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# **Truck Production at the Soviet Kama River Plant— Western Technology in Action**

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**A Research Paper**

NGA Review Completed

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# **Truck Production at the Soviet Kama River Plant— Western Technology in Action**

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**A Research Paper**

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This paper was prepared by [ ] Office  
of Soviet Analysis, with contributions from [ ]  
[ ] Comments  
and queries are welcome and may be directed to the  
Chief, Defense Industries Division, SOVA, [ ]

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# **Truck Production at the Soviet Kama River Plant— Western Technology in Action**

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## **Summary**

*Information available  
as of 9 August 1985  
was used in this report.*

The Kama River Motor Vehicle Plant (KamAZ) is the centerpiece of a major Soviet plan for modernizing transportation. It is the world's largest truck plant and began production in 1976. The overall strategy of a 15-year modernization plan, adopted in 1965, called for a larger and more varied truck fleet, with KamAZ to produce heavy diesels. The plant was built with considerable Western help, and the large purchases of foreign equipment were widely hailed in the early 1970s as an example of Moscow's commitment to East-West trade. By the late 1970s, however, there was considerable controversy in the West over whether, and how much, those technologies (and the KamAZ trucks) were contributing to Soviet military strength—a contribution that has long since been clear.

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The Soviets imported equipment, manufacturing technology, and engineering assistance valued at nearly \$1.3 billion, including an estimated \$500 million from US firms. These purchases probably enabled them to bring KamAZ on line at least five years sooner than they could have if they had relied exclusively on their own already strained machine-building industry.

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Reliance on Western help created some problems, however. The imports included some of the world's most advanced manufacturing equipment—particularly in the foundry and diesel engine lines—which KamAZ did not absorb easily. Workers at the plant installed or used equipment improperly and generally did not follow Western maintenance standards, while managers had difficulty getting spare parts for some equipment. The spare parts problem was exacerbated in 1980 and 1981, when the United States—prompted by the crises in Afghanistan and Poland—imposed increasingly restrictive embargoes that halted all shipments of new equipment and spare parts bound for KamAZ.

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this embargo created short-term disruptions and delayed production, but add that the Soviets have generally acquired what they needed from other sources—usually in Europe or Japan—or from their own industry.

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KamAZ has turned out about 600,000 heavy diesel-powered trucks, including an estimated 105,000 in 1984. It was designed to manufacture annually 150,000 trucks and 250,000 diesel engines. We estimate that when production reaches this capacity—probably about 1990—KamAZ will account for about 17 to 18 percent of the USSR's production of all trucks and about half of its production of general purpose heavy trucks.

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Although KamAZ trucks cost nearly twice as much as some of the trucks they are replacing, their larger capacity and longer operating lives, coupled with greater reliability and ease of maintenance, make them a better investment. [REDACTED]

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[REDACTED] Their use of diesel fuel adds to their overall efficiency; the Soviets claim that one of the plant's models is more than twice as fuel efficient as a gasoline-powered truck it is replacing, even at speeds one-half greater. Overall, Soviet economists claim that when 1.5 million trucks with KamAZ engines have replaced the older vehicles, the fuel savings will be roughly 10 million metric tons per year. [REDACTED]

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Besides having a wide variety of civilian and military applications in the USSR, KamAZ trucks have been exported in large numbers. They have been sold to Eastern Europe; to several Third World countries, including Cuba and Nicaragua; and to a few Western countries, including Great Britain, South Africa, France, and Finland. [REDACTED]

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[REDACTED] KamAZ trucks have been extensively deployed with Soviet and non-Soviet Warsaw Pact military forces, replacing or augmenting the inventory of smaller, older trucks. We judge that the military finds these trucks particularly useful in increasing the lift capacity of motor transport units without requiring more drivers or fuel—at a time when the logistic requirements of the Soviet forces are expanding. We believe that KamAZ does not produce any military vehicles other than trucks and no engines for other military vehicles—for example, APCs and tanks. [REDACTED]

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We estimate that the Kama River Plant delivered 45,000 to 65,000 trucks to the Soviet armed forces between 1976 and the end of 1984. [REDACTED]

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[REDACTED] indicate that during the period 1976-81 at least 5 percent of the entire KamAZ production—that is, about 14,000 trucks—went to the military. Our estimates for 1982-84 are less certain, but we know that deliveries to the military began to rise steeply in 1982. Analysis of production trends and KamAZ shipment facilities suggests that, when it is producing at capacity, KamAZ will supply about 30,000 to 45,000 new trucks to the military each year. The military will then be taking 20 to 30 percent of KamAZ output—about the share it now takes of overall Soviet truck production. [REDACTED]

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## Truck Production at the Soviet Kama River Plant— Western Technology in Action

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### KamAZ and the Soviet Truck Industry

Soviet truck production has increased from less than 1,000 vehicles per year in the late 1920s to about 800,000 in 1984 (see figure 1). The USSR currently is the world's third-largest truck producer, trailing the United States and Japan.<sup>1</sup> However, the vast majority of US and Japanese plant capacity is devoted to pickups and other light trucks; the USSR is the world's largest producer of medium and heavy trucks.<sup>2</sup> Soviet trucks provide civilian transport between the country's widely dispersed industrial and agricultural centers, as well as support and mobility for its very large military establishment.

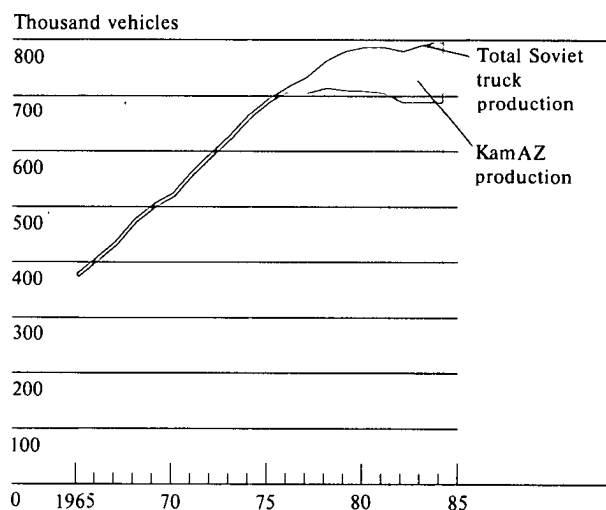
Soviet truck production surged in the 1930s, and again in the 1950s, and the 1970s—each time after large acquisitions of foreign plant and equipment. The most recent surge was the result of a 15-year transportation modernization plan adopted in 1965. Its centerpiece is the Kama River Motor Vehicle Plant (KamAZ), built with considerable Western help during the 1970s at Naberezhnyye Chelny (now Brezhnev). The plant is the world's largest truck manufacturing facility and is also the center of a production association that includes component producers located throughout the Soviet Union.<sup>3</sup> It covers about 48 square kilometers, roughly twice the size of the District of Colombia (see figure 2); it comprises production facilities totaling about 2.2 million square meters; and, when production is at capacity, it will employ 80,000 workers.<sup>4</sup> The plant's planned capacity is 150,000 trucks and 250,000 diesel engines annually.

<sup>1</sup> In 1983 about 2.4 million trucks were produced in the United States and about 3.9 million in Japan.

<sup>2</sup> In this paper the cargo capacity tonnage classes are light (less than 2 metric tons), medium (2 to 5 mt), and heavy (over 5 mt). These are the definitions commonly used in the USSR and differ from those used in the United States.

<sup>3</sup> A production association is a group of plants organized to support the production of certain equipment or goods. One plant in each association—usually the plant where the main product is made or assembled—serves as the lead plant. All major Soviet motor vehicle plants are association lead plants.

**Figure 1**  
**Total Soviet Truck Production,**  
**1965-84**



The figures for total Soviet truck production are from various editions of *Narodnoye khozyaystvo SSR*, except for 1982, which is from Soviet open-source literature, and 1983-84, which are estimates. The figures for KamAZ production from 1976 to 1981 are also from Soviet press reports, and the figures for 1982-84 are estimates.

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<sup>4</sup> Production floorspace does not include administrative, engineering, or storage areas. A reported figure for number of employees in 1983 of 120,000 probably includes the construction crews still working on the plant.

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Within the transportation modernization program as a whole, KamAZ represents a decision to provide not only a larger but also a more balanced inventory of trucks, better tailored to user needs (see figure 3). Before it was built, the Soviets concentrated on long production runs of medium trucks, and most of the civilian and military truck inventory is still made up of medium vehicles produced at the Moscow (ZIL), Gorkiy (GAZ) and Ural (UrAZ) truck plants. According to their writings, the Soviets wanted to realize economies of scale in production, accepting the lower efficiency of medium trucks in intracity and in high-density, long-haul transport. KamAZ alleviates the shortage of heavy trucks, and companion measures were taken to increase the production of light trucks and vans at other motor vehicle plants. [redacted]

The KamAZ plant is noteworthy not only for its size but also for its prominence in Western deliberations on export controls. Western participation in its construction and fitting out was approved in the early 1970s as a premier example of the Soviet commitment to East-West trade. Later KamAZ began to be viewed in the West as a prime example of Soviet acquisition of modern Western manufacturing technology; this created considerable controversy over whether that technology would be applied to the production of (a) special-purpose trucks to be used predominantly by the military and (b) general purpose trucks with wide dual military and civilian uses. Since 1981 the United States, prompted by the Soviet invasion of Afghanistan and Moscow's actions during the Solidarity trade union crisis in Poland, has embargoed sales to the Soviet Union of any goods for which KamAZ is designated as the end user. [redacted]

Almost 20 years have passed since the Soviets made the decision to undertake this gigantic project. In this paper we look at the KamAZ experience with the following questions in mind:

- How has the KamAZ building program progressed?
- What has been the role of Western technology?
- What was the effect of the US embargo?
- How many trucks has KamAZ produced, and what is the outlook for production in the future?
- To what extent has KamAZ production helped the Soviet military? [redacted]

### Development of the KamAZ Complex

Preparations for the construction of the Kama River Plant began as soon as the 1965 transportation modernization program was adopted. The plant was designed as part of a regional development project in a remote area, which meant that the Soviets had to create an infrastructure from a "green field" site—a new city, including housing, municipal services, and industrial transportation support facilities. Construction at the main plant complex in Brezhnev—foundries, forge shops, a final assembly plant, an engine assembly plant, a frame and press plant, a tool shop, and machine shops—has been continuous since 1969. Truck production began in 1976. The plant was still incomplete, [redacted]

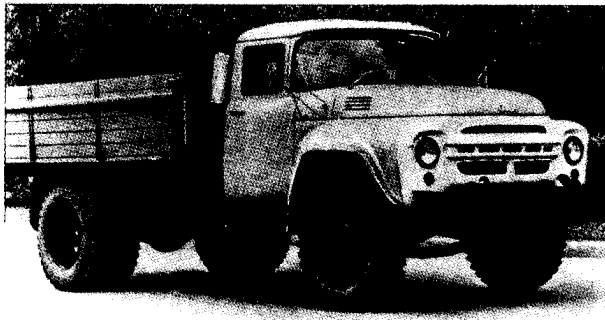
[redacted] the first truck was inoperative and had to be pushed out of the plant for the inaugural ceremony. [redacted]

### The Main Complex

According to Soviet open literature, the first stage of construction was completed in about 1980. The plant then contained all its major components, including the truck assembly line, with a capacity for 75,000 trucks, and the engine assembly line, with a capacity for 115,000 engines. At that time, the plant had about 1.9 million square meters of production floorspace, but parts of several buildings, including the assembly building, were not fully equipped. [redacted]

The second stage of construction was planned to bring KamAZ up to targeted capacity (150,000 trucks per year) by the end of 1985. Some of it has been completed, and some is still under way:

- During 1980-85 the Soviets have increased production floorspace by 15 percent by completing a fourth foundry, a forging shop, and a machine shop. According to Soviet press reports, the new iron foundry (about one-third the size of the first one) will be devoted to casting spare parts for the plant, and the machine shop will produce electric motors and



*Figure 3. Why the KamAZ Truck? Left, the medium ZIL-130 (5,000 kg); right, the heavy KamAZ-5320 (8,000 kg); bottom, the heavy KrAZ-258 (12,000 kg).*

*KamAZ fills a capacity niche, and its growing numbers alleviate a shortage of heavy trucks. Soviet truck fleets have been dominated by medium trucks like the ZIL-130, with capacities ranging from 2 to 5 tons. The Soviets have produced heavy trucks (like the KrAZ-258) with capacities greater than 5 tons, but in smaller numbers than medium ones. For example, in 1975—the year before KamAZ began operating—they produced about 500,000 medium trucks and only about 83,000 general purpose heavy trucks. When*

*KamAZ is operating at capacity, it alone will produce nearly twice as many heavy trucks as the whole Soviet industry produced in 1975.*

*In view of the weakness of the Soviet road network, KamAZ vehicles were designed for a much less burdensome axle load than other Soviet heavy trucks. Heavy trucks decrease the burden on the Soviet rail network—which still transports the vast majority of Soviet cargo—by taking over much of the short-haul freight shipments.*

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generators for the whole Soviet automotive industry. In the truck assembly building, a second assembly line became operational in 1981.

- Construction under way in 1985 will increase production floorspace by an additional 8 percent, to over 2.4 million square meters. New facilities will include a second machine shop (to manufacture electric motors and generators) and an addition to a forge-machine shop. Expansion of the power plant is also under way; this will probably accommodate the additional power requirements of both the truck plant and the current housing expansion in Brezhnev. [redacted]

Our analysis of construction progress indicates that the second-stage expansion will not be completed until at least 1987, roughly two years later than originally planned. Operation of the second assembly line at rated capacity should be feasible shortly thereafter; it took about five years for the first line to reach capacity. [redacted]

Expansion of capacity has been delayed by a host of factors. Western businessmen and the Soviet press have reported instances of poor coordination between construction of buildings, delivery of equipment, and installation of the equipment. Another cause of delay, suggested by several KamAZ workers in a 1979 letter to *Pravda*, may be that high-level interest in KamAZ is waning. The workers felt this was reflected by inadequate financing and shortages of material and labor. All delays were probably aggravated by the remoteness of KamAZ. On the whole, however—and by the standards of Soviet construction performance—we believe the overall delay has not been unduly long. [redacted]

There is some evidence that the central planners may invest further resources in KamAZ to increase its annual truck production capacity beyond 150,000. In late 1984 [redacted]

[redacted] a third final assembly line was being installed. Analysis of the KamAZ truck assembly building indicates that its space could accommodate a third line, at least as long as each of the original two lines, but we cannot confirm that installation is under way. [redacted]

### Supporting Facilities

The Kama River Plant is the main element of a production association that also includes service facilities and component suppliers (see figure 4). According to Soviet press reports, an engine repair plant at Brezhnev began partial operation in early 1985, with the capacity to overhaul 20,000 diesel engines annually. When this repair plant is completed—we estimate in the late 1980s at the earliest—it will be able to repair 40,000 engines a year. Soviet media sources indicate that, when the number of KamAZ engines in the nation's fleet of vehicles reaches the goal of 1.5 million, the USSR will need five such plants—each with a capacity to repair 50,000 diesel engines per year.<sup>5</sup> [redacted]

Satellite plants have been added to the KamAZ association since the early 1970s. Most of them supply components to the main facility in Brezhnev. According to Soviet open literature, about 70 percent of the parts going into a KamAZ truck are made at the Kama River Plant, and the rest come from component and spare parts plants. Major plants in the KamAZ association include the:

- Kostroma Automobile Spare Parts Plant.
- Balakovo Industrial Rubber Products Plant.
- Panevezhis Motor Vehicle Compressor Plant.
- Zainsk Wheel Plant.
- Roslavl' Brake Plant.
- Yaroslavl' Diesel Engine Plant.
- Shadrinsk Truck Radiator Plant.

Construction of some of these associated plants was slower than planned, which meant that they were unable to meet scheduled deliveries to KamAZ. Shortfalls of this kind probably contributed to KamAZ's failure to reach its truck production targets in the late 1970s. [redacted]

There are also many enterprises that supply KamAZ but are not part of its production association.<sup>6</sup> Support

<sup>5</sup> It is unusual in the Soviet motor vehicle industry to have entire plants dedicated to the after-delivery maintenance of specific parts. Motor vehicle depots and service shops would normally provide maintenance for an entire truck; but overhauling a KamAZ engine requires tools and equipment that they probably do not have. [redacted]

<sup>6</sup> Outside enterprises that support the Kama River Plant include the Dimitrograd Bearing Plant, the Nizhnekamsk Petrochemical and Tire Plant, and the Magnitogorsk and Karaganda Metallurgical Combine Plants. [redacted]

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Figure 4

## The Kama River Motor Vehicle Association: Major Plants and Suppliers



Boundary representation is not necessarily authoritative.

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from suppliers has been spotty since construction in Brezhnev began, and this problem continues to interfere with production at the plant. According to the general director of KamAZ, numerous materials needed by the association have not been delivered, and those that are often do not meet specifications or requirements. In a recent 12-month period KamAZ fined suppliers over 3 million rubles for not meeting the deadlines or providing the quantities specified in contracts. In addition, it has begun to produce parts that were not in its original plan—for example, oil pumps and piston rings. [ ]

Still other outside enterprises modify KamAZ-produced chassis or produce support equipment. An association plant in Neftekamsk assembles dump trucks on KamAZ chassis, and plants in Krasnoyarsk and Stavropol' manufacture trailers for KamAZ trucks. About 160 civil technical centers throughout the Soviet Union supply spare parts and repair KamAZ vehicles, and plans call for at least another 60 centers to be operating by 1986. The military operates its own truck maintenance facilities. [ ]

#### Use of Western Technology

In the mid-1960s, when Soviet officials began implementing the modernization program, they talked to several Western automotive manufacturers about providing overall management of the KamAZ construction project (as well as equipping the plant). They reached tentative management agreements with US companies—first with the Ford Motor Co. and then with the Mack Truck Corp.—but neither was ever signed. The Soviets decided to manage the project themselves, but they continued to rely on Western suppliers for most of the plant equipment. To buy Western goods, the Kama Purchasing Commission was established in the early 1970s, and offices were opened in Paris and New York. By the mid-1970s, we estimate the commission had negotiated contracts worth nearly \$1.3 billion,<sup>7</sup> including about \$500 million with US firms (see tables 1 and 2). [ ]

<sup>7</sup> Dollar amounts are those in the contracts and represent their current-year values; that is, price changes over time are not accounted for. [ ]

**Table 1** *Million US \$*  
**Kama Purchasing Commission Contracts**  
**With US Firms, 1970s <sup>a</sup>**

| Firm                               | Equipment                       | Value        |
|------------------------------------|---------------------------------|--------------|
| Swindell-Dressler                  | Furnaces and foundry equipment  | 42.6         |
| C. E. Cast Equipment               | Mechanized foundry lines        | 34.5         |
| Holcroft & Company                 | Foundry equipment               | 19.9         |
| Ingersoll-Rand Equipment           | Engine line finishing equipment | 19.2         |
| National Engineering Company       | Foundry equipment               | 15.4         |
| LaSalle Machine Tool               | Metallcutting machine tools     | 12.4         |
| Cleveland Crane and Engineering    | Materials handling equipment    | 10.4         |
| Gleason Works                      | Axle production equipment       | 10.1         |
| Carborundum Company                | Foundry equipment               | 10.0         |
| <b>Subtotal</b>                    |                                 | <b>174.5</b> |
| Other contracts (estimated)        |                                 | 330.0        |
| <b>Total contracts (estimated)</b> |                                 | <b>504.5</b> |

<sup>a</sup> Dollars are expressed in their current year values; that is, price changes over time are not accounted for.

Soviet writings indicate that the planners had (and continue to have) high expectations for the Western production technologies used at KamAZ. They equipped it to be the most modern motor vehicle plant in the Soviet Union. For example:

- The KamAZ foundries (supplied by Swindell-Dressler) are extremely sophisticated. Designed to be highly automated, these foundries are the only ones of their kind in the Soviet Union.
- The original engine assembly line was provided by Ingersoll-Rand. Its size, production rate, and sophisticated automation made it the only one of its kind in the world.

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**Table 2** *Million US \$*  
**Kama Purchasing Commission Contracts**  
**With West European and Japanese**  
**Firms, 1970s <sup>a</sup>**

| Firm   | Equipment/Service                           | Value        |
|--|---|--------------|
| Renault (France)                                 | Design and installation of engine plant     | 250.0        |
| Liebherr & Huller (Germany)                      | Design and equipment for transmission plant | 171.8        |
| Fata SPA (Italy)                                 | Molding machinery and conveyor equipment    | 42.3         |
| Mitsubishi Heavy Industries Ltd. (Japan)         | Automatic lathes                            | 27.0         |
| Fata Co. (Italy)                                 | Handling equipment                          | 22.0         |
| Drysys Equipment (France)                        | Metal finishing and painting equipment      | 20.0         |
| Ishikawajima-Harima Heavy Industries Co. (Japan) | Press lines                                 | 20.0         |
| Rheinstahl A. G. (W. Germany)                    | Forging equipment and lines for crankshaft  | 16.3         |
| Svenska Flacfabriken (Sweden)                    | Gas filtering equipment                     | 13.5         |
| <b>Subtotal</b>                                  |   | <b>582.9</b> |
| Other contracts (estimated)                      |   | 175.0        |
| <b>Total contracts (estimated)</b>               |   | <b>757.9</b> |

<sup>a</sup> Dollars are expressed in their current year values; that is, price changes over time are not accounted for.

- In the KamAZ truck assembly lines the chassis are mounted on flatcars, a technique that avoids the usual problem of changing line specifications when different chassis are to be assembled. This unusual method allows considerable flexibility in assembling different models at the same time.

Most of the Kama River Plant's facilities are equipped with advanced Western machine tools, and the truck and engine assembly areas have large, automated transfer lines and material handling equipment. Most of the plant's operations were designed to be computer controlled—many, like the foundry area, with a central IBM 370. The Soviets thus acquired equipment more technically advanced than their own machine-building industry could have provided, and they avoided further strain on that already hard-pressed industry.

### Record on Assimilation

We judge that extensive reliance on Western equipment and engineering assistance enabled the Soviets to bring KamAZ on line at least five years earlier than they could have if they had relied exclusively on their own industry. Nevertheless, KamAZ has had considerable difficulty in assimilating Western technology. On some parts of the project, the Soviet technicians and construction engineers asked Western engineers to change the plans and specifications—or altered them themselves. According to [redacted]

[redacted] Soviet literature, KamAZ workers have not always taken the trouble to follow the Western engineering specifications, and they have had difficulty using some of the Western equipment. The Soviets have also put equipment to uses different from those it was designed for.

[redacted] the Soviets split in two a line designed to produce one type of brakeshoe and began producing two different types. This overstressed the equipment, and the line broke down in 1979 after only three years of operation.

Improper installation or maintenance can cause a great deal of waste.

[redacted] US fire protection systems for six computer rooms were delivered to the USSR in 1978 but were left out in the weather until October 1979, when US technicians came to install them. The tops of the crates had been smashed, and water had damaged the machines to the point that 80 percent of the electrical components had to be reordered. The Western technicians assembled one system and had it installed, but the room it was installed in was not suitable for testing, and so the system had not been tested properly when the technicians left.

[redacted] as of April 1980 no further work had been done on any of the other systems, and they are presumably inoperable.

It is not uncommon for the Soviets to have difficulty of this kind with Western plants and equipment, so we cannot be certain that performance at KamAZ is worse than usual. The acquisition of complete Western production lines probably helped the plant's performance; if the Soviets had bought separate Western

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components and tried to integrate them piecemeal into Soviet production lines, their difficulties would probably have been even greater. We believe, however, that the advantage of buying a complete line was more than offset by several other factors:

- Mismanagement of the entire project.
- The sophistication and complexity of the technology.
- The Soviet penchant for modifying Western equipment.
- The poorly developed infrastructure of the remote site.

Overall—and especially considering Moscow's enormous expenditures—we consider Soviet performance in assimilating Western technology to have been worse at KamAZ than at other major projects, including the Volga passenger car plant built by Fiat and various large chemical and metallurgical complexes built by other European companies. [redacted]

#### Effect of the US Embargo

In 1981 the United States imposed an embargo that halted all shipments of new equipment and spare parts that were designated for KamAZ. [redacted]

We believe the embargo created short-term disruptions at KamAZ and delayed some production. Generally, however, the Soviets appear to have been successful in obtaining supplies and equipment elsewhere—usually from Western Europe or Japan; and they have manufactured some of the needed equipment themselves. For example:

- [redacted] the US embargo on computer parts had little effect on the operation of the IBM 370 in the foundry. Parts for it were readily available from Western Europe during the early 1980s.
- When the US supplier of parts for foundry blasting machines would not sell spares, the Soviets arranged to buy them from West European firms.
- [redacted]  
[redacted] the Soviets were able to manufacture an engine assembly line to replace the one that a US firm had been barred from selling to them.

[redacted]  
[redacted] the Soviets purchased another complete engine assembly line from Fiat of Italy.

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KamAZ managers also have resorted to the common Soviet industrial practice of cannibalizing unused equipment and using the parts to maintain operations. For example, they had not been using all of the imported computer systems and could scavenge from unused units to repair the systems that were running.

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#### Future Support

The Soviets still purchase some Western equipment for KamAZ, but levels of support provided by Western firms are substantially lower in 1985 than they were in the late 1970s. According to Soviet media reports [redacted]

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[redacted] nearly all of the equipment installed in the plant's second phase is of Soviet origin. Participation by Western firms is currently limited almost entirely to providing spare parts, technical support, and maintenance services. [redacted]

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We believe that the Soviets will continue to rely on Western firms for equipment and assistance, albeit at a level considerably lower than it was during the initial construction and equipping of the plant. The maintenance of equipment requires recurrent visits by Western engineers. The Soviets will continue to buy spare parts and certain compatible replacement equipment from Western firms. In addition, for some things they probably find it more cost effective to turn to the West than to task domestic designers and manufacturers. [redacted]

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Despite their problems, the Soviets have gained valuable experience in using the advanced production equipment and processes embodied in the Western technology at KamAZ. Soviet officials have publicly called for the diffusion of KamAZ technology to other plants, but we do not know how successful this campaign has been. Most of all, KamAZ production

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technology has given the Soviets experience in mass-producing high-quality components and trucks—experience that they probably already have applied to other vehicles. [ ]

Although Western equipment installed at KamAZ was highly advanced for the early 1970s, it largely predates the dramatic gains in automation that have characterized Western (and especially Japanese) industry over the last decade. For example, Western equipment included no true robots or flexible manufacturing centers controlled by computers. KamAZ's large work force of about 80,000 indicates it is still quite labor intensive by Western standards. The challenge for Western firms stemmed mainly from KamAZ's size—many times larger than a typical Western truck plant—which required design of much unique plant and equipment. [ ]

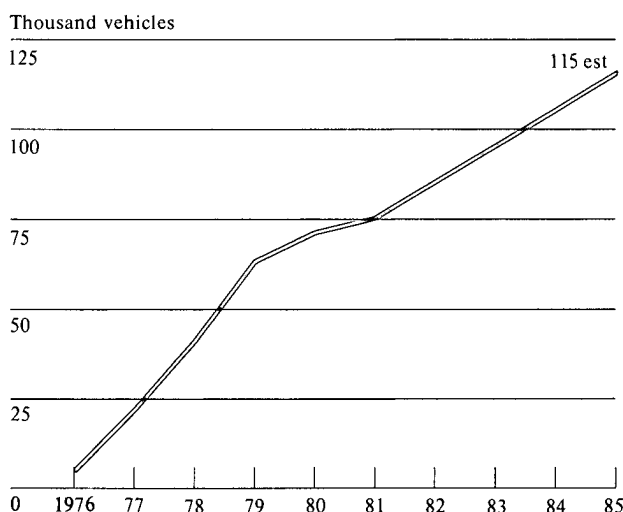
Nevertheless, in recent years the plant has been receiving newer or more advanced equipment both from the West and from Eastern Europe. In the early 1980s, for example, 15 small Hungarian computers were installed in the engine assembly area for automatic testing and adjustment; and, according to a Soviet trade journal, more than 400 Bulgarian robots are operating at KamAZ. In addition, Avtopromimport (the Soviet automotive industry importing agency) has since the late 1970s purchased hundreds of millions of dollars worth of advanced Western production equipment and technology. These include industrial robots, computer numerically controlled (CNC) machine tools, and flexible manufacturing systems. Some of this equipment probably has been installed at KamAZ; this is suggested by the plant's continued expansion, the Soviet desire for continued modernization of all automotive plants, and the fact that some of this equipment is probably compatible with other KamAZ technology. [ ]

#### Production at KamAZ, Current and Projected

In the early 1970s the Soviets expected KamAZ to reach its planned annual capacity of 150,000 trucks and 250,000 diesel engines by the late 1970s to early 1980s. [ ]

[ ] production, in fact, has risen much more slowly than expected—from about 5,000 trucks and 10,000

**Figure 5**  
**KamAZ Truck Production,**  
**1976-85**



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engines in 1976 to about 105,000 trucks and 150,000 engines in 1984 (see figure 5). We estimate that 115,000 KamAZ trucks will be produced in 1985. Slippage in the original goal for bringing KamAZ on line has been caused by a combination of the usual Soviet industrial problems, including construction lags, supply shortages, poor inventory control, and poorly trained and unmotivated workers. [ ]

[ ] we believe the plant will probably reach projected capacity somewhere near 1990—in the late 1980s or early 1990s. [ ]

#### Productivity

Soviet literature indicates that the planners expected the average worker at KamAZ to produce at least 50 percent more than his counterpart at the Volga Automobile Plant (VAZ, the Fiat-constructed turnkey plant that began producing cars in 1973). VAZ labor productivity, in turn, was about one-third higher in the mid-1970s than that at the premier Soviet-equipped plant, the ZIL truck plant in Moscow. [ ]

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We do not know how well KamAZ is meeting its productivity goals, but [ ] it is not the model of efficiency that it is intended to be. Reportedly the buildings are cluttered and the equipment poorly maintained. Worker morale is said to be low, causing abuse, vandalism, and a lackadaisical attitude toward the job. For example:

- [ ] the rate of truck frame manufacture fell from 120 per day in 1977 to 80 during parts of 1978. The decline reportedly was due partly to ill-treatment of factory equipment by workers and the resulting breakdowns and partly to delays in the receipt of materials. To counteract the slowdown, plant managers added more shifts during parts of 1978.

- [ ] in 1975 the USSR purchased 86 automatic riveting machines, worth about \$3.2 million, for KamAZ. As a result of abuse, vandalism, and theft of parts by KamAZ workers, most of these machines were inoperable within two years.

- Of the 16 automatic forges purchased for KamAZ, seven were installed by US technicians in February 1977, with the remainder expected to be installed by the Soviets and operational by about midyear. [ ] as of March 1979 the others still had not been installed. In addition, [ ] the unskilled Soviet operators were able to obtain only one-half of the expected output from the machines that were working.

Personnel turnover at the main plant in Brezhnev has been high (about 15 percent annually), despite special incentives and bonuses. In 1979 employment at the plant reached about 80,000—but, during the four years 1976-79, 39,000 workers had come to KamAZ and gone. One of the major reasons given was the acute housing problem in Brezhnev. [ ]

### Truck Production

**Numbers.** About 600,000 KamAZ trucks were manufactured from 1976 to May 1985 (see figure 6). Production figures are provided by the Soviet media [ ] and estimates are based on our general knowledge of plant performance. [ ]

In 1984, according to our estimates, KamAZ manufactured about 13 percent of *all* the Soviet Union's trucks (heavy, medium, and light) and about 47 percent of its general purpose heavy trucks (those with over 5 tons capacity). When the plant reaches its originally planned capacity, it will account for about 17 to 18 percent of all Soviet truck production.

According to Soviet press reports [ ] about 10 percent of all the KamAZ trucks produced so far have been exported. They have gone to Czechoslovakia, East Germany, Poland, and probably other East European countries; Nicaragua and Cuba; and Great Britain, South Africa, France, and Finland. [ ]

**Models.** KamAZ production consists almost entirely of three basic models (see figure 7 and table 3). Two highway trucks, the KamAZ-5320 and the KamAZ-5410, entered production in 1976. A variant of the KamAZ-5320, with greater mobility, was first produced in 1981. We believe this variant, the KamAZ-4310, was designed primarily for the military, although the Soviets said the major users would be agriculture and industries in remote areas. Variants of the basic truck models incorporate several features that make them especially suitable for military application. In all, KamAZ makes 15 to 20 configurations of its three basic models, including dump trucks and prime movers, for use in the military and in the civilian economy. [ ]

KamAZ trucks are built to Soviet designs prepared by the Kriger Design Bureau, which is a part of the ZIL production association. [ ]

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### Annual Truck Production at KamAZ

The estimates of annual production illustrated in figure 5 are based on the following information and analytical assumptions:

- Production figures (202,000) for the five-year period 1976-80 are provided in Soviet open literature.
- Our estimate for 1981 (75,000 trucks) is based on a daily production rate reported in Pravda in August of that year

(The calculation of an annual production rate from daily rates is necessarily imprecise, because daily rates can fluctuate, depending on material shortages, equipment problems, and other factors. Therefore we give estimates of annual production as a range—the possible high and the possible low production. We believe KamAZ has operated between 275 and 300 days per year.)

- Our estimate (85,000) for 1982 is based on a daily average production rate

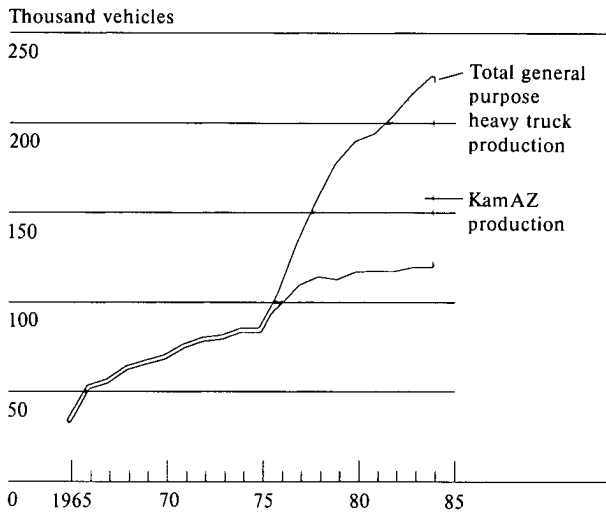
We believe the second assembly line made its first significant contribution to overall KamAZ production in 1982.

- Our estimate for 1983 (95,000) is based on , a reported Soviet production goal of 90,000 for that year, and our general knowledge of the plant.

- The estimate for 1984 (about 105,000 trucks) is based on our judgment that the plant is overcoming problems and gradually increasing production and on a Soviet press report that at least 500,000 trucks had been produced by April 1984 and about 550,000 by early December 1984. This figure is consistent with our other estimates.

- The estimate for 1985 (about 38,000 through early May 1985 and about 115,000 for the year) is based on a total provided in a Moscow television broadcast, which said that KamAZ had produced a total of 600,000 trucks by May 1985.

**Figure 6**  
**Soviet Production of General Purpose Heavy Trucks, 1965-84**



General purpose heavy trucks include those from KamAZ, the Ural Truck Plant in Miass, the Kremenchug, Kutaisi, and Minsk Truck Plants, and two models from the Likhachev Truck Plant in Moscow. These plants supply almost all military trucks. (Heavy mining trucks are not included in these calculations.)

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KamAZ trucks are designed to be simpler and cheaper to service than other Soviet medium and heavy trucks; a KamAZ is supposed to cover a maximum of 300,000 kilometers before major overhaul and to have a maximum service life of 400,000 to 500,000 km. Trucks replaced, like the ZIL-130, have a service life of 350,000 km. Some drivers have complained, however, that the KamAZ diesel engine is underpowered and that the cooling system is inadequate.

**Prospects.** New truck models are planned for KamAZ.

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### ***The KamAZ Truck***

*KamAZ trucks look like heavy US interstate common carriers but are actually quite different. For example, they are designed to operate on a broad range of road surfaces and conditions, because only about 40 percent of Soviet roads are paved with asphalt or cement. All the current KamAZ models are three-axle trucks designed with the weaker roads and bridges in mind, and they impose a load of no more than six tons per axle. This allows them to be used on nearly the entire network of Soviet public highways. In addition, KamAZ trucks are designed to operate under extreme climatic conditions (-40C to +50C). They have three-seat cabs with good noise insulation, an efficient heating and ventilating system, and power-assisted steering, and they have an improved braking system. Some have a sleeping compartment for long-distance hauls.*

*KamAZ trucks are used in a variety of work. In the construction industry the general purpose KamAZ vehicles haul men and material, while special-purpose construction models include dump trucks, tanker trucks, and cement mixers. A special-purpose variant of the KamAZ-5320 designed for agriculture has a stake bed that can tip to either side. Several variations of the KamAZ-5410 tractor truck have been designed for use with trailers for long-distance hauling. The KamAZ-4310—the primary military model—has been built in open and closed cargo versions and as a tractor truck, and it could be used as a mounting platform for multiple rocket launchers and as a prime mover for artillery. KamAZ trucks have also been built in a tanker version for military petroleum, oil, and lubricant (POL) units.*

*in 1981 the Soviets were planning to expand KamAZ production facilities to build a new line of vehicles. The new trucks were described as having a capacity of 15 metric tons and cruising on highways at speeds above 100 km/hr. In an interview published in the December 1984 issue of the Soviet journal *Molodoy Kommunist*, the general director of KamAZ implied that in a few years the plant would produce a two-axle tractor with the same load capacity as the KamAZ-5410 three-axle tractor-trailer*

### ***Soviet Truck Design: Heightened-Mobility Variants***

*Soviet truck designs are greatly influenced by the rough roads and harsh climates within the Soviet Union. The Soviets generally build both highway (limited-mobility) and off-highway (heightened-mobility) trucks from the same design. The highway models are primarily for the civilian sector, the heightened-mobility models primarily for the military. Examples of highway trucks are the KamAZ-5320 and the KamAZ-5410, whose off-highway counterparts are the KamAZ-4310 and the KamAZ-4410.*

*The military variants usually have all-wheel drive, winches, reinforced frames, locking differentials, all-terrain tires, heavy-duty generators, hermetically sealed assemblies and electrical equipment for deep fording, and tire inflation and deflation systems controlled by the driver from the cab. These features allow the trucks to operate year round on a variety of terrains.*

*The military uses limited-mobility trucks for logistic support in rear areas on paved roads and highways. These models are normally produced several years before the military variants. As a result, the military trucks have fewer defects and cost less than the vehicles produced earlier.*

*(19 metric tons). The existence of a new model was confirmed—a two-axle vehicle longer than any of the currently produced KamAZ trucks was sighted in the storage area beside the final assembly buildings.*

*KamAZ's capability to reach its planned annual capacity of 150,000 trucks will in part be determined by production of this new two-axle vehicle, which we believe will not be put into series production before 1986. If it is produced on existing assembly lines, operations will be disrupted by the necessary retooling. If the plant is installing a third line, however, and*

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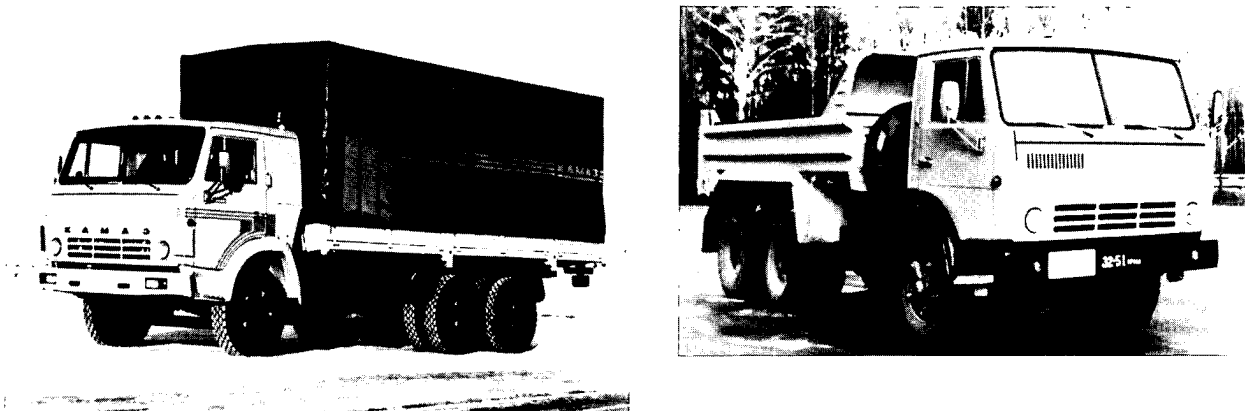


Figure 7. KamAZ Trucks. Clockwise from top left: KamAZ-5320, KamAZ-5510, KamAZ-5410, KamAZ-4310.

the new truck is produced on it, there will be relatively little overall disruption, and planned annual production will probably be reached even sooner than the date (roughly 1990) we have projected.

We believe that when the two lines at KamAZ are operating at planned capacity, the plant could produce trucks at an annual rate of more than the planned 150,000, at least for short periods.

the final assembly area of the plant operates with two shifts working five and a half days a week. If it were converted to a six- or seven-day, three-shift schedule—and if labor shortages and inventory and supply bottlenecks did not interfere—production could rise to an annual rate of 175,000 to 200,000 trucks. A surge of this kind could reflect a decision in Moscow to at least temporarily increase capacity—in the event of industrial mobilization, for example, or to compensate for production problems at other Soviet truck plants. But we believe this rate would be difficult to sustain.

Adding a third truck assembly line at KamAZ, however, would permit higher production with normal operation. Soviet media indicate that the first two lines already can support the rated capacity of 150,000 trucks per year.

#### Engine Production

Three models of diesel engines are produced at KamAZ—the V-8 YaMZ-740 (210 HP), the V-8 YaMZ-7401 (180 HP), and the V-10 YaMZ-741 (260 HP).<sup>8</sup> We judge that the V-8s account for most of the production. Each model is used in one or more KamAZ trucks, and both V-8 models are used in other Soviet trucks (the UrAZ-4320, for example) and in passenger buses.

<sup>8</sup> "YaMZ" is the acronym for the Yaroslavl' Diesel Engine Plant, which designed and produced the first KamAZ engines.

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**Table 3**  
**Characteristics of KamAZ**  
**Trucks Currently Produced**

| Model <sup>a</sup>                              | 5320        | 5510 <sup>a</sup> | 5410                  | 4310        |
|---|-------------|-------------------|-----------------------|-------------|
| Type  | Cargo truck | Dump truck        | Tractor truck         | Cargo truck |
| Configuration                                   | 6 x 4       | 6 x 4             | 6 x 4                 | 6 x 6       |
| Load capacity (kg)                              | 8,000       | 10,000            |                       | 5,000       |
| with trailer                                    | 11,500      |                   | 19,000                | 7,000       |
| Weight (empty, kg)                              | 6,800       | 8,770             | 6,445                 | 8,410       |
| Wheelbase (mm) <sup>b</sup>                     | 3,690/1,320 | 4,160/1,320       | 2,840/1,320           | 3,340/1,320 |
| Length (mm)                                     | 8,295       | 4,600             | 6,140                 | 7,610       |
| Height (cab) (mm)                               | 2,630       | 2,630             | 2,630                 | 2,800       |
| Engine model                                    | YaMZ-740    | YaMZ-740          | YaMZ-740 <sup>c</sup> | YaMZ-740    |
| Horsepower <sup>d</sup>                         | 210         | 210               | 210                   | 210         |
| Maximum speed (km/hr)                           | 85          | 80                | 85                    | 80          |
| Fuel consumption, loaded<br>(liters per 100 km) | 22          | 26                |                       | 30          |
| with trailer                                    | 35          |                   | 35                    | 40          |

<sup>a</sup> The models presented here are the basic type for each of the three "families" illustrated in figure 7. Each family has several variants; the only one shown is the 5510, a variant of the KamAZ-5320.

<sup>b</sup> The first number is the wheelbase length from the first to the last wheel, the second is the distance between the rear wheels.

<sup>c</sup> The KamAZ plant produces several engine models, all of them diesel; these are discussed under "Engine Production." The V-8 KamAZ-740 has 210 horsepower. The KamAZ-741 10-cylinder engine, which is rated at 260 horsepower, is used in some variants of the KamAZ-5410, such as the KamAZ-54102 tractor truck.

<sup>d</sup> The horsepower ratings presented here follow Soviet state standards; an engine with equivalent power would have a slightly higher rating if it was rated according to standards used in the United States.

Sources: *The Billion Dollar Beginning*, Chase World Information; Jane's *Military Vehicles and Ground Support Equipment 1984*; US Department of the Army, Foreign Material Catalog, TB-381-5-22A.

Since KamAZ began producing engines in 1976, some reports have alluded to production of 12-cylinder diesel engines for military armored vehicles. While reports indicate that castings of 12-cylinder engines have been made (probably in experimental molds), we believe series or even batch production of these engines probably has not begun.

the casting equipment used at KamAZ was designed for the production of 8- and 10-cylinder engine blocks, and converting it to the casting of 12-cylinder types would be difficult. In addition, although the YaMZ engines currently produced at KamAZ have sufficient horsepower to be used in armored vehicles, they were not designed for that use. The engines generally used in Soviet armored vehicles

are specially designed and are relatively compact, powerful, and light—as opposed to the larger, less powerful, and heavier engines used for trucks.

#### Dump Truck and Trailer Production

in 1983 the Neftekamsk Assembly Plant assembled about 20,000 dump trucks on chassis made at Brezhnev. The Krasnoyarsk trailer works, which in 1981-82 produced about 20,000 trailers annually for KamAZ trucks, is increasing its production floorspace. According to Soviet press reports, it will turn out about 100,000 trailers

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per year when it reaches capacity. The Soviet press reports that the Stavropol' trailer works manufactured about 100,000 trailers, also for KamAZ vehicles, annually in 1983-84. [ ]

### Distribution of KamAZ Trucks

KamAZ vehicles have been delivered to a wide variety of civilian and military users. These general purpose trucks can be applied to almost any task requiring medium-to-heavy hauling capacity. Their high utility and high quality have made them much in demand. [ ]

Patterns of use of KamAZ trucks have been mainly influenced by the phasing into production of different truck models. During 1976-80, the plant produced only the limited-mobility KamAZ-5320 and -5410, suitable for highway travel and mostly civilian uses. The introduction of the heightened-mobility KamAZ-4310 in 1981 opened up new military and off-road civilian applications. [ ]

### Civilian

KamAZ trucks have been delivered to the so-called common carrier fleets under the control of the various USSR republics, to industrial ministries and plants, and to agricultural organizations. We cannot accurately estimate deliveries to the different users, but the Soviet policy of increasing the importance of the centrally controlled common carrier fleets suggests that in the civilian economy they have first call on KamAZ trucks. Moreover, the Soviets have emphasized the centralization of control in areas where KamAZ vehicles are expected to play a large role, such as long-distance hauling and the movement of construction material. [ ]

The ruggedness and reliability of KamAZ vehicles reportedly make them especially valuable in harsh climates—for example, in the construction of the Baikal-Amur Mainline (BAM) railway in Siberia—in the agricultural sector, and in areas where the roads are unpaved. [ ]

KamAZ trucks are considerably more costly to build than the trucks they are replacing, but they could provide overall savings for the purchasers if they are

**Table 4**  
**Comparison of KamAZ Trucks and**  
**Those They Are Replacing<sup>a</sup>**

| Limited-Mobility Trucks          | KamAZ<br>5320 | UrAZ-<br>377 | ZIL-130   |
|----------------------------------|---------------|--------------|-----------|
| Entered series production (year) | 1976          | 1965         | 1964      |
| Power drive                      | 6 x 4         | 6 x 4        | 4 x 2     |
| Maximum payload (metric tons)    | 8.0           | 7.5          | 5.0       |
| Maximum cruising speed (km/hr)   | 85            | 75           | 90        |
| Total service life (km)          | 450,000       | 150,000      | 350,000   |
| Service life (metric tons)       | 3,600,000     | 1,125,000    | 1,750,000 |

| Heightened-Mobility Trucks       | KamAZ-<br>4310 | UrAZ-<br>375 | ZIL-131   |
|----------------------------------|----------------|--------------|-----------|
| Entered series production (year) | 1981           | 1961         | 1966      |
| Power drive                      | 6 x 6          | 6 x 6        | 6 x 6     |
| Maximum payload (metric tons)    | 5.0            | 4.5          | 3.5       |
| Maximum cruising speed (km/hr)   | 80             | 75           | 80        |
| Total service life (km)          | 300,000        | 175,000      | 300,000   |
| Service life (metric tons)       | 1,500,000      | 787,500      | 1,050,000 |

<sup>a</sup> The service life given for each model is based on Soviet-claimed standards for the most recently upgraded version of that model; it probably is not reached by most individual vehicles.

operated efficiently (see table 4). The larger KamAZ capacity and longer operating lifetime should more than offset higher unit cost (which [ ] ranges from 50 to 100 percent higher than the cost of the models they replace). [ ]

KamAZ trucks also afford substantial operating efficiencies. Diesel-powered KamAZ trucks are substantially more fuel efficient than equivalent gasoline-powered models, and diesel fuel is cheaper. For example, the diesel KamAZ-5320 can haul 8 metric tons at a cruising speed of about 60 kilometers per hour using about 22 liters of fuel per 100 km. The gasoline-powered UrAZ-377, capable of hauling 7.5 tons at only about 40 KPH, uses about 45 liters of fuel per 100 km.<sup>9</sup> [ ]

<sup>9</sup> Fuel consumption is calculated for a loaded truck; actual fuel consumption rates depend on the load weight and other travel conditions. [ ]

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[redacted]  
[redacted] motor vehicle transport accounts for about 60 percent of all the gasoline, diesel, and other light fuels used in the USSR. In 1980, [redacted] civilian vehicles consumed about 52 million metric tons of gasoline and nearly 11 million mt of diesel fuel. According to Soviet plans, when the nationwide fleet of vehicles contains 1.5 million with KamAZ engines—in the mid-1990s—the whole fleet will use about 10 million mt of fuel per year less than it would have used with the older engines. [redacted]

In addition to their capacity and fuel economy, the newer KamAZ trucks appear to be more reliable and more easily maintained than the models they are replacing. They can apparently be driven about 50 percent farther between routine checkups and about 25 percent farther between major overhauls. This affords substantial potential savings in drivers and maintenance personnel. [redacted]

#### **Military**

KamAZ trucks have been deployed extensively with the Soviet and, to a lesser extent, the non-Soviet Warsaw Pact and other allied military forces. They are replacing or augmenting the military inventory of smaller, older trucks, particularly the UrAZ-375 and -377 and ZIL-130 and -131 models. In the services, as in the civilian sector, their increased effectiveness probably more than offsets their higher cost. [redacted]  
[redacted]

The most important benefit provided by KamAZ trucks is to increase the lift capacity of motor transport units. The 8-ton KamAZ-5320 trucks give the unit a lift capacity about 60 percent greater than that of the 5-ton trucks they are replacing, without increasing the unit's requirements for drivers, fuel, and maintenance resources. Units using the 5-ton KamAZ-4310 maintain their lift capacity if they replace older 5-ton trucks or increase it if they replace 3.5-ton to 4.5-ton trucks. This increased lift capacity is being provided at a time when the logistic requirements of the Soviet forces are expanding. The growing proportion of diesel trucks in the military truck fleet is particularly helpful to rear service units, which are already set up to provide diesel fuel for most armored vehicles. [redacted]

By the early 1980s the military was acquiring KamAZ trucks in large numbers. [redacted]

[redacted] Soviet military motor transport units, for example, in East Germany in 1983 reveals that of trucks in use (excluding those in storage), about 65 percent—nearly 3,000—were KamAZ models. This 65 percent accounted for about 47,000 metric tons of lift—almost 75 percent of the unit's transport capacity.<sup>10</sup> [redacted]  
[redacted] KamAZ trucks are being deployed in greater numbers in frontline areas in Warsaw Pact forces, increasing the mobility of ground force units. [redacted]

#### **Estimates of Military Acquisitions**

We estimate that from 45,000 to 65,000 KamAZ trucks were delivered to the Soviet armed forces between 1976 and the end of 1984. The paragraphs that follow present the individual estimates on which this total is based, as well as the evidence and the methods employed. [redacted]

Analysis of imagery, [redacted]

[redacted] indicates that during 1976-81 about 14,000 trucks—at least 5 percent of total KamAZ production—went to the military. All of those trucks were limited-mobility KamAZ-5320s and -5410s, used mainly for rear service logistic support. [redacted]

Deliveries to the military began to rise steeply in 1982. We base this conclusion on increased sightings and on our judgment (discussed under "Truck Production") that most of the increased number of trucks produced after 1982 were the KamAZ-4310 produced on the plant's second line. This pattern is typical for the acquisition of general purpose trucks. The military first acquires limited quantities of the civilian variant; then, when the military variant goes into series production (normally three to five years later), deliveries of trucks from that particular plant increase.

[redacted]

[redacted]

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For 1982, we estimate that KamAZ delivered about 8,500 trucks to the military. This figure is derived from:

- Our calculation, [redacted] that total 1982 production was 85,000 trucks (figure 5).

For 1983 and 1984, we assume that:

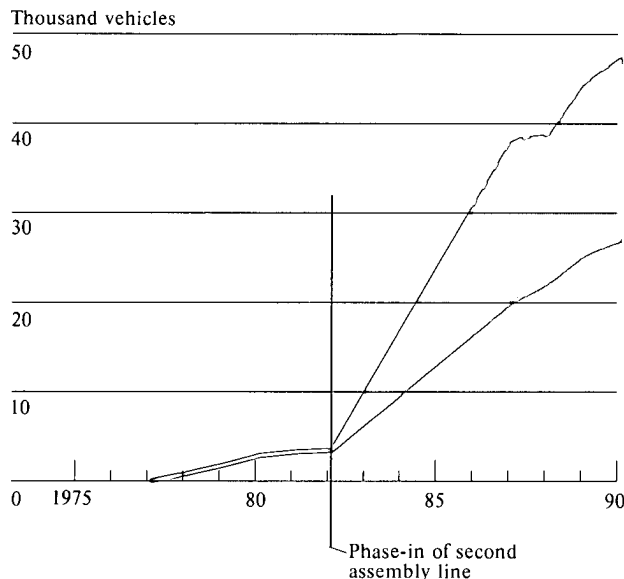
- About 5 percent of all vehicles produced each year in the limited-mobility KamAZ-5320 and -5410 series are delivered to the military. This assumption is based on our estimates of previous deliveries of these trucks and a belief that the percentage has not changed.
- All production above 75,000 per year comes off the second assembly line; this assumption is supported by estimates of the line's capacity. We believe that all of the heightened-mobility KamAZ-4310s are produced on the second line, and we assume that 60 to 90 percent of the vehicles from this line are 4310s.
- Of the 4310s produced, 55 to 75 percent are delivered to the military. We base this assumption on the fact that most of the heightened-mobility variants of other general purpose trucks have been delivered to the military.

By assigning a range of low and high values to these judgments, we calculate that about 31,000 to 53,000 KamAZ trucks were delivered to the military during 1982-84. [redacted]

Using the same assumptions, we estimate that an additional 17,000 to 32,000 will be delivered in 1985 (see figure 8). This will amount to 15 to 27 percent of the total production that we estimated for the KamAZ plant. [redacted]

[redacted] the KamAZ rail transshipment yard validates the order of magnitude of our estimates of KamAZ deliveries to the military. About 10 percent of the yard is separately secured, and in

**Figure 8**  
**Estimated Deliveries of KamAZ Trucks to the Military, 1976-89**



Estimates are year-end totals.

76-84 Based on production estimates.

85-89 Projected production.

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early 1985 it contained about 15 to 20 percent of the trucks in the yard. The secured area contained only KamAZ-4310s and tractor trucks that we believe are KamAZ-4410s—a 6x6 variant of the 4310. All trucks in this area were of the same color tone, probably olive drab.<sup>11</sup> Other KamAZ models also go to the military, but they apparently are stored outside this special area. [redacted]

Production trends, plus analysis of the transshipment yard, suggest that when the plant is operating at capacity KamAZ will supply 30,000 to 45,000 trucks to the military each year. This would include a

<sup>11</sup> Olive drab normally indicates military vehicles. We believe a small number of civilian trucks are painted olive drab, but these are probably not held in the secured storage area. [redacted]

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majority of the 50,000 KamAZ-4310s that we estimate will be produced each year, several thousand KamAZ-5320s, some KamAZ-5410s, and probably some of the "new" two-axle KamAZ trucks. Under these steady-state conditions, KamAZ would deliver about 20 to 30 percent of its output to the armed forces. This is roughly the same share as prevailing in the Soviet truck industry as a whole.<sup>12</sup> [redacted]

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<sup>12</sup> [redacted]  
[redacted] we estimated that 20 to 25 percent of total Soviet truck production between 1970 and 1980 was allocated to the military. [redacted]

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