. In fact, many of these same arguments were directed at military bases, where high levels of aircraft noise affected surrounding communities.

Because military noise regulations were apparently non-existent, it appeared that the public had determined that the most effective means of combating military noise was to voice opposition to land-use issues. But because the military was exempt from regulatory vulnerability due to sovereign immunity, public efforts to minimize military noise by focusing on land-use issues was relatively ineffective.

There was some indication in the earlier literature that the military was concerned about the volume of environmental legislation being implemented at the national level. Early literature also suggested the military was becoming more attuned with public opinion and community relations. The military's recognition of the importance in maintaining sound community relations may be explained by looking at the legislative pressure being put on military installations to adopt stricter environmental standards.

Although legislative pressure to reduce military noise did not appear in the literature, numerous citations related to the military and environmental compliance were present. The military recognized the likelihood that public concerns for the environment and noise would ultimately affect military operations. The following clusters represent major issues that emerged from the regulatory literature.

2.3.1 Public Hearings

A relationship between citizen concerns for military noise and public hearings was not directly apparent. As previously noted, much of the public concern was focused on commercial aircraft and commercial airports, not the military.

However, with respect to commercial aviation, the majority of literature on land-use planning and public participation indicated that public hearings were the main vehicle for voicing public opposition. For example, public hearings addressing concerns about encroachment and the physiological impacts of aircraft noise were influential in limiting noisy airport operations. Public hearings could have been used by the public as a means of vocalizing concerns about military noise.

2.3.2 Noise Control Act of 1972

The Noise Control Act of 1972 established a national policy to promote an environment for all Americans, free from noise that jeopardizes public health and welfare. This Act was the first piece of legislation addressing the presumed impacts of aircraft noise. It was directed mainly at commercial aircraft and commercial airport operations. In addition, this legislation was written to limit the proposed impacts of transportation noise.

However, the Noise Control Act of 1972 had relatively little impact on military operations. The only connection between the military and the Noise Control Act of 1972 was related to the Army's development of Installation Compatible Use Zones.

2.3.3 Installation Compatible Use Zone (ICUZ)

In the interest of fulfilling its basic obligations under the Noise Control Act of 1972, the Army implemented the Installation Compatible Use Zone program. The ICUZ program was a process intended to identify and mitigate noise impacts on installations and surrounding communities. This was the military's first attempt at mitigating the likelihood of future noise-related concerns.

Although military noise was not a major component of the Noise Control Act of 1972, the Army clearly recognized the indirect implications of heightened public environmental concerns. This was also the military's first attempt at proactive noise abatement, targeting land-use planning.

2.3.4 Local Ordinances

Local ordinances were geared toward limiting, or in some cases encouraging, the development and expansion of commercial airports. Runway expansions and proposals to increase the number of commercial flights were often subject to considerable scrutiny. As a result, many localities adopted local ordinances to limit the impacts of increases in aircraft noise.

As with public concern over aircraft noise, the basis for many of these ordinances was on the physiological impacts of aircraft noise. Nonetheless, there was no direct relationship in the literature between local ordinances and military noise.

However, the public's growing concern over the impacts of military noise on human health, coupled with national legislation that excluded for the most part military installations, was likely to result in an increased community reliance on local noise regulations and local land-use ordinances. In fact, the public was dissatisfied with the inadequacy of national legislation in addressing military sources of noise.

Earlier literature implied that local ordinances and state laws would gain a more significant role in combating military noise and growing community annoyance.

2.4 Measurement and Evaluations

This cluster reflected literature concerning assessments of the impacts of noise, methods for measuring and predicting noise, evaluations of particular noise sources, and reviews of noise abatement techniques. Also evident was the emergence of research on community exposure to aircraft noise.

As with previous clusters, the main focus of community exposure predictions was on commercial aviation. However, several sources showed that the military was actively researching measurement and evaluations of military noise sources. Nonetheless, as the public became more concerned about military noise, this body of literature was to reflect a more military-related tone.

Overall, the theme of this cluster was whether or not noise concerns were valid. Numerous citations implied that it was necessary to determine whether or not a particular noise problem even existed. In addition to aircraft noise, there was a need to evaluate helicopter noise and its potential implications. The following clusters emerged as major issues.

2.4.1 Health Based

Public concerns were focused on the physiological and psychological effects of aircraft noise. Auditory concerns were clearly the focal point of public debate. Much of this debate arose from hearing loss caused by workplace noise exposure. It was probable the public perceived aircraft noise to pose the same threats as occupational noise. However, the literature noted the differences in exposure associated with aircraft noise and occupational noise.

Nevertheless, health-based concerns were clearly the driving force behind public debate over the impacts of aircraft noise. Also, some evidence in the literature suggested that the physiological effects of helicopter noise should be measured and evaluated differently than aircraft noise. This showed the possible emergence of health-based concerns associated with helicopter noise and more generally, impulse noise.

2.4.2 Environment Based

Although measurements and evaluations were focused on determining the physiological impacts of aircraft noise, environmental concerns were becoming a more recognized issue. Emphasis on public opinion, questionnaires, surveys, and the emergence of stricter environmental regulations indicated that environmental concerns about aircraft noise were prominent in the public's minds.

It is important to note the differences with respect to environmental concerns between military and commercial databases. A review of noise-related literature in the military database (DTIC) revealed considerable interest in evaluating the impacts of noise on the environment. Conversely, literature related to measurements and evaluations of the impacts of military noise on the environment were limited in the commercial databases (NTIS, BUSI, ACAD, ENGI). This supported an emerging theme suggesting the military wanted to be proactive in mitigating noise-related concerns, including environmental ones.

The emergence of literature addressing the potential impacts of aircraft noise on the environment represented the beginning of the evolution of public debate, and the shift from health-based concerns toward environmental concerns. There were numerous references related to the perceived impacts of aircraft noise on wildlife. Communities may have become increasingly concerned about the environmental impacts of aircraft noise because a concrete relationship to auditory problems could not be established.

However, most of the environmental concerns seemed based on speculations. The literature implied that this area represented a major gap in research. Nonetheless, measurement and evaluations of the environmental implications of aircraft noise were emerging as significant issues.

2.4.3 Methods

This cluster focused on methods for acoustic or noise measurement. Emphasis was on determining the noise characteristics of aircraft, engine, and transportation noise. In addition, there was an indication of the need to develop more appropriate measurement techniques for alternative noise sources such as helicopter noise. Also indicated was the emergence and development of methods for predicting and assessing the impacts of noise on the environment.

One apparent issue was the emergence of methods for predicting community exposure to aircraft noise. This was particularly apparent within the DTIC database. Numerous sources linked the

military to the development of these methods. This suggests that the military perceived the community problems associated with military aircraft operations, and sought to develop the methods to reduce future complaints.

This cluster was also characterized by references to mathematical models and other techniques created for predicting the noise propagation characteristics of particular sources. The literature also linked measurement to community and public relations. This could be explained by the numerous citations about the use of surveys and questionnaires as a component to the development of noise exposure models. In addition, modeling was used as a technique to determine the least annoying flight paths.

2.4.4 Noise Abatement

This cluster focused on evaluations of techniques for minimizing aircraft noise. For example, numerous references focused on evaluating the effectiveness of noise abatement techniques such as mufflers, terrain masking, and flight path modifications. Considerable emphasis was placed on evaluating the effectiveness of barriers, shielding, gun muzzles, flight paths, and other passive means of noise abatement. Also notable was the military's interest in evaluating techniques to reduce noise exposure.

It was clear in this cluster that the military was active in investigating the effectiveness of noise abatement techniques. Analysis of the literature in DTIC also revealed considerable military interest in the measurement and evaluation of noise abatement techniques. Unlike many of the other clusters, this cluster strongly reflected military interests.

Also, there was a feedback relationship between the evaluation and measurement of noise abatement techniques and the military's response to noise issues. When military noise issues arose, such as complaints or design standard questions, the military responded by evaluating the most effective noise abatement strategy.

2.5 Military Response

This cluster reflected the military's response to noise concerns. Although the bulk of early literature focused heavily on commercial aviation and commercial airports, numerous sources emphasized the military's recognition of potential noise problems.

The literature implied that the military was aware of the potential community problems likely to arise surrounding military noise issues. The military remained active in research related to measurement and evaluation. Although much of the military's interest in noise abatement may be associated with strategic combat goals, the need to be proactive with respect to community relations was clear. The following clusters reflected the major issues apparent in review of earlier literature.

2.5.1 Alienation

Some historical sources suggested that the military's initial response to community concerns about the impacts and annoyance of noise was to separate the public's interests from its operations. This stance was backed by the military climate of the times. Before the mid-80s, the military believed that noisy operations were an unfortunate cost of maintaining readiness.

According to numerous abstract sources, this value system remains inherent in military operations today. However, the military community has recognized the benefits of maintaining positive relationships with local communities. This has translated into a proactive military recognition of noise-related issues, and in particular, issues associated with community annoyance.

2.5.2 “Community Relations”

Literature about community relations concentrated mostly on jet aircraft noise, transportation noise, and sonic booms. However, there was some indication of military community relations initiatives. An abundance of literature, particularly in the DTIC database, noted the military's continuous efforts to evaluate and assess the impacts of military noise on communities.

The military's early interpretation of community relations was focused on explaining to local citizens the necessity of conducting noisy training operations. Nothing in the literature suggested that the military actively sought community input into the development of noise management strategies. Consequently, community relations seemed to be employed by the military as a means of suppressing the potential for community complaints.

Earlier literature suggested the military's attempt to implement community relations was more or less an effort to sell military noise to the public as an acceptable annoyance. However, public concerns about the impacts of military noise continued to grow throughout the 80s, and as a result, community relations took on a more proactive tone.

For example, there were start-up programs to educate local communities and incorporate citizen concerns into operating procedures. The literature suggested that the military had begun to assess the effectiveness of incorporating community concerns into noise management strategies. By the mid 80s, community relations had emerged as a significant noise complaint reduction strategy.

2.5.3 Passive Controls

Literature on passive controls focused on the development and application of noise reduction devices. Military emphasis was placed on the development and evaluation of noise reduction techniques such as noise barriers, berms, shields, muzzles, etc. There was an emphasis in the earlier literature on covering up or masking military sounds. This was particularly evident with respect to Army training operations, which were becoming the subject of increasing public concern.

2.5.4 Testing

It is also evident that the issues surrounding helicopter noise, and more generally impulse noise, were becoming a greater military concern. This could be explained by suggestions in the literature that community exposure to impulse noise, unlike aircraft noise, could pose significant physiological harm. There was also an indication of a growing concern about the impacts of impulse noise on the environment.

2.5.5 Planning

Much of the literature in this cluster was focused on land-use planning. This cluster was characterized by the institution of the Army's (ICUZ) program and supports general conclusions that the military was adopting a proactive position with respect to military noise and public concern. The literature suggested the military was active in utilizing land-use planning as a means for preventing community exposure to military noise.

2.5.6 Avoidance

Some literature suggested that the most effective means of addressing community concerns about military noise was avoidance. Because a majority of the complaints about military noise, particularly aircraft and helicopter noise, came from urban residents, the best way to address the issue was to simply avoid training exercises in populated areas. However, the literature indicated rising

public concern over sounds coming from military training ranges. In this case, avoidance would not be an option.

There was also some indication that modifications in flight scheduling were being used to reduce the number of public complaints. This could also be considered an act of avoidance. It was thought that by operating at hours when community noise impacts were minimal, airport operators could reduce the number of complaints.

2.6 Foreign Literature

This cluster represents international noise issues. The majority of the literature came from countries within the NATO alliance. The following clusters were representative of the major issues that emerged from evaluation of the earlier foreign literature. Like previous analyses of domestic literature, the objective of this analysis was to present a general assessment of the noise issues in NATO countries. Narratives on specific countries are presented in chapter 4. The following clusters emerged from review of the 1975 to 1990 foreign literature.

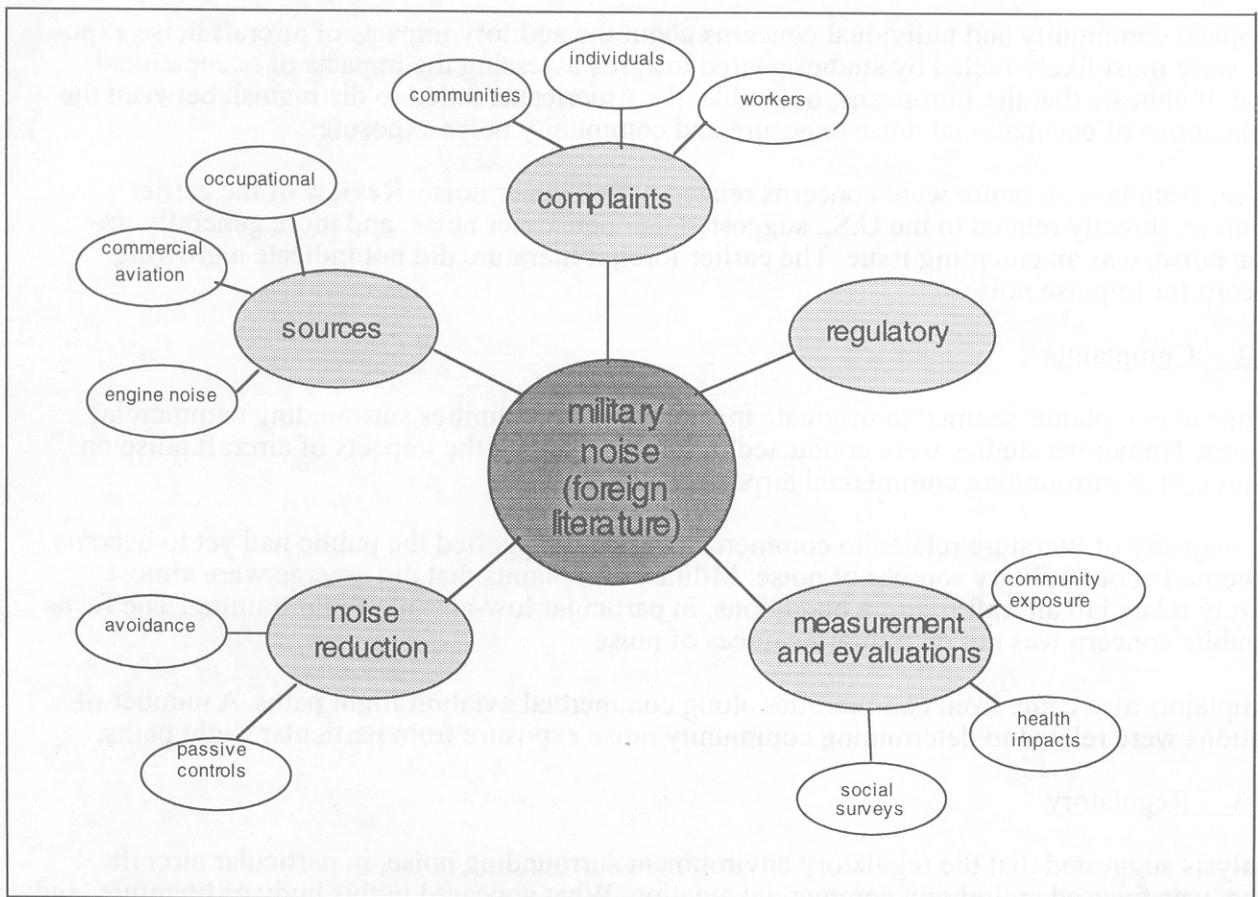


Figure 2.2: Military Noise and the Public Element, 1975-1990, Foreign Literature

2.6.1 Sources

Review of foreign literature suggested that aircraft noise and engine noise were the major sources of public concern. The overall theme focused on commercial aircraft noise, with a concentration on determining the impacts of these noises on surrounding communities. More specifically, there was considerable concern over the impacts of sonic booms and aircraft run-up noises.

Concerns over military aircraft, especially training operations, were beginning to emerge as a public issue. However, the inclusion of concerns related to military aircraft were minimal.

Also evident and reflective of concerns in the U.S. was the absence of significant public concern over the environmental impacts of aircraft noise.

The public, in both the U.S. and European nations, exhibited considerable concern about the impacts of aircraft noise on human health. These concerns were mainly on the potential auditory impacts of aircraft noise. In fact, numerous studies indicated a strong concern about the effects of aircraft noise on sleep as well as mental capacity.

European community and individual concerns about the auditory impacts of aircraft noise exposure were most likely fueled by studies geared towards assessing the impacts of occupational noise. It appears that the Europeans, not unlike the Americans, failed to distinguish between the implications of occupational noise exposure and community noise exposure.

Absent from this literature were concerns related to helicopter noise. Review of the earlier literature, directly related to the U.S., suggested that helicopter noise, and more generally impulse noise, was an emerging issue. The earlier foreign literature did not indicate a growing concern for impulse noise.

2.6.2 Complaints

European complaints seemed to originate mostly from communities surrounding commercial airports. Numerous studies were conducted in efforts to assess the impacts of aircraft noise on communities surrounding commercial airports.

The majority of literature related to commercial airports suggested the public had yet to become concerned about military sources of noise. Military complaints that did emerge were almost entirely related to aircraft training operations, in particular low-altitude flight training. The focus of public concern was not on military sources of noise.

Complaints also came from communities along commercial aviation flight paths. A number of citations were related to determining community noise exposure from particular flight paths.

2.6.3 Regulatory

Analysis suggested that the regulatory environment surrounding noise, in particular aircraft noise, was focused entirely on commercial aviation. What appeared in this body of literature, and what was absent in the U.S. literature, was a focus on aircraft design standards. The European regulations had mostly influenced commercial aircraft designers. This literature was largely focused on making commercial aircraft quieter, and upgrading existing aircraft to meet noise standards.

Although there was a considerable amount of activity in the design sector, modifications did not seem to emphasize making airplanes quieter for the sake of reduced community exposure. The

emphasis seemed to be on making aircraft quieter for occupational exposure purposes. Evidence indicated an interest in making aircraft quieter for passengers. While a regulatory environment existed, the focus was not on reducing community exposure.

Unlike the U.S. literature associated with this time period, a link between noise concerns and land-use was not evident. This could suggest two things: (1) the public was alienated from airport planning decisions, or (2) the public was unwilling to seek out the most effective means to act against commercial aircraft noise.

Environmental legislation had the potential to impact airport operations. However, it did not emerge as a significant factor.

2.6.4 Measurement

The Europeans have been very active in developing accurate techniques for measuring community impacts and human tolerances. This body of literature focused on three major areas: community exposure, human tolerances, and social surveys. A number of articles noted considerable interest in the development and application of methods to better assess community noise exposure. Most of this literature was focused on communities surrounding large commercial airports.

One focus of this cluster was on determining the levels at which humans could tolerate aircraft noises. Much of this research was geared towards investigation of the auditory and physiological impacts of aircraft noise.

This cluster also contained a significant amount of literature emphasizing measurement methodologies. Present in the methodology literature are numerous references to social surveys. Social surveys, as a means to assess noise impacts, were commonly employed.

Although early domestic literature suggested that survey methods were used, the foreign literature clearly stressed the use of social surveys not only as an indicator of public concern, but also as a measurement tool. Surveys were frequently used to measure noise exposure levels, not just to assess public concerns.

2.6.5 Noise Reduction

This cluster represented literature related to the development of devices and strategies for limiting the impacts of noise. The focus was directed at commercial aviation and commercial airports. The most common forms of noise reduction, not unlike what appeared in the U.S. literature, were passive noise controls and avoidance. The literature on passive noise controls emphasized techniques such as shielding, terrain masking, earthwalls, sound barriers, and mufflers. Avoidance as a noise reduction technique was associated mainly with commercial flight path modifications. There was an indication that scheduling was being utilized as a method of reducing community noise complaints.

A major focus of the noise reduction literature was geared towards minimizing occupational exposure. This literature was significantly related to aircraft design standards mentioned previously as having a considerable impact on the aircraft industry. Overall, literature related to noise reduction and community exposure was limited, suggesting that response to community concerns, other than evaluations, was minimal.

2.7 Conclusions

Review of noise-related literature from 1975-1990 suggested that, in comparison to commercial aircraft concerns, military noise had not yet become a dominant issue. There was an indication,

especially in the domestic literature, that the public's concern about military noise was mounting. Conversely, the foreign literature revealed very little indication that military noise sources, in comparison to commercial aircraft, were a major problem.

In both the U.S. literature and the foreign literature, public concerns were focused on the potential physiological impacts of noise. In both cases it is very likely that community noise concerns were being driven by awareness of the impacts on human health associated with occupational noise exposure. The notion that occupational exposure and community exposure are very different with respect to effects on human health was also expressed.

Although there was little indication that community noise exposure caused significant harm to humans, the redirection in public debate, away from physiological issues and toward environmental issues, could show that the public was beginning to understand that community exposure to aircraft noise posed limited human health risks.

Concerns about the impact of aircraft noises on the environment also emerged. Although the foreign literature did not emphasize environmental concerns, the tendency of U.S. trends to be mimicked in Europe offered some indication that environmental issues related to noise had the potential to emerge as a public concern overseas.

What emerged in the domestic literature but not in the foreign literature was a recognition that impulse noise, uncharacteristic of aircraft noise, could have physiological impacts. Nonetheless, it could be seen from the general tendency of issues to emerge first in the U.S., that concerns about the impacts of impulse noise would soon emerge on the European front.

Another distinction between the domestic literature and the foreign literature was the emergence of military public relations strategies. Public and community relations appeared mostly in the domestic literature. This is likely because military noise issues did not emerge as major public concerns in the foreign literature.

3. Military Noise and the Public Element: 1991 - Present

The following narratives re-evaluate the dominant issues in the earlier literature on the topic of military noise and the public element. Many issues remain unchanged. However, a review of the more recent literature revealed numerous noise related issues.

Most notable was the emergence, both domestically and internationally, of significant public concern about the impacts and annoyance of military noise. Commercial aviation did not emerge as the dominant source of community concern. Military noise sources, not limited to aircraft noise, have raised significant public debate. The following key clusters emerged from review of the most recent literature.

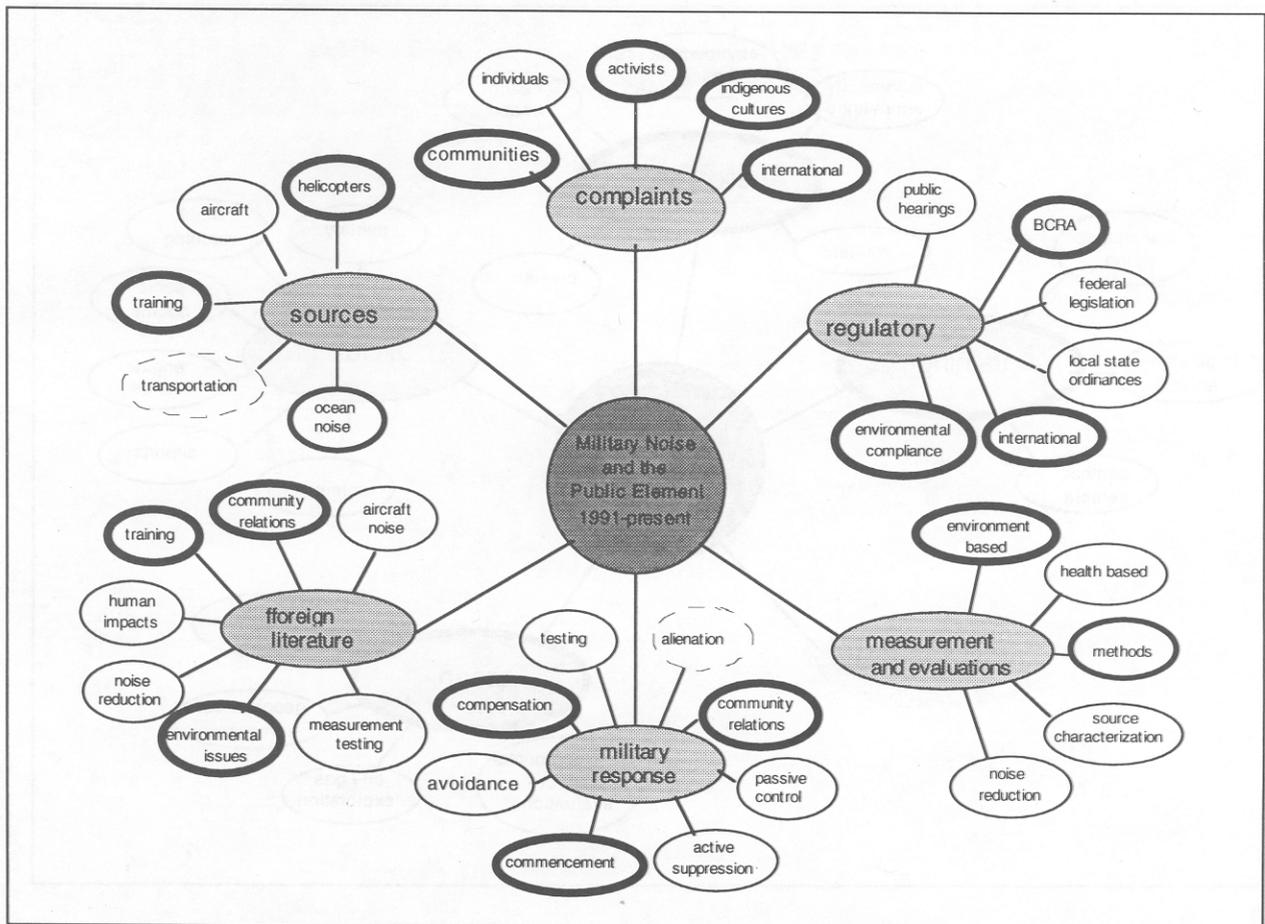


Figure 3.1: Military Noise and the Public Element, 1991 - Present

3.1 Sources

The literature suggested that the most notable shift, with respect to sources of public noise concern, has been the move away from commercial aviation and transportation noise, and in the direction of military noise sources. Although public debate over commercial aircraft, including

commercial helicopters was still apparent, military sources have emerged as a significant source of public concern.

A possible explanation for this could be a changing attitude towards the importance of military operations. Public opinion about the importance of maintaining military readiness at historical levels has declined. It seems the public is no longer willing to accept noisy military operations as inherent to national security. Because noise associated with commercial aircraft has been considerably reduced with the development of stricter design standards, tougher noise control laws, and more effective land-use planning, military noise sources have become more noticeable. The following clusters reflected the dominant issues that emerged from analysis of the most recent literature addressing the sources of environmental noise.

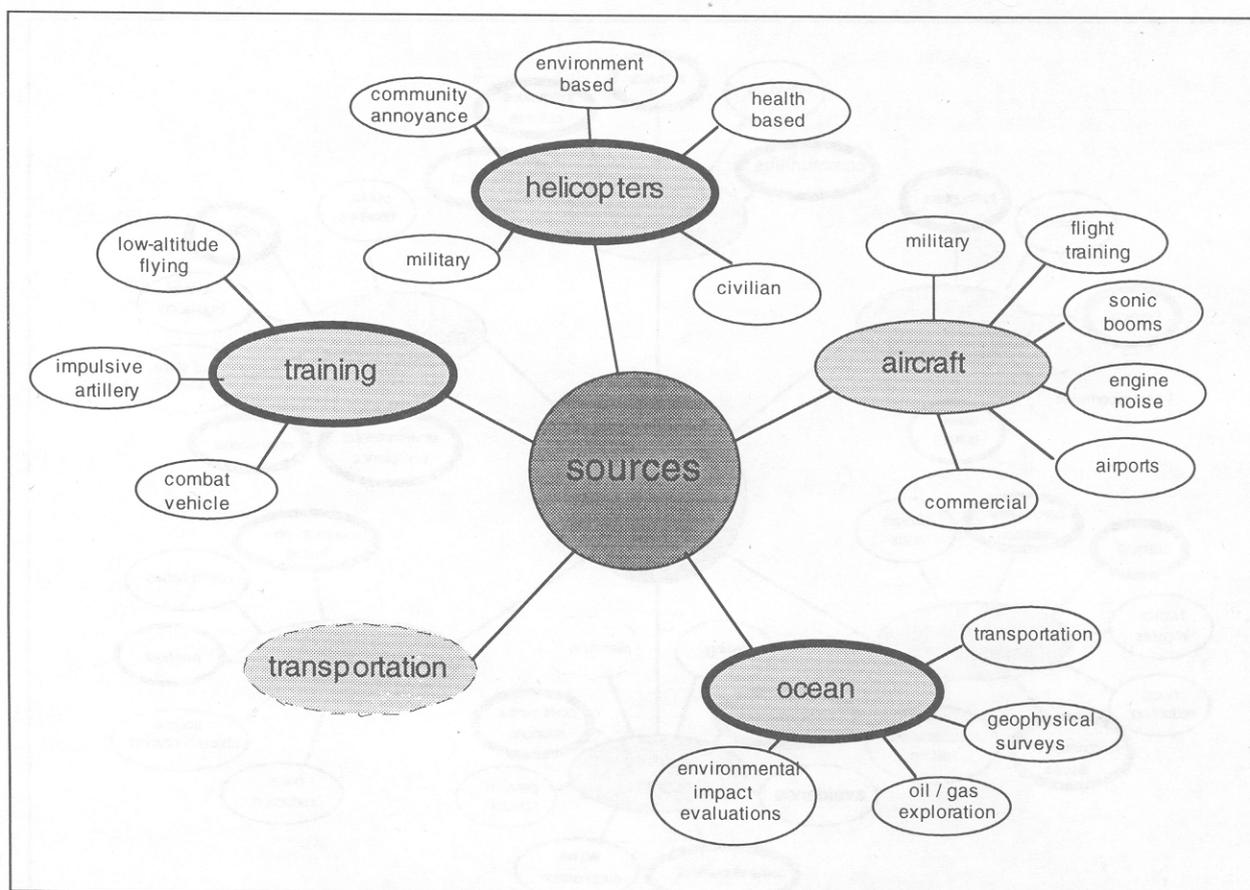


Figure 3.2: Sources and Subclusters, 1991 - Present

3.1.1 Aircraft

Current literature suggested that aircraft noise remained a major issue. However, there was a significant increase in the number of references focused specifically on military aircraft. This is indicated on the sources issues map (Figure 3.2), by the two distinct clusters of literature, one associated with commercial aircraft, and the other with military aircraft. Military aircraft are now the main focus of public noise concern.

Noise emanating from low-altitude military flight training exercises seemed to be the most widely cited source of public complaints. Most notable are the F-16 and the CF-18 aircraft. Review of the earlier literature noted significant concern from the public about the impacts of sonic booms on human health. Conversely, analysis of more recent literature implied that sonic booms have become somewhat accepted. Concerns about the physiological impacts of sonic booms on humans have decreased. However, the suspected environmental impacts of sonic booms have now emerged as a significant source of public debate.

Most of the questions surrounding the environmental impacts of sonic booms were geared toward developing a better understanding of the potential impacts on animals. Concerns have shifted from human based to environment based impacts. While there was an indication of mounting concern over the impacts of sonic booms on domestic pets, the animals of concern were mainly wildlife.

Engine noise also remained an issue. Earlier literature noted considerable concern over airport noises associated with start-ups and take-offs. These concerns have diminished. This could be explained by the development and implementation of more effective noise control devices. Concern has shifted from airport engine noise and to engine testing noise. It may be difficult for the military to effectively measure and test developmental engines, and at the same time, effectively limit noise exposure.

Commercial airports are no longer a significant source of public debate. Although land-use debates continue to characterize the public's unwillingness to accept commercial airport expansions, the number of references related to the public's discontent with commercial airport operations have diminished. Effective land-use planning was the most likely cause of this decrease. However, the literature suggests military air bases are now the center of public concern.

This concern was related to the Base Closure and Realignment Act of 1990. A significant amount of literature addressed the re-use alternatives for decommissioned military bases. Because most military air bases are already equipped with aviation infrastructure, the most common re-use alternative would be a conversion to civil and cargo airports. For many communities this means a dramatic increase in noise exposure, exceeding levels that existed with military use of the airfields. The main distinction between the earlier and recent literature, was that military air bases have emerged in the literature as major noise sources.

3.1.2 Helicopters

Literature related to military helicopter noise has increased considerably. Public debate was also rising over commercial helicopter noise, especially noise from traffic and news helicopters. Both sources are a significant contributor to community annoyance.

Helicopter noise concerns, unlike current aircraft concerns, were focused on both the physiological health effects and environmental effects. The research community has determined that helicopter noise may cause physiological harm, mainly auditory damage, to exposed communities. In addition, the literature noted a clear relationship between helicopter noise and its impulse characteristics.

Emphasis in the literature was on tests and evaluations, and how impulse noise from helicopters affects both the environment and human health. Unlike the shift in aircraft noise-related literature from tests and evaluations to noise reduction, this had not occurred with respect to helicopters. With the exception of a few articles suggesting that terrain masking can reduce the impacts of helicopter noise on communities, research on noise reduction strategies for helicopters seemed minimal.

With the increasing interest of citizens on the effects of impulse noise on the environment as well as humans, literature related to helicopter noise and community concern will continue to emerge.

In addition, concerns associated with the impulse characteristics of helicopter noise have translated into public discontent over other impulse noise sources, mainly those associated with military training.

3.1.3 Training

Low-altitude flight training emerged as a significant source of community complaints. These concerns were also apparent internationally. Within the U.S., concerns about the impacts of low-altitude flying seemed based on the perceived environmental impacts. For example, numerous sources suggested that low-altitude training has had an impact on wildlife. In addition, there was a growing discontent among Americans over the need to conduct low-altitude flight training operations in National Park air space.

Artillery noises associated with Army training operations have also emerged as a pronounced source of public animosity. Public concern was focused on the perceived impacts of the impulsive characteristics of artillery noise. These concerns were not apparent in the earlier literature.

Apparent in the literature was an indication that the military has realized that impulse noises originate from sources other than helicopters. Small arms firing (up to 25mm in caliber) and combat vehicles have been the subject of numerous military tests and evaluations. References noted concerns about the noise impacts of tracked vehicles and other types of combat vehicles. For example, the Army, in response to international concerns, has been interested in assessing the noise impacts of the Bradley Fighting Vehicle.

It should be noted that the training literature and the helicopter literature overlapped considerably, and often community complaints about noisy training operations were essentially complaints about helicopter noise.

The research community has reached a consensus that impulse noise does in fact pose a significant physiological risk to exposed communities. The possibility of community health being affected by military training, coupled with strong public concerns about the impacts of military noise on the environment seem likely to result in the continued complaints over both training and helicopter noise.

3.1.4 Transportation

This body of literature has decreased significantly. Better highway planning and the development of noise abatement structures has resulted in a dramatic decrease in the number of public complaints associated with transportation noise. In addition, there appeared to be no relationship in the literature between the military and transportation noise.

3.1.5 Ocean Noise

This issue has been gaining considerable public support. Numerous newspaper articles noted vocal opposition by activist groups to noisy underwater research. Ship noise could be causing considerable harm to ocean wildlife and environments. The literature indicated specific research initiatives were being conducted to determine the environmental impacts of ship noise and underwater sonic testing.

Although literature on this issue is in its infancy, it may soon be relevant to military operations conducted on and under the oceans. The literature suggested three main sources of ocean noise: transportation, geophysical surveys, and oil and gas exploration. The military is already involved with the transportation aspect. If public concern about the impacts of ocean noise on the environment continue to garner additional support, the military may soon become a focal point of concern.

3.2 Complaints

This literature related to the sources of noise complaints most noticeable in the more recent literature. There were two major distinctions between the earlier and more recent literature. Firstly, the complaints or concerns now focus on military operations versus commercial aviation. Secondly, there was a significant decrease in public concerns related to occupational noise exposure. This trend may be explained by the evolution and integration of stricter workplace noise standards.

In addition to the traditional sources of noise complaints, review of the more recent literature also distinguished the emergence of concerns originating from activists, indigenous cultures, and international entities.

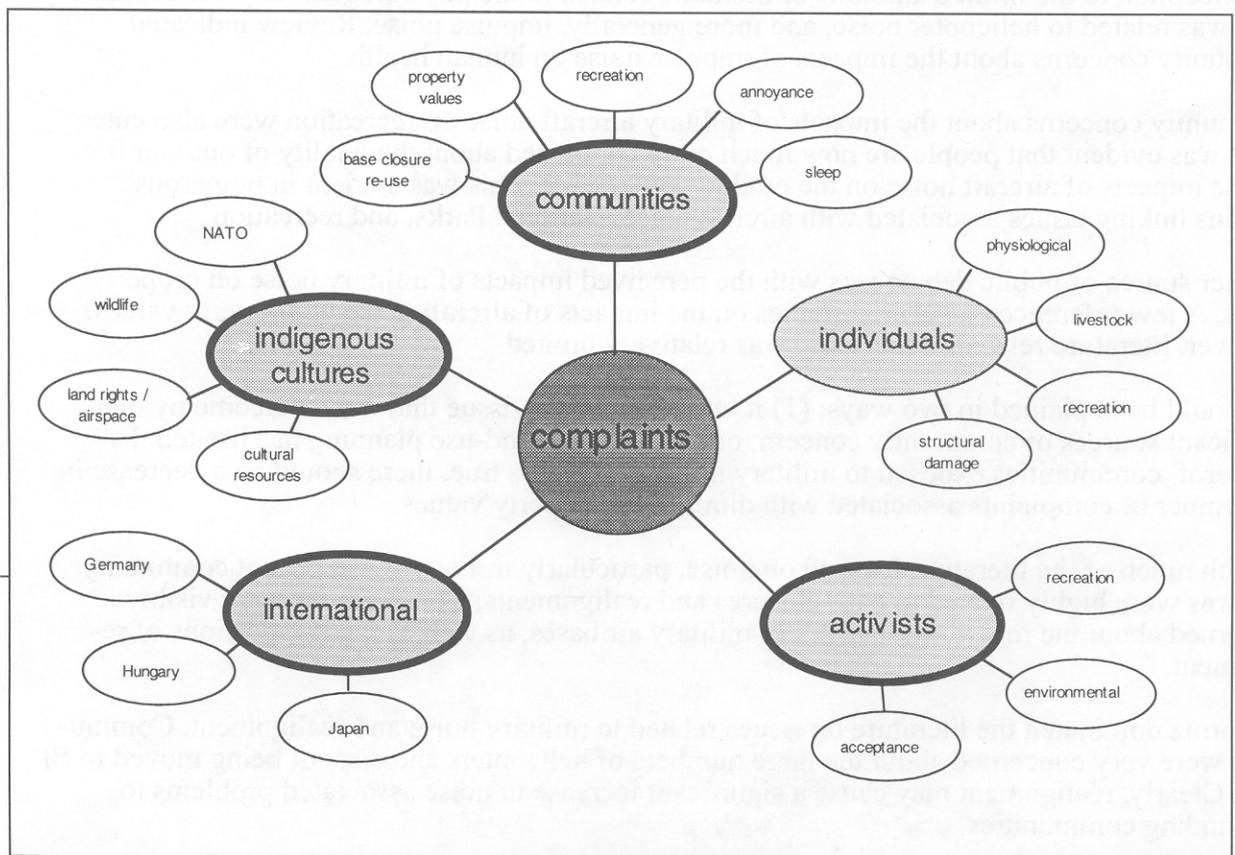


Figure 3.3: Complaints and Subclusters, 1991 - Present

3.2.1 Communities

Earlier literature suggested that communities were most concerned with the physiological effects of aircraft noise and sonic booms. Some indication of environmental concerns existed, but the bulk of literature was focused on health related community concerns.

Community complaints are now more likely to be related to environmental concerns. This indicates a considerable shift in community noise complaints, and supports the idea that concerns about the psychological impacts of aircraft noise have diminished.

Nevertheless, physiological concerns were still apparent. Most notable were concerns about the impacts of military noise on sleep. Both military aircraft and helicopter noise have been the subjects of these types of community complaints.

Annoyance has become a widely used term to describe many types of community complaints. Often the term "annoyance" was used without a clear explanation as to what it meant. The theme in the annoyance literature emphasizes a general displeasure with military noise. The term "annoyance" was rarely related to physiological health concerns, which again supports the contention that community concerns about the health effects of military aircraft noise have subsided.

One exception to the limited amounts of literature related to the physiological impacts of military noise was related to helicopter noise, and more generally, impulse noise. Review indicated community concerns about the impacts of impulse noise on human health.

Community concerns about the impacts of military aircraft noise on recreation were also emerging. It was evident that people are now much more concerned about the quality of outdoor life and the impacts of aircraft noise on the outdoor experience. This was evident in numerous citations linking issues associated with aircraft noise, National Parks, and recreation.

Another source of public debate was with the perceived impacts of military noise on property values. A few references described studies on the impacts of aircraft noise on property values. However, literature related to this issue was relatively limited.

This could be explained in two ways: (1) it was an emerging issue that was overcome by more significant sources of community concern, or (2) effective land-use planning has limited the number of communities exposed to military noise. If either is true, there should be a decrease in the number of complaints associated with diminished property values.

As with much of the literature focused on noise, particularly military noise, recent community concerns were highly related to base closures and realignments. Communities were visibly concerned about the re-use alternatives of military air bases, as well as the implications of realignment.

California dominated the literature on issues related to military noise and realignment. Communities were very concerned about the large numbers of helicopters and aircraft being moved to El Toro. Clearly, realignment may cause a significant increase in noise associated problems to surrounding communities.

3.2.2 Individuals

Complaints from individuals were closely related to complaints from communities. This body of literature remained relatively unchanged.

Complaints about hearing loss have subsided. Most of these concerns were associated with occupational noise exposure. The military has worked to protect its workers from occupational noise exposure. There was some indication of research directed towards improving existing noise reduction devices such as ear muzzles and pilot helmets. Overall, physiological complaints from individuals have diminished considerably.

Farmers have become the source of a growing number of military noise complaints. These complaints were associated with the suspected impacts of military noise on livestock and domestic animals. Most of these concerns center on military aircraft noise. However, helicopter noise and other impulse noises are likely to be subject to these same concerns. In addition, if research indicates that military noise does cause harm to livestock, the number of rural complaints is likely to increase.

As with community concerns, the impact of military noise on recreation was an issue individuals were beginning to complain about. Many of these complaints have been filtered through environmental groups.

Although literature was limited, complaints about structural damage associated with military noise were becoming more common. Nothing in the earlier literature suggested that military noise or commercial aircraft noise could cause structural damage. As individuals become increasingly aware that military noise can actually cause structural damage, the issue is likely to continue to emerge.

3.2.3 Activists

Literature associated with activists was highly linked to environmental and recreational concerns. As environmental issues associated with military noise emerge, it is likely that environmental activist groups will become more vocal. It was evident that many of these groups have been acting as representatives for individual complaints.

Community groups have also voiced their concerns. It is likely that a few community leaders are acting as voices for entire communities. This could result in a suppression of a minority of communities and individuals who are actually indifferent with respect to military noise.

The literature suggested that activist groups and community groups who accept military noise usually focus on the economic benefits that uninhibited military operations bring to their local communities.

3.2.4 International

Complaints from international sources were increasing. An abundance of literature related to the impacts of U.S. military noise on international communities. Most notable were references to the large number of complaints coming from Japanese communities which have been subject to military noise exposure for decades.

These concerns were not limited to Japan. There were numerous references related to military noise complaints in European countries. Hungarian concerns over the re-use of decommissioned

artillery ranges, and German concerns about low-altitude training were also evident. Concerns about environmental noise were apparent in other countries as well. Wherever there are U.S. military operations, there has been some source of concern surrounding the impacts and annoyance of noise.

An acknowledgment of the significance of these concerns was noted in the literature by the military's development of programs developed to recognize noise issues before they become sources of public concern. Host country noise regulations have also become an accepted element of U.S. military operations. However, a mere recognition of host country laws does not imply that they will be followed. Evidence of this was based on literature that indicated that foreign countries were in fact complaining about U.S. military noise. Different cultures and different political environments accept military noise at different levels. This was particularly true in Eastern Europe where the political climate has been continuously changing.

International noise issues, and those more directly related to NATO member countries are evaluated in greater detail in chapter 4.

3.2.5 Indigenous Cultures

Literature in this area has only begun to emerge. Indigenous cultures were concerned about the impacts of military operations on cultural lands. While much of this concern stems from issues surrounding military land-use, there were some indications that military noise is becoming a significant issue.

Some notable concerns from American Indians, as well as the Innu Indians in Canada, were that low-altitude flight training has caused considerable harm to wildlife and children. They also believed that low-altitude training operations violate their legally protected airspace. Literature also stressed a direct relationship between NATO and the impacts of military noise on indigenous cultures. Cultural issues, including those associated with military noise and the military, were emerging as a new source of concern, both domestically and internationally.

3.3 Regulatory

The regulatory arena has not had a significant impact on military noise. However, evidence indicated some shifts in the literature.

Public hearings and public comment periods still represent a legal pathway for the public to voice concerns, however. Public involvement has been redirected from land-use issues to environmental issues. In addition, the Base Closure and Realignment Act of 1990 has raised concerns among many communities about the possibility of increased, rather than decreased military noise sources.

Federal legislation remained concentrated on commercial aviation. Consequently, local noise ordinances were having a greater impact on military operations. Also, environmental compliance has become more directly related to military noise. The literature showed an increased effort by the military to recognize and address international noise laws. Review of the most recent literature yielded the following clusters related to military noise.

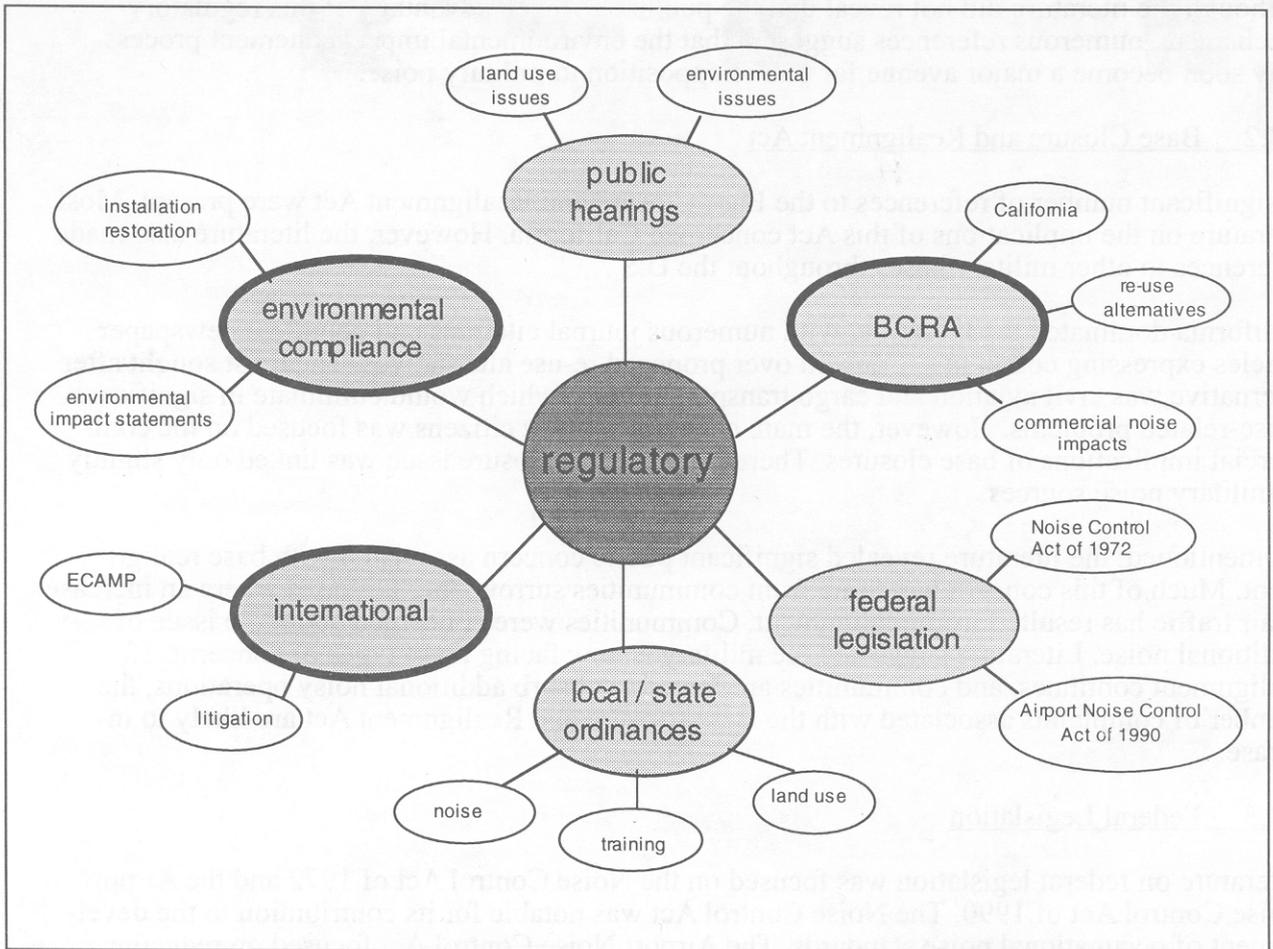


Figure 3.4: Regulatory and Subclusters, 1991 - Present

3.3.1 Public Hearings

Earlier literature suggested that the public's most effective means of voicing concerns about commercial aircraft and commercial airport noise was participation in public hearings associated with land-use proposals. It seemed to be the most effective way for the public to inhibit aircraft and noise encroachment.

Current literature suggested that land-use issues were not the most effective avenue for the public to impact noisy military operations. In fact, land-use issues now appear only in relationship to concerns associated with base closures.

The link between land-use, the public, and noise seemed to have eroded. The public inroads were focused on the environmental impact assessment process. All military operations are expected to go through the environmental impact assessment process. Inherent in this process are opportunities for public comment and public hearings. Because the environmental impacts of military noise have become a heated issue, the most effective means through which the public can

impact noisy military operations is by participating and voicing concerns during the environmental impact assessment process.

Although the literature did not reveal that the public had taken advantage of this regulatory mechanism, numerous references suggested that the environmental impact statement process may soon become a major avenue for public opposition to military noise.

3.3.2 Base Closure and Realignment Act

A significant number of references to the Base Closure and Realignment Act were present. Most literature on the implications of this Act concerned California. However, the literature also made references to other military bases throughout the U.S..

California dominated the literature, with numerous journal citations and countless newspaper articles expressing community concern over proposed re-use alternatives. The most sought after alternative was civil aviation and cargo transport, both of which would culminate in significant noise-related problems. However, the main concern of many citizens was focused on the commercial implications of base closures. Therefore, the base closure issue was linked only slightly to military noise sources.

As mentioned, the literature revealed significant public concern associated with base realignment. Much of this concern has come from communities surrounding air bases where an increase in air traffic has resulted from realignment. Communities were concerned about the issue of additional noise. Literature suggested the military is now facing these types of concerns. If realignment continues, and communities are forced to absorb additional noisy operations, the number of complaints associated with the Base Closure and Realignment Act are likely to increase.

3.3.3 Federal Legislation

Literature on federal legislation was focused on the Noise Control Act of 1972 and the Airport Noise Control Act of 1990. The Noise Control Act was notable for its contribution to the development of occupational noise standards. The Airport Noise Control Act focused on reducing existing commercial airport noise problems. At the same time, despite public concern about the impacts of military noise, federal legislation has not been a significant factor.

3.3.4 Local and State Ordinances

Local and state ordinances have become increasingly important to military operations. Local land-use ordinances have limited the expansion of Army training lands. Military training has also been affected by local ordinances passed to reduce the amount of military noise exposure. Ordinances such as these often affect the scheduling, duration, and magnitude of training operations.

A number of local ordinances were directed towards noise reduction. Most adopt the notion that noisy operations should be conducted during the day, when inhabitants of surrounding communities are least likely to be in areas of high noise exposure. Overall, local ordinances are a viable way for communities to combat annoying military noise. However, there was no indication in the literature measuring the effectiveness of local and state noise related ordinances.

3.3.5 International

Just as the number of international noise-related complaints were increasing, there was an increasing recognition of international laws. Currently, this concern has emerged from issues surrounding military installations in Japan. Numerous references were made to the importance of

recognizing and following international laws. The threat of litigation has also become more evident.

Again, Japan dominated the literature on litigation with respect to military noise violations. However, this situation could easily occur in other countries. A recognition of this threat may have been the basis behind the worldwide Environmental Compliance and Assessment Management Program (ECAMP). This program's goal is to recognize and address military noise-related issues before they become subject to host country regulations.

Overall, the literature suggested that military noise regulations must be acknowledged as a concern internationally as well as domestically.

3.3.6 Environmental Compliance

Compliance with environmental regulations has become a major part of military operations. Literature on environmental impact assessments was closely tied to military operations. However, review of the literature surrounding environmental impacts assessments revealed little recognition of military noise as a major issue.

Including the public comments into the environmental impact assessment process as a means of expressing concerns about the impacts of military noise was expected. However, as noted in the literature on public hearings, the public's involvement in the regulatory process of environmental impact statements was minimal with respect to military noise complaints.

One reason may be that concrete evidence on the effects of military noise on the environment is not well established. To the public, it appeared that the military and other policymakers were unwilling to support public concerns about military noise and its potential harm to the environment. Because of this, the public may think it unlikely that the military will act to reduce noise based on the public's environmental concerns.

Many pieces of environmental legislation, such as the Installation Restoration program, were written to ensure that military operations meet environmental compliance standards. However, the relationship between military noise and Installation Restoration was relatively weak.

Almost all of these reports listed noise as an issue that would ultimately be addressed. However, there was nothing in these reports discussing whether or not noise related actions had actually been taken. Noise-related issues, with respect to Installation Restoration, have been given low priority.

Based on a review of the literature, the DoD (Department of Defense) was not interested in noise-related issues outside of legislative requirements associated with environmental compliance and Installation Restoration. However, much of literature recognized DoD's interest in pollution abatement and environmental compliance. References directly related to noise issues are limited.

If significant research emerges to support the notion that military noise does pose harm to the environment, the public may respond with greater participation in the development of environmental impact assessments. This could be a major community relations issue for the military in the future.

3.4 Measurement and Evaluations

This cluster concerned assessments of the impacts of noise, methods for measuring and predicting noise, evaluations of particular noise sources, and reviews of noise abatement techniques.

Measurement and evaluation was no longer focused on commercial aviation and transportation. Instead, community exposure to military noise, particularly community exposure to impulse noises, has emerged as a significant issue.

Another major change is the shift away from health based evaluations. Although health-based concerns remained a significant public issue, there was a noticeable shift toward evaluations and testing of the impacts of military noise, as well as commercial noise, on the environment. The following clusters represented major issues in this body of literature.

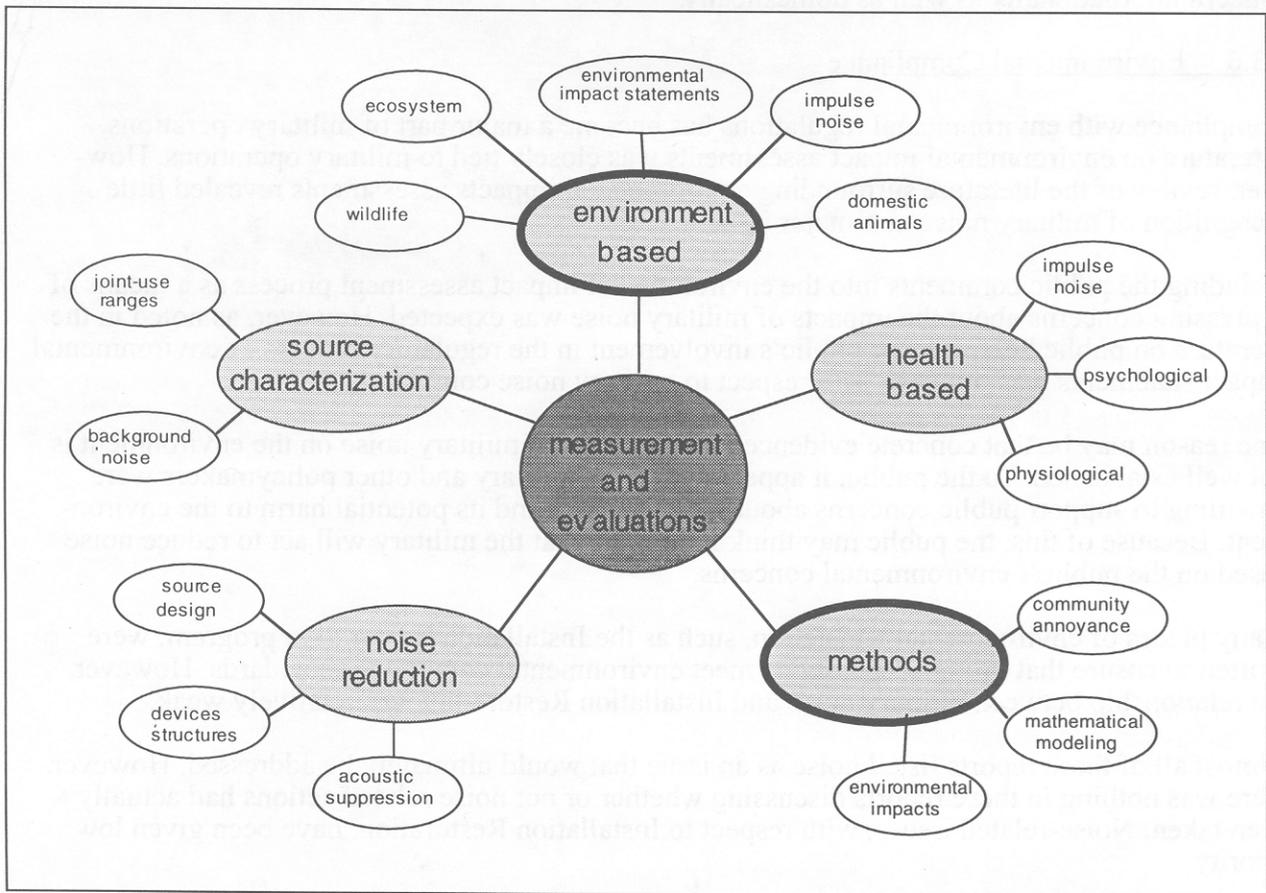


Figure 3.5: Measurement and Evaluations with Subclusters, 1991 - Present

3.4.1 Environment Based

It was apparent from a review of the more recent literature that health concerns about noise emanating from commercial aircraft have subsided. While concerns over community annoyance were still apparent, the focus of literature was on the environmental impacts of military aircraft. There were numerous citations noting studies geared towards measuring the impacts of military noise on wildlife. A small body of literature addressed the impacts of military noise on entire ecosystems. However, this literature was somewhat speculative.

Measurements and evaluations of the impacts of specific flight paths or low-flying operations were the focus of the literature related to wildlife. There was major concern about the impacts of

certain flight paths on wildlife migration patterns. The flight path literature suggested that both helicopter and aircraft noise have the potential to harm the environment.

Numerous references indicated a growing interest in conducting tests and evaluations to determine whether or not impulse noise harms the environment. Much of this concern focused on artillery ranges and helicopter operations. However, there was very little conclusive evidence on the environmental impacts of impulse noise. In fact, this appeared to be an emerging area in the literature.

Also, there was some community concern about the impacts of military noise on domestic animals. However, research directed towards assessing these impacts is minimal.

Another indication that environmental issues were strongly related to military noise was the enormous amount of literature focused on environmental impact statements. Military projects requiring an environmental impact statement, cited in the literature, make reference to noise issues. Although this does not mean noise issues are given priority, it indicates that the military recognizes noise as a potential environmental problem. Nonetheless, the overall tone of this body of literature suggested that public environment-based noise concerns have emerged.

3.4.2 Health Based

With the exception of impulse noise, concerns about the impacts of military noise on human health were stable, if not diminishing. References to the perceived impacts of military noise on human health were still present in the current literature, but they were clearly dominated by concerns about the environmental impacts. What health concerns do exist, are mostly related to the auditory effects of impulse noise.

In fact, physiological research to assess the impacts of impulse noise on human health was emerging as a major issue. Review of the literature suggested exposure to impulse noise from these sources had the potential to cause hearing damage in humans.

Psychological concerns did not appear to be a major issue. However, there was evidence in the foreign literature that the Innu Indians of Canada have raised concern about the psychological impacts of low-altitude flight training on children of their tribe. Other than this, psychological concerns seemed to have declined.

3.4.3 Methods

Another emerging issue was the inadequacies of traditional research methods in assessing the impacts of military noise and other sources of noise on the environment. Some literature suggested inadequacies in current tools and methodologies used for verifying the public's perception of the impacts of military noise on the environment.

Also identified was a relationship between mathematical modeling and military noise as well as commercial aircraft noise. Mathematical modeling was a method frequently employed to determine the least annoying flight paths for military aircraft. Mathematical models were also used to predict community exposure to military aircraft. Most of this literature was related to the development of noise contours.

Numerous sources noted the difficulties in measuring community noise exposure because of weather conditions. This concern may explain the emergence of the development of mathematical noise exposure models which take meteorological conditions into consideration.

Another emerging issue reflected in the mathematical modeling literature related to the difficulties in characterizing background noise in assessments and predictions of community exposure. This issue is vital with respect to the military's use of joint-use ranges.

However, a review of the current literature suggested that mathematical modeling can be useful tool in predicting community noise exposure. What did not seem apparent was the use of mathematical modeling to assess the impacts of military noise on the environment. This supports the idea that much of the concern about the impacts of military noise on the environment is speculative.

A large body of literature described community annoyance. This literature focused on the development of methods to better characterize annoyance levels of communities exposed to military noise. It appeared that traditional community annoyance methodologies have been inadequate. For example, there was considerable skepticism over the Army's use of day/night averages to measure community response to artillery noise. There were numerous references to alternative methods for measuring community annoyance. Nevertheless, recent literature revealed the emergence and development of more accurate methods to assess community responses to military noise.

3.4.4 Source Characterization

Source characterization related to the need to distinguish and characterize noise sources. There were numerous references to specific noise sources and characteristics. There was also growing interest in determining the exact noise source responsible for causing community noise concerns.

Background noise has also become an issue. There was an interest in assessing the influences of background noise on the public's perceptions of where annoying noises originate. The military has argued that background noise, not just that of military origin, may be a cause of public annoyance.

There was also some concern about the military's use of joint-use ranges, or ranges shared by different branches of the military. This interest was directed at distinguishing between noises originating from different military branches using the same training spaces. Clearly, source characterization, and the ability to pinpoint the exact source of noise emanating from joint-use ranges, could have significant cost implications.

3.4.5 Noise Reduction

Literature in this area focused on the evaluation of different methods of noise reduction. Most of the noise reduction methods evaluated were geared toward reducing the impacts of noise on communities and reducing the amounts of noise from training exercises. However, the noise reduction literature was relatively broad and included references to design modifications, noise reduction devices, terrain masking, and noise suppression structures.

Some literature suggested the emergence of acoustic suppression as a noise reduction technique. The literature also suggested that research into acoustic suppression may provide strategic military benefits. The military's main interest in acoustic suppression research has been vested in making quieter, more strategically sound weapons. There was no clear indication in the literature that the military's interest in acoustic suppression is based on reducing community or environmental noise exposure.

3.5 Military Response

Literature focused on how the military reacts and responds to public concerns about the impacts of military noise. Military noise did not appear to be a major public concern in the earlier literature. However, review of the more recent literature suggested that military sources of noise have become a focal point of public debate. For this reason, over the past two decades the military has come up with ways to effectively manage noise issues. Much of the earlier literature suggested the military is quite active in anticipation of potential noise-related issues.

As noted, health-based concerns have shifted toward environment-based concerns. In addition, the effectiveness of regulations to curb commercial aviation noise have resulted in a redirection of public concern towards the military. Consequently, the military's role in managing, reducing, and preventing noise has grown. The following narratives identified the major issues that emerged from analysis of the current literature on military response.

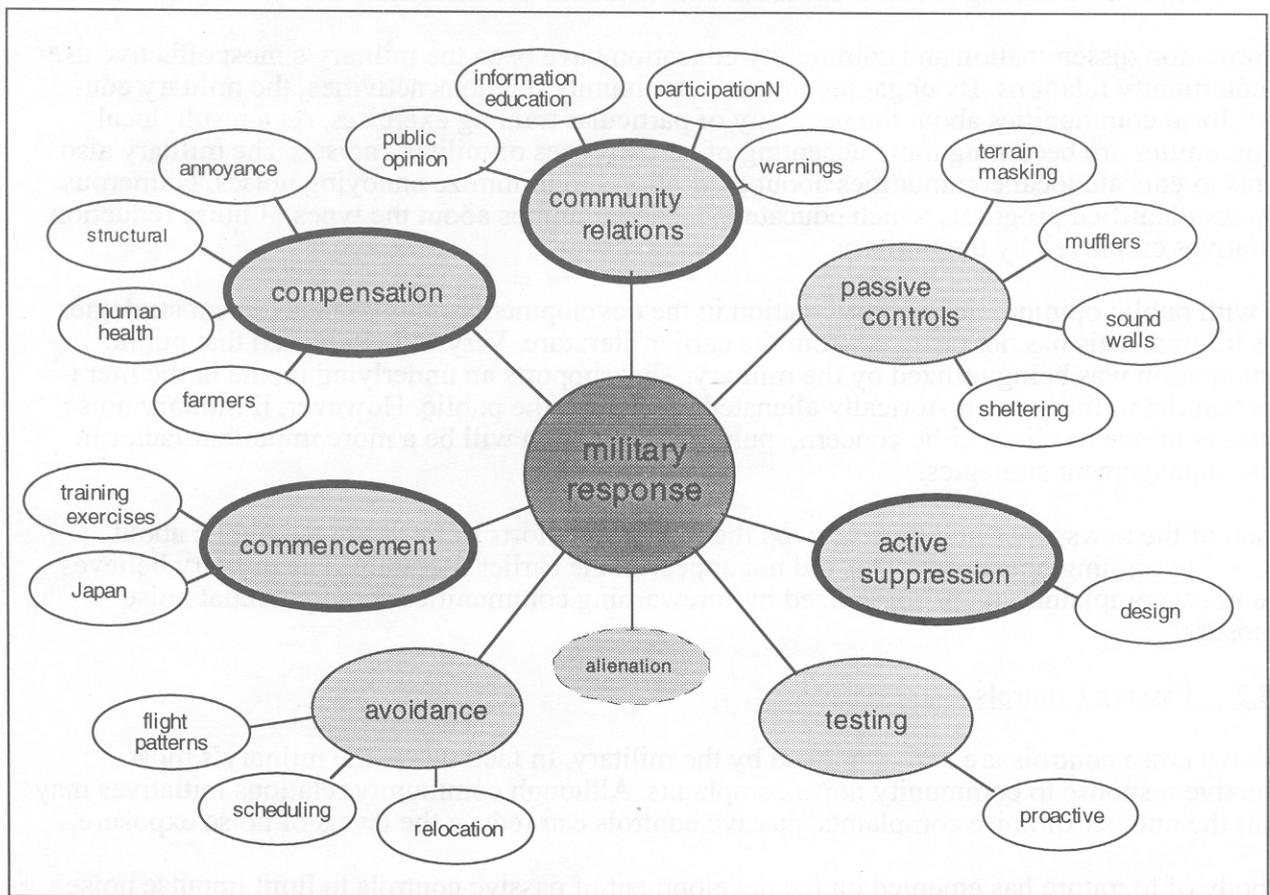


Figure 3.6: Military Response and Subclusters, 1991 - Present

3.5.1 Community Relations

This body of literature has become more significant. The military has effectively managed many military noise issues through community relations programs. However, community relations did

not emerge in the literature at a level that might be expected. This may suggest inefficiencies in community relations strategies.

Current literature also suggested that most of the military's more recent community relations initiatives have been in response to public concerns associated with land-based training operations and impulse noise.

Nonetheless, the notion of "selling military operations to the public," has diminished. The military recognizes that many of the public's concerns about noise are valid. It seemed the public had not accepted the military's arguments that noise is a necessary requirement for a healthy military. As a consequence, the military has now become more sympathetic to public concerns.

However, public opinion has not been a significant player in the development of military noise management strategies. The military appeared to be sympathetic to public concerns, but unwilling to accept public opinion about the most effective ways to limit noise. Public opinion, although found within the community relations literature, is used most often by the military as a measurement tool for determining which areas around installations are most affected by noisy operations.

Information dissemination and community education have been the military's most effective use of community relations. By engaging in these community relations activities, the military educates local communities about the necessity of particular training exercises. As a result, local communities are becoming more accepting of certain types of military noises. The military also wants to educate local communities about their efforts to minimize annoying noises. Numerous sources identified programs which educate local communities about the types of noise reduction initiatives employed by the military.

As with public opinion, public participation in the development of noise management strategies was limited. This has not changed from the earlier literature. Very little indicated that public participation was being utilized by the military. This supports an underlying theme in the literature that the military has historically alienated itself from the public. However, if military noise issues continue to raise public concern, public participation will be a more important factor in noise management strategies.

Much of the newspaper literature showed the military's efforts to forewarn the public about upcoming training operations. This did not appear in the earlier literature. The military believes that noise complaints can be minimized by forewarning communities about potential noise exposure.

3.5.2 Passive Controls

Passive noise controls are still employed by the military. In fact, this is the military's most effective response to community noise complaints. Although community relations initiatives may limit the number of noise complaints, passive controls can reduce the levels of noise exposure.

A body of literature has emerged on the development of passive controls to limit impulse noise exposure. There are now recognized distinctions between the noise characteristics of different military sources. This means traditional passive controls may be inefficient in reducing noise from sources such as helicopters and high-impulse artillery.

However, review of the more recent literature emphasized the use of traditional passive noise control techniques such as terrain masking, mufflers, sound walls, and acoustic sheltering. Literature in this cluster appeared to be stable. Concerns about the inadequacies of traditional passive techniques in abating impulse noise appeared to be the only emerging issue.

3.5.3 Active Noise Control

Active noise control is often referred to as “anti-noise.” Active noise control technologies are most often associated with such things as aircraft pilot helmets and interior aircraft noises. The literature did not indicate a relationship between community noise concerns and active noise reduction. Active noise reduction is driven by design innovations and can involve costly research and development. Active noise control is used by the military to make quieter weapons, not in response to community complaints, but to concerns about the weapons systems vulnerabilities.

3.5.4 Testing

There was no new literature in this area. The military has remained active in testing and evaluating the impacts of noise on both human health and the environment. However, as suggested by the earlier literature, environmental concerns and the potential impacts of impulse noise appeared to be emphasized in current military testing. Overall, the military has been persistent in testing and evaluating public noise concerns.

3.5.5 Alienation

No recent literature suggested that the military has deliberately alienated communities from voicing their noise complaints. In general, the military is now sympathetic to community noise concerns.

3.5.6 Avoidance

The military’s first attempt to mitigate community noise concerns appeared to be avoidance. This has not changed from the earlier literature. Avoidance is the least costly alternative, and is often the most effective way to minimize community noise exposure. Public concerns over aircraft noise can still be abated through avoidance. Yet today, impulse noise and land based combat training noises have emerged as major issues. Community exposure to these noise sources is more difficult to avoid. Nevertheless, three avoidance techniques were in the more recent literature.

Modification of flight patterns is the most effective way to avoid community exposure and minimize the number of complaints. Current literature suggested that modifications in flight paths are usually geared toward minimizing noise exposure to urban areas where populations are the greatest. However, if rural concerns over the impacts of aircraft noise on livestock continue, flight path redirection may not be as effective.

Rescheduling noisy military operations has also become an effective response to community complaints. There were numerous references to the rescheduling of both flight operations and artillery training exercises. However, the military has argued that rescheduling is not always an option. Some training exercises are essential to military readiness and require certain times for operation. As a consequence, rescheduling of these exercises is not always possible.

Relocation is an expensive alternative. Few references suggested that the military has chosen relocation as a response to community concerns about noise. However, this alternative was apparent in the literature. A few articles suggested that, in special circumstances, relocation had been considered. Relocation was usually discussed in association with artillery and combat training.

3.5.7 Commencement

Limited literature suggested that commencement of operations has been accepted by the military as a response to community complaints about noise. However, international noise complaints have increased the threat of commencement in nations where the U.S. military actively trains.

This literature focused almost entirely on Japan. Japanese resentment of U.S. occupation has been displayed in recent debates over the impacts of aircraft noise on major Japanese cities. In fact, U.S. operations are being re-evaluated in Japan. If Japanese concerns continue, U.S. military operations may be scaled back or completely stopped.

3.5.8 Compensation

Literature suggested that the military has accepted responsibility for numerous noise related complaints. Military compensation for damages associated with noise was more apparent in the current literature. For example, evidence suggested that the military has been active in compensating individuals for structural damages caused by military noise sources. Recent literature taken from the World Wide Web indicated that military compensation may be given to farmers whose livestock have been adversely affected by low-flying aircraft noise.

If evidence and research can establish that noise does harm the environment, military compensation for damages to wildlife, domestic animals, and ecosystems may become necessary.

Compensation has not been used by the military in cases involving community health concerns related to noise exposure. The only literature related to the military's compensation for health related complaints was focused on occupational exposure. Because occupational noise exposure has been reduced significantly by more stringent standards and vastly improved noise reduction techniques, compensation for occupational related health complaints is no longer a major issue.

There was some indication that the military has sought to compensate communities surrounding noisy military operations. The military has been able to pay people for their cooperation and acceptance of noise exposure.

3.6 Foreign Literature

This cluster represented literature related to international noise issues. A majority of it came from countries within the NATO alliance. The following narratives present a general overview of current noise issues in NATO countries. Narratives on specific countries are at the end of the this section. The following clusters were representative of the major issues that emerged from evaluation of the recent foreign literature.

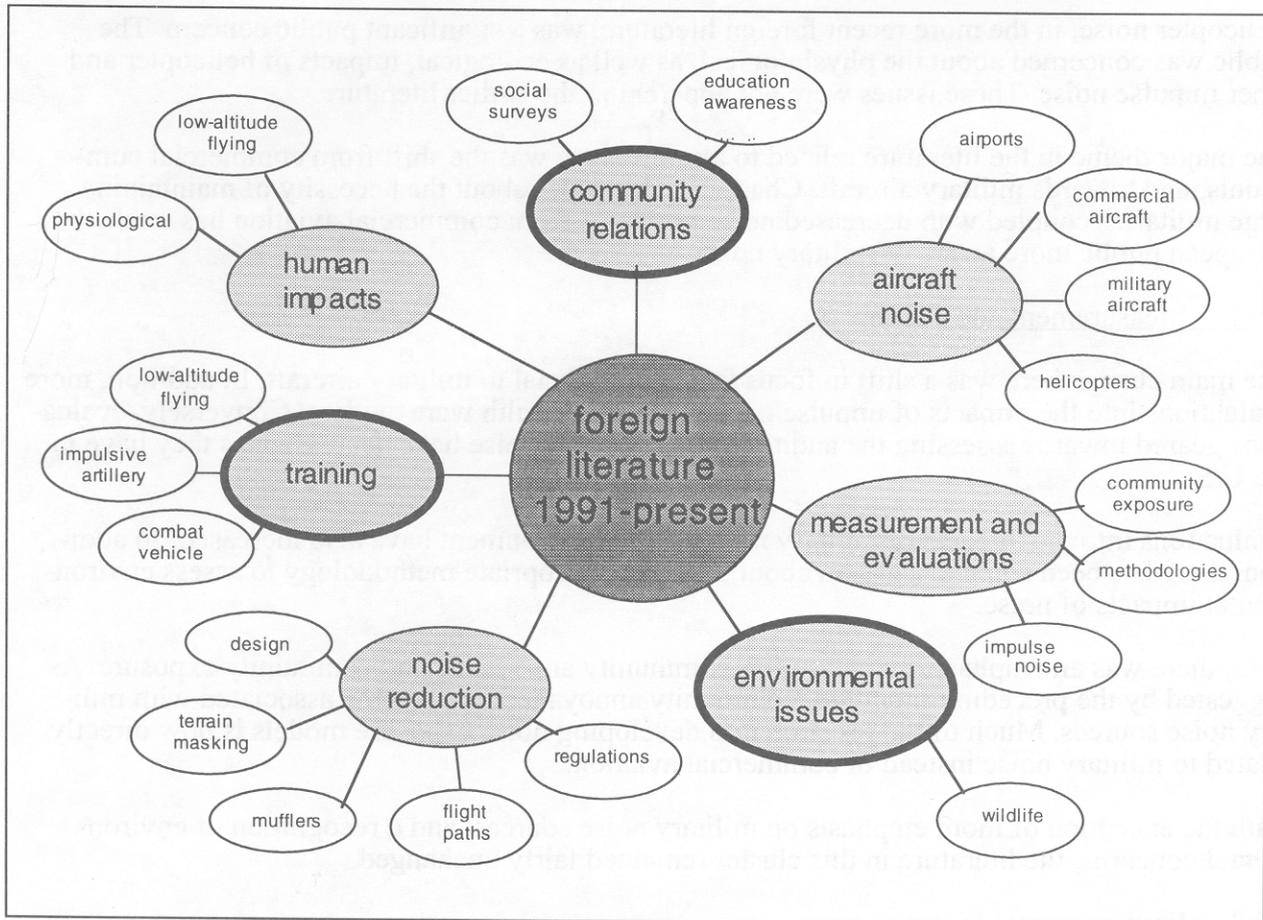


Figure 3.7: Foreign Literature and Subclusters, 1991 - Present

3.6.1 Aircraft Noise

More recent foreign literature indicated a shift in noise concerns from commercial aircraft toward military aircraft. Although public concerns about military aircraft were evident earlier, they have become considerably more pronounced.

The introduction of strict commercial aviation noise standards may explain why military aircraft noise have been receiving more attention. Stricter European noise regulations have led to fewer commercial aircraft and commercial airport complaints. However, these stricter regulations have not greatly impacted military operations. In fact, numerous sources indicated recognition that commercial aviation noise regulations do not apply to military aircraft.

A majority of the concerns about military aircraft noise were associated with the auditory impacts of low-altitude flying and helicopter noise. This was the most prevalent public concern in the European NATO countries. These concerns were most apparent in Germany, the United Kingdom (U.K.), and Canada. In Germany, the population density is so great that military operations almost always have an impact of communities. In Canada, concerns were focused on

NATO training exercises. In the U.K., concerns stemmed from the perceived auditory impacts of low-altitude flight training.

Helicopter noise, in the more recent foreign literature, was a significant public concern. The public was concerned about the physiological, as well as ecological, impacts of helicopter and other impulse noise. These issues were not apparent in the earlier literature.

The major theme in the literature related to aircraft noise was the shift from commercial complaints, and towards military aircraft. Changing ideologies about the necessity of maintaining large militaries coupled with decreased noise problems from commercial aviation has made the European public more aware of military noise.

3.6.2 Measurement and Testing

The main change here was a shift in focus from commercial to military aircraft. In addition, more evaluations into the impacts of impulse noise on human health were evident. Conversely, evaluations geared towards assessing the auditory impacts of jet noise have decreased, as they have in the U.S.

Evaluations into the impacts of military noise on the environment have also increased. In addition, there has been some discussion about the most appropriate methodology to assess environmental impacts of noise.

Also, there was an emphasis on measuring community annoyance and community exposure. As suggested by the preceding literature, community annoyance has become associated with military noise sources. Much of the research into developing noise exposure models is now directly related to military noise instead of commercial aviation.

With the exception of more emphasis on military noise sources, and a recognition of environmental concerns, the literature in this cluster remained fairly unchanged.

3.6.3 Environmental Issues

Environmental issues have gained considerable interest. Much of this concern was related to the perceived impacts of military noise on wildlife migrations and breeding patterns. Overall, environmental issues have become more apparent in recent foreign literature. The European public was more concerned about environmental issues than health-related ones. However, this trend was not as well defined it is in the domestic literature.

3.6.4 Noise Reduction

This cluster was still apparent in the recent literature. Regulations have had a significant impact on commercial aviation. Numerous sources addressed noise reduction techniques for commercial airports and commercial aircraft. Literature related to noise reduction and the military remained relatively unchanged.

Emphasis was still placed on passive noise reduction techniques such as mufflers, terrain masking, and flight path modifications. There was some indication of redesigning for quieter weapons, but most of this literature was related to strategic initiatives, not community concerns.

3.6.5 Human Impacts

Human health concerns were still apparent in the literature. Most human health concerns were related to the perceived auditory impacts of low-altitude flying and impulse noise. Concerns

about the health impacts of impulse noise (particularly helicopter and artillery noise, not apparent in the earlier literature) have emerged in the more recent literature. Research on the military and noise was focused on assessing the impacts of impulse noise on both the environment and human health. Public concerns about occupational noise exposure have diminished considerably.

3.6.6 Training

Literature in this area was closely tied to concerns about the potential harm that can be caused by impulse noises. NATO training exercises, particularly in Germany, have been subject to considerable public scrutiny because of the high levels of impulse noise. Most of these concerns were focused on helicopter noise, small arms firing (up to 25mm in caliber), and other weapons systems generating impulse noise. Concerns about noise stemming from the operation of combat vehicles such as the Bradley Fighting Vehicle were also apparent.

Community complaints about excessive training noises were greater than complaints associated with low-altitude flight training. This could be explained by the fact that while combat training noises tend to be more localized, exposure from low-altitude flight noise is more spread out. Nonetheless, military training noise has become an issue in many European NATO countries.

3.6.7 Community Relations

References to community relations were limited in this literature. However, the number of military noise complaints has steadily increased over the last decade. This may explain the numerous sources indicating the creation of programs and initiatives created to increase the public's awareness of military noise management strategies.

For example, many air bases in the U.K. have initiated programs to educate surrounding communities in an effort to make them more aware of the noise abatement techniques that are being employed. Review also noted similar initiatives that have taken place in Germany. Overall community relations, with respect to military noise, were not very strong in the European community. However, as military noise concerns continue to grow, efforts to improve community relations may become stronger.

In addition, numerous sources referred to the use of social surveys as a means for measuring community opinions about environmental noise. If employed strategically, this could be considered a community relations initiative.

3.7 Conclusions

Public concerns over noise pollution appeared to stabilize over time. However, the public's focus of concern has changed. Earlier literature suggested that commercial aviation noise and transportation noise were the public's main concerns. However, stricter workplace regulations and tighter aviation standards have alleviated most of these concerns.

Now there is growing discontent with the military and its noisy operations. An inherent dilemma exists within the issue of military noise and the public element. Military noise has long been viewed by both the government and civilians as a necessary evil. Maintaining a ready and trained army has been the backbone of our, as well as those of other nations, foreign relations strategy. At the same time, maintaining a modern and skilled military requires noise. Training is not silent.

Now that commercial aviation receives less public criticism, military noise has become more available to public debate. People are often unwilling to accept annoying military noise as a fact of everyday life. While the public wants a strong military, they do not want an excessive military or one that is too loud. This is the case internationally as well.

Nonetheless, the military has responded. The literature suggested that the military has recognized and attempted to address public concerns about noise. Although in the public's eye the military response may not be effective, the military has accepted its responsibility to reduce excessive noise.

In addition, the military's recognition of the possible effects of alternative noise sources is clear, most notably impulsive noises from helicopters and weaponry. Military issues associated with impulse noise are likely to persist into the future.

Environmental concerns about wildlife and recreation were also more apparent in the recent literature. The military, like the public, has become interested in investigating the impacts of noise on the environment. The military's recognition of this issue was not apparent in the earlier literature. It is likely that environmental concerns will become a major rallying point for public debate against noisy military operations.

4. NATO Countries

The amount of literature on specific NATO countries and military noise issues was insufficient enough to warrant individual TOA analyses. However, analysis of the available literature was compared to the TOA findings presented in previous sections. The following narratives are a review of the available literature related to military noise and NATO member nations.

4.1 France

Most of the earlier French concerns emphasized commercial airports as the main source of public complaints. Concerns about military noise sources were not apparent in the earlier literature.

Review of the earlier foreign literature also suggested that the French were particularly concerned about the physiological effects, mainly sleep disturbance, of aircraft noise and sonic booms on communities surrounding commercial airports. Most of the earlier measurement literature was focused on predicting community exposure in areas where sleep appeared to be most impacted.

The measurement literature also suggested that the French were interested in determining the impacts of particular commercial flight paths on communities. This is one area where mathematical modeling was frequently applied. Modeling of the least impactful flight paths has been an effective way of reducing the potential for community noise complaints.

There was considerable interest in designing quieter commercial passenger planes such as the European Airbus. Designing quieter commercial planes was probably a response to the emergence of stricter European design standards, not community concerns about noise annoyance. Military aircraft were apparently not affected by these stricter European regulations.

More recent French literature addressed military noise sources such as aircraft, gunfire, and helicopters. There was a clear relationship between these noise sources and methods of passive noise reduction.

Terrain masking was cited as an effective alternative for military noise reduction. One of France's latest research initiatives focuses on determining whether or not terrain masking can abate impulsive helicopter noise. However, the driving force behind the investigation of terrain masking and helicopter noise is based on developing more strategically sound weapons, not on reducing community noise exposure.

Overall, public concerns about military noise did not emerge in the most recent literature. The public has been annoyed with low-altitude flight training by the French Air Force. However, flight training restrictions have reduced the number of associated complaints. This suggests that the French military has effectively responded to public concerns about military noise. In general, the French were more concerned about the expansion of commercial airports and the subsequent noise increases than they are about military noise.

4.2 Netherlands

Environmental noise was an important issue in the Netherlands. However, nothing in the literature suggested that the public was specifically concerned with military noise. Social surveys reported that people were no more concerned about military noise than they were about commercial aviation noise. However, the literature suggested that aircraft noise was a problem, be it commercial or military.

Concern has grown over the impacts of aircraft noise on the environment, in particular wildlife. However, the amount of literature related to environmental concerns was minimal.

A large body of noise literature from the Netherlands related to measurement. An emerging area of research is focused on measuring community annoyance from multiple noise sources. Overall, noise measurement techniques and the measurement of community annoyance were major issue areas in the Netherlands.

Evidence suggested that the Dutch were involved with the development of active noise, or “anti” noise controls. However, research and development in this area was not in response to community noise annoyance.

However, wind turbine noise issues appeared in the literature. These concerns related to design and efficiency questions, not community annoyance. Numerous references noted the impulse noise characteristics of wind turbines. But nothing in the literature related these impulse noises to the potential impacts on human health or environmental integrity. If research from other countries concludes that impulse noise from military sources pose significant risks to either human health or the environment, then public concern about windmill noise may emerge.

4.3 Denmark

There was no indication that the Danish public is concerned about military noise. There was little indication of concerns about any type of aircraft noise at all. There was considerable indication of public debate surrounding the annoyance caused by traffic and highway noise, as well as windmill noise. Overall, literature related to military noise concerns did not emerge from the body of Danish literature.

4.4 United Kingdom

Public concerns about military noise were apparent in the U.K. The focus of these concerns has been on low-altitude military operations and the high levels of noise associated with them.

Much of the literature on low-altitude flying surrounded the modeling and prediction of community noise exposure. Numerous sources described the development of more accurate models to measure community exposure from both military aircraft and commercial aircraft.

More general annoyance issues continue to emerge in the U.K. There was some indication that the British are realizing that military and commercial overflights do not pose a significant auditory risk, at least in the long-run. There has been, however, some concern about the auditory impacts of impulse noise.

The literature suggested that U.K. military officials have started making assertive efforts to educate local communities about the necessity of conducting certain noisy operations. There was a growing interest in public relations campaigns.

Although the military’s emphasis on minimizing noise concerns through public relations and education has made an impact, rescheduling and flight path restrictions are still used to minimize public complaints.

Numerous World Wide Web sites contained information about noise issues emanating from the U.K.. Most notable was the literature about military noise control at Royal Air Force (RAF) Mildenhall. This installation comprises a major component of the U.S. Air Force’s commitment to the NATO alliance.

Military noise problems were a major public concern. However, emphasis has been placed on the essential nature of training operations, and suggestions about radical noise abatement approaches such as commencement were considered unacceptable.

The overall theme of the British literature supported the notion that planning, scheduling, and public relations can effectively minimize local concerns without jeopardizing essential operations. Active community relations centered around public meetings, operations tours, speakers, and news releases. These actions are an integral part of the noise management strategy at RAF Mildenhall.

There were also some environmental concerns associated with noise. However, they were not overwhelming. The focus of public debate has centered around community annoyance, especially from low-altitude flight training.

4.5 Germany

The major military noise issue in Germany was low-altitude training operations. Recent concerns have emerged over impulse noise, particularly noise emanating from firing ranges. Nonetheless, low-altitude flight training continued to be the dominant military noise issue.

Problems with low-altitude flying have persisted for decades. Until 1990, two-thirds of the Federal Republic of Germany was used for low-altitude flight. Although these areas have been reduced, public concerns have mounted since 1990. Given the dense population of Germany, it is little wonder that low-altitude flying has become a source of public concern and community annoyance.

These concerns remained a pressing issue. However, some literature indicated a unique and emerging philosophy that military noise, especially from NATO sources, should be exported to less populated nations such as Canada. While the literature suggested that many German citizens have come to accept the necessity of low-flying training operations, their acceptance has been underlined by a silent desire to send noisy military operations overseas.

Also apparent was a recognition of the distinctions between aircraft noise and impulse noise. German military researchers have become very active in evaluating the characteristics and impacts of impulse training noise.

Numerous citations noted growing community annoyance with land-based training exercises, including small arms and helicopter training. Of particular interest was the growing opposition and annoyance associated with combat vehicles, mainly the Bradley Fighting Vehicle.

Also of growing concern was the environmental impact of military noise. The general evolution of stricter environmental regulations and an overall ethic that places a high value on environmental quality may be the cause of such heightened concern for military noise.

4.6 Canada

Most of the Canadian literature on military noise and the public element focused on the concerns of the Innu Indians. Their concerns have come in response to the extensive NATO training operations that have taken place over Labrador and Quebec. According to the Innu, continuous low-altitude flight training has had profound impacts on wildlife, wildlife habitats, and psychological impacts on indigenous children.

The Innu felt that these training exercises have violated their land rights and airspace. The Innu people were also very unhappy with the way that their concerns have been handled. Although

environmental impact assessments have been conducted, the Innu have expressed that they have been prevented from properly voicing their concerns. One source suggested that the Innu people were completely cut off and denied a voice during hearing processes. In addition, there were numerous indications that military officials deliberately withheld information related to the impacts of overflights on regional wildlife.

Military officials have initiated an overflight avoidance program to limit the impacts of military noise on the Innu people. There was also some suggestion of scheduling alternatives. However, according to the Innu, such programs have not been effective.

4.7 Norway

Norwegian literature was largely focused on commercial aircraft and commercial airport noise. Military noise does not appear to be a major issue. Nonetheless, there was a strong relationship in this literature between commercial aircraft noise and community annoyance. There was also a focus on the impacts of commercial airport noise on metropolitan areas.

It may well be that military training operations, especially low-altitude flying, take place in rural, non-populated areas. However, if this is the case, rural concerns about the impacts of military noise on livestock may become an issue as they have in the U.S.

Research coming out of Norway addressed the suspected inadequacies of the dose-response relationship model used to assess community noise annoyance. With this exception, the amount of literature related to noise measurement and community exposure measurement was limited.

There was, however, an emphasis on social surveys. Public opinion and attitude surveys have played significant roles in determining whether noise annoyance problems exist. Numerous citations noted the use of social surveys by the Norwegians to assess whether or not people were bothered by sounds emanating from commercial airports.

4.8 Italy

Concerns about noise focused on commercial design. More specific literature on military research and development did not indicate reductions in noise as a major focus. In fact, there has been little public concern over military noise. Community annoyance was not an issue in Italy.

5. NATO Cooperation Partner Countries

While literature on noise issues in these countries was very limited, some general conclusions were determined.

5.1 Poland

It was apparent Poland has serious environmental problems, including noise. Poles were very concerned about the physiological impacts of noise. However, much of this concern has focused on occupational noise exposure. One Polish newspaper noted that deafness ranked first among occupational diseases.

With respect to military noise, public concern was not a major issue. At the same time, there has been some public concern over the replacement of fighter aircraft with helicopters at many installations. The increases in impulse noise associated with helicopter training may become a more pressing issue. As other environmental concerns are resolved, public concern over exposure to military noise is likely to become a more serious issue.

In many European nations, the first concerns over military noise emphasized the physiological impacts of occupational noise pollution. As these issues become better understood and resolved, issues related to public annoyance emerge. Because the literature suggested that Poland has become more concerned about environmental issues, public debate over military noise is likely to emerge.

5.2 Czech Republic

Czech literature suggested that community annoyance over military noise has been considerable. The public regards military noise as a pressing environmental problem. The growing concern over military noise, mainly aircraft noise, has been the result of increasing disaffection for military operations in general.

Although the new Czech government wants to increase its military strength, the public seems adamantly opposed. For example, the literature noted significant public disapproval of the Czech Republic's proposed NATO inclusion. Czech citizens argue that inclusion into the NATO alliance will result in a significant increase in military training noise, mainly from low-altitude flying.

The Czech Republic was also interested in measuring the impacts of military noise on communities. The findings of such measurements, it is believed, will fuel the fight against military expansion. However, the public was concerned about the competency of those responsible for conducting noise measurement studies. Some claim that military officials responsible for conducting community noise exposure measurements deliberately misrepresent findings in the military's favor. This issue has fueled the public's dissatisfaction with the military.

Unlike the Poles, the Czechs were not concerned about occupational noise exposure. Their concerns were clearly related to community annoyance and a general resentment of military operations.

Czech literature did not include physiological or psychological impacts of noise in the public debate over noise issues.

5.3 Georgia

The only concerns related to environmental noise centered around the prospects for the development of a competitive commercial aviation industry. Georgians were concerned that their aging

fleet will become inoperable within the international travel market. Much of this concern focused on the implications of stricter international noise standards for commercial aircraft. Military noise concerns were non-existent.

5.4 Ukraine

The literature identified military noise as a significant problem. However, the public was not overwhelmingly concerned about its impacts.

In general, the Ukrainian military has been unwilling to comply with national environmental legislation. If public concerns about military noise were to emerge, response or actions from military officials would probably be minimal.

5.5 Russia

The Russians appeared to be most interested in engine design. Numerous articles suggested that noise reduction is a major goal in engine development. The Russians were also concerned about their aging commercial fleet and are looking to enter the international market. However, complying with strict international noise standards has been a problem. Overall, there was nothing in the literature to suggest that the public was concerned about engine or military noise.

5.6 Hungary

The Hungarian army has promoted the use of inactive firing ranges by NATO and other foreign troops. Numerous sources indicated that the Hungarian military have tried to rent firing ranges that for years have been inactive. Most of these ranges cannot support training with heavy artillery, and as a result, considerable noise issues have emerged.

Public concern and village annoyance have become major emerging issues with respect to military noise. Since the Soviet withdrawal, Hungarian villagers have become accustomed to a quieter environment. However, their relatively noise-free environment is now being invaded. The reintroduction of noisy training operations, especially from foreign troops, will continue to cause increased concerns and annoyance from affected local villages.

What appears to be happening in several NATO Cooperation countries (notably Hungary and the Czech Republic) is now that people have more say in local and national government, they have begun to voice their concerns more often and with a greater likelihood of response. Add the withdrawal of Soviet training operations over the past decade, and the increasing comfort with quieter surroundings, and the result is mounting discontent concerning noisy NATO operations.

6. Conclusions: Technology Opportunities Analysis (TOA) Assessment

The main method of research for this project was Technology Opportunities Analysis. TOA requires large amounts of raw information, usually in the form of database abstracts. Therefore, the first step in this project was to evaluate the outstanding database literature and determine if TOA would be useful and effective.

The topic of military noise and the public element was evaluated to determine the scale of available literature. Literature related to military noise within the U.S. was sufficient to warrant TOA. However, due to the technical nature of the databases investigated, literature related to the social aspects of military noise was somewhat limited.

Literature related to military noise and the public element in specific NATO countries was also limited. Numerous alternative database sources were searched, but the amount of literature available was insufficient enough to warrant individual TOA on specific countries. This may have been the result of language barriers or insufficient reporting from NATO member countries. Nonetheless, instead of individual TOAs on each NATO country, the available literature was reviewed and compared to the TOA findings from chapters 2 and 3.

Future TOA studies on military noise and the public element in foreign countries should attempt to locate additional international database sources. Overall, the TOA methodology was useful in identifying major issues, as well as those emerging or fading. Because the TOA methodology is still in development, future TOA research on the topic of military noise and the public element should be supported.

Appendix A:

Database Descriptions

The NTIS database was frequently used in this project. Literature from other available databases was often too technically oriented. However, findings from each of the databases contributed to this study.

The electronic databases used in this project were:

ACAD: The Expanded Academic Index covers a broad range of journals. This interdisciplinary database covers over 2,127,700 records.

BUSI: The Business Index covers over 900 business, trade, and industry sources. It totals over 2,775,200 records.

ENGI: Engineering Index covers over 4,500 engineering journals and over 2,000 engineering related publications. It totals over 2,057,000 records.

NTIS: The National Technical Information Service database covers unclassified government sponsored research and development. It includes reports from agencies, their contractors, and grantees. It totals over 1,872,800 records.

INSP: INSPEC covers worldwide physics and engineering publications. It contains over 2,334,300 records.

PAIS: The Public Affairs Information Service Database contains international sources focusing on public issues and public policy. This database contains over 135,600 records.

DTIC: The Defense Technical Information Center database covers military reports and publications across a wide range of topics. This database contains over 1,300,000 records.

WWW: World Wide Web. Literature gathered from the WWW was limited. However, there were numerous sources which augmented findings from other databases.

WNC: World News Connection offers time sensitive information gathered from thousands of foreign media sources, including political speeches, television programs and radio broadcasts, articles from periodicals, newspapers and books. It also includes unclassified military, political, environmental, sociological, scientific and technical data from around the world.