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Controversy in Soviet R&D: The Airship Case Study

Heather Campbell

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PREFACE

This report is part of a broad program on Decisionmaking Processes in Military Organizations, sponsored by the Air Force under Project RAND. A major segment of this program is directed toward the study of the performance of Soviet research and development, particularly in the area of aviation. A general study on R&D in Soviet aviation has already been published.[1] To complement that work, and to test the generality of its conclusions, a case study was conducted on the debate in the Soviet Union, beginning in 1955 and continuing to the present time, about whether airships should be produced and utilized domestically. The airship case study focuses on the process of generating requirements within the Soviet aviation industry -- that is, on how decisions are made to produce a particular product.

Airships, of course, do not constitute a major weapons system of principal concern to U.S. military planners.[2] However, in the Soviet Union the same institutions that are involved in deciding whether or not to produce airships are involved in other aircraft development decisions, both civilian and military. Thus, generalizations from the study of this controversy may yield additional insights into the requirements-generation process.

This particular topic was selected as a case study primarily because it permitted analysis of the influence of organization and structure on the Soviet R&D decisionmaking process and on the basis of its accessibility.

Articles documenting the controversy between the Soviet Ministry of Aviation and some of its customers over development of a domestic dirigible industry have been appearing openly in the Soviet press. The case study therefore serves one of the objectives of the Project

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[1]Arthur Alexander, *R&D in Soviet Aviation*, R-589-PR, November 1970.

[2]For those who consider the airship to be antiquated in an era of high-speed, high-altitude aircraft, it must be pointed out that groups in both England and West Germany, as well as in the Soviet Union, are engaged in studies of modernized versions of the airship concept.

RAND research on Soviet R&D -- to use available information in the analysis of the Soviet Union.

This study has raised some questions still to be explored: What happens in the course of the requirements process? How do users and producers interact at the various stages of research, development, and design of aviation products.

This case study should be useful to Air Force analysts and planners in ACS/Studies and Analysis, ACS/Intelligence, and the Directorate of Doctrine, concepts and objectives.

SUMMARY

The organizational context of the dirigible debate in the Soviet Union is mainly the Ministry of Aviation Industry (MAP), although airship proponents represent many other ministries and industries as well. All resources for the development and production of aircraft are concentrated in MAP, however, and it is there that nearly all the decision-making power in this area is also located. This one organization not only conducts the research, design, and development of Soviet aircraft, but it also manufactures products and materials essential to the production of aircraft, as well as the aircraft themselves.

Within MAP, a standard series of steps constitutes formal design procedure. More expedient methods infrequently bypass this procedure. They include crash programs, *ad hoc* organizations, and political intervention at a high level. Competitive pressure under time constraints influences the designer to restrict himself to creating simple aircraft, with proved features from previous models. Under normal circumstances technological change is incremental. Soviet aviation designers, who have much greater responsibility for their designs than do their American counterparts, avoid daring innovations because of the higher than usual risk of failure.

Actual work on dirigible designs began in 1955, apparently in response to a Five-Year Plan directive to improve the means of transportation in remote areas. In 1957, a design was presented to the Committee on Inventions, which approved it in 1961. In the meantime, a Commission on Lighter-than-Air Navigation had been set up by the Leningrad branch of the Geographic Society of the Academy of Sciences of the USSR in 1957. Branch offices followed in several other cities. In 1961, the All-Union Geographic Society created a Volunteer Dirigible Design Bureau (OKB)[1] in Leningrad. By 1965, the issue of whether to revive dirigibles was so popular that an All-Union Conference of

[1]Obshchestvennoe Konstruktorskoe Biuro, not to be confused with Opytno-Konstruktorskoe Biuro (a design organization that has its own experimental production facilities).

Enthusiasts of Dirigible Building was called in Novosibirsk. In late 1965, the creation of the first school for aeronauts was mentioned in the press. In May 1966, a session of the Scientific-Technical Council of MAP was called to consider the proposals of volunteer workers from the Leningrad OKB, but it had no visible impact on the aviation industry. In 1967, some details of the D-1 dirigible designed by the Ukrainian OKB were announced. And finally, in April 1970, a working model of the TsM-100 dirigible was unveiled in Leningrad.

Parallel with the activity of the OKBs, various aspects of the debate were published in the press. In an interview in late 1962, the Director of the Leningrad OKB recommended the revival of dirigibles. His favorable comments were seconded by representatives of such organizations as ministries, state committees, state planning committees, scientific research institutes, branches of the USSR Academy of Sciences, and others. These people represented such diverse fields as geology, the lumber industry, the fishery industry, and polar research.

The opponents of dirigible construction did not reply directly and openly in the press until 1967, when a single article appeared by an author identified only as someone who had worked "on aviation requirements more than 10 years." Then, in 1968, at the height of the debate, opponents were represented by A. Mikoyan (a prominent Soviet airframe designer); the oldest Soviet arctic pilot; and a well-known test pilot. Their arguments centered around the questions of evolution (dirigibles became extinct because they were outmoded by airplanes); safety (particularly in turbulent weather, super-cooled rain currents, or storms); feasibility (changing of weight in flight and mooring problems); and operating costs (estimates of costs of fuel and of operation and maintenance were considered dubious). The position of MAP could probably be detected in Mikoyan's flat statement that he doubted whether dirigibles could extend the range of problems resolved by airplanes and helicopters.

In view of the normal disincentives to develop experimental aircraft within MAP and the stand taken by the aviation leaders, the prospects for dirigible construction within the Soviet Union are unpromising. Proponents evidently have not been able to exploit to

their advantage two possible leverage points within the aviation industry -- the critical influence of the Scientific-Technical Council and advocacy by a prominent designer. And in spite of some low-level political support (Gosplan and the Communist Party in Leningrad), there apparently has been no high-level intervention to offset the bureaucratic process. Externally, there has not been sufficient progress in the design, production, and application of dirigibles by the developed countries to increase the momentum of the dirigible movement within the Soviet Union.

The main hypothesis of this study is that the Soviet aviation industry has prevented the development of a modern dirigible largely because of organizational concerns. Alternative hypotheses to explain why dirigibles have not been accepted within the aviation industry include the possibility that the technological and economic arguments regarding the operation and maintenance of dirigibles were not convincing enough. The cost of developing a whole new technology and industry may be considered too great in relation to the payoffs. Or MAP may rationally choose to answer requests for dirigibles with helicopters, a proved product. There is some evidence that this last may be the case.

MAP appears to control most of the R&D resources in aviation. Furthermore, MAP seems to reject radical changes in technology, particularly if introduced from the outside. Consequently, its officials do not seem to feel compelled to give a very substantive or public account of their position on this particular development decision. Aeroflot is the official arbiter of civilian customer needs, but in the airship it has failed to satisfy some of the ultimate users of aviation. Some of these users apparently decided that airships were the best solution for their unsatisfied needs and bypassed Aeroflot to present their request to MAP, but the ultimate user seems to have little influence on Aeroflot when it comes to decisions on vehicle systems.

ACKNOWLEDGMENTS

The author wishes to thank Rand colleagues Bruno Augenstein, David S. C. Chu, and Nancy Nimitz for their many helpful suggestions. In particular, Nancy Nimitz supplied valuable background on Soviet industry and rendered special assistance with the intricacies of the Russian language. Arthur Alexander also gave special help with the analysis of Soviet R&D in aviation. And finally, for his patience and encouragement as well as expert guidance, the author is indebted to the project leader, Albert P. Williams, Jr.

In addition, Mr. David D. Hatfield of the Aviation History Library, Northrop Institute of Technology, supplied historical information that put the study in proper perspective.

CONTENTS

I. INTRODUCTION

Previous Rand studies on research and development in the Soviet Union have explored areas of great interest and significance to those persons interested in the planning and economics of R&D; in the functioning of the Soviet economy in general; and in the economics, structure, and functions of military R&D in particular. One such work of special interest to the Air Force lays out the general organizational characteristics of R&D in the aviation system, the information flows within it, its design procedures and philosophy, and its incentive structure.[1]

The pattern that has been revealed has known exceptions, some of which may be as illuminating to our understanding of Soviet R&D as the main design. The difficulty in isolating such exceptions and learning their nature is that the details of decisionmaking are rarely revealed. Although dissatisfaction with a particular product may be discussed publicly, it is comparatively unusual to be able to observe a debate with an unmistakable trend and identify the persons associated with specific points of contention as well as the organizations or institutions with which they are affiliated.

One identifiable exception, the debate over whether dirigibles should be produced and utilized in the Soviet Union, is the subject of this study. The debate centers around the question of whether dirigibles should be constructed as an economical means of heavy air transport and for a variety of other purposes in the economy. The nature of the debate itself will be explored more fully in a later section.

Surprisingly, none of the proponents of dirigibles identified in the Soviet press are members of the regular, well-established, and closely controlled institutions of the Soviet aviation industry. Rather, they are associated with volunteer design bureaus, various sections of the USSR Academy of Sciences, several State Committees,

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[1]Arthur Alexander, *R&D in Soviet Aviation*, R-589-PR, The Rand Corporation, Santa Monica, November 1970.

to put the current debate in proper perspective. Section IV includes an exploration of the nature of the debate on Soviet dirigible construction. Section V contains a discussion of the limitations of Soviet organizational decisionmaking and design doctrine in their present form as evidenced by the debate about dirigibles. In Section VI alternative hypotheses are presented that might explain why this debate took place. Section VII is a summary of the insights gained from the study.

II. ORGANIZATIONAL CONTEXT — THE SOVIET AVIATION INDUSTRY[1]

ORGANIZATIONAL STRUCTURE

Research, design, and development in the Soviet aviation industry are concentrated in one central unifying organization, the Ministry of Aviation Industry (MAP). This ministry manufactures products and materials essential to the production of aircraft, as well as the aircraft themselves. The various organizations that carry on these functions, however, are administratively separate. In particular, research institutes conduct basic and applied research and produce "Handbooks for Designers" in their respective specialties. The design bureaus are semi-autonomous groups with their own prototype construction shops. The plants that manufacture the aircraft are separate from both the research institutes and the design bureaus.

The main research organization within the Ministry of Aviation Industry is the Central Aerohydrodynamic Institute (TsAGI). Some specialized research institutes have split off from TsAGI to become separate, autonomous entities or were created as such: The Central Institute of Aviation Motor Building (TsIAM); the All Union Institute of Aviation Materials (VIAM); the Scientific Research Institute for Aviation Technology and Organization of Production (NIAT); the Scientific Research Institute for Aviation Equipment (NISO), and the Flight Test Institute (LII).

The design bureaus, whether for airframes or for engines, also are autonomous organizations and are named after their head or chief designer. Some well-known airframe design bureaus include those of Antonov, Mikoyan, Tupolev, and Yakovlev. Each bureau not only is responsible for the design of aircraft but also controls a special experimental plant associated with it that constructs prototypes of design projects. Although in the past the design bureaus have had to rely upon the experimental facilities of the research institutes, this

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[1]This section is based on material in Alexander, *R&D in Soviet Aviation*.

seems to be changing as some of the design bureaus obtain laboratories for research on primarily new designs.

The three main customers of the Ministry of Aviation are the Air Force, Aeroflot, and Aviaexport. Aside from the usual passenger and freight services of a civil airline, Aeroflot runs all the other non-military aviation activities such as those needed in agriculture, geology, and forestry; for ambulance services; and for transportation to remote areas. According to the published debate on dirigibles in Section III, therefore, of the three main aviation customers Aeroflot should be most interested in the development of dirigibles. In the 1930s, some work on developing dirigibles was in fact carried out within Aeroflot.

DESIGN PROCEDURES

From the initial proposal to a flying machine, formal design procedure usually follows a set pattern. Occasionally, the formal procedure is by-passed in favor of crash programs, *ad hoc* organizations set up to address specific problems, or political intervention at a high level. Although these devices have been used to achieve large jumps in technology, they have also been seen by the customers, on occasion, as the only way to avoid getting bogged down in the normal bureaucratic channels.

The formal procedure begins with a proposal for a new aircraft, usually put forward either by the customer ministries or by the aviation designers themselves. This proposal goes to the Council of Ministers for approval. After the research institutes have contributed their views, the proposal is submitted to a scientific-technical council representing both the customer and the production ministries. Here the detailed specifications and technical parameters are worked out before the project is assigned to the design bureaus for elaboration. The pre-projects, as they are called at that stage, are then returned to the same scientific-technical commission. The council evaluates the pre-projects and then chooses one or more "for continued development."[1]

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[1] *Ibid.*, p. 18.

The design bureaus chosen to proceed incorporate the recommendations of the scientific-technical council into their work. A mockup is constructed and approved by a special mock-up commission. The next stage is the construction of a prototype. The last stage before production consists of flight tests, conducted by the design bureau and by the Flight Test Institute (LII) under the supervision and direction of the expert commission.

DESIGN PRACTICE

The most important incentives to a designer are certain rewards for designs that are produced and possible dissolution of the design bureau as punishment for failure. A design that is approved for production will result in expanded work for the design bureau in the way of follow-on orders, modifications, and new assignments, requiring more personnel and larger and better facilities.

Under conditions of competition, time is of the essence and may well determine the contest. Such competitive pressure creates an incentive to produce simple aircraft, with proved features characteristic of other aircraft or previous models. These design principles Alexander calls "simplicity, commonality, and inheritance." Simplicity in design means no extra frills, unnecessary gadgets, or superfluous finishing. "Commonality means the use of standardized parts, assemblies, and subsystems wherever possible, as well as the sharing of design features among different aircraft."[1] Design inheritance also denotes the sharing of design features but within a particular series of aircraft as it has developed over time.

Technological change is therefore incremental under normal circumstances. Pushing technology to jump ahead has been possible only with high-level government or Party support, but such influence is not just one way. At times, designers and scientists themselves muster all the weight they can to induce the government and Party to change the direction of research, design, and development.

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[1] *Ibid.*, p. 22.

In general, the Soviet designer has been given greater influence over the responsibility for his design than have his American counterparts. One result is that the customer may have less influence over the technical specifications and limitations of the design than customers in the United States. Another is that aviation designers tend to avoid experimental aircraft, since the probability of production is low and the risk of failure is much higher than usual. Such circumstances, and the nature of the design practices themselves, may militate against the adoption of dirigibles in the Soviet Union.

III. PRELUDE TO THE DIRIGIBLE DEBATE

PRE-SOVIET RUSSIAN AIRSHIPS

Even earlier than the 1950s, airships[1] were not unknown phenomena in the Soviet Union. In fact, the history of airships in that part of the world goes back several years before the Soviet Union was formed in 1917. In the first *Jane's All the World's Airships*,[2] published in 1909, three airships owned by and one airship being built for the Russian government were described. Three of these airships originated in France, and one was built in Russia. *Jane's* description of the Russian "Outchebny" is terse and not very complimentary: "This is a very primitive 'home-made' article. Reported to be a failure. Details unknown."[3]

The 1910-1911 edition of *Jane's* describes four more dirigibles under construction for the Russian government; two in France, one in Germany, and one in Russia. The same edition lists under dirigible constructors the name of Ch. Gilbert in Moscow, and the representatives of two different companies for making fabrics for airplanes and dirigibles in Moscow and St. Petersburg.[4] By the end of 1911 all of the above dirigibles had been added to the military services of the Russian government, as well as another built by Forzmann, a Swede resident in Germany. A smaller dirigible capable of carrying only one person was

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[1]The term airship in this country is usually taken to mean all maneuverable lighter-than-air craft, and the term dirigible is usually reserved for rigid airships. Both *Jane's* and the Soviets themselves use the term dirigible to encompass all types of airships, whether rigid, semi-rigid, or non-rigid. To avoid confusion, the type of design will be specified where it is known. In general, however, the earliest Russian dirigibles were of non-rigid design and the ones currently planned are of rigid design, since they are intended to be used for heavy transport purposes.

[2]The present title of *Jane's All the World's Aircraft* was adopted in 1912, since the term airship had come to designate lighter-than-air craft rather than encompassing all aircraft, as originally intended.

[3]*Jane's All the World's Airships, 1909*, p. 237.

[4]*Jane's All the World's Airships, 1910-1911*, pp. 445 and 448.

also projected to be built by Forzmann and was completed in 1912.[1] In 1913, two more French dirigibles and a German dirigible were added to the Russian fleet, but one of the Russian-built dirigibles was wrecked in the same year, bringing the total to 12.[2] All of these airships were intended for military purposes, and all were of non-rigid design, with the exception of the two Russian-built dirigibles and the earliest French dirigible, which were semi-rigid.

1914 saw the addition of another dirigible and five more under construction. Four "were not delivered on account of the war, and appear to have been requisitioned by France."[3] In 1916, the Russian dirigible count remained 13, the war having prevented the delivery of two Astras ordered in France. *Jane's* notes: "Of these only four are of any fighting value, and their value is small." In addition, "three small ships of which no details are available have been built in Russia (scouting airships)."[4]

SOVIET AIRSHIPS

By 1918, Russia's rather prominent place in the dirigible section of *Jane's* had faded away to one cursory statement: "Russia purchased sundry French and German airships and built one or two ineffective vessels at home."[5] Russian airship activity understandably dwindled down in the period 1919-1920, a period of consolidation for the Soviet Union.[6]

Very little is known of the period 1920-1930. Some research on dirigibles was evidently conducted on a fairly independent basis by the Russian scientist and inventor also known as the father of Soviet

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[1] *Jane's All the World's Aircraft, 1912*, pp. 278, 280.

[2] *Jane's All the World's Aircraft, 1913*, p. 191.

[3] *Jane's All the World's Aircraft, 1918*, p. 103e.

[4] *Jane's All the World's Aircraft, 1916*, p. 216.

[5] *Jane's All the World's Aircraft, 1918*, p. 94e.

[6] No mention is made of it at all in *Jane's All the World's Aircraft*, either *1919* or *1920*.

rocketry,[1] K. E. Tsiolkovsky. Although Tsiolkovsky "confined himself strictly to office work" from 1924 on, "his experiments were conducted in Moscow in accordance with his plans and instructions."[2] Experiments he had begun on an elastic dirigible shell using models of brass were completed successfully in early 1925. In 1927 "with the co-operation of an electrical plant," tests were conducted on welded joints of cold-worked steel worked out for the metal envelope of a dirigible. "The continuation of the tests was conducted in the Prof. N. Ye. Zhukovskiy Academy in 1928."[3]

During the First Five-Year Plan (1928-1932), dirigible activity revived on an official basis. In 1930 Tsiolkovsky published his paper: "Plan of a Metal Dirigible for Forty Persons."[4] At the end of 1930, the civil aviation organization Aeroflot was created, and "work was renewed on developing" dirigibles planned by Tsiolkovsky.[5] In 1931, the Bureau of Experimental Dirigible Construction was formed under the authority of the Bureau of Experimental Dirigible Construction,[6] also known as the "Dirizhabl'stroi" Trust.[7]

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[1] A. A. Blagonravov *et al.*, eds., *Trudy Pervykh Chteniy, Posvyashchennykh Razrabotke Nauchnogo Naslediya i Razvitiyu Idey K. E. Tsiolkovskogo* [*Transactions of the First Lectures Dedicated to the Development of the Scientific Heritage of K. E. Tsiolkovskiy*], Academy of Sciences USSR, Commission for the Development of the Scientific Legacy of K. E. Tsiolkovskiy, Moscow, 1967, NASA Technical Translation, TT F-544, National Aeronautics and Space Administration, Washington, D.C., April 1970, p. iii.

[2] Ya. A. Rapaport, "How K. E. Tsiolkovskiy Worked on the Problem of Developing a Dirigible," in A. A. Blagonravov *et al*, ed., *Trudy Pervykh Chteniy, Posvyaschennykh Razrabotke Nauchnogo Naslediya i Razvitiyu Idey K. E. Tsiolkovskogo* [*Transactions of the First Lectures Dedicated to the Development of the Scientific Heritage of K. E. Tsiolkovskiy*], Academy of Sciences USSR, Commission for the Development of the Scientific Legacy of K. E. Tsiolkovskiy, Moscow, 1967, NASA Technical Translation, NASA TT F-544, National Aeronautics and Space Administration, Washington, D.C., April 1970, pp. 127.

[3] *Ibid.*

[4] *Ibid.*

[5] *Ibid.*, p. 128.

[6] *Ibid.*

[7] V. A. Semenov, "Konstantin Eduardovich Tsiolkovskiy, A Passionate Crusader for a Reliable Transport Dirigible," *K. E. Tsiolkovskiy. Sobraniye*

The Tsiolkovsky Design Bureau consisted of a group of engineers set up to design an airship according to Tsiolkovsky's numerous ideas on the subject, proposed as early as 1886,[1] with most of them published in the intervening 45 years. "In 1933 this group was renamed the Bureau for Building the Tsiolkovsky Dirigible, and provided with an experimental shop."[2] The Design Bureau conducted work on models of all-metal envelopes for the airship and "reflected the technological level of the thirties."[3] In 1933 the Bureau designed an experimental flying model, followed by the design in 1934 and construction in 1935 of a larger model that was the prototype of the envelope of the all-metal dirigible planned by Tsiolkovsky.[4] "K. E.'s death led to a cessation of work on his dirigible at a stage at which not only was the craft still incomplete but not even a working design of the ship as a whole had been prepared."[5] In 1937, after the Hindenberg disaster, the "Dirizhabl'stroi" Trust was liquidated, because dirigibles were considered "dangerous and unprofitable."[6]

Although work stopped on an all-metal dirigible following Tsiolkovsky's death, by 1935 two semi-rigid and four non-rigid airships had been built under the "grandiloquent programme" drawn up by the Soviet government and inspired by the visits to Russia of the "Graf Zeppelin."[7] Beginning in 1930, General Umberto Nobile of Italy, already a well-known dirigibilist, had contributed his services as an

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Sochineniy. Tom III, Dirizhabli, [*Collected Works of K. E. Tsiolkovskiy. Volume III--Dirigibles*] A. A. Blagonravov, Editor in Chief, Academy of Sciences of the USSR Publishing House, Moscow, 1959, NASA Technical Translation, NASA TT F-238, National Aeronautics and Space Administration, Washington, D.C., October 1965, p. 23.

[1] *Ibid.*

[2] Semenov, 1959, pp. 23-24.

[3] *Ibid.*, p. 14.

[4] *Ibid.*, p. 24.

[5] *Ibid.*, p. 14.

[6] R. Strong, E. Zakhar'ev, and A. Podol'skii, "A sporu net kontsa" ["But There Is No End to the Dispute"], *Sovetskaia Rossiia* [*Soviet Russia*], May 24, 1966, p. 4.

[7] *Jane's All the World's Aircraft, 1935*, p. 5e.

airship designer. "In 1936 the construction of a new semi-rigid airship was begun by the Dirigiblestroi (Dirigible Construction Trust) specially for Arctic research flights."[1] Ships of this type, known as the DP-9, are said to have served the Aeroflot route from Moscow to Sverdlovsk.[2]

During the 1930s the Soviets claimed to have the only Balloon Academy in the world that trained airship engineers and pilots.[3] A Soviet book in English published for the New York World's Fair in 1939 contains two pictures of Soviet airships in flight. One caption declares: "The USSR is successfully mastering the technique of dirigible construction." The second states: "Soviet dirigibles have made many distant flights over the air routes of the vast country."[4]

During the late 1930s and early 1940s, four new airships were constructed: the V-6, V-8, V-10 and V-12.[5] In 1946 the Soviets publicized two dirigibles operating at that time. One was the "Pobeda" ["Victory"], serving then as a civil transport, but thought to be "of wartime origin."[6] The other was the "Patriot", completed in 1946, "a passenger carrier with accommodation for 1-12 passengers."[7]

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[1] *Ibid.*

[2] J. Babiejczuk and J. Grzegorzewski, *Lotnictwo Kraju Rad* [*Aviation in the Land of the Soviets*], Wydawnictwa Komunikacji i Lacznosci, Warsaw, Poland, 1969, translated as FTD-HC-23-04-71 by the Translation Division, Foreign Technology Division, Wright-Patterson Air Force Base, Ohio, September 23, 1971, p. 87.

[3] L. S. Hill, *American and Soviet Interest in Airships*, RM-3698-PR, The Rand Corporation, Santa Monica, June 1963, p. 11.

[4] *Soviet Aviation*, State Art Publishers, Moscow and Leningrad, 1939, no pagination.

[5] *Jane's All the World's Aircraft, 1950-51*, p. 2e.

[6] *Ibid.*

[7] *Ibid.*

IV. THE DIRIGIBLE DEBATE

THE CHALLENGE OF THE DESIGN AND TECHNICAL BUREAU OF DIRIGIBLE CONSTRUCTION

On October 6, 1962, the appearance in *Izvestiia* of an interview by special correspondent V. Belotserkovsky with the Director of the Design and Technical Bureau of Dirigible Construction, Engineer F. F. Assberg, signalled the beginning of a public debate unusual for the Soviet press in its reporting of economic events. Although public debate is common *before* a major economic decision is taken, it is rarely acknowledged *after* the appropriate steps have been taken; furthermore, the articles in this instance identify not only the specific points of contention but also the persons associated with them and the organizations or institutions with which they were affiliated.

Some 20 articles deploring the lack of native dirigible construction have been published in various Soviet newspapers since 1962. Public rebuttals by Soviet aviation officials have been scarcer, and at least one was withheld from publication by its authors when the editors of *Izvestiia* would not agree to their demand to suppress all future letters and articles by the proponents of dirigible construction.

Actually, the lack of airships was felt in some quarters even before the first article of the public debate was published. Work began on the design of a dirigible as early as 1955 in connection with the TVES [Substratospheric Wind Power Generator] experimental project.[1] In 1957, the Leningrad branch of the Geographic Society of the Academy of Sciences of the USSR set up a "Commission on Lighter-than-Air Navigation."[2] Shortly thereafter, branch offices were set

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[1] V. Belotserkovskii, "Dirizhabl' prositsia v nebo" ["The Dirigible Wants to Go Aloft"], *Literaturnaia Gazeta*, No. 32 (4110), August 9, 1967, p. 12.

[2] Hill, *American and Soviet Interest in Airships*, p. 2.

up in several other Soviet cities, including Moscow, Vladivostok, Simferopol, and Syktyvkar.[1]

Evidence of opposition to dirigible construction surfaced almost immediately, although inconspicuously. In 1958, A. A. Velizhev states:

> The plan outlining the creation of a major Soviet airship fleet with its own cadres, air bases and industries is worth mentioning...as one of the miscalculations of the first Five-Year Plan in the field of civil aviation development. This measure was surrounded from the beginning by a good deal of unnecessary uproar. Considerable means and cadres were diverted to advance this expensive and fruitless affair.[2]

In contrast, Velizhev says, Soviet arctic aviation "developed considerably" during this period "assuming world-wide incontestable leadership in this field." He cites as part of the evidence for this statement the incident of 1928 in which the survivors of the wrecked dirigible "Italia" were spotted by a Soviet pilot and subsequently were rescued by a Soviet icebreaker.[3]

In 1961, a Dirigible Design and Technical Bureau was established in Leningrad by one of the District Committees of the Communist Party of the Soviet Union.[4] By the time Assberg initiated the public airship debate in an interview headlined "Dirigibles in the Age of Rockets," the Design and Technical Bureau of Dirigible Construction, which he headed, had already been working almost a year since its creation by the All-Union Geographic Society.[5]

Assberg attempted to refute the notion that dirigibles were obsolete. He cited technological innovations in chemistry, electronics, and engines and the availability of helium as contributing to the

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[1] "Karavany vozdushnykh gigantov" ["Caravans of Air Giants"], *Isvestiia*, December 27, 1962, p. 4.

[2] A. A. Velizhev, *40 Let Sovetskoy Aviatsii* [*Forty Years of Soviet Aviation*] *Znanie*, Series IV, Nos. 37-38, Moscow, 1958, translated by Liason Office, Technical Information Center, MCLTD, Wright-Patterson Air Force Base, Ohio, F-TS-9517/V, p. 31.

[3] *Ibid.*, p. 32.

[4] "Karavany vozdushnykh gigantov," p. 4.

[5] V. Belotserkovskii, "Dirizhabli v vek raket" ["Dirigibles in the Age of Rockets"], *Izvestiia*, No. 241 (14095), October 10, 1962, p. 6.

potentialities of the modern dirigible. He referred to their construction and use in the United States, particularly to a "patrol dirigible with an atomic engine" announced by the Goodyear Company. Modern dirigibles could be used to transport heavy and awkward loads to remote areas at a very economic cost in all kinds of weather. "In general," Assberg summed up, "there is no logical, principled objection to a revival of the construction of dirigibles in our country."[1]

The first positive reaction to Assberg's challenge was published in *Izvestiia* in December of the same year under the title "Caravans of Air Giants."[2] Heading this article is a comment by several members of the Arctic and Antarctic Scientific Research Institute mentioning the possibilities for the utilization of dirigibles in polar explorations. The body of the article introduces other remarks in favor of dirigible construction with the following assertion: "Among the great number of letters received by the editorial staff from individual readers and from institutions, not one was found that doubted the necessity for the most rapid revival of dirigibles."

The article reiterated the advantages of the dirigible: its great carrying capacity; its vast radius of movement, safety, "indifference to the whims of the weather"; the ability to be in almost continuous operation; no necessity for airfields or hangars; the absence of vibration; and economy. The economic arguments were presented more strongly: Dirigibles would be three times cheaper than an airplane, 10 to 12 times cheaper than a helicopter. The article even quotes Tsiolkovsky on the economics of dirigibles: "Make a silver dirigible, and it will give you 100 percent return upon the capital spent; even a dirigible of pure gold will give a decent return."[3]

VOLUNTARY DESIGN BUREAU CREATED

The next public reference to dirigibles did not appear until April 1963. In another article in *Izvestiia*, the use of dirigibles was

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[1] *Ibid.*

[2] "Karavany vozdushnykh gigantov," p. 4.

[3] *Ibid.*

advocated in such diverse activities as in the transport of large manufactures, in the control of forest fires, in space and weather observation, in aerial photography, and in polar exploration.[1] A rather important development is mentioned almost in passing -- the establishment of a voluntary design bureau in Leningrad to collect information on the construction of dirigibles (probably the OKB, created in 1961). A meeting of the Aeronautic Subcommittee of the Leningrad Geographic Society is said to have discussed "the possibilities of the application of dirigibles...in scientific research and in agriculture."[2]

Almost a year passed (March 1964) before it was announced in *Izvestiia* that the Leningrad Voluntary Design Bureau had started planning a dirigible for use in agriculture. It was intended to be used for the transport of mineral fertilizers and in the control of agricultural pests and diseases. The announcement was made by N. A. Brusentsev, the deputy secretary of the Aeronautic Subcommittee of the Geographic Society of the USSR.[3]

Two months later, the leader of the Voluntary Design Bureau of Dirigible Construction in Siberia, V. A. Novikov, stated in an *Izvestiia* interview that the design requirements for two dirigibles -- one 6,000 cubic meters in size and the other 70,000 cubic meters -- had been worked out.[4] One dirigible was designed to be an "aerial crane" in logging operations, and the other was intended to take the wood in mountainous areas to a storehouse at a lower level. Novikov noted that although design bureaus and personnel were needed to fulfill these plans, all activity concerning dirigibles was taking place at the amateur level.

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[1] A. Kolesova, "Letat' vozdushnym karavanam!" ["Fly in Aerial Caravans!"], *Izvestiia*, April 30, 1963, p. 4.

[2] *Ibid.*

[3] "Vozrozhdenie dirizhablia" ["Rebirth of the Dirigible"], *Izvestiia*, March 29, 1964, p. 2.

[4] "Vozdushnye lesovozy" ["Aerial Lumber Haulers"], *Izvestiia*, May 20, 1964, p. 6.

ALL-UNION CONFERENCE OF ENTHUSIASTS OF DIRIGIBLE BUILDING AND AFTERMATH

In 1965, the discussion in the press on the dirigible question began to burgeon. An article in *Soviet Weekly* (London) reported in March that "scores of design offices are working on the problem" of airships.[1] "The renewed interest in this type of air transport" was attributed to the availability of technology and materials necessary for fast and safe airships; the possibility of combining the properties of the airplane, the helicopter, and the ship in the airship, with fuel needed only for horizontal flight; the ability of the airship to carry "scores of tons of freight in any weather"; and the lack of need for airports. The work of two separate design bureaus is cited in the article. David Bimbat's team in the Urals has designed the Ural-1, an airship with detachable gondolas (pods), and "has started designing a plastic airship with a payload of some 20 tons." An unnamed Leningrad institute is said to be designing "an airship for use in agriculture," to be 160 feet long and 45 feet in diameter, with two 200 h.p. engines giving it a speed of 60 m.p.h. These specifications are somewhat comparable to the Goodyear advertising blimps of that time, which were 157 feet long by 41 feet in diameter, propelled by two 175-h.p. engines with a top speed of about 60 m.p.h.[2]

In April 1965, some reasons for the renewed Soviet interest in dirigibles were presented in a *Nedelia* article by a Lieutenant -- in the Colonel Engineering Troops. The development of construction and the opening up of new areas have resulted in a sharp increase in the volume of transportation. At the same time, new discoveries and successes in science and technology have "saved the dirigible from its defects."[3] The article recalls the American experience with blimps and describes two dirigibles which have been designed in the United States: the

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[1]"Muscovites See First Airship in Twenty Years," *Soviet Weekly* (London), No. 1, 208, March 25, 1965, p. 8.

[2]L. S. Hill, "Soviet Airship Activity," June 15, 1965, mimeo.

[3]A. Glukharev, "Vtoroe rozhdenie" ["Second Birth"], *Nedelia*, No. 17, April 18-24, 1965, p. 17.

gigantic SMD-100 dirigible with a lift of 100 tons, and the experimental "trigible" [three-hulled dirigible] Aeron III.[1]

In the spring of 1965, the First All-Union Conference of Enthusiasts of Dirigible Building was called "at the initiative of the public and a number of Novosibirsk organizations."[2] The 185 delegates came from 20 cities and included leading officials of economic councils, ministries, and enterprises as well as engineers and scientists. The results of the conference were well publicized by *Izvestiia*, which identified some of the Soviet institutions that had "voted" for the revival of dirigible construction and were then actively promoting it. (See Section V for further details of the organizational implications of this activity.)

The authors of the June 1965 *Izvestiia* article, all participants in the Novosibirsk Conference, included two academicians, two professors, a chief engineer, a secretary of the Machine-Building Industry Science and Technology Society, a member of the Novosibirsk Dirigible-Construction Voluntary Design Bureau, and two *Izvestiia* special correspondents. Their viewpoint on the dirigible question is stated in the opening paragraph:

> In recent years the question of using dirigibles in the national economy has been brought up repeatedly in our press. However, there are still no practical results to show for it. Therefore, we consider it advisable to return to this problem and to cite a number of concrete calculations, made by many economic organizations and institutions, proving conclusively the necessity of the earliest possible resumption of dirigible construction.[3]

A detailed account follows of the potential benefits to be derived from the use of dirigibles in geology and industry and as transportation to remote areas. The authors assert that modern technology has resolved

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[1] Work on the trigible has since been abandoned.

[2] P. Kochina, A. Trofimuk, G. Krylov, A. Vorobyev, V. Zlobin, V. Manuilov, Ye. Vladimirov, V. Belotserkovsky and V. Davydchenkov, "Turn the Sky Over to Dirigibles," *Isvestiia*, June 10, 1965, p. 4, translated in *The Current Digest of the Soviet Press*, Vol. XVII, No. 23, 1965, p. 27.

[3] *Ibid.*

the question of safety, reliability, and maneuverability in any kind of weather. In conclusion they call for support not yet given on an official basis:

> The obvious necessity of creating a special state committee for dirigible building, which would have its own research and educational institutes, design bureaus, and plants, has become imperative. The State Committee for Coordinating Scientific Research would render great assistance here.[1]

Within the next few months, other Soviet newspapers called for assistance on an organized, official level. *Soviet Weekly*, for example, reporting on the Novosibirsk Conference, compared the dirigible with the helicopter — no noise, more stability, greater lift, and lower construction and operational costs. The article concluded: "Experts are urging that a special organization should be set up to take advantage of the many possibilities of using airships in this work [transporting and setting up factories]."[2] *Trud* [*Labor*] reiterated the advantages of the use of dirigibles cited in previous articles, proposed some new applications, and also advocated the establishment of "a special organization for dirigible construction, designing bureaus, hangars, and dirigible ports."[3]

The possibilities of using dirigibles to link together sparse and isolated settlements in a remote, nearly inaccessible region was spelled out in detail in the Russian-language newspaper *Kazakhstanskaya Pravda* [*Kazakhstan Truth*] in October 1965. Referring to the order given in September by the Plenum of the Central Committee of the CPSU to achieve "a maximum speed-up...in all branches of industry," the article cites transportation as the "stumbling block."[4] Mangyshlak

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[1] *Ibid.*

[2] "Factories Delivered--by Airship," *Soviet Weekly* (London), No. 1, 216, May 22, 1965, p. 3.

[3] A. Tarasov, "Prospects for the Use of Modern Dirigibles," *Trud* (Moscow), September 7, 1965, p. 3, translated in United States Joint Publications Research Service, *Translations on Soviet Transportation*, No. 94, JPRS 33, 139, pp. 63-65.

[4] P. Ozitov, "The Distance Will Be Covered by a 'Flying Island'," *Kazakhstanskaya Pravda* (Alma-Ata), October 24, 1965, p. 2, translated

Peninsula, with its scattered oil, gas, and mineral deposits, has transportation bottlenecks typical of those that could be overcome by the use of dirigibles. Echoing the words of other proponents of dirigible construction, the author of this article ends his argument with the following entreaty:

> Do not look at us as unmitigated dreamers; we are quite convinced that the future of Mangyshlak is firmly linked with the dirigible....
>
> It appears that it is time for all the interested agencies and scientific research institutes of Kazakhstan to express their opinions concerning the problem of "flying islands." The word of the republic state planning commission should, naturally, be the decisive one. It is probably for the newly created State Association of the Kazakhstan Petroleum Industry to take this important matter under its control.[1]

ACTIVITIES OF THE VOLUNTARY DESIGN BUREAUS

The first detailed account to appear in the public press of some of the work of the OKBs (Voluntary Design Bureaus) was published in *Izvestiia* in December 1965.[2] The article focused on the groundwork for the construction of dirigibles done by the OKB in Nizhni Tagil under the leadership of designer and theorist D. Bimbat. In addition to the more obvious possibilities of the use of dirigibles in such fields as agriculture, lumbering, and oil drilling, the employees of the OKB worked out a plan to use dirigibles to bear television antennas rather than constructing television towers. According to the article, the Nizhni Tagil OKB has already received orders for the design of dirigibles from two enterprises located in the same region.

The Nizhni Tagil OKB is said to have 26 employees and a circle of enthusiasts of more than 100. Three designers of that OKB have received certificates for the invention of the ballastless dirigible.

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under the title "Dirigibles to Be Used for Transportation in Remote Areas," in United States Joint Publications Research Service, *Translations on Soviet Transportation*, No. 95, JPRS 33, 374, p. 23.

[1] *Ibid.*

[2] "Dirizhabl' vozvrashchaetsia v nebo" ["The Dirigible Returns to the Sky"], *Izvestiia*, December 2, 1965, p. 6.

The establishment of an OKB in the Urals is also referred to, where a dirigible for vertical loads is being designed. The article mentions that the first school for aeronauts has been created, but it does not reveal the location nor the agency under whose auspices the school was established.

CALL TO THE PARTY

The activities of the Leningrad Voluntary Design Bureau of Aeronautics were disclosed in a letter to *Izvestiia* in March 1966 by one of its members, R. Strong. The letter mentions technical and economic investigations of the construction and application of dirigibles in agriculture, as transport in remote regions, in construction, in the laying of oil and gas pipelines and electrical lines, and for geological prospecting. The point of this article, as of previous ones, is the call for special design, research, and production organizations for dirigible construction. On the instructions of his comrades in the Design Bureau, the author proposes "to include in the Directives of the 23rd Congress of the Party a number of points ensuring a skilled resolution of the problem of dirigible construction."[1]

Two months later, R. Strong and two other authors wrote a more extensive article on the activities of the dirigible proponents and the problems they faced.[2] Calculations on the economy of the use of dirigibles are cited. Designers were already working out the plans for thermal and semi-thermal dirigibles with provision for heating the helium to eliminate the need for ballast and to prevent ice formation.

The opposition is also identified specifically. The Ministry of Railroads declared that dirigibles are not needed. The workers of the Research Institute of Complex Transportation Problems under Gosplan of the USSR "consider that 'the dirigible is a large and complex mechanism equipped with aircraft engines and numerous instruments that require

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[1] R. Strong, "Nuzhny dirizhabli" ["Dirigibles Are Needed"], *Izvestiia*, March 18, 1966, p. 3.

[2] R. Strong, E. Zakhar'ev, and A. Podol'skii, "A sporu net kontsa," p. 4.

earnest and painstaking care'."[1] Most important of all, the Department of Aviation Industry of Gosplan of the USSR commissioned the Ministries of Aviation Industry and of Civil Aviation to hear the scientific and technical arguments of the Leningrad OKB of Aeronautics. In April the Scientific and Technical Commission of MAP decided not to study dirigibles, and thus the Ministry of Aviation Industry refused to build them. The authors plead that a government organization is needed to replace the OKBs as quickly as possible.

By 1967, the requests of the dirigible proponents for research and production facilities still had not been met. In August of that year, *Literaturnaya Gazeta* published the first in a series of articles protesting the veto of the dirigible proposals by experts in the Ministry of Aviation. The article explains that work on the design of a dirigible in connection with the TVES [Substratospheric Wind Power Generator] experimental project began in 1955, and that in 1957 a design was presented in the form of a request to the Committee on Inventions. In 1961 the request received approval in the commission of the former Committee on Automation and Machine Building. But it was only in 1967 that work began on the first demonstration model. The article complains about the "unconscionable delay" of more than ten years in taking the first practical step toward implementing the early decisions on dirigibles. The article claims that the decision of the MAP experts was based on the deficiencies of dirigibles 30 years in the past. The article cites improvements in dirigible technology, including construction of the skin from three layers of fiberglass.[2]

In the second article in the series, published in September 1967, the opponents of dirigible construction are urged to come out in the open and reveal the bases for their position. The article points out:

> It is symptomatic that in our periodicals numerous materials are published which fight for the revival of aeronautics. But the opponents also have ideas. Why did not one of them take the risk of coming out openly and substantiatedly in the press? All the reports

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[1] *Ibid.*

[2] Belotserkovskii, "Dirizhabl' prositsia v nebo," 1967, p. 12.

> prohibiting, denying, etc. pass only through officials channels and settle in the drawers of bureaucratic desks.[1]

The article reiterates the operational advantages of dirigibles described in several previous articles. The dirigible is said to be capable of vertical takeoff, and its cruising speed is alleged to be 160-180 kilometers per hour. The economic advantages of the dirigible are heavily emphasized; the total savings possible to the national economy are estimated to be 1.5 to 2 billion rubles. The article's author suggests applications of dirigibles in the transport of heavy turbines and large pipes, in the erection of electric lines across the taiga and marshes, and in agriculture for the application of fertilizer and for pest control. The "military possibilities" of the dirigible are also mentioned but not specified. The article even reports that the first dirigible with a nuclear engine is already being built in the United States.[2]

Taking into consideration the above arguments for the construction and utilization of dirigibles, the article poses the question:

> Why do not small fleets of dirigibles fly over our heads if the economists say it is profitable and the engineers say it is possible and necessary? ... It is completely natural that not all who decide whether dirigibles are to be or not to be are specialists in dirigible construction, and they have available insufficient information for the taking of a final decision. But one ought not to "pass sentence" following an emotional, subjective point of view.[3]

Attempting to elicit the answer that thus far had not appeared, the article concludes: "Once again, we throw down to the opponents of dirigibles the gauntlet of open discussion. Is it possible they will again keep silent?"[4]

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[1] T. Alekseeva, "Brosaem perchatku..." ["We Throw Down the Gauntlet..."], *Literaturnaia Gazeta*, No. 39 (4117), September 27, 1967, p. 12.

[2] This is an erroneous statement. The concept of a nuclear dirigible has been proposed publicly at conferences in the United States but so far has not been acted upon.

[3] T. Alekseeva, "Brosaem perchatku...", p. 12.

[4] *Ibid.*

The reply to this challenge did not come immediately. In the meantime, *Literaturnaia Gazeta* featured an article written by two engineers from the Ukrainian Voluntary Design Bureau of Dirigible Construction, presenting some of the details of the "D-1" model designed and developed there.[1] The hull of the D-1 would be constructed of fiberglass, and the wheel-house, the cabins for the pilots and the passengers, and the cargo compartment would all be located in the lower part of the body. To permit a high degree of maneuverability, the dirigible would be equipped with a mechanism to change its lift (the nature of which is unspecified), a gas rudder, and a jet arrangement, with the ability to change the direction of its gas emissions. The D-1 would also be equipped with a device for a mechanical mooring line to the berthing tower without the help of a ground crew. The turbine propeller engine would permit a cruising speed of 200 km per hour, up to a height of six or seven thousand meters, within a radius of 3,000 km.

STRATEGY OF THE OPPONENTS

During the five years following Assberg's interview in *Izvestiia* of October 1962, the opponents of dirigible construction were quiet about their views, at least in the press. Not until November 1967 was much of the reasoning of the opposition revealed.[2] The arguments may be placed in one of the following categories: evolutionary, safety, technical, or economic.

The evolutionary argument compares the development of dirigibles, which "appeared at the dawn of aeronautics, in the 18th century," to that of living things. Only those creatures that adapt to the surrounding conditions survive; dirigibles, therefore, became extinct because they were outmoded by airplanes.

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[1] R. Gokman and I. Spitsin, "Dirizhabl': Kakim my ego predstavliaem" ["Dirigibles: How We Conceive of Them"], *Literaturnaia Gazeta*, No. 41 (4119), October 11, 1967, p. 10.

[2] Villen Liustiberg, "Dirizhabl' ne nuzhen!" ["The Dirigible Is Not Needed!"], *Literaturnaia Gazeta*, No. 46 (4124), November 15, 1967, p. 12.

The safety argument asserts that the dirigible "depends on the whims of the weather. The bulky and cumbersome thing floating in the air is lightly bandied to the greatest distance even by a faint breeze." For this reason, it would be impossible for a dirigible to take shelter during a storm or to ride out a gale. The author claims that "the powerful ascending and descending currents during a storm taking aim at various points of the hull" create unbearable pressure even for a rigid ship constructed of modern alloys. Reference is made to the Il-62 destroyed by turbulence, necessitating reinforcement of the aerodynamic properties of its wings. Flying in super-cooled rain currents is also said to be hazardous, when the great weight of suddenly formed ice could cause the dirigible to crash.

Besides the technical problems involved in assuring the safety and reliability of dirigibles, the author cites operational and maintenance problems that he feels had not yet been solved satisfactorily. The main operational problem centers around the problem of changing the weight of the dirigible in flight. This, the author says, would necessitate the loss of expensive helium during each trip. Hydrogen, though cheaper, is of course an unacceptable substitute. The chief maintenance problem is that of landing. Mooring masts are not considered sufficiently strong to provide reliable landing sites. The best solution seems to be an airship shed. But this would involve considerable difficulty in maneuvering the dirigible into the shed under a strong lateral wind, and moreover it would add considerably to maintenance costs.

The economic arguments of the dirigible proponents are rejected, although not refuted in detail. The main objection seems to be that the fuel requirements are underestimated (fuel is needed not only for ascending and descending, but also for moving against the air currents). Other expenses, such as for gigantic airsheds, are totally ignored by the dirigible proponents.

In conclusion, the author appeals to the humane instincts of the reader:

> The authors of all these designs say that only experiment will convince them of the unsoundness of their arguments.

> But perhaps it is not worth paying for such a questionable amusement with the life of even one test-pilot? Even from the ranks of enthusiast-volunteers.[1]

REBUTTAL BY THE PROPONENTS

A strong rebuttal to these arguments came in December of the same year when four experts in aviation and technology, on the basis of their belief that "the arguments of the opponents of dirigibles have one source -- amazing lack of information," attempted to refute their assertions on the questions of safety, technological feasibility, and economy.[2] In discussing the opponent's arguments about the safety and reliability of dirigibles, these experts cite in great detail the experience of the United States with its 300 patrol airships, which operated from 1940 until 1967. Only three of these were lost, all of them during the war. Furthermore, during a hurricane on the coast of New England in the winter of 1958, only Coast Guard airships were able to patrol the coast, while ships and airplanes had to seek shelter. Not one accident was suffered in that storm. The technological developments that have improved the safety prospects of dirigibles previously cited are also mentioned in this article, including automation and radar. Modern materials such as dacron are said to withstand any kind of atmospheric influence, even icing.

A number of other technological developments have made modern dirigibles both feasible and economic. The authors mention motors with a changeable plane of revolution of the screw and a stream rudder as increasing the maneuverability of dirigibles. Atomic engines could be used. New mechanisms could change the lift without the loss of gas. Means are available for automating the mooring. The lateral surface of the dirigible may be decreased by new shapes. The economic result of these technological innovations would be that "the expenses for the renewal of dirigible construction, by the most cautious calculation,

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[1] *Ibid.*

[2] V. Burkhanov, I. Beskin, V. Razzhivin, and M. Arie, "Net, dirizhabl' nuzhen!" ["No, Dirigibles Are Needed!"], *Literaturnaia Gazeta*, No. 51, December 27, 1967, p. 13.

will be repaid in the course of the first two to three years of operation."[1]

In addressing the obvious question of why dirigibles have not so far been adopted, the authors propose two reasons, one external and one internal. The external reason is that in the developed countries, dirigibles still are not used for transport and industrial purposes. Therefore the Soviet decisionmakers have no sense of urgency for the development of dirigibles, even though the authors claim that, with its remote and fairly inaccessible regions, the Soviet Union needs them more than any other country. The attitude of the proponents is described as one of confidence that since no other country has outstripped the Soviet Union in dirigibles, they have nothing to fear. The authors, however, warn that in the United States and the Federal Republic of Germany, construction has begun on large dirigibles for military-transport purposes, including the transference of rockets, as well as for tourists. These are proposed missions, but construction has not actually begun.

The internal reason for the slow progress toward the development and domestic construction of dirigibles is given by the formula: "Those who are interested cannot build, but those who can are not interested." However, earlier in the article, the authors are careful to say that the problem is not "the position of the aviation specialists in general, but only the position taken by several leaders in the aviation establishment."[2] Unfortunately for this study, none of the latter are identified either by name or by institution.

The solution to the dilemma is seen as the creation of an *ad hoc* commission to be composed of not only the representatives of the aviation industry but also dirigible designers, including aviation specialists working in the Voluntary Dirigible Design Bureaus, and representatives of the interested ministries as well. The authors are adamant that "the representatives of the aviation industry cannot and should

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[1] *Ibid.*

[2] *Ibid.*

not be the only decisive experts."[1] Ultimately, a special administration for dirigible construction is needed.

The base of dirigible construction was built during the prewar years, including three hangars. This is enough for a beginning, write the authors. Hidden reserves of helium have been uncovered in recent years in the Soviet Union. All the necessary materials and machinery are available. It remains only to get started.

CULMINATION OF THE DEBATE

Assertions of both the opponents and the proponents of dirigible construction were printed in a whole page of articles in *Literaturnaia Gazeta*. Among these was a comment by the editorial board of the newspaper, stating its position.[2] The editors feel that the question of whether or not to construct dirigibles is not within the competence of the newspaper and should be decided by the experts. Nevertheless, *Literaturnaia Gazeta* involved itself in the debate by publishing so many articles because "the adherents of the idea of the revival of dirigible construction are deprived of the opportunity to prove their correctness in special journals and at technical conferences." Further, although the editors are aware of the opinions of the leaders of the Aviation Ministry, they were prohibited from publishing them unless they agreed to cease printing of all articles in favor of dirigible construction. To this condition the editors did not agree. They join with "the many letters received by the editorial board that contain categorical objections to purely administrative pressure and suppression in the resolution of scientific and technical arguments. This never yet furthered progress."[3]

The articles on the future of the dirigible in the Soviet Union are arranged so that the pro and con of roughly corresponding issues appear close to one another. This arrangement helps to convey a sense

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[1] *Ibid.*

[2] "Dirizhabl': Byt' ili ne byt'? -- Ot redaktsii" ["Dirigibles: To Be or Not To Be -- From the Editorial Staff"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[3] *Ibid.*

of the impartiality and balance that the editors of *Literaturnaia Gazeta* were striving for.

A. Mikoyan, one of the best-known Soviet airframe designers, held the position that the functions proposed for dirigibles can be handled by current aircraft, particularly helicopters. He doubts "that the application of dirigibles could extend the range of problems resolved by aviation."[1] Immediately below his article is a section containing three brief statements advocating the use of dirigibles in their respective fields by the First Deputy Minister of Electric Power of the USSR, the Minister of Geology of the RSFSR, and the Deputy Minister of the Gas Industry of the USSR.[2]

Following the advocacy articles is one raising some of the major issues seen by the opponents of dirigible construction. It stresses the high probability of unforeseen technical difficulties and complications and emphasizes that a whole new branch of industry would have to be created. The author agrees that dirigibles better than their predecessors can be built, but asks if they are necessary. Costs must be clarified, especially the cost of creating the new industry and of operating a dirigible fleet. He objects to such categorical assertions that today the dirigible is the most economic means of air transport. He casts doubt upon the U.S. experience with airships cited in previous articles by dirigible enthusiasts, and points out that in 1967-68, not one article on dirigibles appeared in such magazines as *Aviation Week & Space Technology*, *American Aviation*, and *Astronautics and Aeronautics*.

Perhaps most interesting to the student of organizational behavior, the author deplores the "voluntarism" of the dirigible proponents, that is, their conviction that the "objective" laws of nature will yield to dedicated human effort. In answer to the question posed earlier in *Literaturnaia Gazeta*, "Why have the dirigible proponents been silenced?" he replies:

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[1] A. Mikoyan, "A chem plokhi samolety i vertolety?..." ["But What is Wrong with Airplanes and Helicopters?..."], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[2] Ia. Finogenov, S. Goriunov, and Iu. Bokserman, "...Tem, shto ne vsegda primenimy!" ["...It Is That They Are Not Always Suitable"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

> Serious specialists would readily take part only in real technical discussion with all the attributes organically inherent in it: conscientious, well-verified information argued by quantities of facts, and above all others, a calm tone respectful in relation to the opponents.[1]

In this last statement, one gets a hint of the resentment that is by now openly acknowledged by the opponents and proponents of dirigibles.

The next article confirms the bitterness of the debate, calling the April 1966 session of the Scientific-Technical Council of MAP a "dialogue of the deaf." The Deputy Chairman of the Leningrad OKB requested that materials of the Council be sent to the originators of the proposals for dirigibles, but his request was denied. At another debate in Kaluga (the birthplace of Tsiolkovsky), the requests of dirigible enthusiasts for funds for "the substantiation of the theoretical calculations" were turned down. Summing up the helpless feeling of the dirigible proponents, the author writes:

> Again and again the opponents of dirigibles say and write that the economic grounds are doubtful as long as they have not been confirmed by experience. But they also object to experience.[2]

The chief designer of the Soviet dirigibles "Pobeda" and "Patriot" then takes up the argument in a separate article. He deplores the lack of objectivity in some of the previous articles by dirigible proponents and says that is the reason that the aviation experts will not take them seriously. He goes on to answer some of the objections by V. Liustiberg in an earlier *Literaturnaia Gazeta* article (see pp. 24-25). In response to the argument that dirigibles depend on the caprices of the weather, he cites the regular operation of the "Ts-127" on the route from Germany to South America for many years, and of the Soviet V-12 in weather during which airplanes were grounded. He says

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[1] M. Gallai, "Poprobuem oboitis' bez dueli..." ["We Will Try to Manage Without a Duel..."], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[2] V. Infant'ev, "...I bez 'dialoga glukhikh'!" ["...And Without a 'Dialogue of the Deaf'!"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

that dirigibles do not need special devices for turbulence, because under such conditions they neither lose stability nor fall into a spin. Dirigibles do not have anchors, as Liustiberg envisioned them, and may be operated without a mooring mast, as were the V-12 and the Pobeda.

The airplane, the helicopter, and the dirigible are seen not as rivals, but as complementary to each other. "The main advantage of the dirigible over the helicopter is that it is able to be in the air a long time." During World War II, American airships remained in the air for as long as 10 to 15 days. The author does say, however, that the use of dirigibles for the transport of passengers is not sound and that the idea of a high-speed dirigible is fallacious. Dirigibles inflated with helium are said to be safer than airplanes, since engine failure can be repaired in flight without danger of crashing. In conclusion, the revival of dirigible construction cannot be accomplished merely by creating a volunteer design bureau. An authoritative and objective commission is needed to take up the subject in which dirigible specialists must participate.[1]

In a section of the page entitled "Scientists and Engineers Speak," a docent [lecturer] of the Higher Aviation School of Civil Aviation, a docent of the Irkutsk Polytechnic Institute, and an aviation engineer all write in favor of a revival of aeronautics.[2] The docent states that three of his students defended their dissertations on the subject of dirigibles and received an "excellent" grade. Two of the terse comments discuss the technical possibilities of such a revival. One of the writers states that although there is no developed helium industry in the USSR -- in spite of vast reserves allegedly discovered in Siberia -- the technology necessary to modern dirigibles does exist. Another writer reminds the aviation leaders that although dirigibles are dependent on weather conditions, so too is the rest of aviation.

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[1] B. Graf, "Fantazii i real'nost'" ["Fantasy and Reality"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[2] V. Broude, Iu. Sotnikov, and R. Strong, "Govoriat uchenye i inzhenery" ["Scientists and Engineers Speak"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1969, p. 10.

The last two articles appearing in this series are, on the whole, more philosophical and abstract than most of the previous ones. The first of the pair takes the position that dirigibles are repudiated by nature. This position is based on the premise that although "the earth is surrounded by an ocean of air, there is not one living organism that could float in it." The dirigible has no prototype in animate nature, in which the evolution of living things proceeded along the path of dynamic flight -- wings. The author, the oldest Soviet polar pilot, discusses the aerodynamics of lift and drag of the dirigible compared with that of the airplane.[1]

The second article responds to these objections by asserting that in nature there is no prototype of the wheel, yet transportation created by man operates almost exclusively on wheels. And nature gives the dirigible "free" lift, according to Archimedes' Law. In the opinion of the author, a Doctor of Technical Science, dirigible design and construction should be developed completely separately from the aviation industry because of the special requirements for shipyards and mooring towers, the need for resolution of gas problems, and so on. Further, a university, technical school, aeronautics school, and scientific research institute are needed in order to work seriously. Without provision made for these special requirements, work can go no further.[2]

REVERBERATIONS

Publicly, at least, the dirigible debate reached its peak in 1968, apparently without being resolved. Behind the scenes, however, there is evidence that activity on behalf of dirigibles has continued up to the present time. One British airship activist claims that in 1968, the OKBs stepped up their work, wind-tunnel testing the D-1 dirigible, "said to be the prototype of airship freighters intended to ferry military supplies to the Soviet-Chinese frontier."[3] In November 1970, this report appeared in another source, which stated:

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[1]V. Makhotkin, "Otvergnuto prirodoi..." ["Repudiated by Nature..."], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[2]V. Semenov, "...Darovano prirodoi!" ["...Granted by Nature!"], *Literaturnaia Gazeta*, No. 7 (4137), February 14, 1968, p. 10.

[3]David Lampe, "The Great Airship Revival," *True*, September 1971, pp. 33-34.

> The Soviet Union is believed to be working on rigid airships capable, initially, of carrying 100 passengers at speeds of 100 to 150 miles per hour. Apart from civil and commercial use airships, particularly much larger types, are being reappraised for possible Soviet defense use, such as troop and equipment carriers.[1]

By February 1970, volunteer design bureaus had been set up in Irkusk and Bratsk, Siberia, to work on dirigibles for carrying freight and installing heavy equipment. These OKBs were "maintaining close contact" with the Leningrad OKB. Fourteen ministries supported their work.[2]

In April 1970, it was announced in *Sotsialisticheskaia Industriia* [*Socialist Industry*] that the Leningrad Voluntary Construction Bureau had designed the first all-metal dirigible in the country, the TsM-100, which is to have a lift of 100 tons. The aeronautics enthusiasts, together with the workers of the "Orgtekhstroi" Trust of the Construction Ministry of the USSR, also built and experimented with a 12-meter working model of the dirigible. The model took almost a year to construct. Its frame is made of duralumin with strongly constructed strips of bamboo and light balsa covered with duralumin foil. "More than 70 specialists of various types took part in the design and construction of the model." The experiment was considered successful, and "the possibilities of the functioning of dirigibles in construction work were verified.[3]

In December 1970, *Komsomolskaia Pravda* printed an article repeating previous assertions by dirigible proponents about the economy, speed, and range of dirigibles. The TsM-100 model is described and is said to be a passenger air carrier that can be used as a crane as well. However, "despite the obvious advantages, no orders for airships have

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[1] Ray Dafter, "Reassessing the Airship," *The Financial Times* (London), November 5, 1970, p. 17.

[2] "Dirigibles For Siberia," *Gudok* (Moscow), February 28, 1970, p. 4, translated in United States Joint Publications Research Service, *Translations on USSR Trade and Services*, No. 102, JPRS 50216, April 2, 1970, pp. 42-43.

[3] M. Sergeev, "Model' v polete" ["Model in Flight"], *Sotsialisticheskaia Industriia* [*Socialist Industry*], No. 89 (244), April 16, 1970, p. 4.

as yet been placed; not a single organization expressed interest in airship construction."[1] And even in light of a UPI report from West Germany claiming that the Russians (unidentified as individual designers or by organization) are currently working on a 500-passenger airship, there the matter rests.[2]

To recapitulate, numerous articles in the Soviet press from 1965 to the present have called for official support in providing the means for the development of a dirigible industry in the Soviet Union. But by 1971 only two models had been built, and official support still did not seem to be forthcoming. With the exception of the activity of the Volunteer Design Bureaus, which are limited in funds and other resources, the situation has changed very little since the Conference of Dirigible Enthusiasts seven years ago.

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[1] V. Murychev, "The Newest/Oldest Soviet Invention for Air Travel," translated from *Komsomolskaia Pravda* (Moscow), in *Atlas*, Vol. 19, No. 11, November 1970, p. 37.

[2] "German Engineer's Goal: More Durable Dirigible," *Los Angeles Herald-Examiner*, July 18, 1971, p. A-11.

V. ORGANIZATIONAL IMPLICATIONS

LIMITATIONS OF ORGANIZATIONAL STRUCTURE

The organizational structure of the aviation industry in itself plays a great role in limiting the possibilities for the proponents of dirigible construction to achieve their ambitions. For one thing, as noted before, the aviation industry is highly centralized, with specific sub-organizations already designated to carry out all the functions of development and production. Even more important, the aviation industry has great command, more than any strictly civilian economic sector, over the resources it needs to continue functioning. No doubt this is largely accounted for by the military importance of aviation.

Within this highly centralized aviation organization, there is no institution to represent dirigible construction, or even to conduct experimental work on dirigibles. For that matter, little institutional provision has been made for any new technology that is not a natural extension of present work. The research institutes are preoccupied with fulfilling the requests of the designers, and bureaus that undertake experimental designs do so at the possible risk of their own organizational lives.

Demand for a product that is not an internal creation of the aviation system means either breaking into the system or else creating new, separate organizations to further that demand outside the regular organizational channels. The proponents of dirigible construction have apparently attempted both routes. As noted in Section III, a great number of OKBs in scattered sections of the country were set up under the auspices of various already established academic and scientific institutions and have been in operation for a number of years. In contrast to the regular aviation industry, these OKBs are widely dispersed both geographically and organizationally. They also have the further weakness of being unable to command the resources available to the aviation industry. In most instances, the work of the members is voluntary, with no compensation for their time.

Trying the other route, the dirigible proponents also attempted to break into the regular channels of the aviation industry at least once by appearing before the Scientific and Technical Council of MAP with their arguments in 1966. "At the request of Gosplan," the work of a group of scientists and engineers in Leningrad on "The Technical and Economic Bases of the Application of Dirigibles to the National Economy of the USSR" was presented to the Council.[1]

The attempt to impress the leaders of the aviation industry with the need for dirigibles was, by all indications, a failure. According to an article by a Leningrad engineer, a number of the members of the Council did propose to begin experimental work and tests, but the majority did not want "to familiarize [themselves] with the serious engineering arguments on the reliability and safety of flights, although doubt precisely about that became the main argument of the opponents of dirigibles." Evidently, the fight was a bitter one. The engineer charged that the representatives of the concerned ministries were absent from the meeting and that the authors of the report were denied the right to defend their work; she compared the session to "a first-class funeral prepared in advance." The Technical Council decided that the development of dirigibles was "inexpedient."[2]

Although the dirigible enthusiasts have so far failed to make a place for themselves in the official aviation industry, they have continued their efforts both in the OKBs and in the Soviet press. Articles continue to pop up here and there in various industrial publications as well as in the Party press. A wide variety of organizations have been cited as being in favor of dirigible construction. These vary in level from institutes attached to industry, to divisions of the USSR Academy of Sciences, to State Planning Commissions and State Committees, to Ministries. But these lack the cohesiveness and, perhaps even more important, the power to exert a decisive influence on MAP.

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[1] Alekseeva, "Brosaem perchatku...," p. 12.

[2] *Ibid.*

EFFECTS OF DESIGN PROCEDURES

In the normal course of design procedure, at least two points can be identified as important for, if not crucial to, successful development of an aircraft design: the prestige and reputation of the designers and the critical influence of the Scientific and Technical Commission. The individual designers themselves are very influential within their own bureaus in determining what will be produced. The design bureau, whether for airframes or for engines, is usually named after the particular designer who heads it, and his reputation and perhaps his career rest on its success or failure. He is often given great responsibility and at the same time great latitude in matters of judgment about what should be developed and what is not worth the investment of his bureau's time and effort. Even after the design is turned over to the series production plant, "ultimate control over ... it ... is retained in the hands of the chief designer."[1] According to a recent Soviet article, for technical ideas to develop, they must be associated with an outstanding scientist. If anything happens to him, the ideas fare poorly. This seems to be what happened to the idea of dirigibles when Tsiolkovskii died.[2] Apparently, there has been no really outstanding scientist-advocate of dirigibles to take his place.

The other possible crucial point of leverage rests within the Scientific-Technical Commission. At certain stages of the development of a new aircraft, the commission, which is composed of representatives of the customers and the production ministries, studies the proposals, makes recommendations for specific solutions to problems or questions as they arise, and evaluates the product of the design bureaus. Formally, at least, this is done after the research institutes have drawn up their proposals and before the requirements go to the design bureaus; after completion of the pre-projects by the design bureaus, when the commission also selects the design or designs to be developed further; and during testing of prototypes, when production decisions are made. There is probably a great deal more interaction going on at

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[1] Alexander, *R&D in Soviet Aviation*, p. 19.

[2] T. Alekseeva, "Brosaem perchatku...," p. 12.

the informal level, as designers try to anticipate the decisions of the expert commission, drawing on the research institutes for their opinions at every stage. In any case, approval of the Scientific-Technical Commission at a number of points is essential for the work to continue. In this sense, the Commission's actions could be decisive.

In order to override the decisions of the leaders of the closely knit aviation industry, the only recourse a customer has is to appeal for high-level government or Party intervention. Sometimes even the designers themselves have felt the need to do this in order to cut through the red tape or to push some new idea through the system. Evidently, the dirigible proponents are quite aware of this alternative. Apart from Gosplan's initiative in setting up the meeting before the Scientific-Technical Commission mentioned previously, the dirigible proponents have called for Party support in their articles. But so far, they do not have the support they need.

INFLUENCE OF DESIGN PRACTICES

As noted before, the introduction of radically new ideas and new technology in the aviation industry seem to be reserved for aircraft intended primarily for military uses. Even where military objectives might justify extra expenditure, the principles of simplicity, commonality, and inheritance dominate the designer's thinking. This is practical only when the chief incentive to the designer is the reward for a design that is produced, and under the pressure of competitiveness and time constraints. Highly experimental approaches (for which there is a low probability of production) are worked out by the research institutes, such as TsAGI, and then assigned to often unwilling designers. But the aerodynamic problems selected to be investigated usually have some relation to needs or requests of the designers. Therefore, without a prior need established on the part of the designer as well as the customer, a radically new design is unlikely to be worked out.

Design doctrine also exerts an influence on design practices. Aviation, like many other industries and professions, has its own value system, and the Soviet aviation industry is no exception.

Currently the dominant virtues in aviation design are speed and altitude. This seems only natural in an age of jet planes and rapidly expanding space technology. However, in their rush to be at the forefront of aviation, designers may overlook more mundane types of aircraft that seem outdated. Dirigibles would seem to fall in the latter category, although currently groups in Great Britain, Germany, Japan, and the United States are exploring the possibilities for a revival of airships. If these groups are successful, it may well be that the official aviation industry in the Soviet Union will change its collective mind about the desirability of developing dirigibles.

VI. ALTERNATIVE HYPOTHESES

TECHNOLOGICAL AND COST FACTORS

The main hypothesis of this study has been that the Soviet aviation industry has prevented the development of a modern dirigible largely because of organizational concerns. Other explanations are possible. The technological and economic arguments regarding operation and maintenance of dirigibles put forth by the proponents simply may not have been convincing enough to justify further consideration. Since the details of such arguments have not so far been made available in the general Soviet press, it is impossible to say whether this is the case. On the other hand, an objective analysis of the dirigible debate could not overlook this possibility.

Another hypothesis is that, although the technical and economic arguments are powerful, the cost of developing and introducing the new technology that dirigibles would require has been considered too great. It may be that without high-level governmental or Party intervention, the required investment in technology would not be expended on an aircraft with an uncertain military payoff. The possibility of using dirigibles for military purposes was pointed out in one of the articles mentioned earlier, but the details of such use were never elaborated upon. In any case, although dirigibles conceivably could be used to support military missions, it is obvious that not even the most idealistic proponent envisions a return to the days of the military glory of the Zeppelins.

DIRIGIBLES VS. HELICOPTERS

A third hypothesis assumes that the arguments of dirigible technology are sound but that the leaders of the aviation industry might still quite rationally choose to go in another direction. Recognizing the great cost of research and reorganization required in developing dirigibles, they might decide that a better course to take would be to develop giant helicopters based on already established technology,

long an integrated part of the aviation industry. Indeed, there is some evidence that this may be the path already chosen.[1]

The Soviet Union is justifiably proud of its development of the helicopter. At the Paris Air Show in May 1971, a Soviet Mil V-12 heavy lift helicopter with an 88,000 lb. maximum payload was shown.[2] It was announced that the Soviet Union would build several hundred of these giant helicopters, which are designed to "play a key role in Soviet civil development plans as well as military missions." The intended uses of the helicopter parallel those envisioned as applications of the dirigible: It will replace highways in transporting oil and gas equipment and pipe to the fields in Northern and Western Siberia; it will be used to supply remote settlements north of the Arctic Circle, mainly scientific and satellite tracking stations, including a large number of military bases; and it will be used to ferry geological teams and their equipment to inaccessible areas in Central Asia.

The flight characteristics of the V-12 helicopter differ somewhat from those of dirigibles that have been planned by the Soviets.[3] The normal V-12 payload under rolling takeoff conditions is to be 66,000 pounds. In the Soviet Union, dirigible designers are concerned with payloads of not less than 100,000 pounds. A model of the TsM-100 designed by the Leningrad Volunteer Design Bureau of Dirigible Construction is designed to have a capacity of 100 tons. The maximum speed of the V-12 is 163 mph, with a cruise speed of 150 mph. The TsM-100 model travels at 125 mph. There is an even greater difference in the ranges of the giant helicopters and the planned dirigibles. For the V-12, average range with a 78,000 lb. payload is only 310 miles; the TsM-100 is designed to have a range of 13,000 miles.

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[1] "Choppers Bring Call for Blimps," *Engineering News-Record*, March 7, 1968.

[2] Figures for the V-12 helicopter in this section are taken from Donald C. Winston, "V-12 Has Civil, Military Mission," *Aviation Week and Space Technology*, June 7, 1971, pp. 14-19.

[3] Figures for the TsM-100 dirigible model in this section were taken from "The Newest/Oldest Soviet Invention for Air Travel," *Atlas*, November 1970, p. 37.

The Soviet dirigible proponents also believe there would be significant differences in costs, but these are a bit more difficult to document. The dirigible enthusiasts say that dirigibles would require only one-fifth of the power of an airplane and one-tenth or less than a helicopter. They also assert that far less maintenance is required and that air sheds are altogether unnecessary in the light of modern technology. In terms of the cost of transportation for one ton/kilometer under the conditions of the North, one Soviet engineer asserts that for an airplane it is 20 kopecks, for a helicopter it is 150 kopecks, but for a dirigible it is only 3 to 5 kopecks.[1]

Nevertheless, the V-12 helicopter "was ordered designed after a top-level governmental cost-effectiveness study into means of exploiting oil and gas reserves in Northern and Western Siberia. It was determined that it would be more economical to design and operate the giant heavy lift helicopter than to build roads through the remote areas involved."[2] Whether or not dirigibles were considered in this study is not known. For the time being, at least, it seems that they are not being given serious consideration by the Party, government, and aviation leaders.

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[1]Alekseeva, "Brosaem perchatku...," p. 12.

[2]Winston, "V-12 Has Civil, Military Mission," p. 18.

VII. CONCLUSIONS

Bureaucratic influences appear to have played a large role in the Soviet debate on whether to develop an airship industry. Although this may not have been the only factor in the decisionmaking process, the conflict between the dirigible proponents and the officials of MAP allows us some insight into the Soviet R&D decisionmaking process.

The airship case study tends largely to verify Alexander's conclusions about the Soviet aviation industry.[1] MAP appears to be in a position to control most of the R&D resources in the field of aviation. Only meager resources are available to those in research institutes attached to other ministries and in the Volunteer Design Bureaus, greatly limiting the prospects for any product they may develop, especially if they are unable to convince MAP that it is a project worth taking under its own auspices.

MAP also appears to have a tendency to reject radical changes in technology, particularly if introduced from the outside. The activities of MAP research institutes, design bureaus, and production units are geared toward incremental rather than radical change. It may be inferred that radical change must therefore be justified in terms of some pressing objective, such as an urgent military need. Radical change proposed by an organization outside MAP is subject to particularly intensive scrutiny, since MAP considers itself the special guardian of all aviation interests in the Soviet Union.

As explained above, MAP occupies an exclusive position in the aviation field, both in terms of resources and in terms of its influence on the future course of aviation. In the case of airship design, it has resisted what it apparently considers to be an intrusion from the outside. Consequently, MAP officials do not seem to feel compelled to give a very substantive or public account of their position on this particular development decision.

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[1] Alexander, *R&D in Soviet Aviation*, pp. 36-38.

The airship case study also provides some insight into the relationships among MAP, Aeroflot, and other civilian customers. As the second most important customer of MAP (next to the Soviet Air Force), Aeroflot looks to the production ministry's design bureaus for new technology. Work from research institutes attached to ministries other than MAP or from the Volunteer Design Bureaus is given short shift. Aeroflot is the official arbiter of civilian customer needs, but in some cases it has failed to meet the requirements of the ultimate users. In the airship case, the ulitmate users apparently decided that airships were the best solution for their unsatisfied needs and bypassed Aeroflot to prevent their request for airships to MAP. These users appear to have little influence on Aeroflot when it comes to decisions on vehicle systems.

Appendix

FACTS AND FIGURES ABOUT SOVIET DIRIGIBLES

Table 1

INDIVIDUALS AND INSTITUTIONS, PRO AND CON

Date	For	Against
1955	The Ukrainian OKB of Dirigible Construction began work on design of a dirigible in connection with *TVES* [Substratospheric Wind Power Generator] experimental project. [Belotserkovskii, 1967]	
1957	The Leningrad Branch of the Geographic Society of the Academy of Sciences of the USSR created an Aeronautic Commission in Leningrad, with branch offices in Moscow, Vladivostok, Simferopol, and Syktyvkar. ["Karavany," 1962] Ukrainian OKB of Dirigible Construction presented *TVES* dirigible design to the Committee on Inventions. [Belotserkovskii, 1967]	
1958		A. A. Velizhev, in his book, *Forty Years of Soviet Aviation*, made derogatory statements about airship construction.
1959	Publication of *Collected Works of K. E. Tsiolkovskiy, Vol. III -- Dirigibles*, A. A. Blagonravov, Editor in Chief, by the Commission for Preparing for Publication the Works of K. E. Tsiolkovskiy, Department of Technical Sciences, Academy of Sciences, USSR.	
1961	All-Union Geographic Society created a Design and Technical Bureau of Dirigible Construction in Moscow. [Belotserkovskii, 1962] Vasileostrovsky District Committee of the Communist Party of the Soviet	

Table 1, continued

Date	For	Against
	Union created a Design and Technical Bureau of Dirigible Construction in Leningrad. ["Karavany," 1962]	
	The Commission chaired by Academician Berg of the Former Committee on Automation and Machinebuilding gave approval to the TVES dirigible design. [Belotserkovskii, 1967]	
1962 October	Interview of F. F. Assberg, Director of the Design and Technical Bureau of Dirigible Construction, Moscow, by V. Belotserkovskii, *Izvestiia* Special Correspondent. [Belotserkovskii, 1962]	
1962 December	Comment accompanying article by *Izvestiia* editorial board, by Ia. Gakkel' and M. Somov, Doctors of Geographical Sciences; A. Treshnikov, M. Ostrekin, N. Volkov, I. Dolgin, N. Tiabin, Candidates of Geographical Sciences; Iu. Vainberg, Candidate of Technical Sciences; D. Maksutov, Chief Engineer; all of the Arctic and Antarctic Scientific Research Institute.	
	Letter to *Izvestiia* from A. Raiko, engineer and graduate of the former Tsiolkovsky Dirigible Construction Institute in Moscow.	
	Letter to *Izvestiia* from B. Krasnovskii, Designer.	
	Letter to *Izvestiia* from Nikulin, Senior Engineer of the Equipment Department and Shamin, Chief Specialist of the Technical Department, both of the "Giprotsement" Institute.	
	Letter to *Izvestiia* from The Ministry of Transport Construction	
	Letter to *Izvestiia* from The Academy of Construction and Architecture of the USSR.	
	["Karavany," 1962]	
1963 April	Aeronautic Subcommittee of the Leningrad Geographic Society discussed application of dirigibles in scientific research and agriculture.	

Table 1, continued

Date	For	Against
	"Representatives of scientific and design institutes, builders, hydrometerologist, and explorers of the Arctic and the Antarctic" were members of the subcommittee. [Kolesova, 1963]	
1964 March	N. A. Brusentsev, Deputy Secretary of the Aeronautic Subcommittee of the Geographic Society of the USSR, announced the planning of the first dirigible for agriculture by the Leningrad OKB. ["Vozrozhdenie dirizhablia," 1964]	
May	Combine "Tomles" made calculations on the use of dirigibles in logging on the instructions of the Siberian Division of the Academy of Sciences of the USSR. V. A. Novikov, Head of the Voluntary Design Bureau of Dirigible Construction in Siberia commented on this subject. Academy of Sciences of the USSR interested in Novikov's proposal. ["Vozdushnye lesovozy," 1964]	
1965 March	Article reports activities of David Bimbat, engineer, head of a "small group of enthusiasts" in the Urals. Airship designed by "a Leningrad institute" for use in agriculture is described. ["Muscovites," 1965] Siberian Branch of the Academy of Sciences of the USSR organized an All-Union Conference of Enthusiasts of Dirigible Building in Novosibirsk, Siberia. [Ozitov, 1965]	
April	Article by A. Glukharev, Colonel Engineer, on American activity concerning airships. [Glukharev, 1965]	
June	Article by P. Kochina and A. Trofimuk, Academicians; G. Krylov and A. Vorobyev, Professors; V. Zlobin, Chief Engineer of the Novosibirsk	

Table 1, continued

Date	For	Against
	Geology Administration; V. Manuilov, Learned Secretary of the Province Board of the Machine-Building Industry Science and Technology Society; Ye. Vladimirov, Member of the Novosibirsk Dirigible-Building Public Design Bureau; and V. Belotserkovsky and V. Davydchenkov, Special Correspondents of *Izvestiia*.	
	Editors of *Izvestiia* name the following organizations as promoting dirigible construction: The State Geology Committee The State Committee for Installation and Special Construction Projects The State Committee for the Lumber, Pulp-and-Paper and Woodworking Industries and Forestry The State Fisheries Committee The Siberian Division of the Academy of Sciences of the USSR The All-Union Arctic and Antarctic Research Institute	
	The Novosibirsk Geology Administration has made calculations on the use of dirigibles in geology.	
	[Kochina *et al.*, 1965]	
September 7	Article by A. Tarasov, Member of Literary-Historical Section of the Central Hall of Aviation and Astronautics imemi M. V. Frunze	
	Comment by G. M. Orlov, Chairman of State Committee on Lumber, Pulp, Paper, and Wood-processing Industry and the Forest Economy of Gosplan USSR.	
	Comment by A. V. Sidorenko, Chairman of State Geological Committee USSR, Minister of the USSR.	
	Comment by A. V. Gorinov, Corresponding Member of the Academy of Science USSR, Chairman of the Permanent Commission on Scientific Problems of Transportation Development.	
	Comment by I. D. Papanin, Chief, Section of Marine Expedition Work of the Academy of Sciences, twice Hero of the Soviet Union.	
	[Tarasov, 1965]	

Table 1, continued

Date	For	Against
September 17	In memory of Tsiolkovsky, a display on the topic "Dirigibles in the Age of Space" was shown in the House of Political Enlightment in Kaluga. [Korochentseve, 1967]	
October	Article by P. Ozitov, Senior Engineer of the Scientific Research Economic Institute of the State Planning Commission of Kazakh SSR [Ozitov, 1965].	
December	Article by I. Lobanov, Special Correspondent of *Izvestiia*, describing the activities of the following people: David Bimbat, head of the Voluntary Design Bureau of Dirigible Construction in Nizhni Tagil, Urals P. Dobrov and V. Katashov, designers (along with David Bimbat) of the ballastless dirigible. Lida Dudina, Komsomol Organizer and member of the Urals OKB Sergei Petrov, Vadim Kukui, Volodia Lisitsa, and Faina Bimbat, members of the Urals OKB. Rafik Mukhamedzhanov and Vladimir Nogovitsin, designers in Novosibirsk and members of the Urals OKB. Valentin Poliakov, designer in Perm and member of the Urals OKB. Comment by A. Khramov, Deputy Chief of the Technical Department of the amalgamation "Tiumenineftegaz." Comment by V. Belov, Deputy Director of the Institute of "Giprotiumen'neftegaz." [Lobanov, 1965]	
1966 March	Article by R. Strong, Member of the Voluntary Design Bureau of Aeronautics describing the Leningrad OKB activities. Ministry of Energetics and Electrification of the USSR approved the proposal of the Leningrad OKB. [Strong, 1966]	

Table 1, continued

Date	For	Against
April	The Department of Aviation Industry of Gosplan of the USSR commissioned the Ministries of Aviation Industry (MAP) and of Civil Aviation to hear the arguments of the Leningrad OKB of Aeronautics	
	Leningrad OKB of Aeronautics -- presented technical arguments for dirigibles to the Scientific and Technical Council of MAP. [Strong *et al.*, 1966]	The Scientific and Technical Council of MAP decided not to study dirigibles; thus the Ministry of Aviation Industry refused to build them. [Strong *et al.*, 1966]
May	Article by R. Strong, pilot; E. Zakhar'ev, Engineer and Deputy Chairman of the Leningrad OKB; and A. Podol'skii, *Sovetskaia Rossiia* correspondent.	The Ministry of Means of Communication declared that dirigibles are not needed.
	About 20 OKBs have been formed. Membership and activities of the Leningrad OKB named for Tsiokovsky and the Novosibirsk OKB are described.	The workers of the Research Institute of Complex Transportation Problems under Gosplan of the USSR consider the dirigible to be too complex. [Strong *et al.*, 1966]
	A. G. Vorob'ev "one of the oldest aeronautics professors," is a member of the Leningrad OKB.	
	Designers are working out the plans for thermal and semi-thermal dirigibles.	
	Letter to the Leningrad OKB from the leaders of the "Goskhimproekt" Institute.	
	Letter to the Leningrad OKB from the Deputy of the Ministry of Gas Industry.	
	Gosplan USSR is interested in the proposal of the Leningrad OKB. [Strong *et al.*, 1966]	
September	Annual Kaluga Conference of Lectures Dedicated to the Development of the Scientific Heritage of K. E. Tsiolkovskii included the following: Lecture on Tsiolkovsky's dirigible, by Ya. A. Rappoport, an assistant of Tsiolkovsky and later inventor of one of the first Soviet Space suits.	

Table 1, continued

Date	For	Against
	Lecture on Tsiolkovsky's dirigible by R. Strong. [Blagonravov, 1970]	
1967	The Ukrainian OKB of Dirigible Construction began work on the first technological model of the TVES dirigible. [Belotserkovskii, 1967]	
August	Article by V. Belotsevkovskii, Special correspondent of *Literaturnaia Gazeta*. Roman Anan'evich Gokhman, Aviation Engineer of the Ukrainian OKB of Dirigible Construction explains the TVES experimental project. Spitsin, Okeinik, Constantinov, and Ustinov, all are colleagues of Gokhman in the Ukraininan OKB of Dirigible Construction. [Belotserkovskii, 1967]	
September	Article by T. Alekseeva, engineer of the Leningrad Voluntary Design Bureau for Dirigible Construction Design Bureaus for Aeronautics now open in twenty cities, including Leningrad, Kiev, Novosibirsk, Moscow, and Saratov. Article cites the following organizations as being in favor of dirigibles: Ministry of Fisheries Ministry of Energetics and Electrification Ministry of Agriculture Ministry of Geology Ministry of the Conservation of Mineral Resources Aeronautics Commission of the Geographic Society of the USSR in Leningrad receives letters inquiring about dirigibles. [Alekseeva, 1967]	
October	Article by R. Gokhman and I. Spitsin, engineers of the Ukrainian Voluntary Design Bureau of Dirigible Construction, describing the D-1 dirigible. [Gokman and Spitsin, 1967]	

Table 1, continued

Date	For	Against
November	Letter to the editorial board of *Literaturnaia Gazeta* from V. Gerasimov, designer from Vladimir [Liustiberg, 1967]	Article by Villen Liustiberg, aviation worker, refuting the arguments of dirigible proponents on evolutionary, safety, technical, and economic grounds. [Liustiberg, 1967]
December	Article by V. Burkhanov, Engineer-Rear Admiral, Deputy Chairman of the Scientific Council on Technology/Equipment for the North of the State Committee of the Council of Ministers of the USSR on Science and Technology; I. Beskin, Candidate of Technical Sciences, Chairman of the Section of Technical and Economic Bases/Reasons of the Scientific Council on Technology for the North; V. Razzhivin, Chief Engineer of the Scientific Research Institute of Civil Aviation; and M. Arie, aviation engineer. Novosibirsk Geological Administration has made calculations on the economy of the use of dirigibles. Article cites the following as being in favor of dirigibles: Ministry of Gas Industry Ministry of Forestry Ministry of Fisheries Leaders of Electric Power Leaders of Geology Representatives of Gosplan of the RSFSR Academics at the head of various institutes Kiev OKB of Dirigible Construction [Burkhanov *et al.*, 1967]	
1968 February	Comment by Ia. Finogenov, First Deputy of the Ministry of Electric Power of the USSR. Comment by S. Goriunov, Minister of Geology of the RFSR, and laureate of the Lenin Prize. Comment by Iu. Bokserman, Deputy of the Ministry of the Gas Industry of the USSR. [Finogenov *et al.*, 1968] Article by V. Infant'ev	A. Kobzarev, Deputy Minister of the Aviation Industry of the USSR and M. Kulik, Deputy Minister of Civil Aviation of the USSR, refused to permit the letter stating their position to be printed since the editors of *Literaturnaia Gazeta* would not agree to suppress the dirigible debate. ["Dirizhabl'," 1968]

Table 1, continued

Date	For	Against
	[Infant'ev, 1968] Article by B. Graf, Candidate of Technical sciences and Chief Designer of the dirigibles "Pobeda" and "Patriot," [Graf, 1968] Comment by V. Broude, Docent in the Department of Aerodynamics and Design of Aircraft of the Higher Aviation School of Civil Aviation. Comment by Iu. Sotnikov, Docent of the Irkutsk Polytechnic Institute Comment by R. Strong, Aviation Engineer [Broude *et al.*, 1968] Article by V. A. Semyenov, Doctor of Technical Sciences, Honored Scientist of Sciences and Technology of the RSFSR, Major General of the Engineering Service, and Professor of the Military-Aviation Engineering Academy imemi N. E. Zhukovskii. [Semyenov, 1968]	Article by A. Mikoyan, well-known airframe designer. [Mikoyan, 1968] Article by M. Gallai, a well-known test pilot. [Gallai, 1968] Article by V. Makhotkin, the oldest polar pilot. [Makhotkin, 1968]
1970 February	OKBs set up in Irkutsk and Bratsk, Siberia. Fourteen ministries support this work. ["Dirigibles," 1970]	
April	Article by M. Sergeev V. B. Murychev, Leader of the Leningrad OKB for Dirigible Construction has directed the construction of a working model of the all-metal "TsM-100" dirigible. Article mentions the work on the "TsM-100" model of the following members of the OKB and workers of the "Orgtekhstroi" Trust of the Construction Ministry of the USSR: B. Broude and V. Anpilov, Candidates of Technical Sciences E. Postnikova, Engineer-Designer A. Bykov, Engineer Ye. Zheludkova, Engineer-Chemist V. Veselov, Candidate of Technical Sciences I. Volkova, Engineer V. Ivanov, worker. [Sergeev, 1970]	

Table 2

SOVIET DIRIGIBLES VS. HELICOPTERS

	Maximum Payload	Normal Payload	Maximum Speed	Cruising Speed	Range	Altitude
Dirigibles						
D-1	--	--	--	125 mph	1,900 miles	22,000 ft
TsM-100	220,000 lb.	--	--	125 mph	10,000 miles	--
Ural 1	--	--	--	60 mph	--	--
Helicopters						
Hound, Mi-4[a]	3,835 lb.	--	130 mph	99 mph	155-220 miles (with passengers and baggage)	--
Mil V-12	88,000 lb.	66,000 lb. (under rolling take-off condition)	163 mph	150 mph (with	310 miles (with 78,000 lb. payload)	--

[a]At present standard equipment in both military and civilian services.

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[1] Inconsistencies in the transliteration of Russian words throughout this paper are due to the fact that the author preferred the widely used Library of Congress transliterations system, and other sources have used the U.S. Board of Geographic Names System.

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