JPRS-UEQ-87-012 034106
6 NOVEMBER 1987

FOREIGN BROADCAST INFORMATION SERVICE

JPRS Report

Science & Technology

USSR: Engineering & Equipment

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

10
159
A08

JPRS-UEQ-87-012

6 NOVEMBER 1987

SCIENCE & TECHNOLOGY

USSR: ENGINEERING & EQUIPMENT

CONTENTS

PROCESS CONTROLS, AUTOMATION, ELECTRONICS

MISCELLANEOUS

/13046

HORIZONTAL ELECTRODE METHOD FOR METAL REGENERATION

Moscow STROITELNAYA GAZETA in Russian 12 Mar 87 p 4

[Article by V. Romanchin under the rubric "Search, Ideas, and Solutions": "It Has Been Developed--Now Introduce It: A New Life for Metals"]

[Text] How to restore a worn-out part? This problem was studied by scientists at several scientific-research institutes. Now, the first results are obtained.

Specialists at the department for welding processes intensification at VNIImontazhspetsstroy [the All-Union Scientific-Research Institute for Installation and Special Construction], under the leadership of Candidate of Technical Sciences I. Ivochkin, developed an original unit for the regeneration of steel part surfaces using the facing method. The unit was demonstrated at the VDNKh SSSR [USSR Exhibition of Achievements of the National Economy], and was awarded gold and silver medals.

What is new in Ivochkin's method?

Ivan Mikhailovich says "Our principle is based on electric arc welding using a horizontal electrode. This substantially simplifies the unit design, doubles its output, and improves the quality of the worn part regeneration."

The unit is small and compact, and its operation is simple. If, for example, you have to restore the teeth of a caterpillar tractor sprocket, put the part on the working table of the welding unit, wrap a thin electrode around the teeth, and pour small metal granules on top of the teeth. Now, the only thing that is left to do is to press the start button, and after several seconds the sprocket's surface recovers the dull shine of newly surfaced metal.

This original method had already been implemented at some repair plants of Minmontazhspetsstroy [the USSR Ministry of Installation and Special Construction]. This method is especially efficient when the restoration of shaped surfaces is required, because the electrode may be easily shaped to any form.

The implementation of only one such unit into industry will save about 30,000 rubles per year. And wide implementation of this method will save millions of rubles.

Wide benefits will also result from the method developed in the Institute of Strength Physics and Material Science at the Siberian Division of the USSR Academy of Sciences.

Using technologies developed by scientists, the shop of the Tomskneft industrial associations implemented fundamentally new technologies for restoring the drilling and oil industry equipment using methods of hot gas spraying.

The pilot shop operation will result in annual savings of around 900,000 rubles. The implementation of each 1,000 tons of parts from powder wills ave the labor of 190 laborers and will allow the industry to release 80 metal-working machines.

13355/13046
CSO: 1861/161

BELORUSSIAN MACHINE-TOOL QUALITY CRITICIZED

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 87 pp 18-19

[Article submitted by V. Tarasevich, special correspondent of NARODNOYE KHOZYAYSTVO BELORUSSII, consisting of comments by three Belorussian workers on the quality of machine tools operated by them: "Candidly Concerning Machine Tools"; first three paragraphs are source introduction]

[Text] For a long time the editorial office put out a column heading "For the Best Machine Tools in the World." Under it, there were printed correspondence, articles and interviews concerning vital problems of the sector for securing basic changes in the technical level of machine building. Currently, attention on these questions has become intensified. Belorussian machine-tool makers in the 12th Five-Year Plan must not simply increase production output but qualitatively renew it. We refer to increasing production of machine tools with numerical control, of machining centers and of robots and robotic systems.

A decisive step in raising production quality, including that of machine tools, was the introduction of state acceptance. The actual system of state acceptance primes collectives of enterprises to create all the conditions for labor efficiency at each workplace. It is necessary not only to set up a screen against defective output but also to prevent its appearance. It is clear that for this work to proceed successfully the user's opinion should be taken into account, first and foremost the machine builders. We invited readers to take part in a discussion on the pages of the journal of unresolved questions hindering the accelerated development of machine-tool building and in an exchange of advanced experience.

Today specialists from three enterprises express their comments and wishes. As the reader will observe, the criticism is by no means of a one-sided character. Thus Minsk tractor builders are dissatisfied with the quality of products of the Vitebsk Tool-Grinding Machine Plant imeni 22d CPSU Congress. In his turn, the chief of the shop of this enterprise objectively assesses the equipment made at Minsk plants. These interviews did not have as their purpose the provision of an all-embracing analysis. They dealt with what was most pressing and with bottlenecks. At the same time, machine builders did not forget to put in a good word for those who supplied them with reliable modern equipment.

L.G. Pugach, chief machinist of Brest Machine-Building Production Association:

"I shall speak initially of the specifics of our association. It was formed in spring of last year on the basis of two plants. We produce equipment for enterprises of the meat, dairy and textile industry. The assortment is very diverse: pumps for pumping milk, machines for making sausages, storage devices for threads, trucks with hydraulic drive, poultry processing lines and consumer goods. It goes without saying that the association's equipment stock is large, containing 1,240 units; 40 of its machine tools have numerical control.

"It is of no particular importance where this equipment is made. The main thing is that it have high productivity and that it go less frequently out of order. But fulfilling the condition set by the editorial board, I shall discuss in greater detail machine tools bearing the brands of Belorussian enterprises.

"Thanks to the collective of the Orsh Krasnyy Borets Plant for grinding machines. Their merits have already been noted in the press, I shall not repeat them. I want to stress that this equipment in addition to its high technical characteristics is also good looking. And that is how it ought to be: in designing machine tools, one has to think of those who will be working with them and with what impression its external appearance will produce. Unfortunately, these requirements were neglected by Molodechno's machine-tool makers. Their turret drilling machines are very unattractive and their artistic design work is manifestly not on today's level. Incidentally, I, as the chief mechanic, am the first to be concerned about reliability and maintainability of equipment.

"I would like to ask the Molodechno comrades why oil constantly drips down the spindle of the vertical turret drilling machines. Finally, why under these circumstances are the speed change box and the feed gear box so unreliable? Try to eliminate these breakdowns and you are obliged to completely remove and dissassemble the spindle. The work is bound to tie up two repairmen for a shift.

"There are also complaints about the UG 9421 automatic heads put out by the Gomel Plant of Machine-Tool Components. In changing the tool, they are frequently jammed. And despite the fact that an engineer designer came to us to regulate these heads, we were unable to do any reliable work. It was necessary to buy new ones.

"Nor are we satisfied with the organization of the work of specialists in adjusting machine tools. The complaints about Gomel adjusters are particularly many. For more than a year now they have been unable to put the lathes and robotic complexes into operation. Of course, a contract was concluded with them for start-up and adjusting work, but these contracts contain a provision which makes the plant completely dependent on the adjuster contractors: they themselves determine the time periods for completion of the work. The only thing left is to invoke the professional pride of the Gomel specialists. I will state that their Volgograd colleagues did this same work a lot faster and left a good impression behind them. This means that it is not just a case of a standard contract being deficient.

"I would like to speak separately about machine tools with numerical control. Replacement of programs is fraught with many difficulties, yet GDR machine-tool builders were able to solve this problem through standardization of numerical control devices. If a processor goes out of order and it is not possible to repair it at its place, the job drags out over many days. It is necessary to take the unit to Minsk. Moreover, a single trip as a rule is not enough. At one time it was necessary to send the processor for repair, but the machine tool even now does not carry its load.

"The planers that we have from the Minsk Plant imeni the October Revolution are no longer new. Obviously, more advanced are now being manufactured. It would be desirable if their guides were protected with housing or shields. Planer operators are not happy with the dial of the carriage feed: the division markings are not precise. Consequently, it is difficult to secure machining precision, and it becomes necessary to make use of gauges or depend on intuition, on "feel," as the planers say. Incidentally, boring machines, for example, have special optical attachments. Why not do the same for planers?

"Machine-tool builders very likely pay no attention at all to the documentation accompanying new machine tools. The listing of possible failures is quite incomplete, and so is the catalog of rapidly wearing out parts. Oddly enough, those parts not mentioned in the catalog have a shorter service life. I would like the documentation to have more detailed instructions on how to repair various breakages and to have the hydraulic system described in detail. Finally, such documentation for each machine tool should come in several copies. This applies particularly to diagrams."

V.I. Fedotov, chief of the castings and forgings shop of the Vitebsk Tool-Grinding Machine Plant imeni 22d CPSU Congress:

"According to tradition, special concern is paid to the development of castings and forgings production at our plant. It has the main burden of preliminary machining, and the blanks go to the machine shops with minimal allowances. In our shop the mechanized cutting sector, made by the Minsk Machine-Tool Building Plant imeni S.M. Kirov, has now been in operation for several years. It made it possible to significantly lighten the labor of workers: heavy rolled metal is fed to machine tools by mechanisms, and there is no need for a worker to handle sling ropes. There are no criticisms of this sector's work.

"But now production is becoming increasingly saturated with automated equipment. Consequently, I would like equipment that can be programmed to be produced for castings and forgings shops. After all, each time a machine tool needs to be readjusted to a required diameter, you need to measure the length of a blank and to keep count of them by hand. I think that Minsk designers are capable of automating these operations with the help of electronics. In my opinion, it would not be a bad idea if they would program adjustment and cutting processes for a work shift.

"Cutting machines are designed for rolled metal with a diameter basically of 50 to 100 millimeters. And why are not machine produced that could cut up small blanks of 30 to 50 millimeters? After all, not every plant can make such equipment with their own resources.

"And here is still another problem--what to cut with? Circular saws belong to yesterday. When will our industry finally satisfy the need of machine builders for an abrasive tool? Their advantages are well known: sharpening is not required, cleanliness of the cut is improved and labor productivity is increased. I do not know whether there are many band-cutting machines at Belorussian enterprises--we managed to see them only at an exhibit.

"The slab milling machines of Minsk Plant imeni the October Revolution have not been installed in our shop. But I feel it necessary to talk about them. You constantly hear at plan-fulfillment workers' conferences criticisms of the operation of this equipment. They frequently go out of order. The power of the drive is inadequate. The tool's clamp, which is made by the Gomel Plant for Machine-Tool Assemblies, is particularly unreliable. But try to replace it. You have to remove the power drive's electric motor, the distribution box and to disconnect the electric cable. It is very inconvenient to position the table for the motor of the power drive after the repair work. Fitters have to work bent double. All this is far from a trifle.

"Possibly, it may be unpleasant for Minsk's machine-tool builders to hear this, but the equipment from Gorkiy Milling-Machine Plant is much more reliable and more powerful."

K.V. Kirilchik, deputy chief machinist of Minsk Tractor Plant:

"At the conference on the question of increasing the level of technical equipment of the country's agroindustrial complex, Mikhail Sergeyevich Gorbachev, addressing himself to machine builders, said: 'Work on the basis of comradely understanding. You are resolving a tremendous state problem. Here the most important interests of society are concentrated.' Right words. We tractor builders very much need an understanding of our concerns and of the responsible tasks facing the sector on the part of those who supply metal, electrical equipment and machine tools.

"Such an understanding and a readiness to come to someone's aid have always been shown by the workers of Minsk Production Association for the Production of Automatic Lines. They do not wait for the equipoment to go out of order. Specialists of the reliability bureau themselves come to us at the shop and attentively study the operation of machine tools and lines bearing the brand of their association. We modernize old equipment with their help. At the plant for automatic lines, they redesign and make gantries, spindle boxes and other components. And when a machine tool assembled at the Baranovichi Plant for Automatic Lines went out of order, we also were rescued by the people from the Minsk plant.

"And how did those who made this machine tool behave? They soon provided us with another with the same defects. We have many complaints concerning the

Baranovichi machine-tool builders. Take the special AB 1771 transfer machine on which drilling and boring operations have to be performed. It has a poor clamp for the blank, the spindle heads lack alignment and working precision is not secured. We asked for the defects to be corrected. Specialists came from Baranovichi. They tried to adjust their brainchild, but nothing came of it. It was found necessary to ship the unit to the place where it was assembled. After several months, it was returned to us, but we experienced no joy because of this. As before, the weak spot continues to lie in precision of machining. We are not happy with the Baranovichi special transfer machines with a rotating drum because of low maintainability. Should the pinion for turning the drum break--and this happens rather frequently--its positioning is thrown off. Then it is difficult to reposition it.

"It would be logical if suppliers of poor-quality equipment were held to greater accountability and severe economic sanctions were applied to them. This is how it happens when obviously defective items are put out. But try to get individual defects corrected. Yet they reduce to zero all the merits of a machine tool or automatic lines, and one suffers a loss. Thus we had to guarantee to the same Baranovichi plant payment for the costs of designing and fabricating a new spindle box in place of the faulty one.

"I would like to express certain wishes addressed to the Vitebsk Tool-Grinding Machine Plant. Is it really so difficult to get a collector for the cooling fluid? The fact is that puddles are constantly located around the machines, for they do not save the tubs and elbows that we adapted. Because of this, we are obliged to shift to dry grinding and accordingly pay extra to workers. In the machines for sharpening cutters, the hydraulic engine is very unreliable. The same can be said for the device for correcting the disk. These and other work lapses do not permit us to attain the required productivity.

"The sooner designers and those who make machine tools take into consideration our comments and introduce corrections into their work, the more successfully will the task facing agricultural machine-building enterprises be fulfilled of providing agricultural areas with high efficiency equipment."

7697
CSO: 1823/127

MINSTANKOPROM 'ACQUIRES' STANKOIMPORT TRADE OUTFIT

Moscow IZVESTIYA in Russian 21 Feb 87 p 2

[Article by V. Shmyganovskiy, under the "News Panorama: Economics, Service Sphere" rubric]

[Text] If this report were presented in the language, common to the world business, it would sound like: "A large industrial concern (in our case, the USSR Minstankoprom [Ministry of Machine Tool and Tool Building Industry]) has acquired, on very favorable terms, a trade company (Stankoimport), which can considerably enhance its weight in international markets".

Minstankoprom does not need a special introduction. So we shall introduce Stankoimport . The annual trade volume of the association exceeds two billion R. The association used to be a monopoly in the export and import of machine tools, automated manufacturing lines, press-forging equipment and tools. About two thirds of the entire trade volume is with the socialist countries.

What is the essence of combining those who manufacture new equipment with those who sell it?

"What we have been fighting for for a long time, has happened", says I.A. Ordinartsev, First Deputy Minister of Machine Tool and Tool Building Industry. "A foreign trade association that for many years used to be an intermediary between us and our foreign counterparts has, as of January 1, become our own. Its stake in the end result of the industry performance will be the same as our own. Professionals from other associations, such as Avtoimport , Metallurgimport etc., have also been transfered to our Ministry.

"Is it advantageous? We did not have to "buy" the company with over 50 years of experience: the State has given it to us."

"So, now there will be nobody to blame for screw-ups?"

"I am sure there will be fewer of them", says V.I. Marinin, General Director of Stankoimport . "Previously, our interaction was complicated by bureaucracy. In order to solve a problem, I, as the General Director, could not directly approach management of the customer industry: I had to talk to, say, Deputy Minister of Foreign Trade in charge of export. Then, a letter was written that he had to sign, and then the letter was sent to an appropriate addressee... Do I have to continue? And now I only have to pick up a receiver, and Igor Andreyevich [Ordinartsev] and I are solving a number of problems directly, with no paperwork, as it should be the case among real businessmen."

"And now we can put our cards on the barrel", continues I.A. Ordinartsev. "And you know what, the overall picture of our achievements and shortcomings immediately became clearer. Immediate solution of foreign trade problems and reduced time of technical negotiations before signing contracts make it possible to count on efficient industrial cooperation with our foreign counterparts in the future. And in the today's world it is inevitable. Buy here, sell there, tomorrow - in another place, and so on, is a chaotic and ill-managed process. Cooperation puts a lot of things in place. It also results in creation of joint enterprises, which was unthinkable under the old conditions. We tell leading foreign companies: "Let us cooperate. It is better to have a partner than a competitor". Here, in 'Stankoimport , we have even created a production cooperation department."

"Any specific examples?"

"Cooperation of Ryazan machine tool builders with the Olivetti company (Italy), Vilnius machine tool builders with the Macho and Orsha machine tool builders with the Elbschliff companies (both FRG) has produced good results. These products are also being sold to the most developed countries. What is important is that Olivetti that supplies ChPU [CNC] systems had been developing the machine tool design in cooperation, i.e. a specific customer was targeted. Without such flexibility, there is no way to penetrate the today's oversaturated machine tool market."

"What will Stankoinstrument offer in the nearest future?"

"We are planning a very unusual show, or rather a fair of Soviet tooling", answers V. Marinin. "It will not be a gala demonstration, but rather a live concrete market. Contracts will be signed on the spot".

"Let me make it clear", says I.Ordinartsev. "After having worked a lot with former employees of the Ministry of Foreign Trade, we have found, I should say, a promising trend in international markets. See for yourself: it turned out that we manufacture about 800 thousand (!) of various types and sizes of tools. A lot of them have never even been offered to foreign buyers. Here too we were under pressure of the same "gross output" megalomania. But it turned out that this product of ours is in great demand. And we will honor all customers' requests. If in the customer's country this product is made with a yellow handle, then yes, we will run the entire order in yellow. According to your standards and rules this holder must be red? No problem!"

"And the last question, please: how will this benefit the industry?"

"The industry will receive 50% of hard currency allocations. 10% will be given to the Ministry, the rest - to the manufacturing plants. Eight foreign trade companies that have been given the right to directly access foreign markets have been organized at enterprises in Moscow, Ulyanovsk, Kiev, Ryazan and other cities."

"Will the name Stankoimport change?"

"No way! This is a trademark, and people on all continents got used to it over more than half a century".

12770
CSO: 1823/121

IVANOVO PLANTS' RETOOLING PROGRESS CRITICIZED

Moscow PRAVDA in Russian 7 Mar 87 p 2

[Article "Second Line: Why Don't They Use Experience of Local Machine Tool Builders in Ivanovo?" by Z. Bystrova, a PRAVDA reporter, from Ivanovo, under the "Reconstruction: Men of Action" rubric]

[Text] Indeed, why don't they? Today the experience has exact addresses and concrete names. "Reconstruction is risky and burdensome", bluntly states V.P. Kabaidze, a fearless General Director of Ivanovo Machine Tool Building Production Association (ISPO). "He who takes on the road of innovation inevitably takes chances. But, to tell you the truth, one should first take chances, at least reconstruct one's own brains..."

Every time one comes to the association, one faces a fact: they made another step forward. As I go, I catch myself admiring the new multistory apartment building, erected where the road turns towards production buildings of the association. The machine tool builders moved in the other day. Another such 100-apartment building is under construction for a collective customer, UKS [capital construction administration] of Ivanovo gorispolkom [city executive committee]. Composition of personnel at the association is stable, and now one can see the change for better in solving the acute housing problem; social, cultural and communal services are also getting stronger. At a parking lot at the entrance gate--the machine building association seems like a newly-discovered continent rising from the Ivanovo skyline--more and more new cars and buses are parking.

Somewhere here there is an announcement. Whenever the General Director returns from a meeting at the CPSU Central Committee or at the Ministry, or from the international industrial fair in Bulgaria, which is also his workplace as General Director of the international NPO [scientific-production association] "Ivanovo-Sofia", those who wish are invited to meet him. They, the collective of like-minded people, are the first ones with whom Kabaidze shares what is boiling inside him and what has triggered a thought pulse, what has touched and/or inspired him. The meeting room is full of people. Are they here because they have to? Any idle whispers? Not at all! Everything is taken up, absorbed and will be put to use.

It is an amazing group of fighters and innovators who, we shall add, had strapped themselves into rigid self-discipline blinders. They are sure they cannot afford it otherwise. If, for instance, the association gets an assignment to increase the volume of exported products during the Five-Year Plan by 50%, they make all arrangements for doubling the production.

In a year of joint operation within the international NPO framework, the plan for production of machining centers was fulfilled at 111.2%. All in all this represents more than 50 machines in excess of the plan target. Three new models were introduced, and two of them were awarded gold medals at the recent Plovdiv industrial fair.

We are talking technology that forms the basis for flexible manufacturing systems, thus supporting industry retooling, both in the USSR and in the PRB [People's Republic of Bulgaria]. Dealing with extremely science-intensive technology, one must hurry. Each year, a new generation of machining centers (MC) is born. Losing time means falling behind. Cutting extra corners, gaining due to joint development, deeper cooperation, and efficient use of their potential, the international NPO partners are able to gain time too. This is what makes it imperative to clearly realize that making statements, let alone just admiring what can be achieved, is the thing of the past. It is far more important to draw attention to analyzing this progress. How does the machine tool building association manage to do all this?

Where else in Ivanovo can one see production being flushed with such a strong information flow? Where else would people process this flow so thoroughly and with such great interest, fishing everybody at his or her level of the business ladder, for information that is of interest to everybody? Here, the pulse of the international machine tool building industry is checked, thus enriching the common information "bank".

How is all this being achieved? How is it controlled? And how is it stimulated? There are no extra personnel, extra quality control people and/or extra incentives. People find time, they study, they nibble at the language barrier granite. There is only one incentive here: deep personal interest. What is it that motivates these people? Where is this clearly felt smack of obsession, in the very best sense of the word, coming from?

They have proceeded further than many others along the reconstruction road. "Some people, including the Minister, visit us, ask questions, look around and approve", say those at ISPO. "And then they sigh and ask: 'Come clean now, are you guys cheating at all?'"

People at other places are not dummies either and they have comparable equipment, but the results are like day and night. Maybe one should not trust the ISPO people? Maybe it is easier for some people that way? They do not pay attention to an important point. As annual tree rings, turns of the machine tool builders' progress, their style and approach reflect the fate and the age of reconstruction at the ISPO. After all, reconstruction has been under progress at the association for several five-year periods.

In particular, what some places are thriving for and still approaching has already been achieved here long time ago. Those people are called here the "second line", while others are still only aiming at and approaching the problem. And there are those that just dash aside from anything new...

Kabaidze thinks that in all cases, the problem is the same: activization of the human factor. For how many years has the combined schedule of accelerated production of new equipment been effective here? Somewhere in Ryazan and in Plovdiv it is being implemented. But I can assure you that none of Ivanovo directors is in the least worried about this problem.

It was with a bitter feeling of disappointment and unesiness that the machine tool builders were listening to a speech by V. Balinov, General Director of "Ivtekmash", an equipment supplier for the textile industry. "So, to what extent are you using the ISPO experience?" he was asked.

The leader of the association started talking about a number of aspects. An internal aspect, an external one. But the essence of his position was extremely simple: he personally does not feel he has the authority to even slightly deviate from approved standard documentation.

"Ivtekmash" never could and still cannot get hard currency for its products. It has been a long time since the world had been lining up to get its products. It is an olympic tranquility in the face of such modest successes in the textile and light industries.

A year ago, local radio reporters taped a conversation with Ye. Khromov, supervisor, "Ivtekmash" CNC machine tool department, who had been invited and visited the ISPO. The gentleman sincerely envied ISPO tooling and the organization of technical planning.

Another meeting a year later - and nothing has been accomplished.

"Ivtekmash" that in the recent past used to be a venerable and competent company has its own industry branch NII [scientific research institute] and its own experimental plant. It also has a host of problems. And a minimal willingness to make up for the lost time.

Ivanovo "Tochpribor" plant is across the street from the ISPO. Why haven't they jointly blazed trails in cooperation, collaboration and progress here as well?

"There is a difference between them and us", says A. Ugryumov, "Tochpribor" General Director. "They are given, we are not. They get imported components. On the whole, the ISPO lives under green-house conditions".

There is a kernel of truth here. One could not have said it better. The entire country, let alone Ivanovo, knows Kabaidze's catchword: "Rights are not only given. They are also grabbed. But one has to earn the right..."

They are right at the ISPO, when they say that they earn personnel limits, hard currency and imported components by advancing the cause. And by shouldering a superproblem. "Yes, our customer is our favorite person. Before the very word "service" came into vogue, we at the ISPO were trying to first of all organize customer service".

We are saying "reorientation", we are saying "restructuring". In all cases, we are dealing with thinking, whether modern or backward. Professionals from Moscow [automotive] plant imeni I.A. Likhachev and from Gorky automotive plant are not anymore coming here to read lectures and conduct symposiums. With the help of ISPO they themselves make machine tools for flexible manufacturing systems and production lines. Without these, reconstruction and switching over to diesel production at their plants would be unthinkable. Collectives of enterprises and associations from Ryazan and Lipetsk, Lvov and Gomel, Kaunas, Vilnius, Cheboksary and other cities work hand in hand with the Ivanovo machine tool builders. This is the "second line" gathering strength. They make components in accordance with Ivanovites' documentation. Their labor expenses are returning to them in the form of coveted machining centers with the reliable Ivanovo trademark. These, of course, are not words anymore and not just an intent: this is a long-term action.

"They say there is an 'ISPO school' and a 'Kabaidze school'..." continues Kabaidze, thoughtfully. "We are not against it, we will come, if they are expecting us. But let us be honest, for how long can one just keep talking without trying to do something? Admonishments are not the shortest road to a real improvement. How did the "Ivanovo-Sofia" NPO get started? In 1986 the Bulgarians decided to make an IR-200 machining center by the date of their Party Congress. And according to our combined schedule, they decided to make it in four months instead of four years. We supplied frame parts, the spindle assembly and electronic components, and our professionals went there to help them. We offered at NPO our work pace and methods to our NPO partners. The Bulgarian fellow-workers willingly agreed. We were trying to offer the Lvov milling machines plant to start the manufacturing of a scarce IR-320 machining center on the same terms. That plant's entire energy was spent on pettifogging. The time was lost. And today, within the international NPO framework, we are far ahead of this class of machines. We now work on machine tools that employ laser technology".

We again return to where our conversation started. Isn't it time for Ivanovo textile workers and machine builders to more thoroughly utilize the machine tool builders' experience? The Ivanovo oblast Party organization has been always supporting the initiative when it was born: to take up the most promising trend in machine tool building. Why then, as was the case at the very beginning, the ISPO experience is barely finding followers in the oblast? What other decisions and permissions are the machine tool builders' fellow-townsmen are waiting for in order to more actively proceed from words to deeds? Just during the recent months, the ISPO question was twice put on the agenda of meetings of the Ivanovo Party obkom [oblast committee] bureau. The objective was to comprehend and summarize the experience. A resolution was only approved at the second try. Instead of analyzing the method and ways for its dissemination, it only stated what had been known long time ago. The document, compiled from smoothened blocks of words, bricks up the live essence of selflessness of the collective of several thousand people, rather than helps to expose this essence as the help on the road to reconstruction.

Approve, recommend, create a school. We have seen this type of resolution . What is still missing is real action, organizational work in the promising direction. Too many speeches are made to the detriment of live and concrete action.

Kabaidze spent around four hours just outside the bureau meeting room door the day the question was discussed. There were breaks, but he was still standing there. Preoccupied staff employees with papers in their hands had been slipping back and forth past him. When he was invited into the room, he was not given a chance to say a word. What had been the extremely busy man thinking of and feeling during these hours of fruitless waiting? He was looking tired and exhausted.

"Do you have any comments concerning our document, Vladimir Pavlovich?"

With his eyes still looking at the floor, Kabaidze shrugged.

"No comments. You may go".

And that was it?

12770
CSO: 1823/125

BASED ON NEW GENERAL STRUCTURES

Moscow KHOZYAYSTVO I PRAVO in Russian No 2, Feb 87 pp 54-58

[Article by Candidate of Economic Sciences D. Levchuk under the "Problems of management" rubric]

[Text] During the 12th Five-Year Plan, it is planned to first of all ensure radical reconstruction and the ahead-of-schedule development of the machine building complex as the basis for the scientific and technical progress. One of the main conditions for accelerating the development of the machine building industry, as well as of the national economy as a whole, is a radical reform of the business mechanism. Improvement of organizational management structures is an integral part of measures, aimed at restructuring the business system. The 27th CPSU Congress stated the objective of giving management modern organizational structures, taking into account trends of concentration, specialization and production cooperation.

The resolution of the CPSU Centrtal Committee and the USSR Council of Ministers of August 1, 1985, on improving the organizational management structure in branches of the machine building industry paid special attention to improving efficiency of operation of Ministries' staffs and to more precise separation of functions between all management links, while taking into account the increasing role of economic business methods and broadening responsibilities of production associations and enterprises.

At the same time, it is planned to further strengthen associations, expand the scientific sector at factories and plants and more closely integrate science and production. Having started reconstruction of the organizational structure in the machine building industry, all enterprises and associations in this complex have begun working in 1986 under new business conditions, approved in the process of the economic experiment.

Prior to the conversion to the new general structures, management in the machine building industry was basically organized according to a three-tier system: a Ministry - an All-Union industrial association - a production (scientific-production) association or enterprise. Management staff that had been formed by that time became cumbersome and did not meet new requirements.

Under the three-tier management system, a Ministry directed its industry via All-Union industrial associations (VPO), operating on principles of self-support, with the majority of production associations and enterprises directly subordinate to it.

VPO activity was mainly based on administrative management methods, so VPO practically became an additional management layer between enterprises and associations, on one hand, and Ministries, on the other. Life demonstrated that they did not have sufficient rights for implementation of truly self-supporting forms of business activity and for converting them into unified self-supporting complexes.

In 1986, all 11 Ministries in the machine building industry were converted to new general management structures. General management structures are integrated organizational and legal documents that cover basic problems of management of industry branches. According to these documents, a two-tier management structure "a Ministry - a production (scientific-production) association (enterprise)" has become a prevailing structure at Ministries in the machine building industry.

At present, the majority of the largest associations and enterprises are directly subordinate to their Ministries. They manufacture over 50% of the entire production output of the machine building industry. In the process of converting to the new management system, all 108 VPO in the machine building industry were abolished. The rest of small and medium-size enterprises (comprising approximately 50% of managed units) are managed by Ministries via special agencies, main production administrations (glavks), that were created for this purpose within the framework of the central staff, in lieu of the abolished VPO.

Organizational and Legal Forms of Industry Management Under New General Structures

The change in relations between Ministries, on one hand, and associations and enterprises converted to the two-tier management system, on the other, and creation of production glavks in lieu of VPO have led to significant reorganization of operation of central staffs of Ministries and to reforms in the internal structures thereof. At present, two types of main administrations have taken shape, functional and production ones.

Main functional administrations were created on the basis of those that were previously in operation (planning and economics, financial, capital construction etc.). Their role and functions basically remained intact. However, unlike former glavks, they were expanded at the expense of cooperating subdivisions of their Ministries and the staff of VPO. This measure was called for by the need to perform a large functional work with a large number of enterprises and associations, operating under a two-tier system.

The new general structures fix the difference in the organization and in legal forms of management, both under the two-tier system and in the case of glavks.

Under the two-tier system, enterprises and associations directly report to their Ministry management. Functional divisions of the central staff do not have any administrative rights in regards to these primary links.

Glavks are in a special legal position within a Ministry. There have been about 50 of them created, which is less than 50% of the number of former VPO. In early 1986, temporary statutes of main production administrations were approved at all Ministries in the machine building industry.

The specific feature of glavks functions, rights and structures is that it is the glavks that are charged with managing a group of enterprises in a respective subindustry. Usually they are in charge of and directly manage a group of enterprises in one or several related subindustries. They cover problems of production planning, new technology implementation, purchasing and sales, financing, capital construction, legal regulations etc. Ministries give instructions to enterprises via glavks, the latter playing the role of higher management bodies in relation to enterprises. Orders and instructions of a glavk are mandatory for its subordinate enterprises. At the majority of Ministries of the machine building industry glavks are given the rights of legal entities and have their own bank accounts.

If previously enterprises and production associations in the machine building industry were managed mainly by VPO, at present management of a unified subindustry is kind of split between functional divisions (large enterprises and associations) and glavks (small and medium-size enterprises). Therefore, functional structural divisions (planning, economics, technical etc.) are charged with performing consolidated planning, regulating, control and operative business functions. These additional management functions called for reviewing the internal organization of these divisions and creating within these divisions of corresponding departments (groups) in charge of individual subindustries. The scope of work, performed by central staffs of Ministries in the machine building industry, has increased considerably. Functions that were previously performed by VPO have been now assigned to the central staff and divided among its functional divisions and glavks. For this reason, 70% of employees of former VPO were transfered to those divisions and glavks. Taking into consideration the change in activities, practically all Ministries have approved new statutes of functional divisions.

In order to improve efficiency of operations, Ministries perform in a centralized fashion, whether completely or partially, certain management functions, such as auditing, design management, examination of projects and budgets etc. Glavks do not perform these functions, as they are performed by corresponding functional divisions for all enterprises of a Ministry. At the same time, at those Ministries (for instance, at the Ministry of Electrical Equipment Industry) where glavks were not given legal entity rights, performance of bookkeeping, financial and auditing operations is also concentrated at respective functional divisions, and as a result their activity became much more complicated. Responsibility of these glavks for meeting financial targets and for the state of accounting at enterprises has clearly decreased. On-line analysis of financial condition of enterprises has deteriorated.

A year-long experience of operation under the new management structure conditions has demonstrated that at glavks with legal entity rights that have common bookkeeping and financial departments and perform these functions the financial report activity is also considerably weaker.

Of course, the break-up of the internal structure of the central staff as a result of the advent of glavks has made the entire process of managing the industry more complicated. Certain difficulties developed in separating functions, rights and responsibilities of all structrual staff divisions.

Ways for overcoming these difficulties are in wide application of computer technology, creation of large associations, complete conversion thereof to self-support and self-financing and complete conversion to the two-tier management system.

With the advent of glavks, arguments develop within a Ministry staff, when defining tiers in a subindustry administration structure.

Two schools of thought have been often presented in literature. Firstly, a glavk is viewed as an independent middle management link, even though structurally it is a part of a Ministry. Secondly, a glavk is viewed as a part of the central staff of a Ministry.

We think that the attempt to present the management system that includes a Ministry, a glavk and an association (enterprise) as a two-tier system lacks sufficient grounds. Creation of glavks in lieu of abolished VPO has practically kept an additional management level in the structure. It is for this reason that the general structures unambiguously stipulate conversion to a basically two-tier system.

It was necessary to create glavks because of a large number of independent enterprises that were difficult to manage from one center. According to current management standards, one management body is required for 15 to 20 entities. These standards directly depend on specific features of actually used management methods, and first of all on methods for planning and material and technical purchasing. A high degree of detailing in the planning process results in difficulties in balancing plans, generates large volumes of operative work, petty supervision and excessive control on the part of directing bodies, restricts independence and the process of developing self-support. As a result, management staff grows and gets more complicated.

As before, Ministries and enterprises have to meet a large number of indices. During the conversion to the new conditions, their number has practically not diminished. State reports are still complicated. Plan- and report-compiling systems are cumbersome. In order to prepare drafts of annual production plans, enterprises have to fill out over 500 forms. The number of statistical report forms is as high as 200. And this is while central staffs of Ministries have to directly interface with managed objects, and the number of the latter is several times higher than in the three-tier system.

Therefore, further improvement of management structures in the machine building industry should proceed along the lines of improving the planning system, reducing the number of indices approved by government bodies, converting to mainly economic and standard operating methods and a broad use of the wholesale trade of production means. However, the required change in management and planning methods has practically not taken place yet. Improvement of the organizational structure has come ahead of the conversion to economic management methods. That is where, in particular, organizational difficulties in the operation of central staffs of Ministries in accordance with new general structures have originated.

According to decisions of the 27th CPSU Congress, it is planned to concentrate Ministries' staff work mainly on strategic problems of the scientific and technical progress and prospects for development of the corresponding industry, whereas the problems of day-to-day business activity, technical retooling and production overhaul should be solved directly by enterprises and associations. Thus, freeing Ministries' staff from a large volume of routine day-to-day activities will eliminate the need for production glavks. This will create an opportunity for complete conversion to a two-tier management system. Therefore, glavks should be viewed as a transitional form in developing industry management structure. Their functions will diminish steadily, as economic management methods develop further and the rights of associations and enterprises expand.

Organizational and Legal Problems in Creation and Development of Associations

In accordance with general structures, it is planned to further increase the level of production concentration. Associations will account for about 75% of the total production volume, compared to 60% in 1986.

Therefore, conversion to the new structures and development of the two-tier management system have resulted in creation of a large number of new production associations. This process has not been completed yet, but different approaches to formation of the associations have emerged. Accordingly, organizational and legal problems have developed that call for a solution. In many cases, creation of associations still generates opposition on the part of local authorities.

Unresolved legal problems impede the work on implementation of the new general structures that is going on at Ministries of the machine building industry. This is praticularly true for problems that develop in the course of organization and reorganization of production and scientific-production associations. Normative acts that are in effect do not specify how to document preliminary examination of problems, related to creation of associations, by republic agencies.

There are unjustifiable difficulties, related to the mechanism of creating associations. Of course, in studying the problem of whether to incorporate an enterprise into an association, the opinion of local Soviet authorities is taken into account. However, if these authorities disagree, a Ministry can practically independently make a decision on subordination of enterprises. It is in this area that legislation shortcomings and discrepancies as to established relations are especially vivid. However, contradictions that arise cannot be only ascribed to manifestations of local or bureaucratic trends. Such an approach would be too superficial. The difference between industry and territorial interests is based on specific shortcomings of the current business mechanism.

Inadequacy of industry and territorial interests is caused by existing territorial planning indices, by procedures for allocating resources for the social and economic development of a city or an oblast and by sources of forming local budgets. Often, local authorities are not interested in changing specialization of an enterprise to be incorporated into an association, located in another locale (oblast, republic), and in depriving it of its independence. In this case, local authorities lose their leverage for directly affecting such enterprise, as the latter cannot anymore be in charge of its resources, free and without the association consent.

Changing of the profile and deeper specialization can result in lower indices of enterprise performance, which is also undesirable, as far as the region is concerned, because indices of product sales volumes are among the most important ones in territorial plans.

Both common and individual approaches have developed in the creation of new and consolidating existing associations.

The majority of Ministries with a large number of independent enterprises have encountered difficulties in managing a large number of objects under the two-tier system. Thus, for instance, at the Ministry of Electrical Equipment Industry the number of managed units that are directly subordinate to the Ministry is over 80, if one takes into account creation of new production associations.

This forces one to look for ways to create large industrial complexes-associations, in order to reduce the number of managed objects.

At the initial stage of implementation of the new general structures, the majority of Ministries chose the traditional way of forming associations in accordance with a subindustry principle. However, this method does not make it possible to create large and efficient associations with a reasonable territorial structure. As before, associations consist of three to four enterprises that are often remote from the head plant. Because of limited opportunities for creating production associations, many industries began organizing associations under the disguise of scientific-production ones, wherein a head NII [scientific research institute] has several subordinate series production plants, sometimes several dozens of them.

Formation of such enterprises is only due to the desire of a Ministry to transfer a large number of enterprises to its subordinate management agency and at the same time solve the problem of closing the gap between science and production.

However, directives of the 27th CPSU, Congress aimed at consistent conversion to a two-tier management system, require Ministries to look for new solutions.

Attempts to derive more efficient and integrated solutions for creation of associations are made at the Ministry of Instrument Making, Automation and Control Systems, the Ministry of Construction, Road and Municipal Machine Building etc.

These Ministries are examining various versions of creating large complexes-associations, comprised of NII, KB [design bureau], enterprises and organizations of the corresponding industry. One of the versions is an association of enterprises, located in the same industrial centers. The majority of machine building industries have concentrated a large number of their enterprises and scientific and design organizations in main industrial regions and large cities. Such disposition creates additional opportunities for using territorial concentration of capacity for centralizing interindustrial and service production facilities, for reinforcing scientific and technical basis and for an integrated solution of social problems.

The problem of creating an association becomes even more complicated, if one has to combine into a single complex production and scientific-production associations that have already taken shape. It is contemplated that such complex will become the main industrial link, completely self-supporting, self-financing and self-sufficient.

It means self-supporting production-business complexes of a new type that should have an appropriate legal status.

For the majority of such associations, a special (separate) management staff will be needed. Associations with their special management staff are formed at government permission. This measure was justifiable in the case of centralized planning of limits for the number of employees of and money for maintaining the management staff and of limited business independence of enterprises and associations. In converting to complete self-support and self-financing, it is feasible to give Ministries the right to independently create associations with a special staff.

At present, legal acts that regulate activity of enterprises and production and scientific-production associations do not meet the new requirements.

Apparently, the USSR Law on a socialist enterprise (association) should cover main legal and organizational problems of creating large self-supporting complexes-associations of the new type.

Passing such law and providing appropriate legal regulations for implementation of general management structures in the machine building industry will result in considerably higher production efficiency.

12770
CSO: 1823/124

POLAND'S MERA-ZAP, ELEKTRONMASH COOPERATION DISCUSSED

Kiev RABOCHAYA GAZETA in Russian 19 Feb 87 p 2

[Article "Our Mutual Concern" by Boleslav Kovalchik, Chief Director, "MERA-ZAP" plant in the town of Ostruv-Velkopolski, under the "Friends' Experience" rubric; first two paragraphs are RABOCHAYA GAZETA introduction]

[Text] The "MERA-ZAP" industrial automatic equipment plant in the town of Ostruv-Velkopolski is one of the largest enterprises in the Polish machine building industry. Its products are well known in the world markets. Now, "MERA-ZAP" is beginning to organize series production of industrial robots.

Ties of friendship and cooperation have linked the Ostruv-Velkopolski enterprise with Kiev production association (KPO) "Elektronmash". This cooperation and the problems, faced by Polish workers, is what the story by Director Boleslav Kovalchik is all about.

Everything started as usual. We learned from our trade representatives that there was an enterprise in Kiev, Ukraine, that had expressed interest in our enterprise and its product, power supplies for computer devices. We were glad to hear that Kiev production association "Elektronmash" was ready to cooperate with us.

It was back in 1982. Ths information was very important to us. And then, the ball started rolling. In April, 1982, the first technical group visited Kiev, in September a more detailed coordination took place, and next year we began delivering the power supplies to Kiev. This is how it all started.

This cooperation is beneficial to our side. And what about the Soviets? The KPO is a giant, whereas ours is a small plant with just 3,000 employees. It turned out that the cooperation was mutually beneficial.

1983 was a very good year for us, as the climate, both at the plant and over the country, had facilitated establishment of such ties. Documents were signed between various Ministries, and these documents had facilitated further development of cooperation between the PPR [Polish People's Republic] and USSR enterprises.

If one looks back, 1984 was not an easy year for us, as the Soviet counterpart's demand increased. Workers were operating with full efficiency and effort, which was why we fulfilled all contract obligations. We were happy because of it, as we were happy because our products got good marks. The next year, traditional forms of technical cooperation were enriched. A "MERA-ZAP" delegation, headed by the first secretary of the plant PUWP [Polish United Workers' Party] committee, visited Kiev. During the visit, a treaty of direct production and scientific and technical cooperation and exchanging experience between Party and trade union organizations for the period up to 1990 was signed. This was a direct result of a trade and technical cooperation that were proceeding in the right direction.

The time after our Parties' Congresses, the 27th CPSU Congress and the 10th PUWP Congress, called for agressive actions of both parties. We are therefore clarifying and coordinating directions of our activities for the period up to 1990. This is our joint contribution to implementation of decisions of the Congresses. Today's cooperation is manifested in engineers' heads over laboratory benches, when they clarify today's solutions and develop new solutions for tomorrow. We are sure of success, as it is guaranteeed by numerous successful implementations of solutions of technical problems that life and production development pose to our collectives. This is a gratifying picture, which makes the director happy and others as well.

Of course, I can give you a statistic summary of how many meetings of technical groups of Polish and Soviet professionals took place, how many themes and implementations were scheduled and how many of them were successful. But not this is the point. As a result of our cooperation, production volume has increased eightfold, compared to 1983! This is a natural result, because it is a result of solid engineering during the production preparation period. It is also the result of many hours of joint work by technical groups in Kiev and Ostruv. We should keep moving in this direction and improve production. And we have all necessary conditions, as we have an adequate production capacity.

Our main mutual concern is to get from the counterpart, after making a telephone call or receiving a telex, just a few pieces of new products that are so badly needed for accelerating the work, testing different technical versions and sometimes making individual orders.

This cooperation between a large enterprise like the KPO and a smaller, but specialized, plant like ours that can rapidly adjust to changes can produce good results. And if one adds research work on the element base of active and passive elements, unification and implementation of ASU [automated management system] of design work, the results can surpass all expectations.

Within the framework of direct cooperation, joint research is conducted and automated systerms are being developed. In the nearest future, it is planned to expand joint research to cover digital systems. Previously, there were limits to our activities. But now, implementation of decisions of our Congresses on joint enterprises and on cooperation makes it possible to optimistically look to future development of the cooperation.

If, as a result of technical and trade cooperation of enterprises, individual friendships develop and ties between workers get stronger, one can say that we achieved the most important result. Let me be honest with you: my dream is to attend a wedding of young people, in Kiev or in Ostruv, who got acquainted as a result of our joint work, fell in love with each other and decided to join their lives.

The prospects for our cooperation are bright. Let us keep going ahead together, in the name of the bright future of the Polish and Soviet Peoples.

12770
CSO: 1823/123

DELAYS IN IMPLEMENTATION OF NEW TOOL STANDARDS DISCUSSED

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 7 Mar 87 p 2

[Article "Examination Board Sounds Alarm" by Yu. Pugachev, Deputy Chairman, Goskomizobtreteniy [USSR State Committee for Inventions and Discoveries], with subtitle "With Such GOSTs, One Cannot Reach World Level"]

[Text] For the second year in a row the USSR State Committee for Inventions and Discoveries has been conducting examination of drafts of standards for new equipment, production of which will begin in 1990. Recently we have summarized the results and came to a disquieting conclusion: **machine building Ministries are not in a hurry to incorporate in the standards the technical level that would force developers to design machines, equipment and instruments that are up to par with the best world units.** For instance, in 1985 only 85 prospective standards were examined, instead of 237 that had been scheduled. Why such a gap? It turns out that a lot of Ministries have not even started the work. And half of the examined prospective standards were returned for rework, as they did not meet current requirements.

Let us ask ourselves: why do machine builders try to develop GOSTs [State All-Union Standards] that are advantageous for them? Why is this happening now, when all conditions are being created for fruitful work? In the first place, it happens because Ministries and agencies incorporate in drafts of standards parameters, oriented toward already existing equipment rather than toward the prospects of technology development.

It is clear that machines and equipment, developed in accordance with such low level standards, will not support accelerated development of industry branches, let alone will they be capable of competing in world markets. By incorporating such parameters in new technology plans, Ministries and agencies are planning to fall behind: what is new today will be helplessly obsolete by 1990.

Examiners have encountered another serious phenomenon. It turned out that 20% of drafts of prospective standards cannot be examined at all. Why? Because there is simply nothing available that parameters the developers are trying to use in order to characterize a new product can be compared to. In the nomenclature of parameters that characterize similar products in world markets, these data are either not available or are considered insignificant in determining the quality of a product. But generally accepted parameters that do reflect consumer properties and the technical level of innovations are... eliminated from the drafts.

For instance, Minavtoprom [Ministry of Automotive Industry] presented for examination a draft of GOST "Trucks". It includes five parameters. But they only make it possible to judge the quality of manufacturing the product. At the same time, such important consumer data as truck weight, engine power, maximum speed and fuel consumption have simply disappeared. So even the experts were not able to understand how future trucks will be better than today's. That's how far the camouflaging goes!...

Unfortunately, substitution of parameters is not an accidental phenomenon. It happens not due to ignorance, but due to the desire of Ministries and agencies to make their life easier. Had not developers of CNC devices at Minpribor [Ministry of Instrument Making, Automation Equipment and Control Systems] known that none of the six indices of consumer properties of products, offered by them, are not used in world markets? Of course, they did. As they knew that during certification of these devices for the Quality Mark and comparing them to foreign analogs a scandalous fact was revealed: our devices had half the programmed displacement velocity, ten times lower discreteness and were seven to ten times less reliable. And on top of that they practically had no memory whatsoever. One is at a loss of words for qualifying such facts. Especially now.

Why, in principle, is it possible for such equipment to appear? The thing is that determination of parameters is an exlusive prerogative of the developers themselves. Ministries and agencies decide independently the level and quality of equipment they will make. In this case, as a rule, requirements of customer industries are not taken into account. Manufacturers are only concerned with their own capabilities. And they justify the low level of their products by allegedly having no information on the required nomenclature of technical and economic parameters of a specific product.

What can one say about this excuse? Industrial catalogs of all types of products, manufactured around the world, have been regularly published for a long time. These catalogs contain the necessary data. Professionals in all countries actively use this information in developing parameters for new products.

One could object that not all developers can get their hands on such catalogs. This is a problem indeed. But the catalogs are not the only source of information. In our country, there is a data bank whereto data on new domestic and foreign inventions and patents are added continuously. Practice demonstrates that where patent search is conducted at a proper level, there are no problems in forecasting prospective equipment. Production association "Leningradskiy Metallicheskiy zavod", Electric Welding Institute imeni Ye.O. Paton and Physics and Technical Institute, AN BSSR [Byelorussian SSR Academy of Sciences] are examples of this approach. Equipment and technology, developed by these organizations are capable of competing in world markets, therefore they are extensively exported. Unfortunately, not all developers are in a hurry to start using the data bank.

I think, however, that for a better orientation of developers it would be feasible for all machine building Ministries and their customers to have bulletins of foreign industrial analogs with parameters, forecasting future developments in world markets. Professionals at Goskomizobreteniy have developed a trial draft of such bulletin on the subject of agricultural equipment. The draft contains information on the world level of agricultural machines and equipment.

But, of course, this is not the main point. Apparently, we should now review our policy for preparing prospective standards. As before, let the developers of new equipment develop the standards. Who could do it better? But the task of approval the GOSTs should be assigned to special expert groups that would know world development trends in science and technology in a particular industry and be capable of comparing them to planned targets of domestic designers. These groups could be comprised of representatives of GKNT [State Committee for Science and Technology], Goskomizobreteniy, Gosstandart [State Committee for Standards] and Ministries-customers. A prospective standard should not be an easy to reach goal, but rather a target that can only be reached by actively utilizing all available resources.

12770
CSO: 1823/126

INDUSTRY STRATEGY IN RESTRUCTURING PROCESS DISCUSSED

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 4, Apr 87 pp 3-11

[Article by M. Shkabardnya, minister of instrument making, automation equipment, and control systems, under the rubric "Restructuring: Results, Problems": "Industry Strategy Under Conditions of Restructuring"]

[Text] The party and the entire Soviet population are methodically bringing to life the acceleration strategy developed by the April (1985) plenum of the CPSU Central Committee. The 27th party congress presented workers with large and complicated tasks involved in switching the national economy over to an intensive path of development and has specified the necessity of radically restructuring the economic mechanism and system of managing the economy.

The January (1987) plenum of the CPSU Central Committee gave a fundamental evaluation of the course of restructuring and the first results of implementing the decisions of the party congress. It was noted at the plenum that in our society noticeable changes are underway, positive trends are emerging, and a strong foundation for further transformations is being created. It would however be an error to think that the negative, one can even say critical, symptoms may be overcome in so short a time. Work to solve the problems that have accumulated over past years is hardly being being carried out with the necessary effectiveness on a universal scale at the present time, and the psychology of administrators and managers is changing slowly.

The party has set the acceleration of scientific-technical progress as the main strategic direction in intensifying the national economy and subsequently making better use of the potential accumulated thus far. The prime role in this process has been delegated to the machine building sectors and to instrument making in particular.

At the 27th CPSU congress it was decided to make the development of instrument making a priority. In the 12th Five-Year-Plan the sector will have to increase its production volume 1.7-fold (without any increase in the number of workers), renovate more than 70 percent of production output, and advance to the level of the highest world progress. With such intense and complex quotas, the sector's enterprises and associations must reduce its production costs by 15 percent.

Achieving these indicators requires extensive and complex work as well as the utmost intensity from all forces of the labor collectives and associations and enterprises, scientific and design organizations, and the apparatus of the ministries.

For the sector, 1986 was a year of reassessing values. First and foremost an objective evaluation of the technical level of production output was done, and the plans for new construction and retooling enterprises were reviewed. It may be said that our labor force, including all levels and ranks of managers, underwent a serious examination for professional maturity. And although the sector as a whole was successful in handling the first year of the five-year-plan, we nevertheless feel a definite dissatisfaction with the course of the restructuring of the sector to the intensive path and are concerned for the future. For many enterprise managers, today's problems still shade the long-range future. The future is "blurred" by crash work necessitated by poor planning and by the need to resolve critical situations in supporting the plan. In a number of cases preference is still given to current problems because the latter are more absorbing and continually give a sense of finished work. Nevertheless practice has shown that insufficient attention to future issues inevitably results in serious negative economic consequences.

Therefore a persistent search is underway for those economic factors and levers that would stimulate each manager and each collective to work seriously and thoroughly on future tasks and problems together with current ones.

Another factor reducing the effectiveness of the enterprises' work is the weak effect of the management system and the economic mechanism on the development of creative initiative and the insufficient link between the most important economic goals and the interests and goals of the collectives. The economic mechanism must arouse a direct interest on the part of each worker and collective in finding the most effective ways of fulfilling quotas with minimal expenditures of material, labor, and financial resources.

In our view, planning cannot be effective unless the end economic and social result (effect) for the collective as a whole and for each individual worker is known precisely. Indeed each enterprise has its own problems--social, technical development, improvement of labor conditions, etc. And the collectives must see a clear and distinct way of solving these problems. This was certainly not the case under the conditions of the previously existing economic mechanism. Solving problems virtually did not depend on the results of enterprises' economic activity since the volumes of capital investments (including those for social and personal needs) and the directions and time frames for implementing them were hardly directly related with the efforts of their own production and scientific collectives.

Combining the interests of society, the collective, and individual laborers is a serious economic problem. The key to solving it is to change all enterprises and organizations in the sector over to complete economic accounting and to economic operating methods.

Beginning in 1987 the sector changed over to complete cost accounting and self-finance, which in our view should make it possible to quickly accomplish the complex tasks set for the 12th Five-Year-Plan and for subsequent periods with respect to production volume as well as the technical level of production. Plans call for raising the initiative of the labor collectives and activating social enterprise and the human factor by persistently and comprehensively introducing the principles of cost accounting--economic independence, self-supporting production, self-finance, material interest, and economic accountability.

Moreover, the principles of cost accounting and self-finance have been introduced in the Ministry of Instrument Making, Automation Equipment, and Control Systems on the sector level since 1970. At that time the sector completely rejected allocations from the state budget, and all expenditures for development over the course of the next 15 years were offset by profit, with withholdings duly added to the budget each year. Unfortunately this system could not be extended to the main production unit since the rights and economic independence of the associations and enterprises were limited by a framework of rigid and unjustified regulations. And above all, the plans and norms were unstable. For many years the ministry has made proposals on these topics to the central planning organs, but they are only now beginning to find support and be implemented.

The distinctive feature of the current stage in the development of production relations is that the associations and enterprises are for the first time receiving sufficiently broad economic rights. This has been reflected in the draft of the Law on the State Enterprise (Association). The switch to complete cost accounting in the main production unit is a large step along the path of restructuring the economic mechanism (i.e., restructuring rather than improving its individual elements). Unlike previously conducted economic experiments, it stipulates a number of fundamental changes, in particular reducing the number of directive planned indicators, use of stable annual and 5-year economic norms, complete self-provision with financial resources from profit, and inevitability of economic losses including incentive funds when planning quotas and long-term debts are unfulfilled.

Under the new conditions profit becomes the most important generalizing indicator that most completely characterizes the operating effectiveness of associations and enterprises. It serves as the main factor in implementing the principle of the self-finance of expanded reproduction and the unified fund-forming indicator, whose measure of growth is planned and computed based on stable norms for the material incentive fund, social development, and scientific-technical progress.

The self-finance system and use of economic norms are significantly increasing the interest of the enterprise collectives in rational management of the economy. The task is to bring the essence of work under the new conditions to every laborer. The sector has done definite work in this direction. Practically the entire management of the enterprises and organizations has received training in special courses, and instruction directly at the enterprises has been organized. But this is not enough; continued urgent and unremitting explanatory work and instruction of all labors in the sector is needed. They must feel real results, if only based on a year's results, and must be keenly aware of the fact that all losses of profit (losses from defective output, fines, price reductions for failure to conform to the technical level of production output, and payments for above-norm reserves, etc.) are their own personal losses. Here lies the effectiveness of one of the main underlying principles of cost accounting--material interest.

Long-range economic norms confirmed by the five-year-plan have been given a leading role in the system of complete cost accounting and self-finance. They help specify the wage fund, distribute profit between the enterprise and state budget, establish withholdings to the ministry for centralized costs, and form funds for economic stimulation (the funds for developing production, science, and technology; social and cultural measures and residential construction; and material incentive).

The benefits of economic operating methods lie in the fact that they eliminate the subjective approach to distributing resources and evaluating an enterprise's operation. The universally understood principle--"The better you work, the more you receive"--is at work here. It is completely obvious that as long as there is a shortage (of specified types of materials and component parts and individual types of equipment, computer technology, and instruments) the enterprises must establish, by directive, quotas for the output of the most important product list, rejuvenation of the products output, and a number of other important indicators. Under conditions of complete cost accounting, however, such indicators must be brought to the enterprises in tenfold lesser amounts, and the accountability, inventories, etc., will be correspondingly lesser as well.

However, the economic management mechanism that seems so simple and clear at first glance is not so simple to implement. Each sector has its own peculiarities, and they require specific measures to prepare for the change to new management conditions. Thus a set of standard rules or guidelines cannot be equally effective for all organizations and enterprises (or sectors as a whole).

There are, however, a number of common issues that must necessarily be resolved for any specific enterprise (sector) when changing over to the new conditions.

Technical level of production output. At present practically all forms of production are subject to a rigid system of economic sanctions and surcharges for the indicator of its technical level, which is directly linked to profit. Therefore the strategies of immediately bringing the main types of series products to the highest world level and replacing obsolete production are required as primary measures to support the welfare of enterprises that have changed over to complete cost accounting. Enterprises will not be able to operate effectively under conditions of self-finance unless the aforementioned measures are implemented.

Finances. This form of activity has not received sufficient attention from enterprise managers for many years. Practically speaking, they only control the expenditure of the wage fund and the fulfillment of quotas with respect to reducing production costs. Under the new conditions an enterprise must have a distinct structure for expenditures for all types of activity and must regulate these expenditures strictly, constantly comparing them with sources of supplementing profits. Included among these sources are markups for production of the highest quality category and 100 percent fulfillment of agreements to deliver production, introduction of progressive technology accompanied by a reduction in costs, and also reduction of nonproduction losses (fines for low quality of production delivered, above-norm reserves of materials and component parts, low equipment load factor, etc.). Inasmuch as the development of the enterprise on both a technical and social plane may not only be accomplished by raising incomes over expenses (and the greater the difference, the more intensively it will have developed), the management of any enterprise must also have a specific strategy.

Organizational structure. Economic accounting requires simplifying organizational structures in the framework of the primary production unit since the necessity of the existence of any subdepartment in an enterprise and the evaluation of its activity are now examined through the prism of the profit indicator.

In our view, when preparing to change an enterprise over to self-financing it is necessary to take the following into account: how centralized or decentralized must the responsibility for decision making be and what principles for dividing the structural subdivisions of the enterprise are needed. This is very important since organizational structures have been charged with creating a system of roles and their interrelationships so as to attain the goals that have been set. Thus, even in the case of a typical enterprise, its administrative structure must not be prescribed from above. Issues of structure and the numbers of engineering and technical personnel and their wages must be decided by the management of each individual enterprise, proceeding from the established wage fund norms.

Personnel. The preponderance of administrative operating methods for many years has resulted in a situation where many enterprise managers have grown unaccustomed to economic thinking. The command management style has conditioned the formation in a number of instances of administrative-management labor forces that are not made up of creative, innovative minds but rather of obedient, "comfortable" workers, i.e., those whom it's easier to manage. Those who are capable of "beating out" more resources under a lesser plan turned out to be the more "animated" managers. Independence and rights aren't so necessary to this type of manager. And now, when the first steps have already been taken in the direction of expanding enterprises' rights, they are not in any hurry to use them. The mode of awaiting instructions and delaying actions--such is the working style taught by administrative operating methods. The administrative, command management style is least suitable for radical transformations, especially in the sphere of managing scientific-technical progress.

The revolutionary restructuring that has begun in our society demands that managers have a high level of intellect, culture, erudition, competence, professionalism, and party devotion to matters. Therefore the system of special training for managers and the search for and advancement into management of talented, gifted people have become most important social necessities. There are not many talented managers; a shortage of them is felt in all spheres of activity. Evidently the search field must be expanded.

Definite steps in the specified direction are already being taken, and they are not yielding bad results. Above all this refers to the first experience of selecting various levels of managers, and undoubtedly this experience must be developed. It is necessary to move more actively along the path of advancing youth to management posts. The young are more receptive to innovation and are theoretically more prepared for the introduction of modern science and technology and for restructuring in all of its diverse manifestations in general. It should be noted that without trained, modern-thinking, working managers, the cost accounting economic mechanism cannot work.

Balance of the plan. Under the conditions of economic management it is acutely obvious that the system for material and technical supply has not yet been worked out. The formation of a plan for outputting production does not correspond to the capabilities of supplying resources. Thus, the first months of operation of the enterprises in the Ministry of Instrument Making, Automation Equipment, and Control Systems under the conditions of self-finance have shown not only the lack of a mesh between the production plan and allocatable resources but also serious problems with implementing these resources. The absence of necessary materials and component parts has resulted in a situation where it is virtually impossible to make agreed-upon deliveries 100 percent, maintain an optimal equipment load, or eliminate downtimes and overtime work. And all of these are nonproduction losses that are taken from the profit that is above all intended for the social and personal needs of the collectives, material incentive, and the development of enterprises. In our view, this issue demands that the USSR Gossnab and USSR Gosplan along with interested ministries undertake a special examination of it and that the necessary decisions be made. Without a distinct, strictly regulated system of material and technical supply, the transition of enterprises (associations) to complete economic accounting cannot become a reality.

The aforementioned five very important factors do not exhaust the entire set of problems connected with the transition to new management conditions, and naturally each sector and each enterprise alike have their own peculiarities that must be studied and taken into account.

The problem of maintaining the stability of economic norms is not as simple it may seem at first glance. In essence, it is derived from the problem of giving stability to the quotas of the five-year plan, and as has been obvious, the latter task has not yet been accomplished in the necessary manner. For example, as recently as 1986, the first year of the five-year-plan, the Ministry of Instrument Making, Automation Equipment, and Control Systems established around 100 additional quotas for the development and output of new production amounting to approximately 1.5 billion rubles that were not stipulated by the five-year-plan. Inasmuch as the ministry is obliged to organize the way in which they will be fulfilled, it has developed supplementary quotas for the corresponding enterprises. But it has not generally been able to create reliable material and technical support in such situations since the opportunity has been missed. How can a similar practice be combined with work under the new management conditions and policies concerning enterprises' rights in accordance with the draft of the new Law on the Socialist Enterprise (Association)?

Moreover, in the majority of cases, quotas to produce new technology require increased expenditures for developing new production and making it operational. Naturally, the enterprises' costs increase, and profitability and planned profit decrease, and additional working capital is often required. Who should make up the enterprises' losses? Indeed the executor ministry has no reserves for this purpose. Nevertheless this practice continues. Some department heads even pass off as "valor" the fact that they have been able to "force" a decision about an additional quota on other sectors for the output of some product or other after the plans have been established. And of course they are not interested in others' losses. The new economic mechanism is incompatible with this type of practice.

It is of course difficult to expect that a plan will be absolutely fixed over the course of 5 years. The national economy develops dynamically, and the need for specified types of production will inevitably arise. In this context a policy addressing planning and other departments should be stated that would keep the number of supplementary quotas to a minimum and establish specific responsibility for their nontimely development and inclusion in the plan. Moreover, complete cost accounting objectively presents higher requirements for planning quality that still leaves hope for the better.

It is also necessary to provide economic and legal protection for enterprises. In our view this means that each decision made concerning an additional quota for production output must simultaneously provide for allocation of material and financial resources that would make it possible to the enterprise to compensate the additional expenditures. It seems that compensation resources must be allocated at the expense of the ministries (departments) that make official requests to the corresponding party authorities about supplementary quotas or at the expense of the reserves of the organs establishing these quotas. It is thought that such a compensation mechanism should be fixed (stipulated) in the Law on the State Enterprise (Association).

The new conditions make it necessary to create reserves, especially material and financial reserves, at all levels of management and economic operation. The point is that the enterprises' and associations' transition to complete cost accounting and self-finance has been accompanied by the introduction of a number of rigid requirements and serious economic sanctions. Undoubtedly the specified measures are timely and completely justified; nevertheless, fulfilling the profit plan under the conditions of the effect of expanded economic sanctions for enterprises is becoming significantly more complex.

We are speaking about reductions from the wholesale price for production that has not been certified as being of the highest quality, about the possible loss of profit under conditions of the state acceptance [gospriyemka] (especially in the initial period), about sanctions for the nontimely commissioning of facilities (even if this was not the contractor's fault), about supplementary deductions from profit for above-norm reserves of material resources, and finally about fines for nondelivery and low production quality.

These are perhaps the most critical moments that create anxiety in many economists. There is one way out here--to introduce order and increase the level of organization of production, scientific developments, and economic work. The new conditions make it necessary to not only know how to use earned resources rationally but also to comprehensively prevent possible losses, perform accounting on a daily basis, and implement effective monitoring of each ruble of economic activity. When our government was just being formed, V.I. Lenin wrote, "Indeed count money accurately and scrupulously, manage economically, do not loaf, do not steal, and observe the strictest discipline in labor." Vladimir Ilyich called these requirements "the recurrent and main slogans of the time." [1] This can be soundly applied to our transitional period when the party is undertaking a radical restructuring of the system of economic operation.

Solving the problem of striking a balance between plans for production and those for material and technical supply is especially important. Currently in the works is a production plan that makes an allowance for that fact that obtaining the maximal profit does not very often match capabilities to supply material resources. From this position, the system of self-finance is virtually undefended. The absence or nontimely supply of the necessary materials and component products often leads to downtimes, a breakdown of production rhythms, and rush work, which results in a situation where all the efforts of the collectives to completely meet agreed-upon production deliveries is impossible--especially under conditions of the gospriyemka. Moreover, disturbance of the normal production process inevitably brings with it an increase in production costs and a loss of profit.

Many authoritative decisions have recently been made indicating the necessary of striking a complete balance between plans and improving material and technical supply; unfortunately, however, no effective ways of doing so have been found. For example, several enterprises in the sector that are already operating under the new conditions have turned out to be without the assets for part of the most important component products and materials, and indeed the presence of resources far from always guarantees receiving material resources since great difficulties often arise in utilizing assets. In January of this year production plans at several plants were torn up as a result of the absence of individual types of component products.

Unless the problems of balancing and stabilizing plans and radically improving the system for the material and technical supply of associations and enterprises are solved in the necessary manner, it is difficult to count on the successful use of new methods of economic operation. It is therefore necessary, in addition to the economic responsibility of enterprises and associations, to establish the responsibility of central planning and finance organs for stabilizing and balancing the five-year and yearly plans. Or another mechanism must be found to create interest on the part of the enterprise collectives in accepting additional orders, i.e., making them materially and mentally prestigious for collectives.

Methods of evaluating the fulfillment of a plan are acquiring more importance under the conditions of associations' and enterprises' transition to cost accounting. The established order for evaluating the enterprises', associations', and ministries' fulfillment of five-year- and yearly plans based on an increasing result must be observed without deviation (centrally and on site). This will rid enterprises and associations of many irrational expenditures that often result from requirements of fulfilling monthly plans "at any cost," even when they have more than fulfilled the plan for the corresponding period.

The enterprises' transition to complete cost accounting has made it necessary to impart some order to the connections between industrial enterprises and supported organizations and facilities. Diverting a significant portion of workers to agricultural, construction, and other operations leads to overexpenditure of the wage fund and an increase in production costs and other losses at the same time that the system of self-finance stimulates enterprise collectives to value every ruble. Thus the relationship between the enterprises and the kolkhozes, sovkhozes, truck gardens, etc., must be placed on a cost-accounting, contract basis with complete payment for the labor of workers involved. It is important that this policy be observed without deviation by local organs.

In the production sphere restructuring must begin with the formation of the broad economic and legal independence of enterprises and organizations. The time has finally come to "liberate" the enterprises and production and scientific production associations in deed rather than just in word from excessive guardianship and give the labor collectives the capability of uncovering their creative potential.

The system of complete cost accounting and self-finance will become a serious test for the associations and enterprises, especially for those that have operated unstably and have grown accustomed to dependency. It is certainly no secret that a certain percentage of enterprises have been supported with the help of the ministry for many years and that they have primarily received allocations from reserves and partially from the redistribution of so-called excess working capital from well-operating enterprises. This does not exclude the possibility that the poorly operating enterprises will be reorganized or eliminated. The draft of the Law on a State Enterprise (Association) allows for this possibility. The measure is of course extreme but completely justified from the state's position since dependency and "charity" are incompatible with true cost accounting.

Restructuring sectorial science is the primary strategy for developing industry. It must be transformed into a real, determinant force for technical progress. Philanthropy and partnership between enterprises and institutes with equal responsibility for results--this is the basis for the successful creation of new technology. All scientific organizations in the sector are being switched over to complete cost accounting for this purpose. The functioning of scientific organizations and enterprises on unified cost-accounting principles with unified criteria for evaluating results is the economic and organizational basis for integrating science and production, which should yield weighty dividends in the form of advanced technology.

Advancing to the leading edges of technical progress is the main purpose of restructuring sectorial science. Here the shortest route is the priority use of original domestic developments. The economically destructive duality where our scholars and developers create fundamentally new engineering and technology while producers stubbornly acquire the import--and often not of "first-day freshness"--must no longer be sustained.

Reducing the "research-to-production" cycle is one of the goals of restructuring sectorial science. For the current five-year-plan, the Ministry of Instrument Making, Automation Equipment, and Control Systems has set the task of substantially increasing the quality and effectiveness of the operation of scientific research, experimental and design, and design and production organizations and reducing the time periods taken for conducting research and development three- to fourfold.

The scientific-technical, socioeconomic, and organization factors and conditions exert a significant effect on reducing research and development time spans. They are rather typical for any sector in industry.

Factors of a scientific-technical nature: improvement in the extent of equipment, instruments, and test stands at scientific research institutes [NII] and design bureaus [KB]; increase in the level of automation of design operations based on the introduction of computer-aided design [CAD]; comprehensive development of automation workstations for designers, technologists, and scientific workers; wide-scale use of mathematical modeling methods; development and introduction of systems for automated preparation of production; automation of work in the area of investigation, experimentation, and data processing; creation of scientifically established series of homogeneous production groups and wide-scale use of unitized-modular designs; and development of experimental production and testing areas with wide-scale outfitting with program-controlled equipment.

Factors of a socioeconomic nature: use of new forms of organization, wages, and stimulation (brigades, temporary scientific-technical collectives, etc.); introduction of progressive systems for evaluating the effectiveness of the labor of scientific and engineering and technical personnel at organizations, including evaluation of the work of management personnel; use of complete cost accounting in organizations and in their subdepartments with the introduction of progressive norms for the work being carried out, for numbers of subdepartments, etc.; and use of monetary monitoring for failure to fulfill contract provisions.

Factors of an organizational nature: elimination of excess agreements for technical documentation during the process of developing new products and putting them into production; combination of individual stages and substages of research and development [NIOKR] and putting it into production; involvement of the organizations of the USSR Academy of Sciences, the member countries of the CEMA, the USSR Ministry of Higher Education, and other sectors in research and development of new production based on economic agreements; maximal liberation of the capabilities of experimental production from the output of series production; and creation of a flexible and developed information service system for designers, technologists, and scientific personnel.

The implementation of intersectorial measures also exerts a great effect on the effectiveness of work to reduce the time spans for research and development of new production. Included among these are, above all, the development of a material and technical base for the production of tools and special production equipment as well as liberation of the capabilities of experimental enterprises, shops, and sections from manufacturing series production.

Restructuring is multifaceted in its manifestations, as is life itself. And there is only one way to turn the party's decisions into productive results for our entire society--persistent, creative work on the part of each collective and each Soviet person.

FOOTNOTES

1. Lenin, V.I., "Poln. sobr. soch." [Complete Collected Works], Vol 36, p 174.

12794
CSO: 1823/160

CZECH-SOVIET, CEMA COOPERATION IN MACHINE BUILDING

Forward Together

Moscow KOMSOMOLSKAYA PRAVDA in Russian 5 Apr 87 p 3

[Article by Ye. Nefedov, KOMSOMOLSKAYA PRAVDA correspondent in Prague,and V. Kozin, KOMSOMOLSKAYA PRAVDA correspondent in Kazan, under the "Bounds of Integration" rubric: "Forward Together"; first section by Ye. Nefedov]

[Text] The line of plants comprising the Prague Drafting and Design Documentation [ChKD-Praga] Production Economics Association extends for several kilometers along the sometimes wide, sometimes narrow, but always animated Sokolovskaya Street. Buses and streetcars move by, people crowd along the throughways and spread around the enclosures and buildings of the stops--it seems this way whereever you go along Sverdlovsk and Gorkiy. And the route itself creates a native tune inasmuch as it is named in honor of that great settlement near Kharkov where Ludwig the Free's battalion once fought its first battle.

I turn to the necessary throughway. Here children from the Socialist Youth League [SSM] plant committee are waiting for me. The first thing I do with them is what I thought about on the way. Here Steglik, committee secretary, points to a nearby sign post.

I read, "This plant makes important export deliveries to the USSR." The children smile: the two countries are connected! The Compressors ChKD was even awarded the Soviet Friendship of the People Order 3 years ago.

I admit I already knew about this--good fame has great wings. I heard about the award and the really impressive sized deliveries--this enterprise exports nearly three-quarters of its production to our country. You can find Prague compressors almost everywhere. Siberia, the Ukraine, the land along the Volga--hundreds of plants and buildings, mines, agroindustrial enterprises, and municipal services. But at the same time--what would today be if not for yesterday? And what will tomorrow be like in a year, or a year from now, or 5 years from now?

Vladimir Shimek, chief designer, started to answer these questions. And he began by reading the word that was boldly outlined on his work calendar somewhere in the middle of April--"Intercompressor."

And then he explained, "At this time we planned to have a meeting in Kazan. A scheduled meeting. But fundamentally new. We have thus been cooperating for 5 years now, jointly creating new radial and screw compressors. However, work on the contract is nevertheless being done without a clearly defined system. We therefore need to take the matter more seriously and thoroughly and to create an international scientific production association. We have prepared our drafts of the documents and thus are meeting in Kazan."

"And is everything else already clear for you?"

"There is still little clarity; indeed, it's a completely new matter. But both sides feel it's necessary to cooperate. This I know well. I worked in Moscow for several years and directed the processes of assembling and adjusting our equipment, and I can say with authority that in many positions our contacts need improvement, a better understanding of each other's tasks and capabilities, and even definite simplification--in a good business sense. For this reasons the term "direct links" instills us with optimism. It indicates a rejection of routine and bureaucracy. And we are putting a lot of hope in our young forces, in creative and sensible people."

[Following section by V. Kozin]

[Text] The air compressors with the trademark of the Kazan Compressor Machine [Kazankompressormash] Scientific Production Association are not only known in our country--the equipment of the Kazan machine builders was well recommended in Czechoslovakia, Hungary, Poland, Bulgaria, and India.

Four years ago the Kazankompressormash concluded an agreement to cooperate with the ChKD-Praga. The union of the two related enterprises from sister nations proposed cooperation in all areas of production activity, in scientific developments, and even in the social sphere.

This is what I was told by F. Kalmullin, head of the scientific-technical information department of the Kazankompressormash scientific production association: "Cooperation with our Czechoslovak colleagues has already brought its fruits. I will only give two examples. In the association work is underway to improve the methods of testing centrifugal compressors. And here Czechoslovak machine builders have helped us a great deal. We are using their experience in the field of automating testing processes for the technology. Based solely on preliminary computations, the economic effect from such cooperation will constitute more than half a million rubles. We in turn are helping our friends put the production process of rivetting centrifugal impellers into operation. In the corresponding section at the ChKD-Praga there is a great deal of manual labor, and of course our experience is very opportune for our colleagues."

And where will the efforts of Soviet and Czechoslovak specialists be directed in the future? The Kazan machine builders are certain: their "long-range artillery"--science--has still not uttered its principal word. Only close and productive interaction in this area can solve the main problem--producing only equipment with outstanding quality.

It is true, as residents of Kazan say, that they are only welcome guests of their friends--"tourists." Brief, introductory out-of-town job assignments do not make it possible to thoroughly study our friends' experience and to delve into the gravest problems. As is believed at the Kazankompressormash, cooperation will be more productive if we travel to one another not only to examine the rarities of our cities, but above all with a specific business program.

V. Pirozhkov, deputy secretary of the Komsomol at the Kazankompressormash NPO, spoke about this. He said, "Unfortunately we still do only have, as they say, a nodding acquaintance with our peers from our allied organization in Prague. And indeed we have something to learn from one another. For example, the organization of competitions among Komsomol youth brigades."

Strengthening the bonds between two enterprises of sister nations has real promise. It was recently decided to create an international association for manufacturing compressor technology and making it operational. Cooperation is being raised to a new, higher-quality degree.

UDC 061.22(063)(1-664)

Conference of Directors of Machine Building Scientific-Technical Societies of the Socialist Nations

Moscow MASHINOSTROITEL in Russian No 3, Mar 87 p 10

[Article by G.A. Maslov, deputy chairman of the Central Administration (TsP), Scientific-Technical Society of the Machine Building Industry (NTOmashprom)]

[Text] The Ninth Conference of Directors of Machine Building Scientific-Technical Societies of the Socialist Countries--Bulgaria, Hungary, the GDR, Poland, the USSR, the CSSR, and Yugoslavia--was held in Eger (Hungary) last year.

At the conference a great deal of attention was devoted to implementing the Integrated CEMA Program for Scientific-Technical Progress Before the Year 2000. The USSR delegate explained the fundamental content of this program and specified tasks of the national machine building societies (NTOs) in the socialist countries that are geared toward implementing the program. The directors of all the delegations who took part in the discussions approved the basic measures for implementing the program that the delegate proposed. In the resolution adopted with regard to this topic it was noted that it is necessary to activate cooperation among the machine building NTOs of the Socialist countries in implementing the specified program by focusing particular attention on introducing integrated automation, using computers in machine building, putting new technologies and materials into production, and reducing the power-intensiveness of production.

In their reports the representatives of the USSR, Bulgaria, the GDR, Hungary, and the CSSR spoke of the work being done by their national societies in the area of using microprocessors. They noted that in recent years the use of microprocessors for production purposes has expanded significantly in the machine building sectors of the Socialist countries. In the CSSR, for example, it was decided to use microprocessor technology in 8 of the 36 statewide tasks in the field of machine building. In Poland the society's metrology, automation, and precision mechanics section is gearing its members toward using microelectronics in measuring and testing systems and creating specialized microprocessor-based production equipment for producing electronic instruments.

The conference approved the work being done by the national machine building societies with respect to using microprocessors in production and proposed examining computer technology as a means for facilitating the development of machine building and production processes. It was deemed advisable to conduct an international conference on the use of microprocessor technology in flexible automated systems within the framework of the CEMA.

Reports by the delegations from Hungary, the USSR, and the GDR were dedicated to the machine building societies' work in the area of automating the technical preparation of production. It was noted that the use of electronic computer technology in the technical preparation of production has acquired a special significance for intensifying the development of machine building. At the present time this is a complex of technological measures and engineering and technical operations to prepare for the output of new or modernized products. The activity of the machine building scientific-technical societies in this area is expediting the creation of specific systems to automate planning and design and production operations, organize the exchange of experience with respect to specific topics, and generalize and disseminate the advanced know-how of other countries.

Having approved the societies' work in the area of developing the automation of the technical preparation of production, the conference recommended that the International Committee on Machine Building Technology examine this problem in greater detail at the next scientific-technical conference.

The role of the machine building societies in increasing specialists' qualifications who are society members was discussed in reports by representatives of the USSR, Hungary, and the CSSR. It was noted that at the current rates of scientific-technical progress, machine building specialists need modern materials facilitating the effective introduction of progressive technology, mechanization and automation of production, improvement of the designs and production quality of machines, and rational solution of problems of management, economics, production planning and organization, and the labor of workers. The task of increasing specialists' qualifications is therefore extremely important. It must be carried out by the national societies on a daily basis. The forms of this work are diverse--courses to increase qualifications with respect to individual specialties, seminars, scientific-technical conferences, institutes, faculties for increasing qualifications, etc. The conference participants expressed great interest in how to conduct their work in the direction specified by the USSR Ministry of the Machine

Building Industry. It was deemed advisable to periodically exchange information on this topic among the national societies.

In accordance with the proposal of the GDR delegation it was decided to conduct the scheduled Conference of Directors of Machine Building NTO next year in Karl-Marx-Stadt (GDR). The program for this conference has been approved.

The conference participants unamimously adopted a decree on all the topics discussed.

The USSR delegation proposed that a number of proposals of an international nature whose implementation would be of interest to all the national societies be included in the conference proceedings. Included among these were the following proposals: conducting an international conference on the use of microprocessor technology in flexible automated production within the framework of the CEMA, having the International Committee on Machine Building Technology develop recommendations on the forms and methods of the national societies work to develop the automation of the technical preparation of production in the machine building of the socialist countries.

In the conversations of the conference participants it was noted that it is necessary to increase the role of NTOs in machine building to accomplish the tasks set by the party congress of each of the socialist nations in the area of scientific-technical progress and socioeconomic development. The participants stressed the advisability of further developing bilateral links among societies and regularly exchanging scientific-technical information, as well as the necessity of the wider-scale participation of specialists from the socialist countries in implementing the scientific-technical measures of an international nature.

The conference took place in a friendly and businesslike manner and facilitated the development of contacts between the national machine building societies.

12794
CSO 1823/157

FIRST RESULTS OF GOSPRIYEMKA PROGRAM DISCUSSED

Moscow STANDARTY I KACHESTVO in Russian No 3, Mar 87 pp 3-6

[Article under the epithet by M.S. Gorbachev "We have undertaken a great project and are obliged to see it through to the end."]

[Text] The state acceptance [gospriyemka] has completed 3 months of operation. A large team of workers from the USSR State Bureau of Standards [Gosstandart] is working at 1,500 enterprises. Its first and foremost task is to not allow defective motor vehicles and tractors, machine tools and electric motors, televisions and refrigerators, and many other very important industrial products to reach consumers.

At the end of this past year and in January through February of the current year the Gosstandart took the gospriyemka under close scrutiny. At practically every meeting, the Gosstandart examined problems related to preparation for the gospriyemka and then to the first results of its operation at the enterprises of a number of union ministries: the Ministry of the Electronics Industry; the Ministry of the Automotive Industry; the Ministry of Instrument Making, Automation Equipment, and Control Systems; the Ministry of the Timber, Pulp and Paper, and Wood Processing Industry, etc.

A great deal of attention has been paid to the gospriyemka for mass information--central and local newspapers, radio, television.

An analysis of the materials presented to the USSR Gosstandart as well as those published in printed media make it possible to conclude the following: with all acuity, the gospriyemka has discovered a number of negative phenomena in our economy that have a direct effect on production.

Above all this refers to the insufficient effect of the action of economic levers, which resulted in a displacement shift of priorities and a predominance of labor estimates based on quantity produced rather than quality.

One illustrative fact is that noted by the Gosstandart when they examined the problem of the quality of wood chip panels produced by the enterprises of the USSR Ministry of the Timber, Pulp and Paper, and Wood Processing Industry. According to data from the services of the state inspectorate, 28.1 percent of the total production volume was rejected as a result of audits conducted in 1985-1986 at 64 of the ministry's enterprises. A total of more than 4 million rubles in economic sanctions were levied for violation of standards. Nevertheless the first results of the gospriyemka indicated that there has been no change for the better at a significant portion of enterprises. The main reasons for rejecting the wood chip panels were already noted during the course of previous audits for violation of the requirements of GOST 10632-77. The effectiveness of the sanctions turned out to be insignificant.

People have grown accustomed to the fact that quality is not asked for and that they are almost never punished. Thus the 4 January issue of PRAVDA, in an article entitled "What's in the Careless Worker's Wallet?," stated, "a total of 500 rubles was retained from those responsible for a total sum of 46,000 rubles in defective output at the Heavy Machine Tool and Hydraulic Press [Tyazhstankogidropress] Association imeni A. Yefremov in October 1986." According to issue no. 5 ("Testing by the State Acceptance") of EKONOMICHESKAYA GAZETA, in the past year the Starooskolskaya Furniture Factory paid more than 4,000 rubles for delivering low-quality goods and only fines careless workers 4 rubles and 67 kopecks (!).

The position of the technical monitoring department [OTK] is a direct consequence of the displacement of priorities. The configuration of any price plan has compelled production managers to "cut off" OTK from the production process, especially at the end of an accounting period. This was especially clear in a review of reader letters published by SOVETSKAYA ROSSIYA on 4 January. Previously the OTK was a "senior procurator," noted one reader, "whereas now it has lost its force and sense of principles."

As a result, in its first days the gospriyemka had to return hundreds of products that had already been accepted by plant inspectors for further development. For example, according to data from the USSR Gosstandart, in the beginning of January only 60 percent of Elektron color televisions accepted by plant OTK were turned over to the gospriyemka from the first presentation, and by only only the end of the month this indicator increased to 86 percent.

When the gospriyemka was subjected to close scrutiny, the following became particularly evident: an absence of organization and discipline leading to a lack of production rhythm, to a disregard of technical documentation requirements, and to a failure to observe norms and standards at both the enterprises manufacturing finished products and the suppliers. For example, when the Gosstandart examined the problem of the operation of the ZIL production association [PO] under conditions of the gospriyemka, it was noted that because of the improper quality of component parts, the association's main enterprise experienced significant difficulties in January. There are serious complaints to the USSR Ministry of the Petroleum Refining and Petrochemical Industry on account of the quality and rhythm of deliveries of rubber engineering products, to the USSR Ministry of Ferrous Metallurgy on account of the quality of metal shipped, and to the USSR Ministry of the Electrical Equipment Industry on account of shipments of conductors for electrical equipment.

All of these negative phenomena related to the imperfection of the economic mechanism, poor organization of production, and a lack of discipline have long been well known. They were discussed at the 27th CPSU congress, Central Committee plenums, and specialists' meetings. But the gospriyemka's work, which is widely shown via the mass media, has made the television screen, radio, and the newspaper page its property and has thereby given all the Soviet people vivid examples of the effect of so-called brake levers. It is sufficient to recall the television reports from the KamAZ and ZIL and such publications as the aforementioned article "Testing by the State Acceptance" in EKONOMICHESKAYA GAZETA, "Treatment by Shake-up" in PRAVDA (10 February), and articles in IZVESTIYA, SOTSIALISTICHEKSKAYA INDUSTRIYA, etc.

What are the first positive results of the gospriyemka's operation?

The main one, as has been mentioned by the Gosstandart and the central press, is that the gospriyemka has forced everyone--from the worker to the director--to face the problems of increasing quality and has made them think about the unsolved problems of accelerating scientific-technical progress and strengthening labor and production discipline.

A reduction in complaints for production output has been noted.

Design and production documentation has been put in order at many plants. It has been presented in accordance with the existing standards and other normative technical documents.

Technical monitoring services have been noticeably activated. Practically everywhere where the gospriyemka is acting, plant managers have begun to pay a great amount of attention to the needs of this most important plant service; intake monitoring operations are being organized, OTK is being conducted by new personnel and is being developed, and in some places plans for the retooling of OTK have begun to be implemented.

Searches for new forms of interaction with suppliers of materials and purchased products are being conducted. A grievance operation is being set up.

An experimental and testing base, measurement technology--and tools--is being organized.

But unfortunately this is far from the way things are everywhere. The reassessment and correction of technical documentation is being implemented slowly, and measures to bring measuring and testing technology to a suitable state are not being taken.

The lack of rhythm in present production to the gospriyemka is a serious flaw. For example, in an article entitled "First Lessons of the Gospriyemka" (4 February), PRAVDA noted that in the first 10 days in January the Leningrad automotive plant, Kiev plant Bolshevik, and Bakin high-voltage equipment plant presented practically no products to the gospriyemka, whereas the Kazan compressor, Aleksandriyskiy lifting and transport equipment, and Minsk automotive plants presented between 60 and 80 percent of the production from their monthly plan in the final days of January.

In a report at the January (1987) plenum of the CPSU Central Committee, General Secretary M.S. Gorbachev said, "...The process of having personnel master modern management methods and approaches in work is not progressing easily but in a contradictory manner and is not progressing without painful symptoms and relapses to the old way. A clear example is the introductions of the gospriyemka....Some workers have been found who have shirked in the face of high requirements. Instead of setting themselves to increasing quality, they have begun to scare themselves and others with possible complications, conflict situations, and even plant shutdowns."

And in fact some managers have begun to write off their own organizational omissions to the gospriyemka. Based on the old times when the threat of not fulfilling a plan would compel the departmental control to close its eyes just as their own OTK have done until recently, these managers have taken to looking for ways of pressuring gospriyemka workers instead of treating production's long-time old "ills." Examples of such situations at the Gorkiy Television Plant imeni V.I. Lenin, the radio products plant in Dagestan, etc., have been presented in the press.

These conditions have resulted in a special demand for a sense of principle on the part of gospriyemka workers, for their being well founded in their requirements, and for their bringing state policies in the area of production quality to life in a sequential manner. But there must be a significantly greater demand for production leaders. They must know how to be answerable to the state for their own blunders, for inertia, and for an absence of discipline.

The establishment of a style for relationships between the gospriyemka and the managers and collectives of enterprises is a very important issue.

There are well-known cases where instead of trying to help the gospriyemka replace the enterprise's own OTK with its own workers, managers try to hide the perpetually gaping breaches in the controller labor force by examiners from the USSR Gosstandart.

It must be stressed yet once again that the gospriyemka does not duplicate OTK. In numbers, it is smaller. It has other problems--to provide interdepartmental monitoring and acceptance of production that has already been accepted by OTK. Without placing itself in opposition to plant services, the gospriyemka is at the same time fighting with it to supply quality materials and purchased products (with the involvement of organs of the state inspectorate) and to introduce order and discipline into production.

Directors for the Gosstandart have recently done a lot of speaking with journalists to explain the distinctive features of the new service's operation. The Policy on Organization of the Operation of the State Acceptance (RD 50-612-86) and GOST 26964-86 "Regulations of the State Production Acceptance. Main Policies" have been been commented on widely. Nevertheless, there is much that is experimental in its operation; indeed the gospriyemka is not yet functioning at all enterprises. It is therefore important that the experience that has been accumulated, including all publications discussing improving the gospriyemka's operation and uncovering problems in its relationship with plant services, be subjected to close scrutiny.

On 21 January the USSR Council of Ministers assessed the state of affairs with respect to increasing production quality and introducing the gospriyemka. It was noted that "...in several associations and enterprises work to introduce the state acceptance is not being implemented in a sufficiently organized manner. This is occurring because many operations managers have approached the most important task of introducing the gospriyemka in a formal manner. It is not uncommon to find cases where there has been weak control exercised by the ministries over the development and implementation of specific measures related to switching associations and enterprises over to the new principles of accepting production. As a result, the newly created organs of the state acceptance frequently fail to find support, which speaks negatively for the support of their coordinated work with enterprises to accomplish the common task of increasing production quality."

At the meeting of the USSR Council of Ministers particular emphasis was placed on the fact that the animated work of the gospriyemka sometimes begins to be enveloped in formalism. It was stressed that the old methods, conservatism, and bureaucratic fuss are entirely incompatible with what is now being undertaken in the issues of increasing quality. The animated work of the gospriyemka's organs must not be replaced by a comparison of multiple references and reports.

The audit conducted by the Gosstandart from December 1986 to January 1987 uncovered evidence of formalism and generation of red tape.

The intolerability of similar manifestations of bureaucratism are noted in the USSR Gosstandart decree from 10 February; moreover, GOST 26964-86 and RD 50-612-86 stipulate a flexible accounting and accountability system that makes it possible for a gospriyemka manager to simplify many procedures.

The Gosstandart established a unified order for operational 10-day period accountability for gospriyemka organs based entirely on three indicators, noted measures for optimizing and simplifying documentation, and required that gospriyemka managers at sites organize the introduction of accounting documentation in accordance with the requirements of document managers with an allowance for production specifics.

In addition, the managers of gospriyemka organs have been instructed to train their OTK personnel and workers at their enterprises in correct interaction at work and in informal observation of the established order for production acceptance.

The directors of the territorial organs have been forbidden from requesting information from the gospriyemka organs that is not stipulated by the established accountability.

And so work goes on. The problems are many and complicated. In this article we have only touched on the main problems on which the Gosstandart is working directly; however, there are many other such problems, such as the reassessment and establishment of scientifically based output norms in production, whose necessity was discovered by the gospriyemka, the improvement of labor wage systems, etc. All of these are extremely urgent problems, and they must be solved in a timely manner during the transition to complete cost accounting. The issue of the further expansion of the circle of enterprises at which the gospriyemka must be introduced is currently being discussed.

The main conclusion from the first months of operation is as follows: the gospriyemka is a drastic but necessary means of accelerating reorganization.

12794
CSO 1823/152

UDC 658.310.16
658.310.33

HUMAN FACTOR QUANTIFIED BY ECONOMISTS

Moscow MASHINOSTROITEL in Russian No 1, Jan 87 pp 23-24

[Article by L.I. Zhukov, professor and doctor of economic sciences, and A.N. Marzhinyan, I.L. Zhukov and V.A. Lovkov, candidates of economic sciences, under the heading "Economy, Efficiency, Quality": "The Human Factor and Labor Productivity: Analysis and Planning"]

[Text] Switching the economy over to an intensive path of development in the 12th Five-Year Plan is 39- to 43-percent connected with accelerating the rates of labor productivity growth in the machine-building branches. A significant place is given to the human factor in increasing output by machine builders, as is pointed out in the CPSU Program: "Successful resolution of the tasks outlined by the party is associated with increasing the role of the human factor. Socialist society cannot function effectively without finding new ways of developing the creative activity of the masses in all areas of life."

The extensive use of FMS, automatic lines, multiple-operation NC machine tools and robot equipment complexes increases the efficiency of social production many-fold and makes it many times easier, but it does not eliminate live human labor. In this regard, machine-oriented labor will become the basic type. By engaging embodied labor substantivized in means of production in the sphere of its production activity, live labor -- the human factor -- is the organizer of the production process as a whole and the producer of machinery, machine tools and equipment. Therefore, any increase in labor effectiveness is achieved only by man, not by the means of labor.

Classification of human-factor reserves, that is, of changes in the elements of the labor process which are caused by a decrease or increase in working time or in consumer features socially necessary to production, is the basis of scientifically substantiated labor productivity planning and management at machine-building plants. These are the motive forces (causes) under whose impact the level and dynamics of labor productivity over a specific interval of time change at a particular plant.

The following human-factor reserves have been revealed at Leningrad machine-building enterprises: worker labor skill level under-utilization, incomplete use of worker competence and fitness due to the failure of working conditions to conform to established norms and requirements and failure to ensure effective leisure and working conditions, inadequate collective stability due to the fact that work selection and placement in the labor process fails to consider the individual capabilities and psychological features of the personality, shortcomings in the wage and bonus distribution system, incomplete use of the creative opportunities of the workers, low level of labor satisfaction and worker discipline.

The increment in labor productivity as a result of actualization of the human factor is determined using the formula

$$П = \frac{Ч \times 100}{F - \Sigma Ч},$$

where $П$ is the increment in labor productivity from the fullest possible use of the potential opportunities of the human factor, in percent; F is the number of industrial-production personnel; $\Sigma Ч$ is the total calculated personnel savings connected with using the human-factor reserves available at an enterprise.

Under-utilization of the level of worker labor skill in machine building (performing jobs in a lower skill category or spending more time than is anticipated in the norms on performing jobs which do correspond to their skills) is a significant human-factor reserve . The working time saved $Э_1$ can be determined using the formula

$$Э_1 = \frac{А}{Б},$$

where A is total annual (plant-wide) additional payments, up to the wage rate, to workers performing jobs in a lower skill category, in rubles; $Б$ is the average annual rated wage fund per worker, in rubles.

The fullest possible use of the competence and fitness of the workers is a big human-factor reserve at the enterprises. The deviation of actual working conditions in production from the conditions adopted as normative leads to heightened physical and nervous-psychological tension and, in the final analysis, to increased fatigue and reduced competence of machine builders.

The savings in staff $Э_2$ thanks to use of this human-factor reserve is expressed by the formula

$$Э_2 = R \frac{И}{100 + И},$$

where R is the number of plant workers for which actual working conditions are not normative; $И$ is the possible increment in output associated with bringing the actual level of working conditions up to normative. It is determined by using the integral indicator of work-ability ("Mezhotraslevyye trebovaniya i normativnyye materialy po NOT" [Interbranch NOT (scientific labor organization) Requirements and Normative Materials], Moscow, Izd-vo NII truda [Scientific

Research Institute of Labor], 1979, could serve as a possible variant for substantiating integral indicators).

Reduced worker competence and fitness is determined by the discrepancy between actual and normative working conditions. In production, this is expressed as a rise in whole-day losses of working time due to temporary inability to work or to production or occupational morbidity. The number of workers $Э_2$ freed by reducing whole-day losses of working time for these reasons is calculated using the formula

$$Э_3 = \frac{C_1 + C_2}{Д} \cdot F$$

where C_1 and C_2 are, respectively, actual and normative losses of working time due to temporary loss of fitness per worker per year, in hours; $Д$ is the annual working time available per worker, in hours; F is the number of people working at the machine-building plant.

The use of human-factor reserves is predetermined in considerable measure by the attitude of the workers towards labor, which is manifested in such concrete forms as labor and creative activeness, self-discipline, and the striving of workers to achieve higher labor results than are anticipated by the current norms, plans and assignments through efforts which depend on their individual abilities and opportunities.

The next human-factor reserve, $Э_4$, which is associated with worker under-performance of rated (planned) assignments, depends on the status of labor rate-setting and on the forms and systems being used to pay wages. It is expressed as the function

$$Э_4 = \frac{E_1 - E_2}{100} F,$$

where $Э_1$ and $Э_2$ are, respectively, normative and actual plan assignment fulfillment, in percent; F is the number of hourly-wage workers.

Organizing socialist competition is a substantial human-factor reserve. The release of output is the end result of its influence on labor activeness and labor productivity. The staff savings $Э_5$ associated with raising the level of competition and increasing the increment in above-plan output is calculated using the formula

$$Э_5 = \frac{FK}{100 + K},$$

where K is the increment in above-plan output obtained when the level of competition organization is raised, in percent.

Shaping favorable moral-psychological relations in the collective is a very important condition for using human-factor reserves. Such conditions are created by the collective form of labor organization and wages. Let's define the staff savings as

$$Э_6 = \frac{N}{100 + N} M,$$

where N is the increment in level of performance of output norms in the brigade (determined using special methods), in percent; M is the number of workers in the brigade.

The role of the human factor is increased given reduction in or total elimination of losses of working time caused by violations of labor discipline (absenteeism, tardiness, not starting and stopping work at the proper times, leaving for lunch early, walking off one's job). In the final analysis, this facilitates labor productivity growth. In this regard, the staff savings, $Э_7$, is expressed as the function

$$Э_7 = \frac{T}{Ж},$$

where T is whole-day losses of working time caused by absences, in man-days; $Ж$ is the annual working time available, in days.

The staff savings $Э_8$ as a result of eliminating intrashift losses of working time revealed by special one-time surveys and time-and-motion studies is determined from the expression

$$Э_8 = \frac{T_B}{Ж_Ч},$$

where T_B is intrashift losses of working time for which the worker is at fault, per year; $Ж_Ч$ is the annual working time available, in days.

Satisfaction with labor and with material and moral incentives also increase the role of the human factor. This is manifested in a reduction in personnel turnover and in the associated losses. By putting the personnel turnover coefficient at the planned level, we obtain a savings of

$$Э_9 = F_p \, (Y_1 + Y_2) \, (1 - Y_3),$$

where F_p is the number of workers, Y_1, Y_2 are the planned and actual values the worker turnover coefficient, in percent; Y_3 is the ratio ofthe average monthly output preceding dismissal of the workers to their average monthly output in the customary units of measurement (for that particular shop or sector).

Thus, the methods proposed permit:

-- determining the share of the "human factor" in labor productivity and output volume increment, as well as reserves for thus reducing the number of workers;

-- selecting priority and "economical" reserves for accelerating the rates of labor productivity growth. The factors proposed here (as distinct from factors at the material-technical level) do not require capital investment, that is, expenditures of embodied labor, but are rather aimed at revealing intraproduction reserves with greatest effectiveness;

-- "controlling" labor productivity growth reserves at the plants, inasmuch as they are subjective in nature. One can determine the "share" and "proportion" of each human-factor reserve, which is especially valuable when analyzing and planning labor indicators under conditions of plant production intensification. The methods permit determining what measures are needed to achieve the planned labor productivity growth.

The methods are interbranch in nature and can be used at all enterprises of the machine-building complex.

11052
CSO: 1823/103

UDC 331.101.68:621

QUANTIFICATION OF LABOR INTENSIVENESS MODELED ON GAZ PO NORMS

Moscow MASHINOSTROITEL in Russian No 1, Jan 87, pp 24-26

[Article by Yu.V. Charukhin, candidate of economic sciences: "Labor Intensiveness in Machine Building"]

[Text] Given the current intensification of social production, proper determination of the level of labor intensiveness creates prerequisites for increasing labor productivity and resolving issues connected with improving working conditions and labor organization, setting and paying wages.

Labor intensiveness is described by such temporal indicators of working time use as coefficients of engagement in active work in operating time $K_{З.О}$ or unit time $K_{З.Ш}$ or, for multiple machine-tool work, by the coefficient of engagement in active work in a cycle $K_{З.Ц}$. The indicator which takes engagement in active work into account most fully is the coefficient of employment of the available working time per shift $K_{З.СМ}$, which can be determined using the formula

$$K_{З.СМ} = \frac{\Sigma T_{З.СМ}}{\Phi_{СМ}},$$

where $\Sigma T_{З.СМ}$ is worker engagement in active work in the course of a shift; $\Phi_{СМ}$ is the available working time per shift.

These coefficients are, in our opinion, extensive indicators describing the proportion of engagement in a specific time interval. Increasing engagement in active labor and increasing labor intensiveness differ in nature, but yield identical results: increasing expenditures of working time.

Labor intensiveness is described most accurately by indicating the speed with which labor operations are performed (work tempo). The coefficient of change in speed of performance of operations $K_{В.О}$, which can be defined as the ratio of reference speed of performance $\nu_{ЭТ}$ to planned speed $\nu_{ПР}$ would be one such indicator. In this instance, speed is a generalized concept: it might be the speed at which the finger, wrist or entire hand moves, the speed at which the entire body or individual parts of it move, the speed at which audio, visual or any other signals are processed, or speed of thought when making an intelligent decision in multivariant tasks.

The speed with which manual operations are performed depends on many factors, in particular, on the weight of the part, the tool, the force applied, and also on the distance over which the particular object is moved. These factors are taken into account at the GAZ [Gorkiy Automotive Plant] PO [production association], for example, in setting differentiated hourly wage rate supplements for assembly-line workers in large-series and mass production. The size of the wage rate supplements varies from five to 30 percent as a function of the worker engagement factor (unit time), the number of items machined per shift per work station or the number of part-operations performed in a shift, and the complexity group. The pay is thus higher for labor which is more intensive.

It should be noted that, when working with machine tools, the higher the speed of the machining, the more attentively and the faster the person must perform his operations. The human factor is therefore in some measure a factor slowing the intensification of cutting processes. When production processes are automated, some of the functions performed by people are transferred to machines and are mechanized or completely automated, that is, prerequisites appear for intensifying cutting processes, increasing machining speed and reducing the total time spent machining parts. However, even under these conditions, the worker retains certain labor functions to be performed at the machine tool, which limits the potential of the equipment.

The transition to comprehensive automation of technological processes is permitting the total elimination of human participation in machining items and the use of maximum speeds to obtain prescribed properties and the necessary precision. People will be trouble-shooting and maintaining equipment and monitoring its automatic operation. Intensifying equipment operation and intensifying human labor thus become independent of one another, which permits increasing equipment output and ensuring intensification of production processes without endangering human health.

The speed at which human labor operations are performed directly influences their duration (the higher the speed, the less time is required to perform the operations). In view of this,

$$K_{B.\,O} = \frac{T_{ЭТ}}{T_{ПР}},$$

where $T_{ЭТ}$ and $T_{ПР}$ are the reference and planned (established time for human performance of the operations. As distinct from coefficient $K_З$, which might be attended by temporal characteristics related both to the equipment and to the person, coefficient $K_{B.\,O}$ describes only live labor.

In practice, the time norm consists of elements which vary as a function of what production processes the person is engaged in (debugging equipment, controlling the machine tool, routine monitoring of equipment operating automatically). Thus, given modern, highly automated metalworking production, machine-only time accounts for an increasingly large share of operating time, machine-only time being the time a machine tool operates without human participation, with the worker performing specific functions on an operating or nonoperating machine tool (auxiliary time, active observation, moving from one machine tool to another, and so on). Therefore, when evaluating the intensiveness of worker labor, one is concerned with only that portion of operating time in which the person is engaged in active work. This is very important, since labor intensiveness is a category describing only live labor.

Reference time is understood to mean the time needed to perform any given operation and is calculated using microelement or interbranch time normatives. These normatives are developed based on efficient speeds of motion. For example, psychophysiological studies were conducted to develop microelement normatives to substantiate work tempo (worker fatigue under production conditions was evaluated). Under the base system of microelement time normatives developed by the Scientific Research Institute of Labor, the basis is the average work pace of skilled workers, which ensures high productivity, but which also leads to people becoming overtired. The normative pace of work is equivalent to a base microelement ("extend arm") performance speed of 93 cm/sec over a distance of 40 cm with low-level monitoring. This was adopted as the base microelement since it is the one most often encountered in labor processes. This pace is the optimum level of human functioning, the level perceived by the implementer as being most comfortable and requiring no special effort or strain to quicken or slow one's movements. Thus, the time normatives incorporate a certain speed of job performance. At the same time, they must be set as a function of various working conditions so as to not lead to workers becoming overtired and they must consequently stipulate a normal (normative) degree of labor intensiveness.

A planned or established time norm is the time a person works as calculated on the basis of other normatives or derived experimentally. Reference time may be either greater or less than planned, as a function of which value $K_{B\ O}$ may be less or greater than one. This signifies that the planned speed of performance of the operations (which is the most important labor intensiveness factor) may be greater or less than the normative values.

It can be argued, of course, that there need not be differences between the reference and planned time norms, and in fact, the planned time norm does not need to differ from the reference norm, since that is what rate-setting aims at. However, they are, in practice, often different values. The reason is that labor norms directly influence wages. Overstated time norms or understated output norms often permit "pulling" wages up to a needed level.

Severity of labor is one of the indicators which takes the characteristics of labor activity into account most fully, and it is determined by the degree of aggregate influence of the production elements of labor on the condition of the human organism, its competence and fitness. According to the methods developed by the Scientific Research Institute of Labor, labor severity is characterized by the aggregate of various indicators reflecting working conditions (sanitation, psychophysiological and others). In connection with the fact that labor severity is an integral, points-based evaluation of all the factors influencing a person in the work process, it also includes descriptions relating to labor intensiveness, that is, the severity of the labor, and including, in particular, degree of labor strain. Delineating it from the labor severity category is a very difficult task and ultimately not an essential one. The main thing is that change in labor strain is quantitatively reflected in labor severity as well.

In actual production, the severity of each labor process can be evaluated using a severity factor $K_{Т}$ (specific labor severity), which is determined using the formula

$$K_{Т} = \frac{И_{Т}}{480},$$

where $И_{Т}$ is the integral evaluation of labor severity at a given work station for the given working conditions, in points; 480 is the available working time per eight-hour shift, in minutes. If the labor severity exceeds category 3 (that is, if $И_{Т} > 45$ points and $K_{Т} > 0.094$ points per minute), then steps must be taken to improve working conditions.

How can these indicators be used when planning labor organization so as to bring its intensiveness up to normal (normative) values? Under mass, flow-line and large-series production conditions, coefficients $K_{З.О}$, $K_{З.Ш}$ and $K_{З.Ц}$ can be used not only as indicators of engagement in operating or unit time, but also as an extensive description of engagement in the available shift time. If a worker performs an operations job, an equipment setup or adjustment function, and so on, then the generalizing indicator will be $K_{З.СМ}$, the coefficient of engagement in active work in the working time available in the shift.

Thus, the ratio of the planned value of the coefficient of engagement in active work $K_{З}^{ПР}$ to its normative value $K_{З}^{Н}$ can be used as a criterion of labor organization effectiveness (with consideration of extensive factors), but the value of this ratio (less than, equal to or greater than one) shows whether or not the worker's labor has been organized efficiently:

$$K_{Э.Т} = \frac{K_{З}^{ПР}}{K_{З}^{Н}}.$$

Depending on what engagement coefficient is being examined (in operating time or in available shift time), the normative value is determined in different ways. Thus, for single machine-tool work, $K_{З.О}^{Н}$ will apparently equal one $K_{З.Ш}^{Н}$, and $K_{З.СМ}^{Н}$ will equal $1 - \dfrac{T_{О.Л.Н}}{T_{Ш}(Ф_{С.Ш})}$, where $T_{О.Л.Н}$ is time for rest and personal needs; $T_{Ш}$ is unit time. In unit time, the time for rest and personal needs is ordinarily expressed in percentages of operating time.

The use of extensive and intensive indicators permits consideration of a majority of the factors influencing expenditures of human energy:

$$K_{Н.Т} = K_{Э.Т} K_{В.О},$$

where $K_{Н.Т}$ is the labor strain coefficient. Unfortunately, it is very difficult to calculate $K_{В.О}$. In this instance, we can avail ourselves of the effectiveness coefficient developed from the VAZ experience ($K_{эф}$), but that is a very subjective indicator.

In connection with the fact that it has been proposed that consideration be given to the influence of labor intensiveness on the human organism for particular production conditions through the category of its severity under those conditions, one can adjust K_T using $K_{H.\ T}$. In this instance, the actual severity category $K_{T.\ факт}$ will take into account the engagement in active work and the degree of rigidity of the time norms:

$$K_{T.\ факт} = K_{H.\ T}\, K_{T.\ исх}\ .$$

Is it legitimate to adjust $K_{T.\ исх}$ using factor $K_{H.\ T}$, which is a derivative of two coefficients? There is no contradiction in logic, since both indicators ($K_{B.\ O}$ and $K_{Э.\ T}$) influence labor severity independently, but their aggregate influence is greater or smaller.

Thus, when planning labor organization, it is possible to calculate estimated organism expenditures in performing production assignments. This permits determination of the sphere of normal, permissible and impermissible labor severity with consideration of extensive and intensive factors.

11052
CSO: 1823/103

SLOW-SERIES PRODUCTION OF NEW EQUIPMENT DISCUSSED

Kiev PRAVDA UKRAINY in Russian 21 Mar 87 pp 1-2

[Interview in Zaporozhye-Kiev with B. Chumakov, candidate of technical sciences and docent from the Zaporozhye Machine Building Institute, by V. Alfimov, candidate of pedagogical sciences and deputy secretary of the party committee of Donets State University, under the rubric "We Are Creating the 9 Billionth Innovative Asset for the Economy": "They Insulted Him"; date not given; first three paragraphs, PRAVDA UKRAINY introduction]

[Text] A unique machine tool was created in Zaporozhye. It was exhibited in the machine building pavillion at the Exhibition of UkSSR National Economic Achievements [VDNKh UkSSR]. However, one of the inventors of this development, engineer B. Chumakov, wrote the editor saying that the exhibition award insulted him.

Of the many exhibits at the exhibition I remember this one most of all. The machine operated without an operator and skillfully filled a container with products. At the time, the plant representative provided detailed explanations.

Of course, it could not have occurred to me at that time during the exhibit that 2 years later I would become acquainted with one of the authors of this intelligent, nevertheless entirely natural automaton and with the history of its creation.

V. Chumakov--docent at the Zaporozhye Machine Building Institute, candidate of technical sciences, inventor with many years of service, and the holder of tens of patents--is well acquainted with the Tool Plant imeni Voykov and its technical problems. His students complete production practice here. He has long focused his attention on the obsolete bulky machine tools for stamping taps--tools that help cut threads.

They make a lot of noise, and to put it plainly, working with them is not very attractive. He formulated his task in rigid terms: First, the new press should be an automaton. Second, it should be less material- and energy-intensive but more productive, precise, and reliable. And we would hardly be speaking about success today had not former plant director A. Solovyev personally participated in and supported the work. He himself took to the vises with a saw in his hand. The student V. Layko was intrigued with creating an automaton and was interested in the idea of his teacher. And strictly speaking that laid the groundwork which resulted in this press-automaton. And now the words of V. Chumakov himself:

"The automaton was sent to the plant for operation in 1984. And if the prototype hadn't been exhibited at the VDNKh UkSSR in 1985, everything would have come about without the negative morale shocks that are unfortunately still traditional for the majority of inventors. Although the machine tool was sent to the exhibit by the plant, the documents indicated that it was developed jointly with the institute, that is, jointly by science and production. From that time on the machine tool has been at the exhibit.

"In January of this year the VDNKh UkSSR sent awards--a second-class certificate to the plant and nothing to the institute. The authors were acknowledged as follows: A. Solovyev and I received second-class certificates, and V. Layko (he is now head of the production and mechanization office at the same plant imeni Voykov) received a first-class certificate.

I can say honestly that I didn't work for the award, but I never expected such a crying injustice, such a diminishing of my role and that of my higher educational institution. Why did they degrade me in the eyes of my pupils and everyone who knows me? And why has the exhibition still not returned the machine tool to the enterprise? It must output production and recoup the investment made in it."

Any insult is bitter. Even one caused by an award. But after receiving this letter it occurred to me that the sources of this insult should not only be sought at the exhibition. Judge for yourself. A machine tool with no analogue in our country or abroad was created after 9 years of exploration. And it's allowed to stand at an exhibition, visibly demonstrating the strong unity of science and production. And let the numerous visitors to the machine building pavillion be convinced that thanks to the practical embodiment of V. Chumakov's idea the Zaporozhye enterprise advanced to a fundamentally new technical level in the production of taps.

What am I saying? The same presses that were considered obsolete more than 9 years ago are still banging away as before at the plant section where taps are manufactured. The automaton in question still remains the sole, one can say, exhibition version.

And the machine tool was completely executed in metal in 1984. Why the long delay before introducing an innovation? The oblast newspaper ZAPORIZKA PRAVDA tried to untangle the matter more than a year ago. They got the following answer. The USSR Ministry of the Machine Tool Building and Instrument Making Industry was not interested in the development. Well, the plant heads are interested in it.

But indeed the enterprise provided itself with press-automatons through its own efforts and by itself, without the ministry. They don't cost a lot--the authors only spent about 4,000 rubles on their prototype.

Obviously the reasons for the delayed introduction must be sought more in the plant offices rather than in the ministry offices. A conversation with plant engineer V. Mosgovoy more precisely, his very restrained evaluation of the automaton convinced me of this. This, despite a document written by him clearly stating that in the time that the machine tool was able to operate at the plant, it had an economic effect of about 40,000 rubles thanks to a triple increase in labor productivity, a 40 percent savings in high-speed tool steel, and a 25 percent increase in the strength of a finished tool. One can add that the plant's current press weighs 7 tons, whereas its exhibited counterpart weighs about 500 kg and operates noiselessly.

V. Mozgovoy's opinion about the more-than-strange decision of the exhibition committee is curious.

"I agree," he said, "that the machine tool has been created by Chumakov's persistence. But I don't understand why he is complaining that they acknowledged him with a reward. Is who got what class certificate really so important?"

So much about Chumakov. Now about Mozgovoy. One of the inventors of the machine tool, A. Solovyev, responded to our question about what role the chief engineer himself had in creating and introducing the development: "None!" he stated flatly and without compromise. And yet the VDNKh UkSSR also awarded V. Mozgovoy a second-class certificate for this machine tool.

As we see, the synthesis of science and production that has been so convincingly demonstrated by the exhibition does not turn out to be so monolithic.

"In the last few years," said B. Speranskiy, science prorector of the machine building institute, "our connections with the plant have started to break off one after the other. Why? Because the current director of the tool plant G. Smolyarov has announced that he has no time to get involved with all the developments there. Our teachers prefer to cooperate with Krivoy Rog, Kazakhstan, and Dalnyy Vostok enterprises. Not long ago we received a letter from the Makeyevka Metallurgical Combine with which we have been involved in research for more than 20 years. They have asked us to maintain contacts with them in the current and subsequent five-year-plans. And we understand that in the past year the higher educational institution's developments have yielded an economic effect of 18 million rubles. And they have the power to do more. In my view, a small current has jammed the tool plant's directors--there are no new technical developments there."

Such is the opinion of A. Tsokur, docent at one of the institute's departments. The plant is in no hurry to circulate his vibration unit for surface machining components with a complex shape, which has received good reviews from specialists. And only V. Mozgovoy maintains his peculiar opinion.

And what does B. Chumakov think about all this? He said he does not want a conflict with the plant since his plans call for creating a new press-automaton generating a force 1.5-fold greater than an automated line. And without a plant base, this cannot be done. As we have seen, the inventor has a lot of plans, but he is not certain that his plant partners have not been "offended" by his frankness.

Such is the fate of a valuable invention protected by two patents. And does everything ultimately end with the exhibition prototype? It seems that there is no basis for pessimism. A. Solovyev, former director of the plant imeni Voykov and chief engineer of the VPO [not further identified] of the Main Administration of the Production of Cutting and Measuring Tools and Instruments [Glavinstrument] of the USSR Machine Building Industry Ministry, assured us of this. The sector's internal needs for this press-automaton have already been determined. Requests for it have also come from abroad. Specific measures are being taken to circulate it.

Well how did the frustrating overlapping of the award turn out? We turned to the exhibition. The response to the question why L. Mozharov, director of the machine building pavillion, decided suddenly to single out not B. Chumakov but rather V. Layko was categorical.

"Everything was done in strict accordance with the plant proposal."

We saw a copy of the plant proposal. The name B. Chumakov was the first one noted on it.

Unfortunately we were unable to meet with V. Layko. He was on an extended out-of-town work assignment. But we received word that he is embarrassed about the award.

"Many people consider me a fool," Boris Nikolayevich Chumakov told us bitterly. "Indeed almost everything needs to be done on a social basis, by hand. The material rewards amounted to 90 rubles each twice. But you really don't only create something new for the materials rewards..."

How many such fools have we smeared. And for such reasons as thoughtlessness, indifference, and formalism in evaluating their difficult and at times agonizing labor.

Boris Nikolayevich asked us to return his certificate to the exhibition...

1823/135
12794

ODESSA MIRRORS REPUBLIC MANPOWER PROBLEMS

Kiev EKONOMIKA SOVETSKOY UKRAINY in Russian No 2, Feb 87 pp 10-18

[Article by A. Butenko, first deputy chairman of the Odessa Soviet of People's Deputies oblispolkom: "Problems of Updating the Production Apparatus of Industry (following the example of Odessa Oblast)"]

[Text] After a comprehensive evaluation of the state of the Soviet economy, the 27th CPSU Congress formulated a scientifically substantiated concept of accelerating the socioeconomic development of our country and qualitatively transforming the material-technical base of the national economy.

Resolution of these tasks presupposes not only quite a precise determination of the economic essence of the process of developing the national economy, but also clarification of the role and place of the various factors in its acceleration.

It is appropriate to analyze the on-going trend toward improvement in the production apparatus using the "workplace" concept, since that is the primary cell of social production. The effectiveness of social production as a whole depends in considerable measure on ensuring the effective functioning of each workplace.

The unfavorable economic development trends referred to at the 27th CPSU Congress have been caused to a considerable extent by inadequate attention to shaping the workplace, and foremost to ensuring its balance with another very important production factor, manpower. The new revision of the Party Program notes the necessity of "planned balancing of jobs and labor resources in all branches and all regions of the country."

In our view, when evaluating the proportionality of the production factors being examined here, one should distinguish quantitative and qualitative balance between jobs and workforce. The first describes the quantitative ratio of jobs to workforce, and the second describes their conformity to modern technical, organizational, skill, age, sex and other requirements. Whereas quantitative balance is a result primarily of a well-founded investment policy, qualitative balance reflects, in considerable measure, the effectiveness of work done within the framework of workplace certification and rationalization.

The quantitative and qualitative aspects of job and labor resources balance are shaped by decisions at various national economic levels. Thus, the quantitative balance of jobs and workforce is determined in considerable measure at the national and regional levels, where the pace and proportions of development are determined and the socioeconomic features of the individual regions are taken into account, while qualitative balance is determined by decisions made at the branch level and right in the associations and enterprises. At the same time, disproportions in shaping the workplace can arise due to inadequate coordination or to failure to observe priorities when making economic decisions at national economic levels contiguous with the "authorized" ones. Thus, the large-scale addition of new jobs by ministries and departments without the concurrence of territorial planning agencies leads to a reduction in the quantitative balance of jobs and workforce, to disruption of regional social reproduction processes.

Analysis shows that only one in every five jobs is created with the knowledge of the regional labor agencies, while in the remainder, issues of building new enterprises and expanding existing ones are either decided in circumvention of standard procedures for reconciling them or the appropriate materials are submitted for reconciliation when the corresponding resolutions have already been adopted to build the enterprise.

Development of the production apparatus of Odessa Oblast industry are in considerable measure characteristic of republic industry as a whole. Thus, in spite of the changes in the economic conditions, oblast industry has continued to develop primarily extensively. In the 10th and 11th five-year plans, the rate of growth in jobs outstripped the rate of growth in the workforce, the figures being 109.2 and 105.9 percent, respectively. In other words, instead of developing the production apparatus intensively, through attrition, it has continued to accumulate jobs.

A low job use coefficient is one feature of the development of industry in Odessa Oblast. Consequently, raising the job use coefficient to the level achieved in republic industry as a whole is an important reserve for improving the effectiveness of its social production.

The creation of new jobs for which manpower is unavailable disrupts the process of reproducing and using the available production potential. In this regard, it first of all freezes capital investment and, in so doing, diverts funds needed to update the production apparatus: in the 10th and 11th Five-Year Plans, expenditures on accumulating new jobs in the oblast exceeded the funds directed into replacing obsolete ones 3.3-fold. In the preceding five-year plan, only 1.3 percent of fixed production assets were replaced annually, which is clearly inadequate to ensure a high production apparatus technical level. Disruption of the production apparatus reproduction process has also made itself evident in injustified expenditures on repairs and in a reduced level of useability of fixed production assets.

Nonconformity of the numbers of jobs created to actual manpower resources leads to the accumulation of unfilled jobs at the enterprises. An analysis of the job structure based on data from a one-time survey of the Ukrainian SSR Minlegprom [Ministry of Light Industry], Ukrainian SSR Minstroymaterialov [Ministry of Building Materials Industry] and Ukrainian SSR Minmestprom [Ministry of Local Industry] (as of 1 May 1984) showed that the proportion of unfilled jobs was 6.6 percent at oblast enterprises examined, 4.6 percent of which was understaffing and two percent of which was excess jobs. According to the calculations, ensuring the balance of jobs and workforce achieved in the republic in 1975 in Odessa Oblast industry today (K = 0.9) would permit the updating of an additional 18,600 jobs, taking obsolete fixed production assets worth 295.7 million rubles out of circulation, a 322.6 million ruble increment in commodity output, and a 17.6 percent increase in the return on capital (as compared with 1984). Other production indicators would also be improved correspondingly.

It is necessary to increase the role and importance of the local Soviets in the process of using and updating the production apparatus, in regulating the ratio between the number of workers and the number of jobs and in setting limits on the latter. It is also appropriate to increase the participation of territorial planning agencies in certifying and rationalizing jobs by broadening their rights to organize work and monitor job performance.

Although the indicated work is within the province of the branches and enterprises, it should still be coordinated at the regional level. First, that will permit corresponding large-scale work on a unified organizational basis and will avoid a formal approach on the part of individual enterprises (in this instance, a formal approach consists in reflecting insufficiently critically the situation which has evolved at the enterprises, undemanding job certification, inflated evaulations of the technical-economic level of production, although the proportion of workers employed at manual labor is high and the amount of obsolete equipment is significant, as we know). Thus, according to official data, about 79 percent of all jobs subject to certification in Odessa Oblast had been certified as of 1 January 1986, but that is, we feel, considerably above the true indicator. Looking at the experience of the "Dnepropetrovsk Combine Plant imeni K.E. Voroshilov" production association, it should be noted that the first year, only one in every four jobs was certified here but indicators analogous to certification results at other enterprises of Odessa Oblast were achieved only after 3-4 years.

Second, it is precisely the socioeconomic features of individual regions which determine the orientation of job certification work and, correspondingly, the control indicators which must be achieved based on work results. For example, in regions with a perceptible labor resources deficit, one needs to anticipate first of all steps to introduce labor-saving technology.

Enterprise experience testifies to the effectiveness of certification. However, conducting it is associated with certain organizational-technical measures: introduction of the brigade form of labor organization and wages, combining occupations, eliminating surplus equipment, and others, whose implementation is appropriately done based on the target-program method.

Given the concentration of enterprises, institutions and organizations of very diverse subordination -- union, republic and local -- within a single region, the development and implementation of comprehensive target programs is the most effective way of combining long-term branch and regional economic, scientific-technical and socal development problems.

The experience of Odessa and other oblasts of the Ukraine shows that three levels are defined in the management of comprehensive target programs, depending on the scale of the tasks being resolved. The first relates to the authority of the program coordination council under the oblispolkom and to its central working group. The coordination council chairman is the program leader.

The second level of program management is carried out by the scientific-technical councils under the lead organizations, their leaders being the chairmen, the scientific leaders of the programs and sections. The coordination and scientific-technical councils are comprised of economic leaders, scientists, specialists, and representatives of party and Soviet agencies and public organizations.

The third level is provided by the administrations of the enterprises, institutions and organizations, the implementers of the subprogram measures and assignments, who are organized into working groups which are generally headed by the chief engineers or deputy directors (rectors) for scientific work.

The coordination council exercises organizational-methods leadership of development of the program structure and directions and monitoring program implementation; it meets 2-3 times a year. Between coordination council meetingd, day-to-day leadership of shaping, implementing and developing the program is exercised by a central working group headed by the council deputy chairman. It meets as necessary, but at least once every two months. The scientific-technical councils approve measures and assignments and monitor their implementation, ensuring that the work is done at a high scientific-technical level. They follow annual plans and review work progress quarterly, resolving organizational, scientific-technical, production-economic and other issues involving work acceleration and introducing work results, and they hear reports by council members and individual implementers. Between scientific-technical council meetings, day-to-day leadership of the subprograms and sections is exercised by their working groups.

When issues concerning the interests of individual oblast associations and administrations, scientific-production associations, enterprises, organizations, institutions, VUZ's and public organizations are reviewed at meetings of the coordination council and its central working group or the subprogram scientific-technical councils, sections and their working groups, representatives of those organizations attend. The decision of the council or its working group is passed on the the appropriate implementers in the form of a copy of the decision or the minutes of the meeting.

Coordination council and working group decisions on the development, implementation and elaboration of a program are binding on all scientific-technical councils and program participants, and on the corresponding subprograms and sections.

The effectiveness of the system for monitoring implementation and elaboration of a program is ensured by providing prompt, reliable, complete information on all indicators being monitored. Implementers sent the information to the appropriate scientific-technical subprogram councils quarterly in 1986 and are sending it twice a year beginning in 1987. The subprogram scientific-technical councils also provide information to the central subprogram working group, and the section scientific-technical councils provide it to the scientific-technical councils for the corresponding subprograms and to the central program working group.

The program coordination council keep party and soviet agencies and public organizations regularly informed about progress in implementing and elaborating the program and publish an annual information bulletin on the composition of the coordination council and the central working group and the leaders of the subprogram scientific-technical council and section leaders. The information bulletin is sent out to all scientific-technical councils and program participants. The organization of computer-automated monitoring of program implementation will be examined subsequently.

In the early 1980's, Odessa Oblast worked out a target interdepartmental scientific-technical program for improving the effectiveness and quality of machine-building enterprise operation (the "Machine Building" program). It encompassed 48 scientific-production associations and enterprises, 25 branch scientific research and planning-design technological institutes and special design bureaus, 13 institutes of the Ukrainian SSR Academy of Sciences and seven oblast VUZ's. Lead organizations and implementers were determined for 30 ministries and departments to develop and implement 10 sections of the program.

The program tasks reflect a system of assignments and measures aimed at the thrifty, efficient use of material, labor and financial resources, introducing waste-free and low-waste technologies, improving the equipment shift index, perfecting the machine-tool inventory structure, developing production specialization and consolidation, cooperative use of the available reserve capacity in foundry, billet and auxiliary production, improving economic incentives and scientific labor organization, improving product quality, and environmental protection.

These measures, including scientific research, retooling, increasing labor productivity, and participation in union and republic comprehensive target programs, will unquestionably result in the anticipated technical-economic indicators of machine-building enterprise operation being rated at the oblast level. However, an absolute majority of them are not the prerogatives of territorial management agencies; this applies both to the program as a whole and to the individual subprograms.

Experience shows that the initial prerequisites for many of the measures being worked out are assignments included in current and long-range enterprise economic and social development plans which are agreed to and approved by the branch ministries. At the same time, simplified systematization of these measures will not ensure the necessary coordination of jobs and implementers at the regional level. Coordination of this kind is often done voluntarily and, lacking juridical regulation, permits formalism. In our view, the statute on the oblast main commission needs to formulate more clearly the rights and duties of that agenciy as regards the development and implementation of comprehensive target programs of scientific-technical and socioeconomic development of the enterprises and organizations within the oblast, regardless of departmental subordination, but with the consent of the appropriate management levels. The functions of the oblast planning commission also need to be broadened with regard to substantiating the proportionate participation of the ministries and departments of the subordinate enterprises and scientific organizations in the sociocultural and scientific-technical development of the city and the oblast.

In accordance with the provisions of the oblast "Machine Building" program, more than 2,000 scientific, technical, organizational and other assignments and measures were carried out in 10 subprograms drawn up under the principle of production and technological homogeneity and resolving one or several program tasks during the 11th Five-Year Plan. As a result of fulfillment of the program, commodity output volume was increased by 21.5 percent, and three-fourths of the increment was obtained through labor productivity growth. The economic impact of carrying out all the measures was 83 million rubles. Thus, the "Metall-85" and "Kokil-85" subprograms, whose basic purpose was to save ferrous and nonferrous metals and use them efficiently, dissemination of the operating experience of the collective at Odessa's "Kislorodmash" NPO [scientific-production association] in ensuring an increment in production volume without increasing expenditures of metal (experience approved by the Central Committee of the Ukrainian Communist Party), introduction of a resources control system, and a rise in the technical level of foundry production permitted a savings of 11,300 tons of ferrous and nonferrous metals, other materials and labor resources in 1985 and a savings of 70,600 tons in 1981-1985. Castings production at machine-building enterprises increased by 26 percent, and the level of application of progressive technologies reached 86 percent.

Fifty machine-building and metal-working enterprises carried out the "Metall" subprogram. Machine-building product designs were improved in the course of it, permitting lower metal consumption at the heavy machine building PO [production association] imeni January Uprising, at the "Stroygidravlika," "Orion" and "Elektronmash" PO's, at the "Poligrafmash" and "Prodmash" plants, at the food-processing equipment machine shop, and elsewhere. A number of progressive technological processes were mastered: friction welding (the machine tool manufacturing PO), cross-wedge rolling and drawing ("Kislorodmash" NPO), laying out rolled sheet in billet shops ("Pressmash" PO), and so on. With the start-up of the rolling mill at the "Krasnaya gvardiya" machine shop, worm reduction gear blank rolling has decreased the amount of preliminary turning required, permitting a savings of up to 200 tons of rolled metal per year. Introduction of an automated line combining four technological operations into a single process enables the "Odesskabel" plant to save six tons of aluminum foil. In the 12th Five-Year Plan, this subprogram will become part of the oblast's new "Resursy-90" program.

The "Kokil-85" subprogram anticipated the development and implementation of measures to automate and mechanize production processes, save materials and energy, and improve blank casting precision in oblast foundry production in the five-year plan through the introduction of progressive low-waste and waste-free technological processes in foundry shops and sectors, by optimizing the castings cooperative deliveries system, lowering the level of manual labor, improving working conditions, and several others. Implementation of the program assignments helped further develop foundry production in the oblast. Thus, castings production volume rose by 22 percent at oblast enterprises during the five-year plan, including a 26-percent increase at machine-building enterprises. About 86 percent of all the castings produced at machine-building enterprises were made using progressive technologies. Together with the territorial administration, the subprogram scientific-technical council has been working to eliminate empty-run and inefficient shipments of castings.

In the 12th Five-Year Plan, issues of saving materials and raising the technical level of foundry production will be resolved within the frame work of the oblast "Resursy-90"'s "Metall-90" subprogram.

The impact of using fixed production assets in accordance with the assignments of the "Fixed Production Assets-85" subprogram on efficiency was determined and studied for 12 enterprises with different types, volumes and extents of series production. However, due to the absence of precise production modernization plans in many ministries and inadequate capital investments allocated for these purposes, we did not always succeed in actively influencing the fuller and more intensive use of the available production potenthal through this subprogram. In recent years, all oblast machine-building enterprises have been working in a planned manner to certify and rationalize jobs, using for this purpose the experience of the collectives at Sumi Machine-Building Association imeni Frunze (increasing production efficiency), Odessa Precision Machine Tools Plant imeni 25th CPSU Congress (increasing equipment shift indices) and Dnepropetrovsk Combine Plant imeni Voroshilov (job certification). However, the equipment shift index remains below the republic level. Job certification is being done formally, without active worker participation, at some enterprises and has not been linked to concrete production intensification indicators, including best possible use of fixed production assets, as a consequence of which we have succeede only in slowing the rate of reduction in the return on capital in oblast machine building.

The participants in the "Instrument-85" subprogram are the "Spetstekhosnastka" scientific-production association, "Kislorodmash" NPO, OPI [Odessa Polytechnic Institute], OTIPP [Odessa Technological Institute of the Food Industry imeni M.V. Lomonosov and 39 industrial enterprises. Its basic goal was to improve enterprise stockpiles of tools by creating and introducing progressive types of tools and fittings and the technologies for manufacturing them, improving quality, raising the level of tool production economy and management organization, and retooling and renovating tool shops and sectors. These problems were solved on a contractual basis and through creative cooperation by the joint efforts of the enterprises and scientific-technical organizations carrying out the subprogram, as well as branch and interbranch institutes. A number of assignments were carried out by the enterprises themselves. Institutes of the Ukrainian and Moldavian SSR Academies of Science, Leningrad Polytechnic Institute and branch organizations were enlisted in carrying out the subprogram's scientific research.

The main task of the "Stankostroyeniye" subprogram was to coordinate and set up monitoring of work on raising the technical level and improving the competitiveness of metalworking equipment. The efforts of the enterprise and organization collectives participating in the subprogram were directed at continuing to improve metal-cutting and forge-press equipment scheduled for release in the 12th Five-Year Plan. The special machine tools SKB [special design bureau] has developed new machine tools, complexes and automatic lines in recent years, including ones to produce parts for the new "DON" family of combines. Just three automatic piston machining lines permit the freeing of 94 people for other jobs and obtaining an economic impact of 680,000 rubles.

The Precision Machine Tools Plant imeni 25th CPSU Congress and its SKB PS [special design bureau for precision machine tools] followed a modular-unit principle in developing new equipment and set up experiments in the predesign period. That enabled them to increase the degree of part and subassembly unitization within the machine tools to 80 percent, to significantly increase their productivity, reliability and durability, to shorten the "design to product" cycle to 1-1.5 years, and to approximate the world's best in terms of technical sophistication.

Using SKB PS documentation, the precision machine-tools plant and machine-tool manufacturing plants in Vitebsk and Vilnius set up series production of a set of high-precision horizontal and vertical drilling-milling-honing machining centers with automatic tool and blank replacement and equipped with modern domestically-produced monitoring and positioning systems in the 11th Five-Year Plan. The purpose of these machine tools is to automate single-item and small-series production, providing a two- to 2.5-fold increase in productivity. Each machine tool has a national economic impact totalling 40,000-50,000 rubles. Automated CNC machine-tool sectors performing a fully automated cycle of machining complex housing parts and permitting automatic selection of the optimum technological variant through continuous operation over several shifts are now in series production. This sector, consisting of four "machining centers," has increased housing parts machining productivity six-fold, freed 30 highly skilled machine tool operators for other work, and provided an economic impact of 250 million rubles. Prototypes of flexible manufacturing models [as published] capable of actively monitoring the dimensions of the parts being machined and operating as "unmanned technology" have been manufactured.

The Milling Machines Plant imeni Kirov developed the design for and masteried production of a number of new machine tools providing increased productivity, accuracy and reliability in the 11th Five-Year Plan.

However, the level of work achieved by Odessa technological design organizations and enterprises of the Minstankoprom has not yet ensured the creation or mass production of new-generation equipment capable of increasing labor productivity many-fold, accelerating the introduction of progressive technology, reducing materials consumption and increasing return on capital.

Designing and mapping out the technical level of new equipment are generally done using as a model not the predicted world level of analogous output, but the level of equipment already available. As a result, new equipment often seems to be of inferior quality and competitiveness by the time it gets into series production. The equipment being developed often incorporates isolated innovations and technical improvements for which patents [author's certificates] are held, but issues of mechanizing and automating technological operations, reducing the proportion of manual labor, and multiple machine-tool servicing are not resolved in a comprehensive manner.

Inadequate use is made of the opportunities for increasing automation by increasing the use of CNC to create rapidly readjustable manufacturing systems, complexes and cells. This applies in particular to forge-press equipment which must, in connection with the changeover from traditional forms of working metals by cutting to metal-saving methods, become the basic equipment used in manufacturing blanks and parts in the very near future.

Specific materials- and energy-consumption is being reduced slowly and the labor-intensiveness of manufacturing new metalworking equipment is rising; as a result, the increase in its cost is significantly outstripping technical-economic indicators and is leading to poorer return on capital, even given two- or three-shift operation.

The basic direction of the "Selkhozprodmach-85" subprogram in the 11th Five-Year Plan was to set up work aimed at further improving the technical level and quality of technological equipment for the food branches of industry, increasing their production, and continuing to improve the technical level and quality of machinery and equipment for agriculture, increasing their use, and increasing deliveries of them. Some 700 assignments were carried out during the five-year period, resulting in a national economic impact of 25.2 million rubles. However, the shortcomings characteristic of the "Stankostroyeniye-85" subprogram also became evident in the course of carrying it out. They resulted first of all from the fact that enterprises are producing output not conforming to today's demands, and with no clear plans for replacing it. It should also be noted that scientists at the Polytechnical Indtitute and the Technological Institute of the Food Industry have not made an appreciable contribution to resolving the subprogram's tasks.

The 1986-1990 programs anticipate a substantial increase in capital investment in developing machine building. In this regard, at least 50 percent will be directed into renovating and retooling existing enterprises. Annual comprehensive updating of the active portion of production fixed assets will reach 10-12 percent, and the pace at which obsolete and obsolescent equipment is withdrawn from production will be increased two- to three-fold. The structure of the existing metalworking equipment will also change due to a significant increase in forge-press machinery and other devices which work metal by plastic deformation. Production bottlenecks and disproportions will be eliminated.

The intent is to increase the load on production capacities, raising the equipment operation shift index to 1.6-1.8 by 1990 (including an increase to 1.9 for NC equipment and automatic lines and an increase to 2-2.5 for flexible manufacturing modules and systems), continuous job certification and rationalization, balancing jobs and the available labor resources, intensifying autonomous financing in all production links, developing brigade forms of labor organization, combining occupations and multiple machine-tool servicing, and perfecting moral and material incentives for achieving good indicators in the efficient use of production fixed assets.

Much attention is being paid to further automating production through the extensive introduction of robot equipment. It was established in the course of implementing the "Promrobot-85" subprogram that the introduction of single industrial robots is generally effective in welding, painting, electroplating, stamping and assembly, that is, in monotonous and physically demanding jobs. Currently, the extensive use (including collective use) of rapidly readjustable (flexible) automated (a number of operations performed manually) and automatic (unmanned technology) systems (FMS at the sector, shop or enterprise production-complex (module) level) is one of the cardinal areas in which labor productivity and efficiency are being increased at a majority of Odessa machine-building enterprise with single-item and small-series production. Such an approach to robotization requires changes in the traditional forms of production organization and management, the development of group technology, automated design and control of FMS's as an ASUP [automated production management] system, and changes in the attitudes of many production workers.

The "Promrobot-90" subprogram outlines the introduction of 52 flexible readjustable modules and sectors, 121 robot equipment complexes and 227 industrial robots and manipulators at machine-building enterprises, which will permit the release of 670 people for other jobs. We will continue training and improving the skills of workers involved with the operation of robot equipment.

Fast-paced machine building, frequent product changes and the introduction of multiple-operation NC machine tools and other progressive equipment demand well-defined, prompt provision of production with fixtures and tools, with their structure, quality, durability, productivity, versatility and capacity for rapid readjustment taking on important significance. The "Instrument-90" subprogram was formulated to resolve these and other tasks. It encompasses all machine-building enterprises and coordinates work on retooling tool shops and sectors, the use of progressive equipment and technology in tool production, the accelerated introduction of fixture design standardization, increased fixture rigidity, the introduction of advanced methods of organizing the tool system, and so on. Implementation of the measures planned will permit increasing the role of the tool shops and sectors in accelerating scientific-technical progress and intensifying machine building. This will also be facilitated by the fact that workers in the tool shops and other production preparation shops are now categorized as workers in basic production.

Production of commodity machine-building output in our oblast will increase 1.4-fold in the 12th Five-Year Plan, and even more in machine tool and instrument manufacturing; the entire increment in production must be achieved through increased labor productivity; product labor intensiveness must be reduced by 30-40 percent and net cost must be reduced by 9-11 percent. Nearly the entire product mix will be updated.

Implementation of the oblast "Mashinostroyeniye" program will help machine builders solve important retooling issues. Carrying out its more than 2,000 assignments will have a significant economic impact on the national economy.

11052
CSO: 1823/133

DETERMINATION OF OPTIMAL SERVICE LIFE OF MACHINES AND EQUIPMENT

Moscow IZVESTIYA AKADEMII NAUK SSSR: SERIYA EKONOMICHESKAYA in Russian No 6, Jun 86 pp 66-75

[Article by Rayatskas, R.L. and Yalinskas, A.P.; first paragraph is source introduction]

[Text] The article examines theoretical problems of physical wear and obsolescence of tools of labor. A model is presented for determining the optimal service life of machines and equipment based on the minimization of socially necessary costs per product unit in the forecast horizon equal to the service life of several generations of equipment. A mechanism is also proposed for motivating economic units to adhere to optimal service life of equipment; it is based on use of the Unified Fund for Development of Science and Technology.

The 27th CPSU Congress, as an urgent precondition for breakthrough in intensification of production, pointed out the necessity of a fundamental renewal of the national economy's equipment stock. Consequently, determination of the optimal service life of the production apparatus requires careful scientific validation.

Timely replacement of machines and equipment creates preconditions for speeding up the rate of materialization of achievements of scientific and technical progress. At the same time, determination of the optimal service life of machines and equipment reveals the possibilities of raising the validation level of plans on the size and structure of capital investment and determination of basic types of machines and equipment, norms of amortization deductions and renovation and financial policy in the field of reproduction of fixed capital.

An unjustifiably frequent replacement of machines and equipment brings in its wake a certain share of labor embodied in them inasmuch as procrastination in replacement of equipment is fraught with increased expenditures of socialized labor in the operation, maintenance and repair of old, worn out equipment. In the last instance, there must also be taken into consideration the economic consequences of obsolescence, that is, the appearance of operational inferiority of old tools of labor in saturation of the national economy with new, more effective equipment of the same functional type.

The consideration of the physical wearing out of tools of labor is based on the supposition that outlays on operation, maintenance and repair of all kinds grow with the age of a machine while amortization amounts for restoration of tools of labor decrease with the growth of its service life. The calculations known so far usually begin with the determination of the optimal service life of the production apparatus only with respect to the conditions of physical wear and then indicatorare corrected for the rate of obsolescence connected with the rise in efficiency of newly created machines and equipment and with reduction of their cost.

In the simplest case, the optimum life is determined for the conditions of physical wear on the basis of Domar's formula

$$t_\Phi = \sqrt{\frac{2K_0}{c}}, \tag{1}$$

where t_o is the optimal service life of equipment, taking into account physical wear. K_o is the value of a machine after exclusion of liquidation cost and c is intensiveness of expenditure growth on maintenance, operation and repair of all types.

Relation (1) was obtained on the basis of solving the following problem:

$$\min_t Z = \frac{K_0}{t} + \frac{1}{t}\int_0^t (S_0 + ct)\, dt, \tag{2}$$

where (S_o+ct) is growth of current costs with growth of the equipment's service life (as has already been pointed out, the chief factor in such growth of current costs is growth of expenditures on the operation, maintenance and repair of all types of machines and equipment with increase of their age); S_o is the initial level of current expenditures.

Solving the problem of finding t_Φ minimizes average production cost for the period of time t.

Aside from linear, another type of dependence of current expenditures on length of service life is often used:

$$Y = S_0 + ct^\alpha, \tag{3}$$

where c and α reflect the increase in current expenditures depending on the age of the machines. In this case, the optimum service length of service life of the machines and equipment based on the conditions of physical wear, minimizing the production cost, is

$$t_\Phi = \sqrt[\alpha]{\frac{\alpha+1}{\alpha} \cdot \frac{K_0}{c}}. \tag{4}$$

The time periods established according to formulas (1) and (4) do not reflect the obsolescence of tools of labor but act as an immanent property, inwardly inherent in a given type of equipment or a given machine model and fully determining its technical and economic characteristics. Given the present rate of scientific and technical progress determining the efficiency of newly created tools of labor, the study and consideration of the process of obsolescence of the operated equipment become increasingly more important.

However, opinions of economics concerning determination of optimal service life while taking obsolescence into account differ. Some consider obsolescence similar to physical wear [1, p 150], that is, in formula (1) the rate of obsolescence D is taken into account together with the growth rate of current expenditures c:

$$t_{\text{фм}} = \sqrt{\frac{2K_0}{c + D}}. \qquad (5)$$

Inasmuch as obsolescence is a phenomenon that is qualitatively more complex than physical wear, such an inclusion of it (by analogy with physical) could hardly be considered felicitous.

Most economists look upon the inclusion of obsolesence as a correction to the obtained optimal service life of machines and equipment while taking physical wear into account [3-5]. While the values of correction proposed by different authors vary, common to them is the determination of service life of equipment on the basis of physical wear and obsolescence independently of each other, although in actuality they are always manifested inseparably like the two sides of the one and the same process of economic wear of tools of labor. The artificial separation of the process of physical wear from obsolesence has led certain economists to the conviction that optimal service life is determined as a minimum value of two sides of operation, one of which is determined according to conditions of physical wear and the other on the basis of obsolesence [5, p 139]. With such an understanding, the interaction of obsolescence and physical wear of tools of labor is lost sight of in the end. We believe that obsolesence of tools of labor can entail both an increase as well as the reduction of the optimal service life of machines and equipment. This depends on the rate of change of the technico-economic characteristics of tools of labor, and the time that has elapsed since the start of series production of this or that machine and other concrete factors. One of the chief factors is physical wear, as it just does not determine optimal service life of equipment and like obsolescence is not the sole factor in determining the optimal duration of functioning of a given machine or equipment. Only joint analysis of the two basic factors can properly solve the set problem.

Model of determination of optimal service life of machines and equipment. If we were to consider a model of a machine of a certain functional type apart from other models of machines of the same type, we could not count on a bigger result than the establishment of an optimal service life for this machine while taking into account physical wear, since its technical and economic parameters would be in this case initial and determining the present value of optimal service life on the basis of physical wear. Consideration of obsolesence as a rule is done with the help of a comparison of technical and economic characteristics of the given model with the characteristics of a more efficient model of the same functional type. In our view, it requires not a comparison of the model of the machine with another, even if it be the most progressive model of the machine, but an analysis of a whole series of models of this kind of equipment for the purpose of elucidating the patterns of change of their basic technico-economic parameters in the transition froml one model to another as well as their corresponding prognosis for the long term.

Let us assume that it was determined that all the technico-economic characteristics of this type of equipment do not change with one exception--the cost of the machine which on the basis of data obtained from the manufacturers of the machines has been going down from year to year at an average rate designated β. With such assumptions, it is clear that only obsolescence of the first form occurs.

The cost of one machine at the time of its acquisition (t) is expressed as follows:

$$K(t_i)=K_0(1-\beta t_i), \qquad (6)$$

where $K(t_i)$ is the cost of the machine at the moment of time t_i, K_0 is the cost of the machine in the base year with which all subsequent calculations begin and β is the indicator showing the intensiveness of reduction of the cost of the machine or equipment.

Let us suppose that production cost (with the exception of amortization deductions) producible on this machine with the growing age of the machine and because of higher costs of operation and maintenance as well all kinds of repair grows linearly at an average rate α which is constant for all examined and predicted models of this type of equipment.

$$S(t)=S_0(1+a(t-t_i)), \qquad (7)$$

where $S(t)$ and S_0 are respectively production cost (without amortization deductions) at moment of time t and 0 and t_i is the moment of time the new equipment replacing the old goes into operation.

The existence of a linear dependence of current expenditures on length of service has been noted by a number of authors. Thus A.L. Gaponenko points out that "this type of dependence of the cost of a product unit on the length of service of a tool of labor may be used for many kinds of tools of labor" [1, pp 129-130].

As a criterion of optimization of service life, let us take minimum production cost on the average for a certain interval of time equal to t for the years:

$$\min_{t_1,\dots,t_n} Z = \frac{K_0}{t_n} + \frac{1}{t_n}\int_0^{t_1} S_0(1+at)\,dt + \frac{K_0}{t_n}(1-\beta t_1) +$$
$$+\frac{1}{t_n}\int_{t_1}^{t_2} S_0(1+a(t-t_1))\,dt + \dots + \frac{K_0}{t_n}(1-\beta t_{n-1}) +$$
$$+\frac{1}{t_n}\int_{t_{n-1}}^{t_n} S_0(1+a(t-t_{n-1}))\,dt. \tag{8}$$

The numerator of the criterion (8) reflects the sum of current and one-time expenditures for the period of time t_n in the course of which one after another n of the models of equipment of a specific type is replaced.

An immediate aim of the calculation is determining the specific value of t_i, that is, the optimal service life of the basic model of the equipment. But more accurate values of service life, that take into account obsolescence are obtained if one takes into account the technico-economic characteristics of several future generations of equipment. At the same time, difficulties naturally arise in validation of the prognosis of the technico-economic characteristics of models of equipment in the future, especially if they change by jumps.

For determining the minimum of efficiency function Z, its partial derivatives for time $\partial Z/\partial t$ need to be made equal to zero:

$$\begin{aligned}
&\frac{\partial Z}{\partial t_1} = \frac{1}{t_n}(-\beta K_0 - aS_0t_2 + 2aS_0t_1) = 0,\\
&\frac{\partial Z}{\partial t_2} = \frac{1}{t_n}(-\beta K_0 - aS_0t_1 + 2aS_0t_2 - aS_0t_3) = 0,\\
&\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\\
&\frac{\partial Z}{\partial t_i} = \frac{1}{t_n}(-\beta K_0 - aS_0t_{i-1} + 2aS_0t_i - aS_0t_{i+1}) = 0,\\
&\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\\
&\frac{\partial Z}{\partial t_n} = \frac{2}{t_n^2}\Big(\frac{aS_0t_n^2}{2} - nK_0 + \beta K_0(t_1+t_2+\dots+t_{n-1}) +\\
&+ aS_0t_1t_2 - aS_0t_1^2 + aS_0t_2t_3 - aS_0t_2^2 + \dots + aS_0t_{n-2}t_{n-1} - aS_0t_{n-2}^2 - aS_0t_{n-1}^2\Big) = 0.
\end{aligned} \tag{9}$$

The specific times of replacement of models of the equipment t_1, t_2, t_3, . . ., t_n are unknowns in the system of equations (9). Each of the equations in the system (9) couples three adjacent unknown quantities with the exception of the last equation which couples all the unknowns in the system as well as the first which couples unknowns. If we were to consider only two generations of machines or equipment (n=2), system (9) would be transformed into the following:

$$\begin{cases} -\beta K_0 - aS_0 t_2 + 2aS_0 t_1 = 0, \\ \dfrac{aS_0 t_2^2}{2} - 2K_0 + \beta K_0 t_1 - aS_0 t_1^2 = 0. \end{cases} \tag{10}$$

Solving this system, we obtain

$$t_2 = \sqrt{\frac{8K_0 aS_0 - \beta^2 K_0^2}{S_0^2 a^2}}, \tag{11}$$

$$t_1 = \frac{\beta K_0}{2aS_0} + \frac{1}{2}\sqrt{\frac{8K_0 aS_0 - \beta^2 K_0^2}{S_0^2 a^2}}. \tag{12}$$

The obtained result shows the dependence of optimal service life on the rate of reduction of the cost of equipment (β), on the absolute size of one-time expenditures (K_0) and on the growth rate of current expenditures (α).

If we take into consideration that

$$aS_0 = c, \text{ а } \beta K_0 = D, \tag{13}$$

we cbtain a completely different interrelationship among the above-enumerated factors than in formula (5):

$$t_{\text{фм}} = \frac{D}{2c} + \frac{1}{2}\sqrt{\frac{8K_0}{c} - \frac{D^2}{c^2}}. \tag{14}$$

With the hypothesis of absence of obsolescence (D=0), we obtain the well-known formula of determining optimal service life solely on the basis of physical wear (formula 1).

It would be interesting to trace how optimal service life would change given the condition of expansion of the forecasting period. Let us take a period equal to the service life of three generations of equipment, that is, n=3.

Solution of the system of equations (9) brings about the following results:

$$t_3 = \sqrt{\frac{6\,(3K_0 aS_0 - \beta^2 K_0^2)}{S_0^2 a^2}}, \tag{15}$$

but

$$t_1 = \frac{\beta K_0}{aS_0} + \sqrt{\frac{2}{3}\left(\frac{3K_0 aS_0 - \beta^2 K_0^2}{S_0^2 a^2}\right)}. \tag{16}$$

Thus, as we can see, lengthening of the forecasting period results in a change of optimal service life by the amount

$$\Delta t' = \frac{\beta K_0}{2aS_0} + \frac{1}{aS_0}\left(\sqrt{2K_0aS_0 - \frac{2}{3}\beta^2K_0^2} - \sqrt{2K_0aS_0 - \frac{1}{4}\beta^2K_0^2}\right). \quad (17)$$

More complex problems arise in consideration of obsolescence of the second form. In such a case, it is necessary to take into account the greater efficiency of newly created tools of labor. Growth of efficiency in changing over from one model of equipment to another may be manifested in higher productivity of machines and equipment and economy of capital investment, raw materials and operational costs. In this, problem (8) becomes more complex although the principles of its solution remain the same. For example, the efficiency function when considering obsolescence may look as follows:

$$\min_{t_1, t_2, \ldots, t_n} Z = \frac{K_0}{Q} + \frac{1}{Q}\int_0^{t_1} S_0(1 + at)\,dt + \frac{K_0}{Q}(1 + \gamma_1 t_1) +$$

$$+ \frac{1}{Q}\int_{t_1}^{t_2} S_0(1 + \gamma_2 t_1 + a(t - t_1))\,dt + \ldots + \frac{K_0}{Q}(1 + \gamma_1 t_{n-1}) +$$

$$+ \frac{1}{Q}\int_{t_{n-1}}^{t_n} S_0(1 + \gamma_2 t_{n-1} + a(t - t_{n-1}))\,dt. \quad (18)$$

where Q is the volume of produced products for time t_n in physical terms:

$$Q = \int_0^{t_1} R_0\,dt + \int_{t_1}^{t_2} R_0(1 + \gamma_3 t_1)\,dt + \ldots + \int_{t_{n-1}}^{t_n} R_0(1 + \gamma_3 t_{n-1})\,dt,$$

where R_0 is the productivity of the basic model of the machine or equipment and γ_1, γ_2, γ_3, stand for the intensities of, respectively, growth of cost of machines and equipment, growth of current expenditures connected with growth of the volume of produced products and growth of the productivity of the machines and equipment.

The efficiency of the machines is increased through observance of the following inequality:

$$\gamma_3 > \gamma_1 \text{ при } \gamma_2 = \gamma_3 \text{ или } \gamma_3 > \gamma_2$$
$$\text{при } \gamma_1 = \gamma_2, \text{ т. е. } \gamma_3 > \gamma_1 + \gamma_2. \quad (19)$$

The solution of problem (18) makes it possible to obtain t_1, t_2, ..., t_n. is the optimal service life of a tool of labor taking into account physical wear and obsolescence.

The criteria of (8) and (18) are based on a minimization of average production cost. For this reason, the derived service lives of machines and equipment are still not optimal from the national-economic point of view since the goal of minimization should not be production cost but socially necessary outlays on the production of a given quantity of a certain product.

In the economic literature, specific adduced expenditures are as a rule presented as such a criterion. In our opinion, this criterion adopted for selecting the best variant of capital investment is little suited for determining preferable service lives of machines and equipment. Actually, the determination of this or that service life for machines will directly influence investment proportions. At the same time, norms of effectiveness of capital investment naturally have to be observed. But it is necessary to note that the use of a criterion of specific adduced expenditures provides the possibility of comparing variants with different sizes of capital investment and production costs and selecting the best one of them. In this connection, variation is carried out by means of capital investment. Different service lives of equipment are also accompanied by different sizes of capital investment and production-cost levels. But in this case variation is carried out by means of service life and not by means of capital investment. In addition, the use of adduced expenditures of the normative coefficient of efficiency in the criterion presupposes an unlimited service life for fixed capital [7, p 284]. In our view, because of the indicated difference, the use of one and the same criterion in both cases is hardly justifiable.

Since it is known, that capital investment in amount K per unit of time provides an economy of production cost in the amount EK, growth of the service lives of tools of labor amounting to the quantity Δt provides the possibility of economizing in other sectors for reduction of production cost in the amount

$$L = \Delta t E K_0 (1 - \beta (t_{\text{фм}} + \Delta t)).$$

However, an increase of service lives by Δt in a part of the national economy results in losses in the amount

$$N = \int_{t_{\text{фм}}}^{t_{\text{фм}}+\Delta t} S_0 (1 + at)\, dt. \tag{20}$$

If

$$\int_{t_{\text{фм}}}^{t_{\text{фм}}+\Delta t} S_0 (1 + at)\, dt = \Delta t E K_0 (1 - \beta (t_{\text{фм}} + \Delta t)), \tag{21}$$

then in the final analysis no saving of socialized labor occurs. Economy in one part of the national is offset by losses in another, that is, from the point of view of the entire national economy, the service life of machines and equipment, obtained on the basis of solving problems (8) and (18)--$t_{\text{фm}}$, is the equivalent of ($t_{\text{фм}}$+Δt), where Δt is the quantity obtained on the basis of equation (21).

The optimal service life of equipment ($t_{опт}$) from the point of view of the entire national economy is to be found between $t_{фм}+\Delta t$ and $t_{фм}$, that is,

$$t_{фм} \leqslant t_{опт} \leqslant t_{фм} + \Delta t. \qquad (22)$$

The length of optimal service life ($t_{опт}$) is determined on the basis of the solution of the problem

$$M = \Delta t E K_0 (1 - \beta (t_{фм} + \Delta t)) - \int\limits_{t_{фм}}^{t_{фм}+\Delta t} S_0 (1 + at)\, dt \to \max_{\Delta t}. \qquad (23)$$

At first $\Delta t_{опт}$ is found, maximizing function M and then the sought quantity (optimal service life from the national-economic point of view)

$$t_{опт} = t_{фм} + \Delta t_{опт}, \qquad (24)$$

where $t_{фм}$ is determined on the basis of the solution of problem (8) or (18).

Mechanism of stimulating optimal renewal of equipment. Having established the optimal service life of machines and equipment from the national-economic point of view, it is possible to proceed to a determination of amortization of norms. Usually three possible methods of amortization are proposed for this purpose: (a) the uniform, when the amortization norm is not changed with time; (2) the progressive, when the amortization norm grows with time; (3) the regressive, when the amortization norm shows a tendency for reduction.

The most simple and seemingly the most widespread in national-economic practice is the method of uniform amortization, corresponding to the hypothesis of uniform wear of tools of labor. Inasmuch as this hypothesis does not reflect objective reality, the method of uniform amortization will be replaced by progressive amortization [6] which, in the author's opinion, most fully reflects the process of physical wear. Progressive amortization norms, as asserted by adherents of this amortization method, motivate enterprises to speed up renewal of their production apparatus.

Actually, with a constant price for products produced with the aid of the said tools of labor and progressive amortization norms, the profit norm is constantly being reduced and, other conditions being equal, the only way of raising it is through renewal of the production apparatus. But the question arises: is reduction of the profit norm fair in the given case? In our view, if optimum service lives are established for equipment and for the duration of this time inevitably increasing operational costs are acknowledged to be socially necessary, they should not exert any influence on the profit norm. The diminishing profit norm on the one hand stimulates the process of renewal and, on the other, slows it down as the absolute amount of profit put in particular into the funds for economic stimulation and development of production diminishes. But the main thing is that over the course of the optimal service lives of equipment, the operational units, aging at different rates, find themselves in an unequal position. Consequently, indicators, depending in one way or another on the norm or amount of profit, cannot be used for the evaluation of the operational activity of enterprises and the formation of economic stimulation funds since in progressive amortization objective conditions (age of used equipment) determine the norm and amount of profit and not just the efforts of production collectives. At the same time, stimulation of renewal of operative equipment with the aid of the method of progressive amortization can entail aside from everything else an unjustifiably early replacement of equipment.

Operational units do not receive an effective signal in this pointing to the need of implementing measures for renewal of the production apparatus. Such a warning for an enterprise should be diminution of profit with exceeding of the socially necessary service life of machines and equipment. But for this it is necessary to eliminate the influence on the norm of profit of such a factor as age of equipment within the limits of the optimal time periods of its service. For this purpose, the method of regressive amortization should be used.

This method presupposes a change in the norm of amortization deductions from the maximum level in the first year to the minimum level in the last year corresponding to the optimal service life of machines and equipment. In order to exclude the operation of the factor of objective heterogeneity of funds on the basis of their age characteristics, a curve of the norm of amortizxation deductions should be determined from the condition of the constant in time profit norm:

$$Ц-(S_t+A_t)=P=\text{const}, \tag{25}$$

where Ц is the price of a product unit, S is the cost of the product unit (less amortization deductions), A is the sum of amortization deductions belonging to the product unit and P is the sum of profit secured from the sale of a single product unit.

$$A_t=Ц-S_t-P. \tag{26}$$

Since for S growth with time is characteristic, amortization deductions contrariwise decrease. The total size of amortization deductions for optimal service life naturally should equal the initial cost of the equipment.

Since at the expiration of the optimal service life of equipment, further growth of operational expenditures would be impracticable from the point of view of the national economy, they are fixed at level $S_{t_{опт}}$, but the amount of amortization deductions is not further reduced:

$$A_t\equiv A_{t_{опт}}, \text{ если } t>t_{опт}. \tag{27}$$

From our point of view, such an approach to determination of the norm of amortization deductions has one significant defect. The amortization norm in this case to a certain extent loses its main function--to reflect the objective process of wear of tools of labor--and is essentially directed at stimulating timely renewal. Nonetheless the use of regressive amortization is practicable in our view from the point of view of its basic function. The functional designation of this or that tool of labor is not found in work for a certain, even an optimal, time but contributes to life labor in the production of a certain amount of products for the optimal time of its service life. Thus the norm of amortization deductions in our view should be established according to the following formula:

$$h_t = \frac{AQ_t}{K}, \tag{28}$$

where h_t is the norm of amortization deductions in year t, A is the sum of amortization deductions for a product unit, Q_1 is the quantity of products in physical measurement for year t and K is the cost of the machine.

In its turn

$$A = \frac{K}{\sum_{t=0}^{t_{\text{опт}}} Q_t}. \tag{29}$$

Inasmuch as the productivity of machines with growth of time of them being in operation as a consequence of physical wear is constantly diminishing, then

$$Q_0 > Q_1 > Q_2 > \ldots > Q_{t_{\text{опт}}}. \tag{30}$$

It is clear that in this case according to formula (28) we have regressive amortization. Since the production cost of a product unit (with the exception of amortization deductions) grows with an increase of t and the amortization deductions remain constant, a t exists for which

$$\begin{gathered} \text{Ц} - (S_t + A + H_t) = P, \\ H_t > 0,\ H_{t+1} < 0, \end{gathered} \tag{31}$$

where $H_1 > 0$ is the sum of profit per product unit which needs to be, in our view, withdrawn from enterprises equipped with advanced equipment into the Unified Fund for Development of Science and Technology (YeFRNT), $H_{t+1} < 0$ is the sum of deductions from the Unified Fund for Development of Science and Technology per product unit which chould be put at the disposal of enterprises that have old equipment for the production of this product that is still operating within the limits of optimal service life. Naturally, outside the limits of this time period no additional deductions should be taken from the Unified Fund.

Such a rather simple mechanism, in our opinion, would serve as an additional stimulus for enterprises and associations for timely (optimal from the national economic point of view) renewal of production potential and at the same time would contribute to the creation of equal conditions of management in production units with dissimilar fixed capital being used in operation. This also would contribute to the adoption of a more accurate solution in the sphere of economic activity of production collectives and their economic motivation.

Production by machine-building sectors of new, more efficient models of machines and equipment raises before their users even prior to the expiration of their optimal service life the question of replacement of functioning equipment with new equipment. The actual raising of the question attests to the existence of different criteria for determining optimal equipment service life at different levels of operation of the national economy. It is clear that the determination at the national-economic level of the service life of machines and equipment will be adhered to if they meet the economic interests of production collectives at the lower levels of the national economy's operation.

The possibility exists of creating with the aid of a proper economic mechanism (for example, H_I) such conditions of management in which the use of old (within the limits of optimal service life) as well as new equipment would result in the same maximized end results (for example, norm or amount of profit). But such an approach is defective since after the expiration of the equipment's service life economic units would not be interested in selecting more progressive equipment as its use would produce the same cost-accounting effect. At the same time, if more efficient equipment produces a bigger cost-accounting effect, the desire may arise in the economic units to replace equipment before the prescribed service life.

Let us suppose that an enterprise is guided by the following criterion for replacement of machines and equipment:

$$Q_n P_n - Q_t (P + A) \geqslant 0, \qquad (32)$$

where Q_n is the quantity of products in physical terms produced with the aid of new, more efficient equipment for the year, P_n is the sum of profit obtained from the sale of a unit of this product produced on new equipment, Q_t is the quantity of products in physical terms in the t year of operation of old equipment, P is the sum of profit obtained from the sale of a product unit made on old tools of labor and A is the total of amortization deductions per product unit.

AQ_t designates losses on amortization deductions. It is clear that from the national-economic point of view it would be practicable that with this criterion the following inequality would be observed:

$$Q_n P_n - Q_t (P + A) \leqslant 0, \text{ если } t \leqslant t_{\text{опт}}.$$

In order to achieve an agreement of global and local criteria of optimality in replacement of equipment, it would be useful to set in the initial years following putting new capital in operation higher deductions into the Unified Fund for Development of Science and Technology than those specified by formula (31). Moreover, before the expiration of the equipment's service life, it would be necessary to boost compensatory payments to enterprises.

The maximum level of such an increase is equal to

$$\Delta H_t = \frac{Q_n P_n - Q_t (P - A)}{Q_t}, \text{ где } t \leqslant t_{\text{опт}}. \quad (33)$$

Thus operation of equipment in excess of optimal time periods or prior to expiration of the designated time results in reduction of the amount of profit which, being an effective cost-accounting level, forces economic units to adopt solutions favoring replacement of old equipment with its new models at the optimal time period.

REFERENCES

1. Gaponenko, A.L., "Moralnyy iznos i obnovleniye orudiy truda" [Obsolescence and Renewal of Tools of Labor]. Moscow, Mysl, 1980.

2. Kurenkov, Yu.V. and Palterovich, D.M., "Tekhnicheskiy progress i optimalnoye obnovleniye proizvodstvennogo apparata" [Technical Progress and Optimal Renewal of the Production Apparatus]. Moscow, Mysl, 1975.

3. Selivanov, A.I., "Osnovy teorii stareniya mashin" [Bases of the Theory of Aging of Machines]. Moscow, Mashinostroyeniye, 1964.

4. Tokarev, G.O., "Ratsionalnyye sroki sluzhby avtomobiley" [Rational Service Life of Motor Vehicles]. Moscow, Avtotransizdat, 1962.

5. Kantorer, S.Ye., "Amortizatsiya i sroki sluzhby mashin i oborudovaniya v stroitelstve" [Amortization and The Service Life of Machines and Equipment in Construction]. Moscow, Stroyizdat, 1975.

6. Lyubimtsev, Yu.I., "Tsikl vosproizvodstva i amortizatsiya osnovnykh fondov" [The Reproduction Cycle and Amortization of Fixed Capital]. Moscow, Ekonomika, 1973.

7. Kobrinskiy, N.Ye., Mayminas, Ye.Z. and Smirnov, A.D., "Ekonomicheskaya kibernetika" [Economic Cybernetics]. Moscow, Ekonomika, 1982.

7697
CSO: 1823/110

PROBLEMS WITH KIROV INSTRUMENT PLANT

Moscow EKONOMICHESKAYA GAZETA in Russian No 7, Feb 87 p 12

[Article by V. Yakovlev, chief of Economic Planning Department of Krasnyy Instrumentalshchik Plant, Kirov, in the column "Problem of the Day": "Is It Easy to Be Part of a Scientific-Production Association?"; first paragraph is source introduction]

[Text] When the USSR Ministry of Machine Tool and Tool Building Industry decided by way of experiment to transfer our plant in 1985 to the formation of a production program based solely on customers' orders, we breathed easier.

After all, this is a most proper way of excluding the production of unneeded products and contributing to the thrifty use of material resources. Through supply organs, our sales people relatively quickly found a place with customers, trying thereby to establish direct, long lasting ties. Their share for several quarters in a row amounted to about 75 percent of the total volume of deliveries, which suited both us and the customers.

Unfortunately, the picture for the present year of 1987 is turning out a lot worse. This seriously bothers us. For a number of positions, our customer turnover is one-third and perhaps as much as one-half, i.e., the existing pattern of deliveries has broken down to a significant degree. Today, approximately 2 million rubles' worth of basic items are "left hanging" in the enterprise's plan. This is, so to say, a defect. We are told: "Look for customers yourselves and close up the gap."

We did not sit with folded arms, otherwise it would not have been 2 but more like 3 million. But the ministry is also not right in closing its eyes to the abnormal situation of a jurisdictional enterprise. We did not ask the sector's headquarters to look for customers for "consumer goods" produced by the plant. We dealt ourselves with the problem. Basic production is another matter.

Organizing the production of automatic checking machines and instruments for one-time current orders still is completely unregulated. These items go to help equip automatic lines produced by our ministry for the motor-vehicle industry and agricultural machine building. The ministry's technical control did not specify whether these products are subject to certification, but state acceptance has already been put in operation at the enterprise.

"Urgent" assignments (and they constitute almost one-fifth of total production volume) give us a lot of trouble, primarily in the matter of supply. According to present procedure, when "mandated orders" of the ministry frequently descend like snow on our heads, we are unable to compile ahead of time requisitions for needed resources. Clearly, a certain reserve needs to be provided not only in regard to basic materials but also with respect to components.

The year has begun, but we still lack a production plan or clarity regarding capital investment. We do not have enough guideline materials for improvement of wages.

Evidently all these problems must also worry no less than us our VNII Izmereniya Scientific-Production Association. Alas, the impression is created that the plan is only mechanically included in the scientific-production association. And yet the actual designation of scientific production association attests to the fact that we should much more be concerned with developing and putting out promising items and strengthening the tie of science with production. In this regard, marked changes are also not seen....

7697
CSO: 1823/111

ARTICLE SCORES INADEQUATE USE OF OLD MACHINERY, INEFFICIENT USE OF NEW

Moscow EKONOMICHESKAYA GAZETA in Russian No 7, Feb 87 p 18

[Article by L. Gontar, chief of Industrial Statistics Department, Donetsk Oblast Statistical Administration, in the column "Economic Work at Enterprises": "On Unemployed Machine Tools, or On Why the Shift Coefficient Is Low at Enterprises in Donetsk Oblast"]

[Text] The Don Basin is not just coal. The share of machine building and metalworking has now reached 16 percent of the total production volume of the oblast's enterprises.

As one of the key sectors determining scientific and technical progress in the economy, the oblast's machine building is developing at an accelerating rate. In the course of the years of the 11th Five-Year Plan, the sector's fixed capital grew 32 percent, and the capital-labor ratio of machine-building workers rosed by more than one-third. At the same time, yield on capital was lower than at the beginning of the 5-year plan.

We know that capital yield will rise only on the condition that labor productivity grows faster than the capital-labor ratio. But this important economic correlation has so far not been obtained. For each percent of rise of the capital-labor ratio, labor productivity growth over the course of the 5-year plan amounted in the oblast to only 0.6 percent.

Why is this taking place?

At the oblast's enterprises, worn equipment is still largely being used. Each fourth metal-cutting machine tool has had a service life of more than 20 years. This results in higher repair costs. The following data are on hand: growth of expenditures on capital repair of machines and equipment is outpacing by almost a factor of two growth of their cost. Last year, the replacement coefficient of metal-cutting machine tools amounted to only 0.9 percent in the oblast. Only about one-fourth of received new equipment was installed as replacement of physically worn and obsolescent equipment. For the most part, it only expands the park in a quantitative sense. But is modern equipment, particularly machine tools with numerical control, being used rationally everywhere?

Here are examples. At Zhdanov Machinery Plant of the USSR Ministry of Construction, Road and Municipal Machine building, a robot costing more than 22,000 rubles was installed for fitting out a bending machine. According to calculations of the actual enterprise itself, in the given case, the conditional release of personnel due to reduction of labor intensiveness amounted to... 0.3 person. All in all, it secured no actual release.

A year ago, 6 robots with a total cost of 190,000 rubles were installed at a number of machine-building enterprises. In this connection, 9 persons were provisionally released, but actually the number was three. In this way, the cost of these robots will be reimbursed through wage savings roughly in the course of... 27 years.

Unfortunately high-efficiency machine tools go out of order significantly more frequently than other equipment. Downtime of machine tools with numerical control because of poor working order and unplanned repair is more than twofold that of ordinary machine tools. The reason is to be found in violations of the rules of their operation.

Growth of yield on capital is most directly connected to a rise in the shift coefficient. Yet there are many reserves here. Data of daily observation conducted on the basis of a program of the USSR Central Statistical Administration show that of the metalworking equipment operating that day, 95 percent was used in the first shift, 70 percent in the second shift and only 12 percent in the third. But the actual shift coefficient was even lower than would be judged by the presented data because each sixth unit of the equipment had not been operating in general for whole days at a time.

The example of the Krasnoarmeyskiy Plant for Dust Suppression Equipment of the USSR Ministry of Coal Industry is "instructive." With a 2-shift regime of operation for the plant, the shift coefficient for all the equipment as a whole was 0.66 according to daily-observation data, and for machine tools with numerical control, another coefficient--0.44--was reached. The quotation marks here are possibly out of place. Actually, we have to speak of achievements: quite recently, it did not exceed 0.1-0.17. What is the matter?

This enterprise is new, and its production is acutely needed by the coal industry. But the All-Union Soyuzuglemash Industrial Association was unable to rationally load the newly operative capacities. On the other hand, analysis shows that a great deal of the equipment at the plant is simply unnecessary. It is true that today work is going on: the previously installed equipment is being disassembled and turned over to other enterprises of Soyuzuglemash. Question: why was it installed?

Each present manager knows that the use level of capacities and yield on capital are important criteria of production efficiency. Still analysis of the yield of fixed capital at many enterprises is not produced systematically. This is what takes place: the equipment is not loaded fully, the shift coefficient is low, production capacities are not used on the whole, but targets for production output are overfulfilled. For this reason the situation seemingly does not evoke any special concern and interest is not created in more efficient use of equipment at the enterprise.

Yet with improved labor organization and the elimination of idling due to defects in the preparation and organization of production, it would be possible to achieve a significant improvement in the state of affairs and to boost yield on capital. The development of brigade forms of labor organization and motivation could be of great help. It was established that work stoppages of workers in brigades, especially there where their work is organized on the basis of a single order, is one third lower than in the case of persons working individually. The problem of securing worker cadres is becoming less acute.

It is important to make maximum use of existing reserves. This should be an explicit task and matter of honor for all labor collectives.

7697
CSO: 1823/111

FACILITY SIZE, EFFICIENCY COMPARED IN KAZAKHSTAN

Alma-Ata NARODNOYE KHOZYAYSTVO KAZAKHSTANA in Russian No 1, Jan 87

[Article by O. Yanovskaya, instructor at Alma-Ata Institute of National Economy: "The Relation of Sizes of Enterprises to Their Efficiency"]

[Text] The 27th CPSU Congress pointed out that the rate of the country's economic growth decisively depends on machine building. "Specifically, basic scientific and technical ideas are materialized in it," M.S. Gorbachev stated in his accountability report. "New tools of labor and systems of machines, determining progress in other sectors of the national economy, are created. Here the foundations are laid for the wide-scale emergence of essentially new, resource-conserving technologies for raising labor productivity and production quality."

In the years of the 11th Five-Year Plan, the republic's machine building developed at a faster pace. Thus, while the production volume of all industry for the 5-year period grew 1.2-fold, product output of machine-building production grew 1.4-fold and amounted to more than 3.6 billion rubles. At the same time, the average rate was 7.3 percent for machine building compared to 3.9 percent for the republic's industry as a whole. During the 12th Five-Year Plan, the sector's rate of development is planned to be 1.9-fold higher than that of industry as a whole. The coefficient of advance, as we see, is quite significant, which makes it possible to bolster the priority economic positions of machine building.

At the present time, enterprises of all-union and republic subordination exist in the Kazakh SSR which have no counterparts in the country: these are plants for the production of antierosion equipment and the production of drawing mills and mining equipment.

The level of production concentration is constantly rising. Such a course is frequently determined by rising efficiency of production.

In practice, in determination of sizes of enterprises usually such indicators are used as gross-production volume, value of production capital and number of workers. At the same time, we need to always take into consideration that, depending on the degree of production development, the importance of each indicator changes significantly. Let us say that under the conditions of machine-free production, product output basically depends on the number of workers. Consequently, the size of the work force could completely characterize the scale of an enterprise.

Under the conditions of developed socialist production, the size of the work force no longers characterizes the scale of an enterprise. Although statistics still resort to the use of this indicator. Increasingly more importance is being attached to such an indicator as the fixed industrial production capital (OPPF) of an enterprise.

With the development of scientific and technical progress, of course, the technical equipment of labor increases, the quantity of advanced producer goods, the fixed capital of an enterprise and the relative share of embodied labor grow, but the relative share of live labor decreases. Still the indicator of the cost of fixed industrial production capital cannot fully provide an estimate of the scale of the enterprise. It only refines the characterization of groups of enterprises from the point of view of their technical level and production resources.

The value of an enterprise's fixed industrial production capital is formed as the result of long accumulations, while price changes, the different times of its purchase at enterprises render difficut a comparison on the basis of this criterion. Reappraisals of fixed capital according to restorative value occurring from time to time temporarily eliminate these defects, but in periods between reappraisals they make themselves felt.

Thus the size of an enterprise is determined by the aggregate of live and embodied labor concentrated at an enterprise. Each of these indicators by itself does not permit calculating the scale of the enterprise. They show only one or the other side of the production apparatus. Thus, in order to provide an estimate of the scale of an enterprise it is necessary to measure aggregate embodied and live labor, that is to find a generalizing indicator. In our view, the following can serve:

$$R = (Z+P) + Na \times Pf,$$

where Z is the annual wage fund in thousands of rubles, P is the profit for the year in thousands of rubles, Na is the amortization norm (in machine building Na = 0.04) and PF is the average annual value of fixed working capital in thousands of rubles.

In determining the sizes of Kazakhstan's machine-building enterprises according to the generalizing indicator, 33 enterprises were taken. It can be seen from the presented table that the share of small machine-building enterprises in the republic is small, amounting to only 6.1 percent, while it was 54.6 percent for those of average size, the rest were large ones. The latter are to be credited with almost 80 percent of the gross production volume of machine building, 73.4 percent of the number of workers and 80 percent of the fixed industrial production capital. On the whole, this is determined by the high technical equipment of labor.

Table. Grouping of Kazakhstan's Machine-Building Enterprises in 1985 According to the Generalizing Indicator (in % of average value to the sector)

Grouping of enterprises according to generalizing indicator, thous. of rubles	Number of enterprises	Share of average annual size of industrial production personnel	Workers	Relative share of average annual fixed production capital	Gross production volume	Production output per worker (IPP)* in % of average output at enterprises	Yield on capital
	in percent of total						
up to 500	---	---	---	---	---	---	--
501-1,000	6.1	0.5	0.5	0.4	0.6	86.2	146
1,001-10,000	54.6	26.1	27.2	19.6	20.0	91.3	126
10,001-20,000	27.3	36.8	36.1	36.0	31.0	101.5	128
20,001-30,000	9.0	11.7	11.1	11.0	17.1	105.4	103
over 30,000	3.0	24.9	25.1	33.0	31.3	98.2	98

* (IPP) = (industrial production personnel)

(Based on data of Kazakh SSR Central Statistical Administration)

Analysis shows that small enterprises do not play a significant role in meeting the needs of the machine-building industry for products (0.6 percent). Medium-size enterprises in many cases have low indicators of the level of specialization and technical equipment and low indicators of production's economic effectiveness (production output per worker of industrial production personnel is 91.3 percent of the average output for the sector).

The sector's large enterprises (according to the generalizing indicator, more than 10 million rubles per year) have the highest series production output, successfully combining a high level of concentration and specialization of production. Since a many-item production character is one of the principal features of the sector, and this sets forth the special importance of improving enterprises' specialization, such a level of series operation at the large enterprises should be retained in the future, and special attention should be directed to this in planning.

Large enterprises also have the best indicators of technical equipment per worker and the highest power capacity per unit of equipment in the sector, which attests to the technico-economic advantages of concentration of production. But in recent years, it has occurred in the sector mostly through organizational and operational centralization (the 4 existing machine-building production associations provide 45 percent of the sector's gross production) and least of all through production and technological concentration.

It is necessary to keep in mind that during the past 5-year plan prices of technological equipment and other of fixed production capital rose significantly, prices rose for basic materials and technological processes did not undergo significant changes. For this reason, as can be seen from the table, yield on capital decreased with growth of enterprise size. The share of the conditionally permanent part of specific adduced expenditures, depending on cost of fixed production capital, maintenance and operation of equipment and shop costs, has grown. Consequently, adduced costs increased per product unit.

This again confirms the conclusion that the extensive trend does not offer advantages to large production. One can attain higher efficiency of machine-building production not by a simple increase in the amount of equipment and size of workers but through a qualitative change in equipment and technology with a simultaneous rise in the level of concentration.

7697
CSO: 1823/128

TASS: POLITBURO NOTES ENGINEERING INDUSTRY 'SHORTCOMINGS'

LD232219 Moscow TASS in English 1949 GMT 23 Jan 87

[Text] Moscow, 23 Jan (TASS)--The manufacture of more than 200 flexible production systems, more than 13,000 industrial robots and a large number of mechanized, flowline, automatic and rotating production lines by the Soviet engineering industry during the first year (1986) of the current five-year plan period enabled the key industries to achieve better quality of output with higher labour productivity. Comprehensive mechanization ensured the introduction of advanced processes at 8,000 production lines, workshops and sections. Progress in the industry was noted at the latest meeting of the Politburo of the CPSU Central Committee.

Continuously monitoring progress in the fulfillment of the resolutions of the Party Central Committee and the Council of Ministers of the USSR on the accelerated development of engineering, the Politburo stipulated measures to ensure dynamism and drastic change in production itself and in the management of the engineering complex. Practice shows, however, that they are not yet used with full effect. although there are realistic conditions for the acceleration of the drastic reorganization of performance in the engineering industry.

To begin with, it is necessary drastically to cut lags in the development and production of new technology. In the current year engineering should already produce at least 38 percent of major types of output on a par with the world's standards. By the end of the five-year period, advanced technology should account for 80 to 95 percent of the engineering output.

The rates of the revolutionary renovation of the output of the engineering complex are organically related to its quality and technical standards. Shortcomings in the design of machine tools and equipment today will be projected 15-20 years ahead and can seriously hamper the development of the national economy as a whole. That is why it is especially necessary today to pay attention to the reorganization of the entire system of research, design, development and experimental work and to the introduction of advanced technology to automate the work of designers and engineers.

The Politburo noted at its meeting that the ultimate turnaround to the observance of the discipline of supply had not yet been achieved in the engineering complex.

/9274
CSO: 1823/120

TASS: SOCIALIST COUNTRIES POOL EFFORTS ON ROBOTICS DEVELOPMENT

LD200445 Moscow TASS in English 2145 GMT 19 Feb 87

[Text] Moscow, 19 Feb (TASS)--A machine-tool-building plant in Mukachevo, the Ukraine, has started the production of numerically controlled conveyer accumulators for robotized production lines. The novel machines were developed in a short period of time by Soviet and Czechoslovak specialists through pooling their efforts and using the experience of both countries. This intricate machinery was produced so far by several Western firms.

Several new transmitters of outside information for production robots were created recently thanks to equally close cooperation of specialists from socialist countries.

The international research and production amalgamation Interrobot set up recently by Bulgaria, Hungary, Cuba, Poland, the USSR and Czechoslovakia promotes the speeding up of developments in this sphere. The council which is the steering body of the amalgamation is made up of representatives of member countries. Everyday control is exercised by the board of the amalgamation which has research and production centres in six countries.

In their turn, the centres control the work of their research and production organizations connected with robotics. Production forms and records, know-how and licences are passed over to the institutions taking part in the developments on mutually coordinated terms.

The creation of the amalgamation permits to pursue a single scientific and technological policy in the development and production of new robots on the basis of specialization and cooperation, of direct ties between research and production organizations.

The organizations and enterprises of the member countries of the amalgamation have concluded already 28 agreements and contracts. On their basis the creation of 80 new types of robots, manipulators and devices for the comprehensive mechanization of production to which first-priority importance is attached in all the CEMA countries is to be completed in the coming two years. It is planned to finish 136 developments by 1990.

/9274
CSO: 1823/120

'ROTOR' INCREASES ITS CAPACITY

Kiev RABOCHAYA GAZETA in Russian 23 Jan 87 p 1

[Article by a "Rabochaya gazeta" reporter from Cherkassy]

[Text] Cherkassy production association "Rotor" will soon become one of the largest machine building enterprises in the oblast. A new production building has been commissioned at the association head enterprise, the special production equipment plant. Four production departments are housed in the 20,000 square meters building, where 215 pieces of equipment have been installed. Builders have created favorable conditions for highly efficient and creative work by workers, engineers and technicians.

Today, the association collective makes equipment for manufacturing power supplies, such as batteries and galvanic cells, as well as cable products and electrical insulation materials. In addition, production of CNC milling machines and control systems for them has been organized. These products are in great demand, both in our country and abroad.

When the block of ancillary production departments, the boiler room, the pump and compressor station, administrative and service buildings and other objects are commissioned, "Rotor" will start making yet another type of products, industrial manipulators. With their basic design as the basis, robotic manufacturing complexes and automated lines will be developed.

12770
CSO: 1823/122

ROBOT-TIMBERER

Kiev RABOCHAYA GAZETA in Russian 30 Jan 87 p 2

[Article by a "Rabochaya gazeta" reporter from Kharkov]

[Text] The All-Union Scientific Research Institute of Organization and Mechanization of Mine Construction has developed an automated manipulator for erection of roof bolting. A prototype was developed in Electrification and Automation Laboratory under the direction of I.P. Titov.

The manipulator drills holes, inserts cartridges with binding agents into the holes, installs and fastens anchor bolts. The automated device has a rail base with a boom on it. The drilling, cartridge-feeding and anchor installation mechanisms are also mounted on the base. The manipulator has a remote and programmed control system.

Mechanization of timbering operations will make it possible to save 22,000 R per machine. But the most important thing is that the pace of implementation of the progressive metal-saving roof bolting will increase drastically. And this means elimination of manual labor in hazardous conditions.

12770
CSO: 1823/122

SECOND INTERNATIONAL FMS CONFERENCE IN MAGDEBURG

Moscow PROBLEMY TEORII I PRAKTIKI UPRAVLENIYA in Russian No 3, Jul-Sep 86, p 82

[Article by Mikhael Shmidt, doctor of technical sciences, MNIIPU, Vladimir Kalachev, candidate of technical sciences, MNIIPU, and Yevgeniy Khobotov, candidate of physicomathematical sciences, MNIIPU]

[Text] The Second International Conference on Flexible Manufacturing Systems (FMS), organized by MNIIPU [not further identified], with the assistance of the Institute of Socialist Economic Management (Rostock, GDR) and GDR heavy machine-building enterprises, was held in Magdeburg.

Conference participants analyzed FMS development trends in CEMA member-nations, exchanged experience in directing the development, introduction and operation of FMS in metalworking industry, discussed FMS automated design systems and methods (the use of CAD systems) and selection of the mix of products to be designed using them, examined issues involved in setting up CEMA member-nation international cooperation in the FMS field, and familiarized each other with GDR experience in introducing and operating FMS.

Conference participants had high praise for its results. It was noted that definite progress in this field has been achieved in countries of the socialist community since the first FMS conference (PROBLEMY TEORII I PRAKTIKI UPRAVLENIYA, No 1, 1985, p 39).

First, we have succeeded in using the experience accumulated in developing and operating FMS to sharply reduce production labor intensiveness and schedules, in improving the quality of the FMS being developed with various levels of integration and automation and the effectiveness of the scientific-technical resolutions being used in FMS design and operation. Thus, for example, a PRISMA-2 FMS has been operating successfully at the GDR's lead enterprise at the imeni Fritz Gekkert Machine Tool Manufacturing Combine for nearly 15 years now, machining knife-edge parts. A modern, highly automated FMS-1000 will be put into operation at this enterprise in early 1986. The Czech SSR is working successfully to integrate several FMS into a unified production system at the TOS Gostivarzh plant.

Second, the efficiency and level of automation of developments in the area of creating integrated systems for the organizational-technical preparation and control of production, transport, loading and assembly processes with the use of computers.

Third, CEMA member-nations have coordinated their FMS policies within the framework of an FMS general agreement signed at the 40th CEMA session meeting.

The following were pointed out as being among the most pressing problems of further developing modern automated production:

improving FMS production control systems;

improving the reliability and quality of FMS components;

developing high-efficiency systems for automating the design of items to be produced by FMS;

improving the training and retraining of personnel to develop and operate FMS.

Conference participants visited the heavy machine-building combines imeni Karl Liebknecht and imeni Ernst Tehlman.

The combine imeni Karl Liebknecht is in a 15- to 20-year program of gradually automating production and making it more efficient. In 1981, the combine's lead enterprise introduced II-ROTA-I integrated production sectors (IPU) which are specialized by technology and II-ROTA-II IPUs, which are specialized by products mix.

Plant specialists' evaluations of the economic effectiveness of introducing the IPUs yielded the following data: labor productivity increased by 60 percent, 66 workers were freed for other jobs, payback period was 1.5 years, sector shift index is 2.46, and N C machine tools in these IPUs operate 16 hours a day, as opposed to 11 hours a day for other machine tools.

A ZF-RO- TA-PZ-08 FMS has been machining solid-of-revolution parts since 1985 at the lead enterprise of the imeni Ernst Tehlman combine. It includes 39 machine tools, 36 of which are NC and three of which are four-spindle machine tools with automated tool replacement. In 1987, the lead enterprise will introduce an FMS with 10 machine tools for machining knife-edge parts.

11052
CSO: 1823/101

FMS FUTURE IMPACT ASSESSED

Moscow PROBLEMY TEORII I PRAKTIKI UPRAVLENIYA in Russian No 3, Jul-Sep 86 pp 72-81

[Article by Petr Belyanin, corresponding member of the USSR Academy of Sciences: "FMS: Prospects and Opportunities"; first paragraph italicized in source]

[Text] The documents of the 27th CPSU Congress stress the necessity of raising the level of production automation approximately two-fold, of creating fully automated production facilities which can be readjusted quickly and economically. This article analyzes the most important FMS criteria. The social changes caused by their introduction are studied, and there is a comparative analysis of the economic effectiveness of flexible automated lines and stand-alone NC machine tools. The stages of FMS development are delineated.

The ability to, at any instant, stop manufacturing one product and quickly, without losses, switch to the effective release of new items with better consumer features and in a run of any size (with slight differences within the lot), and at an acceptable cost, has become a primary feature of modern, progressive, high-efficiency production, regardless of type.

Today, competitive machine-building output can be achieved only by production of this type. Flexible manufacturing facilities (GAP) based on flexible manufacturing systems (FMS) best meet the demands of modern, progressive production.

The main distinguishing feature of FMS is that the system is computer-controlled and that it incorporates DNC and CNC equipment as primary components. The first such system created in the USSR, in the early 1970's, to operate in series production was the ALP-3-1 readjustable automatic line, which produces a wide variety of complex housing parts without the aid of operators.

Depending on its organizational structure, the FMS is subdivided into the following levels:

- flexible manufacturing module (GPM);
- flexible automated line (GAL) or flexible automated sector (GAU);
- flexible automated shop (GATs);
- flexible automated plant (GAZ).

The flexible manufacturing module (GPM) is a piece of technological equipment with an automated programmed-control device (NC). It is capable of functioning autonomously and repeating cycles. It is equipped with automated devices (robots) for loading blanks and removing machined parts (subassemblies) and scrap (chips, for example), for feeding and replacing tools, for measuring and monitoring the machining (assembly) process, and also for diagnosing malfunctions and failures. The GPM is capable of automated readjustment to produce a variety of items in a prescribed products mix within its technical abilities, as well as of being incorporated into a higher-level system.

The flexible manufacturing line, sector or shop is a complex (GPK) consisting of several (two or more) interconnected flexible manufacturing modules unified by a fully automated control system (KASU), an automated transport-storage system (ATSS) and an automated tool system (ASIO) whose operation is synchronized (as is control of the entire production cycle) by a single control computer (or computer network) which ensures stand-alone GPK functioning over a prescribed interval, with rapid changeovers to machining any other part (subassembly) within the technical possibilities of the equipment. The GPK is capable of being incorporated into a higher-level system such as a flexible production facility (plant).

The flexible manufacturing facility (plant) is a production system consisting of several (two or more) interconnected GPK (lines, sectors or shops) linked by a unified production control system and ATSS (KASU) with flexible, automated engineering and technical production preparation which ensures rapid restructuring of production technology to release new items by integrating the systems for automated production target design (SAPR-K) and technological support technology and devices design (SAPR-T) systems, as well as automated scientific research (ASNI) and technological process control (ASUTP) systems, automated production control systems (ASUP) and automated technological preparation of production systems (ASTPP).

All the enumerated automated systems comprise the aggregate of functional FMS, that is, the systems which ensure functioning of the FMS technological equipment, and they also include additional automated monitoring systems (SAK), automated scrap removal systems (ASUO), and others.

The primary technological features of FMS are:

production flexibility -- the ability to switch automatically to machining (assembling) any prescribed part (subassembly);

structural flexibility -- the ability to function normally if individual technical devices (a machine tool, for example) or device element malfunctions; achieved through function interchangeability;

incorporation into GAP, accretion of devices and functions;

unmanned (more accurately, few servicing personnel on second and third shifts) operation, ensured by the use of hoppers on all production elements, as well as devices for automatically diagnosing and eliminating (or preventing) malfunctions.

The development and introduction of FMS in no way excludes the use of any other widely used and time-tested methods and means of production automation, including the most traditional; FMS supplements, rather than abolishes, these devices.

Each automation device has its own sphere of efficient application, one in which it is most effective. The appropriateness of using a particular piece of technological equipment with various degrees of flexibility and automation (automatic lines, GPM, GAL or GAU, and others) is determined foremost by considerations of economy and by the necessity of obtaining the highest possible capital investment effectiveness, in which regard consideration should be given to annual output volumes and numbers of type-sizes.

Specialists make the following recommendations in this regard: when producing in excess of 2,000 - 5,000 parts in a couple of type-sizes per year, it is appropriate to use the traditional fixed-control automatic lines and rotor or rotor-conveyor lines. If 1,000 - 15,000 of each of 2-8 type-sizes of parts must be produced per year, one should use readjustable automatic lines with a very limited flexibility. The annual release of 50 - 1,000 parts in any of 5-100 type-sizes makes it appropriate to use FMS; GPM are effective given an annual release of 25-500 units in any of 15 - 1,500 type-sizes; NC machine tools are also effective if the annual release of a single type-size of part is 5-30 units in a products mix which includes upwards of 200 type-sizes.

Machining GAL are the type currently being used most widely in the USSR and abroad, but we have begun seeing GALs for blank stamping, welding, casting, heat treating, electroplating and other technologies.

Assembly FMS have thus far been based primarily on assembly robots. Along with the assembly itself, the robots load the parts and monitor the finished subassemblies.

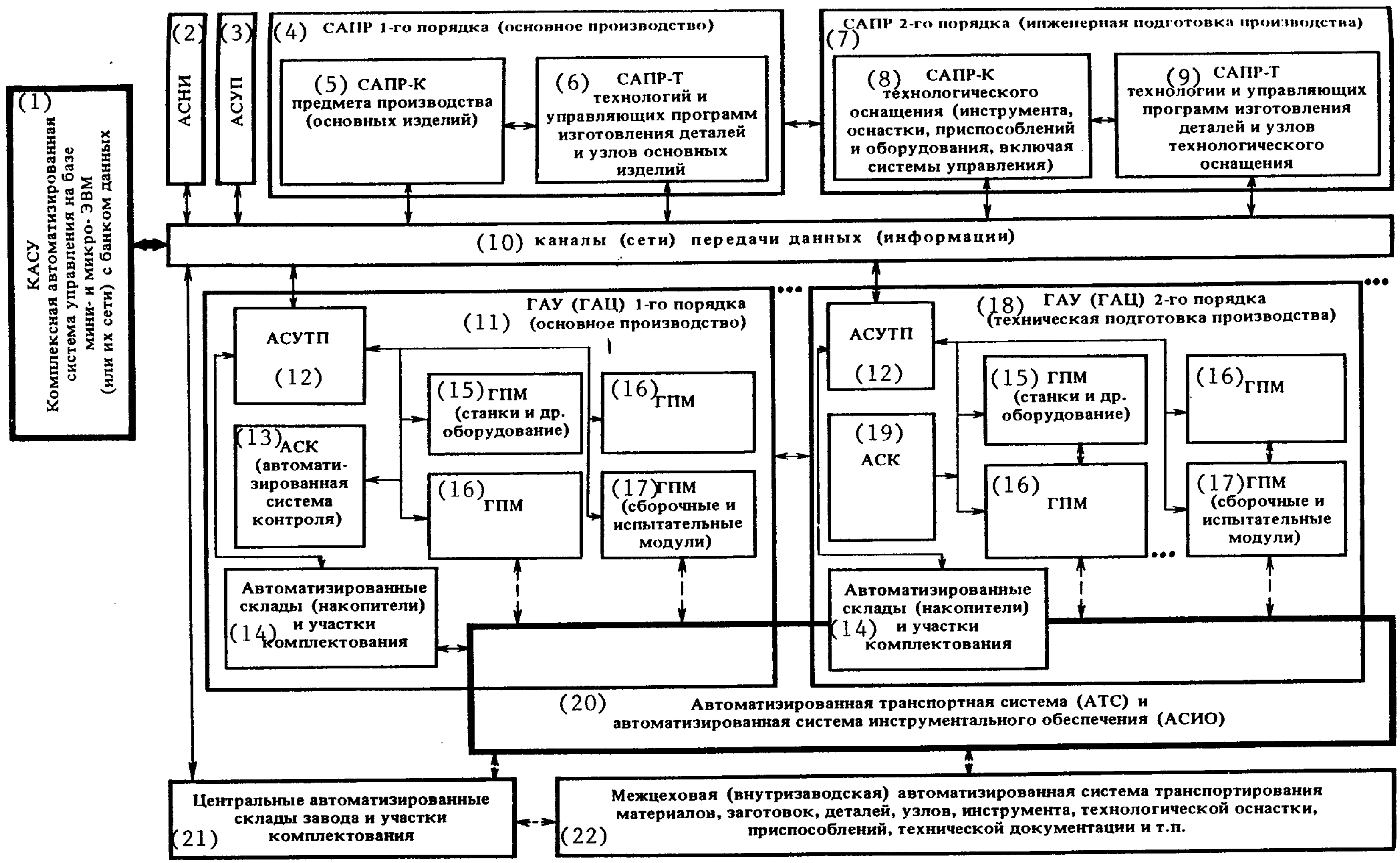
The production of automatic assembly machines has increased sharply in the developed capitalist countries in recent years, so one can anticipate an imminent increase in the production and use of assembly GAL and GAU in machine building, since about half of all labor expenditures in the manufacture of machinery are currently accounted for by assembly, which process has heretofore been manual and little mechanized.

Utilizing FMS fully and efficiently is an important problem, with the technology for group-machining parts taking on particular importance. The effective use of FMS is impossible without combining parts of the same kind from different products mixes into groups. Full FMS utilization is possible only given two situations: the FMS machines several different mass-produced parts or the FMS is used to machine a large products mix of small-series parts combined into groups on the basis of group-technology principles.

GATs and GAZ must be oriented towards three-shift operation, with minimal staff on second and third shifts. Otherwise, the GATs and GAZ payback period becomes problematical, as is also true for single-shift operation of GPM, GAL and GAU.

The composition and structure of GAP of all types are shown in Figure 1 [following page] The experience accumulated shows that flexible automation is most effective when used at the line or sector level or higher. The flexible manufacturing facility for producing robots and machine-tool parts at the Krasnyy Proletariy plant in Moscow is instructive in this regard. This facility does both machining and assembly.

Figure 1. Composition and Structure of Any Type of Flexible Manufacturing Plant (facility)



[Key on following page]

information channels ————————

transport channels - - - - - - - - -

[Key to Figure 1, preceding page:]

1. KASU: fully automated mini- and microcomputer (or computer network) and databank-based control system
2. ASNI
3. ASUP
4. First-order SAPR (basic production)
5. Production object (basic item) SAPR-K
6. SAPR-T for technologies and control programs to manufacture parts and subassemblies of basic items
7. Second-order SAPR (engineering preparation of production)
8. SAPR-K for tooling (tools, fittings, accessories and equipment, including control system)
9. SAPR-T for the technology and control programs to manufacture parts and subassemblies for tooling
10. Data (information) transmission channels (networks)
11. First-order GAU (GATs) (basic production)
12. ASUTP
13. ASK (automated monitoring system)
14. Automated storage (hoppers) and component-assembly sectors
15. GPM (machine tools and other equipment)
16. GPM
17. GPM (assembly and test modules)
18. Second-order GAU (GATs) (technical preparation of production)
19. ASK
20. Automated transport system (ATS) and automated tool support system (ASIO)
21. Central automated plant and component-assembly sector storage
22. Intershop (intraplant) automated system for transporting materials, blanks, parts, subassemblies, tools, fittings, accessories, technical documentation, and so forth.

The number of FMS available in the socialist and the industrially developed capitalist countries is rapidly growing. In 1985, some 194 FMS were introduced in the USSR. Specialists estimate that there were on the order of 190-200 different types of FMS (lines and sectors), using various designs, in the world in 1984 (USSR excluded).

Thirty different GAL and GAU models were in operation in the socialist countries (USSR excluded) in 1984.

There are currently an estimated 230-250 different GAL and GAU systems in operation (USSR excluded). Practically all of them are used to machine parts (up to 65 percent are used to machine housing parts, 12 percent for turning, eight percent to manufacture flat parts, and the remaining GAL can machine parts in a variety of groups).

The USSR has now developed and is operating more than 70 machining GAL and GAU, a significant percentage of which have been developed by the "Experimental Scientific Research Institute of Metal-Cutting Machine Tools" scientific-production association. These GAL and GAU consist of from two to 20 GPM. (slightly over 40 percent of all GAL and GAU worldwide include five or fewer GPM, a third of the total have from six to 10 GPM, and the remaining GAL and GAU are comprised of 11 or more GPM).

The most typical GAL contains 5-8 GPM. NC machine tools of the "machining center" type are the most common (comprising more than 35 percent of all the metal-cutting equipment used in GAL and GAU).

It was initially thought that FMS could be used most effectively in small-series production. We are currently beginning to use FMS in large-series production and even in mass production. In 1984, nearly two-thirds of all GAL worldwide (USSR excluded) were being operated in machine-building branches whose production is predominately small- and medium-series (machine tool manufacturing uses more than 35 percent of all GAL, heavy machine building and aviation industry use about six percent, ship building about four percent), and the remaining GAL are used in large-series and mass-production machine building (automotive manufacturing uses more than 19 percent of all GAL and GAU worldwide, and agricultural and tractor machine building uses more than 16 percent). We are now seeing GPM and GAL in instrument manufacturing, electrical equipment industry and other branches of machine building.

The development of GAP with a structure like that shown in Figure 1 is something for the immediate future. They will operate reliably around the clock for many years, with brief shutdowns for precautionary replacement of individual devices which have reached their projected service life.

For the time being, though, a variety of GPM and GAL are being developed, produced and introduced at the enterprises on an increasingly broad scale.

The flexible manufacturing line currently in use, the ALP-3-2, is housed in a special shop and is used to completely machine 70 complex housing parts for 250 x 250 x 250 mm units.

The line is composed of eight typical "machining center" GPM, including four multiple-operation, five-coordinate SM 630F4.4 NC machines, three multiple-operation, six-coordinate SM400F4.4 NC machines and one five-coordinate SG 400F4.5 NC machine for drilling deep holes.

Blanks are fed to the GAL machine tools automatically from a pallet storage rack using automatic transport-storage system stackers and automatic loaders situated near the line's machine tools. The stacker feeds blank pallet to the pallet storage rack from the loading position and feeds machined parts on the pallet from the pallet storage rack to the unloading position and to the inspection position.

Tool feed to the machine tool's magazines from the stationary storage bin and removal of (worn, broken or written-off) tools from the machine tool is done automatically, following a preset program, by robot-operators of the tool support system in such a way that transitions to machining different parts do not take longer than 20 seconds.

Operation of the line machine tools and the ATSS and SIO systems is guided by a control computer complex based on an SM-2M computer housed in a special area.

Production engineering preparation is partially automated on the ALP-3-2 line (technological processes and all machine-tool control programs are computer-generated).

Experience has shown that the productive life of the machine tools in an FMS is double that of machine tools in ordinary applications, reaching 60-70 percent of the total annual working time available (about 5,500 hours) given an appropriate level of equipment reliability, since the FMS operates operates uninterruptedly for three shifts and since the machine tool readjustment time is reduced to 150 hours.

Together with substantially reducing the number of servicing personnel (first of all machine tool operators), increasing process equipment use time sharply increases equipment and labor productivity in the FMS (as compared with machine tools operating autonomously). Consideration should also be given to the fact that adaptive control of the system permits a reduction in equipment idling and in the time required to set up blanks and parts, and the availability of extensive diagnostics systems in the FMS for analyzing malfunctions and automatically detecting equipment faults (and displaying or printing out the information) reduces equipment down time due to technical problems. Reducing the number of times parts are positioned and integrating technological operations also help increase labor productivity and reduce machining cost in FMS (thanks to the introduction of monitoring during the machining process). Automatic error correction based on parts measurements during the machining process increases machining accuracy and ensures consistent machining quality.

Technical and organizational effectiveness when switching from individual NC machine tools to flexible manufacturing lines and sectors is achieved by increasing two- to three-fold the effectiveness of NC equipment use by minimizing the time needed to readjust it to produce other output, as well as by relieving the operator of the necessity of constant, monotonous observation of the operation of the machine tool. Combining autonomously operating automatic process equipment into a GAL permits improving the load factor (machine time) for the machine tools from 0.4 - 0.6 to 0.85 - 0.9 and the shift index from the current 1.3 - 1.6 to 2.5 - 3.

The products mix of parts machined on GPM, GAL and GAU is an indicator of their flexibility (the higher it is, the more flexible they are). Another important indicator of flexibility is the time involved in changing a system over to machining different kinds of parts, prepared for in advance, and the time required to produce a new type of part, including engineering preparation (designing the technology, control programs, fixtures, tools and so on) and technical preparation (manufacturing the fixtures, tools, and so on).

In order to compare the economic effectiveness of flexible manufacturing systems, it is instructive to compare the ALP-3-2 machining GAL (eight machine tools) and a sector of 16 autonomously operating "machining-center" NC machine tools producing exactly the same number of identical parts per year (Table 1, following page).

Table 1. Comparative Indicators of the Economic Effectiveness of Operating ALP-3-2 Machining GAL and 16 Stand-Alone NC Machine Tools

Показатели (1)	При работе в две смены (2)		При работе в три смены (3)	
	(b) АЛП-3-2	16 станков (a)	(b) АЛП-3-2	16 станков (a)
(4) Затраты, тыс.руб.				
Капиталовложения в станки (5)	1280 (c) (8 станков по 160 тыс.руб.)	2560 (16 станков) (a)	1280 (8 станков) (a)	2720 (16 станков) (a)
Капиталовложения в управляющий вычислительный комплекс СМ-2М (6)	375		375	
Капиталовложения в транспорт (7)	(d) 380 (СИО и АТС)	по нормам завода 25 (e) (межстаночный)	380	25
Капиталовложения в оснастку (8)	36 (72 спутника) (g)	131 (сменяемость 2 г) (h)	54 (108 спутников по 2 установа) (i)	196
Единовременные вложения в оборотные фонды (с коэффициентом 0,15, т.е. на 6 лет) (9)	9	71	13	105
Итого (10)	2080	2787	2102	3046
(11) Экономия, тыс.руб.				
Капиталовложений в станки (5)	1280		1440	
Единовременных вложений в оборотные фонды (12)	62		93	
Заработной платы производственного и обслуживающего персонала (13)	93		122,2	
Затрат на наладку (14)	20		23	
Годовой экономический эффект от внедрения АЛП-3-2 (15)	542		708	

Key:

1. Indicators
2. Operating in two shifts
3. Operating in three shifts
4. Expenditures, in 1,000 rubles
5. Capital investment in the machine tools
6. Capital investment in the SM-2M control computer complex
7. Capital investment in transport
8. Capital investment in fixtures
9. One-time investment in circulating capital (with a coefficient of 0.15, that is, payback in six years)

[continued on following page]

[Key to Table 1, continued:]

10. Total
11. Savings, in 1,000 rubles
12. One-time investment in circulating capital
13. Wages to production and maintenance personnel
14. Set-up expenses
15. Annual economic impact of introducing the ALP-3-2

a. Machine tools
b. ALP-3-2
c. (8 machine tools @160,000 rubles)
d. (SIO and ATS)
e. Based on plant norms
f. (between machine tools)
g. (72 pallets)
h. (service life of two years)
i. (108 pallets for every two installations)

The great social effectiveness of introducing GPM, GAL and GAU is manifested in the higher labor standards among servicing personnel, improved maintenance (particularly by relieving people of night work), the elimination of hard physical labor, improved equipment, fewer accidents on the job, as well as a reduction in expenditures on housing, cultural and personal-services construction (in connection with the reduction in the numbers of workers required).

Social changes caused by the introduction of GAL can be demonstrated in the way the ALP-3-2 machining GAL is used. Tables 2 and 3 [following two pages] provide data on the change in the quantitative and qualitative composition of production and servicing personnel when housing parts are machined on multipurpose machine tools, stand-alone NC machine tools, and the ALP-3-2 machining GPL.

Five types of operations are performed in all production (specialized or nonspecialized): preparatory, working, transport-storage, organizational and maintenance.

Since all transport-storage and organizational operations are automated in flexible manufacturing, as are planning, dispatch and record-keeping, human participation in production organization becomes considerably less necessary.

Automating production organization is thus a very important new feature and fundamental distinguishing criterion of flexible manufacturing.

FMS at last enables one to automate not just production, but all production organization as well. It is this, in particular, which GAP introduces into production for the first time (along with other very important GAP criteria such as flexibility and being "unmanned").

When analyzing production organization of various types, it is essential that one evaluate its structure, degree of adaptation to changing internal and external conditions, and also its degree of synchronization and optimization.

Table 2. Shift Complement of Personnel to Operate 16 Stand-Alone NC Machine Tools and Complement Required to Operate An ALP-3-2 Machining GAL

(1) Смены	16 станков (2)				АЛП-3-2 (8 станков) (3)			
	Количественный состав персонала (4)	Участвующие подразделения завода (5)	Количество профессий персонала (6)	Наименование профессий (7)	Количественный состав персонала (4)	Участвующие подразделения завода (5)	Количество профессий персонала (6)	Наименование профессий (7)
1-я (8)	52 (при двух-сменной работе) или 61 (при трех-сменной работе) (12)	цех механообработки, отдел главного механика отдел главного технолога (14)	28	операторы станков; мастера, распределители работ, контролеры, электрики, наладчики: инструмента, механики, электроники, гидравлики; технологи; конструкторы; программисты (16)	36 (при двух-сменной работе) или 40 (при трех-сменной работе) (19)	цех с ГАЛ, отдел главного механика, отдел главного технолога (21)	21	как для обслуживания автономно работающих станков, но с сокращением числа операторов, распределителей работ и управленческого аппарата (23)
2-я (9)	18	цех механообработки, отдел главного механика (15)	11	сменный мастер, операторы станков, транспортный рабочий, контрольный мастер, контролер, распределитель работ; электрики, наладчики: инструмента, механики, электроники, гидравлики (17)	4	цех с ГАЛ (22)	4	бригадир-наладчик; оператор ЭВМ, оператор-станочник, наладчик-механик (24)
3-я (10)	12	цех механообработки, отдел главного механика (15)	7	те же, кроме: контрольного мастера; распределителя работ; наладчиков, электриков, гидравликов (18)	3	цех с ГАЛ (22)	3	бригадир-наладчик, оператор ЭВМ, оператор-станочник (с функциями наладчика-механика) (25)
Всего при трех-сменной работе (11)	91 (с годовой зарплатой 250,2 тыс. руб.) (13)				47 (с годовой зарплатой 128 тыс. руб.) (20)			

Key: [see following page]

[Key to Table 2, preceding page:]

1. Shifts
2. 16 machine tools
3. ALP-3-2 (8 machine tools)
4. Number of personnel
5. Plant subdivisions participating
6. Number of occupations
7. Occupations
8. First
9. Second
10. Third
11. Total, given three-shift operation
12. 52 (two-shift operation) or 61 (three-shift operation)
13. 91 (annual wage: 250,200 rubles)
14. Machining shop, departments of the chief machinist and chief technologist
15. Machining shop, department of the chief machinist
16. Machine tool operators, foremen, work distributors, inspectors, electricians, trouble shooters (tools, mechanics, electronics, hydraulics), technologists, designers, programmers
17. Shift foreman, machine tool operators, transport worker, inspection foreman, inspector, work distributor, electricians, trouble shooters (tool, mechanics, electronics, hydraulics)
18. As above, except for: inspection foreman, work distributor, trouble shooters, electricians, hydraulics specialists
19. 36 (two-shift operation) or 40 (three-shift operation)
20. 47 (annual wage: 128,000 rubles)
21. GAL shop, departments of the chief machinist and chief technologist
22. GAL shop
23. As for servicing autonomously-operating machine tools, but with fewer operators, work distributors and administrators
24. Trouble-shooters brigade leader, computer operator, machine tool operator, machinist/trouble-shooter
25. Trouble-shooter brigade leader, computer operator, machine tool operator (with the functions of machinist/trouble-shooter)

Structure may vary in the flexible manufacturing facility, but synchronization and adaptation are strongest there (whether induced or external, the production plan is carried out basically by machines, rather than people).

GAP (and GAP alone) permits the practical implementation of a flexible (variable) structure of the organization, management and technological preparation of production and the placement of equipment.

Typical of GAP is strong, pervasive top-to-bottom production formalization and structuring in the form of a pronounced, at any given instant, sequence of actions (algorithm of interaction) of all elements of the production system, a priority of interactions, including informational ones. Computers and robots synchronize GAP operation.

Table 3. Change in Production and Servicing Personnel Staffs (release of identical output in two shifts)

	(1) Профессии и должности	(2) Численность работающих в производстве, оснащенном:		
		(3) универсальными станками	(4) станками с ЧПУ	(5) ГАЛ механообработки АЛП-3-2
(6)	Рабочие-станочники	90	30 операторов (7)	4 оператора (7)
(8)	Сменные и старшие мастера	7	3	3
(9)	Контролеры и контрольные мастера	10	6	6
(10)	Наладчики оборудования и систем ЧПУ		9	5
(11)	Операторы по загрузке, разгрузке и подготовке оснастки		6	6
(12)	Транспортные рабочие и распределители работ	8	8	
(13)	Инженеры по вычислительной технике			8*
(14)	Программисты		8	8
(15)	Общая численность работающих	115	70	40

Key:

1. Occupations and positions
2. Numbers of workers at facilities equipped with
3. Multipurpose machine tools
4. N C machine tools
5. ALP-3-2 machining GAL
6. Machine-tool operators
7. Operators
8. Shift foremen and senior foremen
9. Inspectors and inspection foremen
10. Equipment and N C system trouble shooters
11. Operators loading, unloading and readying fixtures
12. Transport workers and work distributors
13. Computer engineers
14. Programmers
15. Total numbers of workers

* Decreases to 2-3 people when the control computer complex is under warranty

People cannot arbitrarily and continuously "wedge" themselves into GAP operation and disrupt its structure. They can only create that structure, alter it, or destroy it entirely.

GAP actualizes the principle of "organization through synchronization within a flexible structure."

Good adaptability is an important GAP feature; it is provided by the variable structure of all the components and by flexible production preparation. The control computer (or computer network) resolves the task of adapting and optimizing all production elements during the production process, that is, dynamically.

Computers are also used to increase the stability of GAP operation, which is ensured by good structural reliability and adaptation capabilities, which permit redistribution of functions among the GPM and the control devices, by automatic diagnostics, and by rapid replacement of malfunctioning units and modules.

It should be noted, however, that there is inadequate use of computers in the GAL and GAU in use in the USSR and abroad. Hence the very important GAP development and introduction problem of rapidly expanding the use of computers and increasing the range and raising the level of tasks handled by computer, so as to increase the effectiveness of all types of GAP.

A number of top-priority problems need to be solved to ensure the broad dissemination of flexible automation. Most important among them is that of increasing the reliability and service life of current and future FMS and of all the devices comprising them. Mean time between failures of N C systems must be increased to 500 - 1,000 hours or more, FMS control computers must operate trouble-free for at least 4,000 - 5,000 hours, and the reliability of machine tools and other process equipment must be increased two- to threefold. The strength of the automatically-replaceable tools used in FMS must also be increased five- to eight-fold.

Training the engineers and technicians required to develop, manufacture and operate FMS remains a serious problem. So long as FMS are operated by inadequately trained people, FMS equipment will break and malfunction, which sharply reduces their effectiveness.

Retraining GAL and GAU client-plant specialists at training centers at the supplier plants has proven to be successful. A number of plants of the USSR Ministry of Machine Tool and Tool Building Industry already operate such centers and do not ship systems they manufacture to the client until the operating staff has been trained at those centers.

In our opinion, the creation and extensive use of GAP will be in stages in the immediate future (see Table 4, following page).

Extensive use of FMS in various branches of the national economy and the development and introduction of the first GAP are signifying radical changes in production. Restructuring production, changing its appearance, is a statewide task, and one requiring the implementation of major measures involving retooling machine building on the basis of its flexible automation.

[concludes with Table 4 on following page]

Table 4. Basic Stages and Tasks of GAP Development

(1) Этапы	(2) Главные задачи		
	(3) производства	(4) технической подготовки производства (ТПП)	(5) управления производством
I (1980–1990 гг.)	Создание и широкое (6) внедрение ГПМ основного производства на базе нового и используемого технологического оборудования. Модернизация (с целью автоматизации) основного оборудования	Разработка САПР (7) конструкции, технологии и программного обеспечения ГПС	Расширение (8) номенклатуры АСУТП. Решение задач управления на уровне предприятия. Широкое применение персональных ЭВМ
II (1985–1995 гг.)	Создание и широкое (9) внедрение новых ГПМ и гибких производственных комплексов (линий, участков), создание локальных сетей управляющей техники	Создание (10) автоматизированных участков ТПП на уровне предприятия, цеха, участка. Создание технологических заводских банков данных	Создание (11) автоматизированных участков (бюро) управления на уровне цеха. Создание локальных сетей вычислительной техники
III (1990–2000 гг.)	Создание и внедрение (12) гибких автоматизированных предприятий (цехов) на базе ГПК (линий, участков)	Создание и применение интегрированных систем автоматизации ТПП (ИСАТПП) (13) на базе участков ТПП и банков данных	Создание и применение интегрированной АСУП (ИАСУП) на базе участков (14) (бюро) АСУ цеха. Создание интегрированных банков данных. Создание отраслевых сетей вычислительной техники

Key:
1. Stages
2. Main tasks
3. Production
4. Technical preparation of production (TPP)
5. Production management
6. Creation and extensive introduction of basic-production GPM based on new and current process equipment. Basic equipment modernization (with a view towards automation)
7. Development of FMS component, technology and software CAD
8. Expanding ASUTP products mixes. Resolving control tasks at the enterprise level. Extensive use of personal computers.
9. Creation and extensive introduction of new FPM and flexible manufacturing complexes (lines, sectors); creation of local control-equipment networks
10. Creation of automated TPP sectors at the enterprise, shop and sector levels. Creation of plant process data banks

[conclusion on following page]

11. Creation of automated shop-level control sectors (bureaus). Creation of local computer networks [LAN]
12. Creation and introduction of flexible manufacturing enterprises (shops) based on flexible manufacturing complexes (GPK) (lines, sectors)
13. Creation and application of integrated TPP automation systems (ISATPP) based on TPP sectors and data banks
14. Creation and application of integrated ASUP (IASUP) based on shop ASU sectors (bureaus). Creation of integrated data banks. Creation of branch computer networks.

11052
CSO: 1823/101

CAD/CAM IMPLEMENTATION IN CONSTRUCTION INDUSTRY DISCUSSED

Moscow STROITELNAYA GAZETA in Russian 7 Feb 87 p 3

[Article by N. Konovalov, engineer, under the heading "Branch Technical Potential": "Design: Are We Moving Towards SAPR [CAD]? A Moscow Engineer Says 'Too Slowly!'"; first two paragraphs boldfaced in source]

[Text] A couple of decades ago, when the sum of the software for the first computers consisted of a meager library of standard routines and interpreters, designers were able to automate only individual strength-of-materials, modular room-unit, accounting and other calculations.

The algorithms and programs now available in the branches include applications software for designing reinforced concrete and steel components and standard-series buildings made with prefabricated reinforced concrete elements, linking standard buildings to financial estimate calculations (drawing up materials records), plan calculations, highway and railroad routes -- a total of 1,000 such links.

The SG editorial offices were recently visited by a specialist who was very informative about automated design systems (CAD). We talked about how effectively the steps outlined in well-known directives to improve estimate planning are being implemented, about increasing the labor productivity of designers, and about how substantial the return is on money spent to automate design.

"Let's first determine the 'ante'," the specialist says, confidently. "I have some calculations in my notebook. Take a look. Capital investment in one CAD varies, according to press reports, from half a million to seven million rubles. That means the average cost per system is about four million. If the three thousand planning organizations in all the branches were to be equipped with such systems, we'd need to spend 12 billion rubles. But annual CAD maintenance expenses (wages, repair, facilities) would be another 40 percent of that. That means total expenses would increase to 17 billion! Sound right? For that money, you could build another KamAZ and another BAM.

"But now," the specialist continues, "let's point out that about three billion rubles worth of design work is being done annually in this country. We would be able to automate probably no more than a fourth of it, about 700 million rubles worth. That means we will be be paying upwards of three billion rubles annually for the rest of the five-year plan to automate 700 million rubles worth of work. Isn't the acquisition cost too high?"

We agreed that you can pay too much. Of course, the specialist's calculations were clearly intended to make a point. They didn't take into account the impact of reducing the laboriousness of design or the fact that the ratios would be different for construction-industry applications. Nonetheless, it must be recognized that design automation is among the most capital-intensive types of production, and that obligates us to pay very close attention to our notions of the economic effectiveness of using technical devices in planning and to the actual organization of estimate-planning work.

We invite the readers' attention to the article below, by Moscow engineer N. Konovalov, on the reliability of tne methods support for design automation equipment. The SG editors invite specialists to express their opinions on the issues he raises.

Designers have available to them a large, compatible series of computers with system software which enables them to access the same processor from different terminals at their different workstations. We are approaching the stage of being able to resolve the issue of creating automated workstations for designers.

The progress is tangible. But difficult issues of reducing the cost of automating calculations never leave the agenda. It was precisely to reduce expenses that ways were sought to increase integration in automating design calculations by moving from single programs to applications packages and then to computer-aided design systems, CAD. Specialists are unanimous in their opinion that, in order to reduce the unit cost of calculations, one needs to be constantly concerned about one thing in particular: raising the level of automation. The next goal is clear: directive assignments for the 12th Five-Year Plan call for 23- to 27-percent automation. The CEMA member-nation specialists at the construction design conference in Ostrava (Czech SSR) favored approximately the same level.

But here's what is especially interesting. For the first time, our directives on improving the economic mechanism are linking raising the level of design automation not only to increased designer labor productivity, but also to fundamental improvement in the quality of the technical documentation being produced. This feature is of fundamental importance. Level of automation has been changed from an ordinary technical indicator into an economic-order category. There is every basis for assuming that we do not yet fully realize the new responsibilities this will impose on all who are incorporating modern design equipment complexes.

First, what do we mean by design automation level? It is not so easy to define as might appear at first glance.

In 1982, the USSR Gosstroy published "Methods for Determining Design Automation Level" which anticipated measuring that level as "the ratio of the cost of design done using automation to the overall cost of design done by design organizations using their own forces in the reporting year." The proposed method elicited no objections, but, as often happens in life, the implementing organizations began to artificially inflate their levels of automated design in the reports. The USSR Central Statistical Administration's instruction on procedures for reciprocal calculations for completed designs helped those wanting to make a little more off the client.

That instruction anticipates payment for actual machine time at computer facilities. This means that if a problem being solved by a designer takes more machine time, because of unsatisfactory computer condition or because of sloppy work by the computer operators, the price for the service increases. The higher the level of design automation as measured in rubles, the higher the cost. In other words, the worse the better. Paradoxical, no? The bureaucratic effect in no way coincides with state goals in this instance.

In April 1985, the State Committee for Science and Technology, USSR Gosplan, USSR Academy of Sciences and USSR Gosstroy approved a joint resolution, "Branch-wide Methods Materials on Determining the Economic Effectiveness of Using Automated Design Systems in Planning, Planning-Design and Technological Organizations, Mainly in Production and Capital Construction." An interesting document. It outlines criteria for evaluating the effectiveness of using CAD in all links of the investment cycle: design, construction and operation of the facility. But here as well, we find no specific formulas for calculating level of automation.

Let me presume to say that there's probably no one who knows right now what the level of automation actually is for design work in the construction branch. Or how much labor productivity has been increased in design organizations doing some of their work on computers. Or how much design labor intensiveness has decreased in preparatory operations.

We have no reliable methods at hand for answering those questions. But if there is no clear understanding of the levels we have achieved, is it possible to evaluate objectively the economic effectiveness of technical devices used in design? Will we move towards creating CAD by overcoming the expense mechanism of previous criteria for evaluating accomplishments or will we get bogged down in intermediate indicators of effectiveness?

The methods experience we lack can be sought outside the branch as well. It is available, and it is fully applicable.

Very interesting methods recommendations on monitoring the creation, introduction and operation of CAD devices at design institutes are in effect at Kiev's GPI-5 [No 5 state planning institute] of the USSR Ministry of Light and Food Industry and Household Appliances. The monitoring indicators introduced there include number of specialists hypothetically or actually freed for other work, physical indicators on automatically-generated design documentation produced, economic effectiveness achieved in planning through reduced labor intensiveness, number of specialists needed to produce all designs when operating CAD devices and, finally, CAD profitability.

The recommendations are well-substantiated economically. Their purpose is to create the best conditions for achieving end results, which means the production of a design with solid parameters all around. As a supplement to the USSR Gosstroy methods, the Kiev methods actually eliminate any arbitrary interpretation of the indicators of automation level for narrow departmental interests.

Of course, our approaches to evaluating a process as complex as design automation will be more concrete and have greater depth if we are very attentive to the development of new methods documents by the USSR Gosstroy institutes. But I assume there is sufficient necessity for taking a selective physical inventory of the entire complex of characteristics determining the successful development, introduction and operation of CAD in the construction branch prior to the adoption of any new documents and methods. It would be very useful to discover our mistakes, both deliberate and unwitting, at this point.

The inventorying should guarantee objective conclusions. A working group (commission) goes to a design organization and, after studying the books, the machine time records and other documents, evaluates the basic physical and financial indicators of design automation. It is not the annual reports that the verification commission uses (everything is fine, as a rule, in the reports), but "physical measurements" materials based on objective information.

Inventorying helps refine the degree of reliability of our calculation of the levels of automation and the economic effectiveness of automating design, and it helps us make the necessary adjustments in current normative-technical documents.

11052
CSO: 1861/156

GDR BUILDING MATERIALS INDUSTRY AUTOMATION PROGRESS

Moscow EKONOMICHESKOYE SOTRUDNICHESTVO STRAN-CHLENOV SEV in Russian No 9, Sep 86 pp 46-52

[Article by Werner Kohl, professor and active member of the GDR Construction Academy: "Robot Equipment and Microelectronics in GDR Construction"; first paragraph boldfaced in source]

[Text] Comprehensive automation of production processes, an important area of the KP NTP [Comprehensive Program of Scientific-Technical Progress], is increasingly a decisive factor in improving the productivity and quality of social labor. The extensive introduction of microelectronics and robot equipment into GDR construction is a clear example of this. It opens up entirely new opportunities for production intensification in the branch. Relying on their own achievements and using the experience of fraternal countries, republic scientists, specialists and workers are fully resolved to actualize the instructions of the 11th SEPG [Socialist Unity Party of Germany] Congress on opportunities for using technical innovations. Speaking at it, Comrade E. Honnecker stressed that "It is is important first of all to link science more closely to production and production more closely to science. This applies foremost to mastering advanced technologies."

Since 1975, on instructions from the GDR Ministry of Construction, extensive research has been done on specific microelectronics and robotics applications and on revealing ways to better use the advantages associated with them.

Based on extensive research and evaluation of international trends, scientific institutions, in close cooperation with the combines, have developed new technical resolutions for modernizing production installations by using robots, for introducing microcomputers to control automatic equipment, machinery, transport, banding and stacking devices, and for using microcalculators to optimize and control energy use in drying and high-temperature process and in hardening concrete.

The efforts of the construction combines have been directed foremost into using robot equipment to automate operations ordinarily done by hand, into using microelectronics to modernize facilities and to optimize the control of individual processes and thus create individual automated production sectors as prerequisites for the changeover to integrated automation.

The Comprehensive Program of CEMA Member-Nation Scientific-Technical Progress Up To 2000 sets us these tasks: reduce expenditures on designing and manufacturing items approximately 1.5-fold; ensure good interchangeability of units and modules manufactured in CEMA member-nations; reduce the labor-intensiveness of their manufacture two-fold. In the area of lift-transport, freight handling and warehousing: increase labor productivity at least four-fold. The comprehensive automation of production processes is thus being transformed into a determining factor in the development of productivity and efficiency.

By using microelectronics and robotics, as well as modern microcomputer-based information, testing and measuring equipment, the GDR is creating conditions for the integrated automation of sectors and full-function flow lines and will thus be saving energy and reducing overall production expenditures.

Building Materials Production

Over the past 10 years, the branch has achieved significant results, such as the automation of individual production processes and stages, as in the manufacture, shaping and transport of concrete. However, the servicing, control and monitoring of the machinery and devices operating on the flow lines and also a number of auxiliary jobs such as stacking, grading and testing items are still being done by hand. This, in particular, holds potential for substantially improving production efficiency and productivity.

As of late 1985, branch enterprises were using 1,350 industrial robots, 85 percent of which were manufactured (in 30 standard versions) by the construction combines themselves. Robots have been created at all building materials industry combines to modernize existing facilities. Figure 1 [following page] shows the most progressive types of robots designed and manufactured by the combines.

The structural clay products combine, whose program anticipates primarily the release of lime-and-sand brick, building brick, clay conduit, ceramic tile, cement roofing tile and drainage pipe, had created and was operating 246 robots in late 1985 for the purpose of automating production processes. Standard resolutions have been developed for reusing many of them at other facilities, to reduce introduction expenditures to a minimum. The most typical example of that is a slide-fit robot used to load dried clay conduit onto special tunnel-kiln trolleys following a preset slide-fit scheme (Figure 3 [third page following]). This frees three workers per robot for other jobs.

Another example. Stacker, slide-fit and banding robots used to increase efficiency at installations producing cement roofing tile, mosaic tile, cement bridge brick and small concrete elements: each does the work of 4-6 people.

The use of microelectronics to control installations and technological processes has enabled us to find progressive new solutions. Its enormous technical and economic advantages lie in its simplicity, obviousness, flexibility, reliability, self-diagnosis, high-speed processing of information during the course of the process, monitoring of all parameters over a preset time period. All this constantly broadens the field of application of microelectronics in building materials production. In recent years, the following have reached the series-production stage:

Figure 1. Robot Applications in Construction Materials Production

	(10) Типы функции роботов \ (1) Область применения робототехники		(2) Строительная керамика	(3) Керамические плитка и сантехника	(4) Заполнители и естественные камни	(5) Цементная промышленность	(6) Снабжение стройматериалами	(7) Строительные и волокнистые материалы	(8) Инженерное оборудование зданий	(9) Местная промышленность стройматериалов
(11)	Роботы для расштабелирования, поштучного разделения, перестановки		●					●		●
(12)	Съемно-отсадочные роботы		●							●
(13)	Роботы для пакетирования и упаковки		●					●		●
(14)	Опрокидные манипуляторы, поворотные роботы		●	●						●
(15)	Отрезные и транспортные роботы		●	●						●
(16)	Роботы для формовки		●	●						●
(17)	Роботы-питатели, группирующие роботы		●							●
(18)	Сдваивающие роботы и роботы для распалубки		●							
(19)	Электронно-управляемые установки для передвижки		●	●						
(20)	Электронно-управляемые установки для затвердевания		●							●
(21)	Электронно-управляемые установки для обжига		●	●						●
(22)	Портальные роботы		●	●						●
(23)	Манипуляторы для загрузки, разгрузки и передвижки		●	●	●		●			
(24)	Роботы для сортировки			●						
(25)	Роботы для бандажирования		●					●		●
(26)	Манипуляторы для обеспыливания		●	●						
(27)	Автоматы для вырезки пазов и раскалывания				●					
(28)	Автоматы для шлифования и полировки		●	●	●					●
(29)	Автоматические электронно-управляемые функции экскаватора				●					
(30)	Разливочные роботы					●				
(31)	Роботы для укладки мешков с вяжущими на поддонах					●				
(32)	Автоматизированное изготовление минеральной ваты с кофекционированием					●				
(33)	Автоматизированное изготовление гипсового картона с конфекционированием					●				
(34)	Автоматы для сварки и резки					●				
(35)	Разгрузочные роботы для сыпучих материалов						●			
(36)	Загрузочные роботы для загрузки бункеров транспортных средств						●			
(37)	Автоматы для очистки цементовозов						●			
(38)	Полуавтоматические обрезные и нарезные пилы и устройства для удаления сердцевины							●		
(39)	Полуавтоматы для сверления и выточки канавок в оконных и дверных окладах							●		
(40)	Поворотные и прочие устройства в деревообработке и переработке							●		
(41)	Автоматизированные устройства при изготовлении изоляционных материалов (роботы для загрузки и отбора)							●		
(42)	Автоматизированные установки при приготовлении асбоцемента							●		
(43)	Роботы-питатели	(50)							●	
(44)	Роботы-штабеляторы	в автоматической линии							●	
(45)	Роботы-разделители	по изготовлению							●	
(46)	Робот—контролер герметичности	плоских батарей							●	
(47)	Робот-сварщик	центрального							●	
(48)	Робот-перестановщик	отопления							●	
(49)	Робот-конфекционер								●	
(51)	Оптоэлектронно-управляемые установки для распознания образцов, контроля и сортировки		●	●						
(52)	Робот-ороситель			●						
(53)	Промышленный робот для изготовления плиток для терраццо		●							●
(54)	Промышленный робот для шлифования плиток для терраццо		●							●
(55)	Робот для укладки на поддонах			●						
(56)	Автоматизированная линия для изготовления мостового камня				●					
(57)	Автоматизированная линия грохоты				●					

[Key on following page]

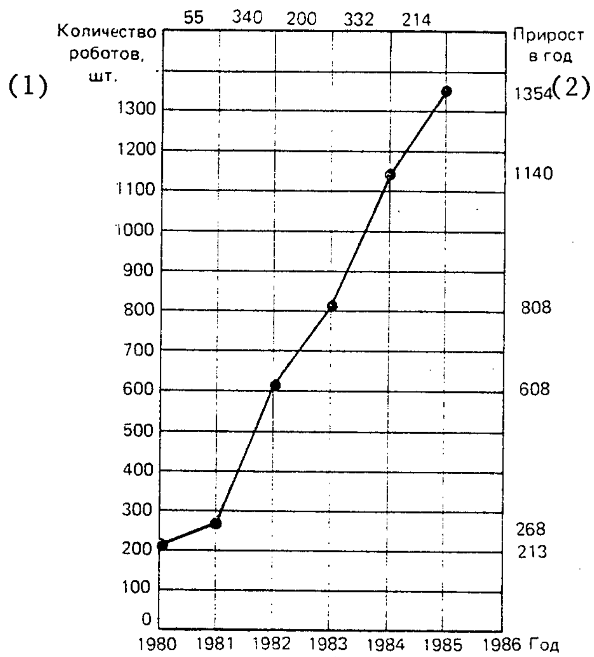
Key: [to Figure 1, preceding page]

1. Robotics applications
2. Structural clay products
3. Ceramic tile and sanitary engineering
4. Aggregate and natural stone
5. Cement industry
6. Building materials supply
7. Construction and fibrous materials
8. Engineering equipment for buildings
9. Local building materials industry
10. Robot functions
11. Robots for unstacking, separation into items and rearrangement
12. Stripper-jigger robots
13. Palletizing and packaging robots
14. Dumper manipulators, turning robots
15. Cut-off and transport robots
16. Molding robots
17. Feeder robots, grouping robots
18. Coupler robots and form-dismantler robots
19. Electronically-controlled transfer installations
20. Electronically-controlled hardening installations
21. Electronically-controlled roasting plants
22. Gantry robots
23. Manipulators for loading, unloading and moving
24. Grading robots
25. Banding robots
26. Vacuuming manipulators
27. Automatic mortising and splitting machines
28. Automatic grinders and polishers
29. Automatic electronically-controlled earth-movers
30. Casting robots
31. Robots for bagging binders on skids
32. Automated manufacture of form-fit mineral wool
33. Automated manufacture of form-fit gypsum board
34. Automatic welding and cutting machines
35. Robots for unloading bulk materials
36. Robots for loading vehicle hoppers
37. Automatic cement truck cleaners
38. Semiautomatic grooving and trimming saws and coring devices
39. Semiautomatic machines for drilling and grooving door and window frames
40. Turning and other devices in woodworking and reprocessing
41. Automated devices for manufacturing insulation (loading and screening robots)
42. Automated devices for manufacturing asbestos cement
43. Feeder robots
44. Stacker robots
45. Seperator robots
46. Robots for checking air-tightness
47. Welding robots
48. Rearrangement robots
49. Build-up robots

[continued on following page]

50. In automatic lines for manufacturing flat central-heating radiators
51. Optoelectronically-controlled devices for pattern recognition, monitoring and grading
52. Sprinkler robots
53. Industrial robots for manufacturing terrazzo tile
54. Industrial robots for grinding terrazzo tile
55. Robots for packaging on pallets
56. Automates lines for manufacturing bridge stone
57. Automated grizzly line

Figure 2. Robot Equipment Introduced Into GDR Building Materials Production During 1981-1985



Key:
1. Number of robots
2. Increment, per year

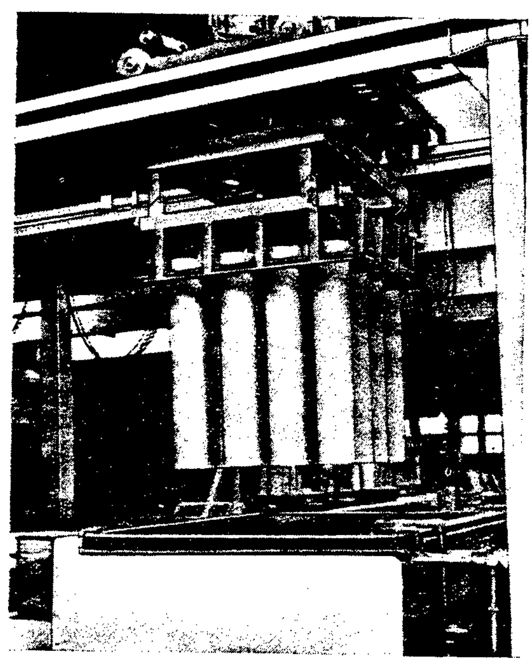


Figure 3. Slide-Fit Clay Conduit Robot (ϕ up to 200 mm)

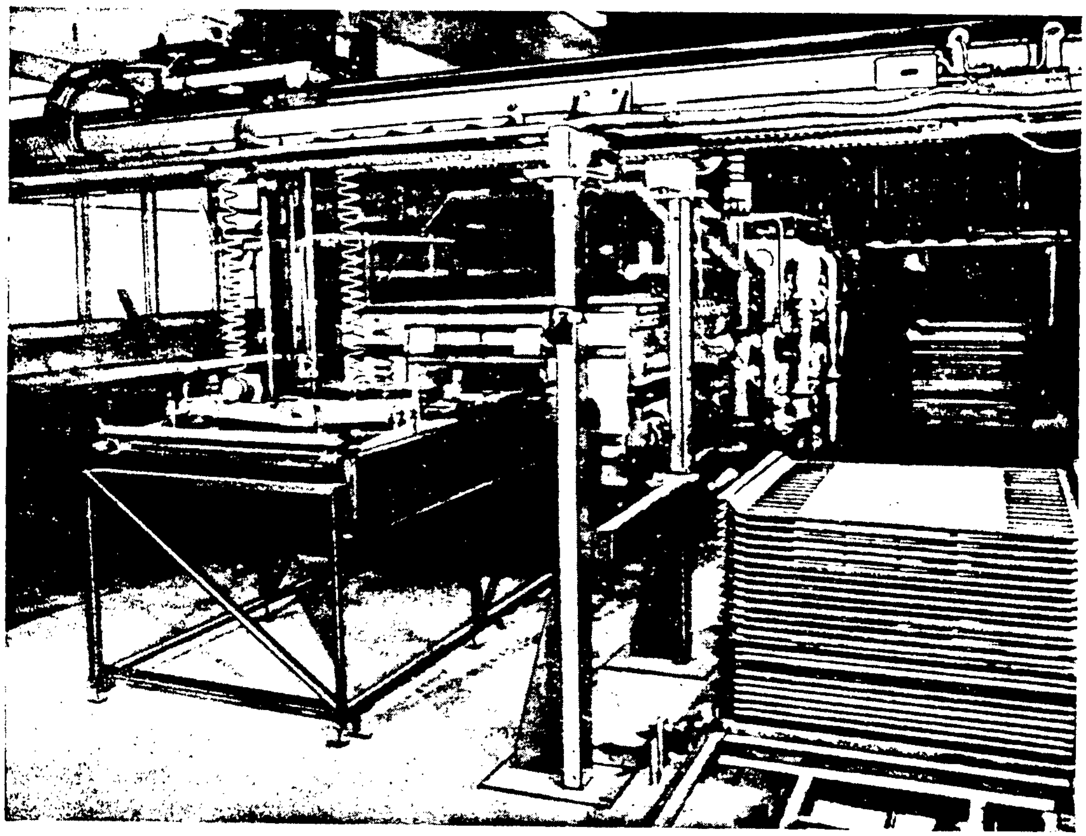
control systems for robots, automatic machines and transport installations;

measuring and testing equipment using microcomputers to ensure reliable quality;

microcomputers for controlling interconnected production processes.

Drying, hardening and roasting processes are computer-controlled so as to save electricity and heat, fuel and cement, and also to improve productivity.

Figure 4. Gantry Robot for Storing and Moving Ceramic Tile



To meet national needs, combines, enterprises and the Construction Academy are presently working to ensure productivity growth, especially by introducing key technologies. Research and development attention is focused on combining the robots and installations used in any given technological regime into an automated process. Thus, the finishing and bathroom tile combine has developed a microelectronically-controlled robot for storing and moving tiles. These gantry robots (Figure 4), assembled from standardized components, come in four versions, providing stacking heights to 1,500 mm and movements to 2,000 mm. The entire process is controlled by a single system equipped with an 8-bit microcomputer using a U800D microprocessor. Particular importance was attached to increasing system reliability and performance in terms of error probability, so all the inputs and outputs are connected to the computer by PCP's. The power consumption of each robot complex is 3 kW, and each does the work of three people.

Automating the Production of Concrete Items

In cooperation with the combines, the Construction Academy is studying the advantages and possibilities of using plant technical management automation systems (ASUTP) for planning, automatically monitoring, controlling and coordinating the production of finished products for the prefabricated building components and materials industry. Decisions on a broad range of uses are being worked out simultaneously. The first standard resolutions were introduced in 1985. The most important of these was the creation of automated flow lines for the following areas:

introducing economical microcomputer control equipment configured so it can be changed as the size and complexity of the technological tasks change;

microcomputer control of robots, test facilities and processes integrated into the control technology so as to automate information processing and data exchange;

robot equipment corresponding to the specifics of a process and possessing properties of flexible application;

computer-based measurement and testing equipment to ensure prescribed item quality;

automated transport facilities.

When making finished products for the precast building components industry, the quality of the concrete elements is determined when the cement slurry is mixed, so strict monitoring of the mixing is required. It is therefore necessary to control the mixing and batching process accurately by using reliable measuring equipment and data processing. In combination with modern measuring and testing equipment and with devices for servicing and I/O the indicators of the enterprises producing concrete and panelling, the microcomputer permits the use of new control systems which are reliable and forward-looking.

The advantages of using microcomputers in installations preparing concrete mixtures are obvious. First, they permit control of all technological processes and achieving consistent quality with flexible, optimized time parameters for the technology. In this regard, the only function performed by people is that of monitoring the control board.

Second, repeated optimization (a correction algorithm) ensures accurate batching of prescribed mixture components and adherence to constant quality parameters.

Third, data can be accumulated on unambiguously documented mixture compositions. The recording system is simultaneously improved, improving the recording of technological data and production planning and control, improving production economy. One can switch to computer-equipped workstations for technology preparation, thus ensuring monitoring of the concrete installation's operation without high personnel expenditures.

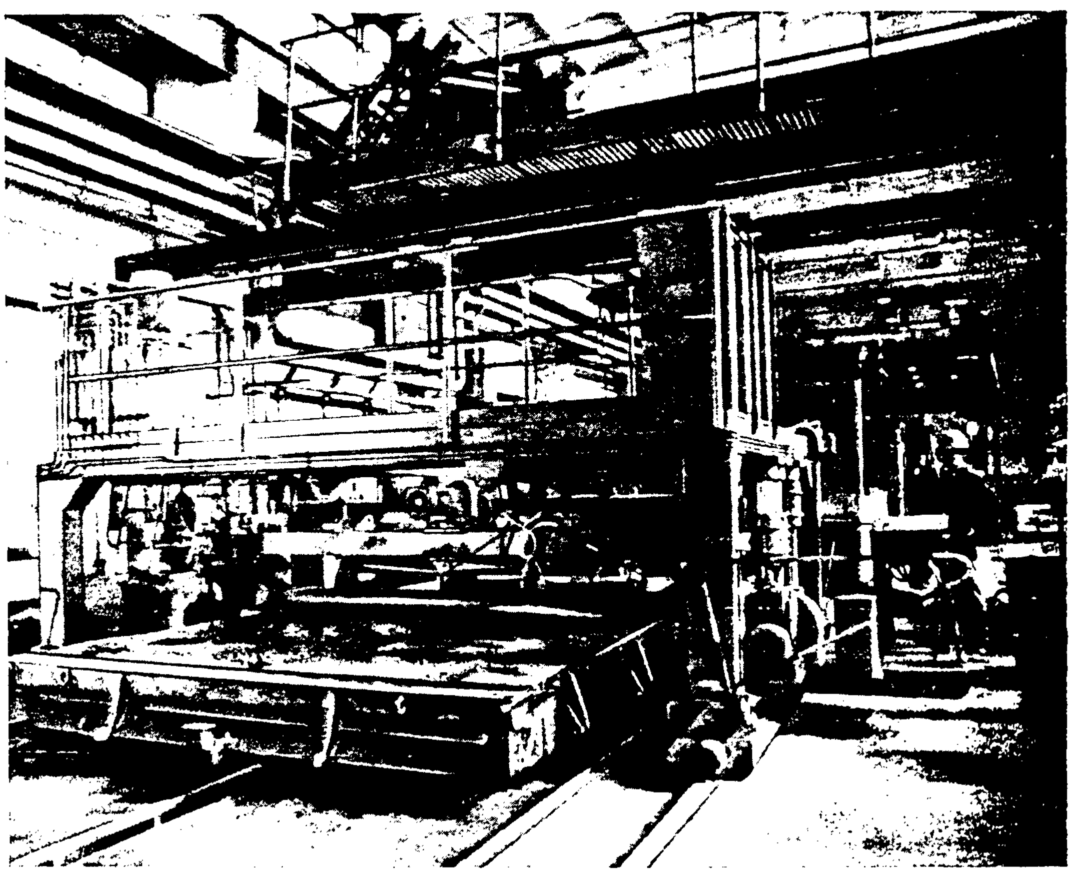
Fourth, it is easy to monitor all processes automatically, which improves the reliability of the cement mixing installation. Self-diagnosis and error-search routines facilitate maintenance in the case of malfunctions.

Fifth, one can tie the microelectronic device for preparing the cement mixture into a microcomputer-based control system and thus create a hierarchic control system, that is, a plant technical management automation system, basically without altering the computer equipment of the cement mixture preparation installation.

Microelectronics and robotics will soon permit a great leap forward in automating production at concrete and panel plants.

Thus, the flow chart for a combined technological line for producing prestressed reinforced concrete spans and concrete roof elements for housing is being modernized using microcomputers and robots. Some 27 percent of the workers on the line have been freed for other jobs as a result of the line's having been equipped with three robots appropriate to this specific process: one for laying prestressed reinforcing in steel forms, one for cutting off the reinforcing protruding after the cement hardens, and one for smoothing and calibrating the concrete surfaces of span and roof elements (Figure 5). Microcomputers control preparation of the cement mixture and the heat and humidity conditions as it hardens and, in combination with the measuring and testing equipment, ensures a 15-percent savings in cement and a 26-percent savings in energy.

Figure 5. Robot for Smoothing and Calibrating the Surfaces of Concrete Elements



This year, the production of prestressed reinforced concrete spans is being controlled by a microcomputer which performs a number of functions.

The "Elektronik" MS 80.30 graphics microcomputer in Gera, which includes peripherals (printers and terminals, in particular) and autonomous microcomputer elements operating in conjunction with it for decentralized machinery and device control, as well as to control energy and materials use (a front-mounted computer), is the primary component of this microelectronic process-control equipment developed by the GDR Construction Academy. The configuration of the devices controlling the process can be varied, depending on the complexity of the technological task. The technical concept is such that the structure of this control equipment can be coordinated with the technological process at hand.

In dialog with the control computer, the main computer can request all the production information and data available, for example, the daily production quota and machinery load, in time sequence; 24-hour output of elements or finished products in each production sector or on each flow line; availability of construction materials, additives, binders and other materials, and the assigned installation values for preparing the cement mixtures, for inventory control.

Production data is converted into information for controlling machinery, automatic devices, robots, transport facilities, and measuring and testing equipment through this central microcomputer control. The central computer transmits the information using processor modules for subsequent development. The central computer receives as feedback information on the execution of commands, production parameters and the status of the process and, in the case of malfunctions, information on the errors.

The central control board automatically records and processes a variety of data on such things as electricity, steam and materials used, so as to monitor production expenditures. By comparing them with normative values, it detects when limits are being exceeded and sends an alarm signal, simultaneously displaying the necessary information and alternative solutions on its screen. Assigned and actual expenditures are automatically shown on the screen at any given moment; they are logged and recorded on the computer's data-storage media. As compared with ordinary equipment regulation and control devices, observation and real-time direction of the production process is considerably more reliable. Thus, the use of existing computer systems is a more efficient way of processing information from automated technological sectors, from production planning to control of the technological process and ensuring product quality, right up to plant record-keeping.

The results of and experience in using microelectronics and robotics and computer-based information processing are indicating concrete ways of introducing comprehensive automation of the production of finished items in the prefabricated building components and construction materials industry, as well as of accelerating research and development.

11052
CSO: 1823/114

EXPANDED USE OF ROBOTS SEEN AS A SOCIAL AS WELL AS INDUSTRIAL BENEFIT

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 87 pp 20-21

[Article by V. Ivanov: "The Robot Takes Over the Shift"]

[Text] In the immediate future new generations of equipment will be produced capable of providing a multiple increase in labor productivity and the way will be opened for automation of all stages of the production process. A significant role is bound to be played in this by industrial robots (IR) and automatic manipulators (AM) whose numbers are growing at a high rate in the USSR.

Robotized technological complexes and sectors of flexible production based on quickly readjusted lines handling many products makes it possible to sharply reduce the time periods of introduction of essentially new products, to accelerate the process of automating production, to release and to more rationally use a part of the manpower resources and to create comfortable conditions at workplaces.

Robots are actively conquering not only industry but also other sectors of the national economy: construction, the service sphere and health care. In the United States and France, mechanical helpers have been developed for bricklaying and installation of concrete blocks, pouring concrete into molds and applying refractory materials to columns and beams by means of a spraying method. In some Tokyo hospitals, robot nurses [roboty-medsestry] dispense food to patients.

However, the wide-scale robotization of production in capitalist countries is sharply aggravating such a social calamity as unemployment. In the past 5 years, the number of unemployed, for example, in Japan has grown by 500,000 persons and now numbers about 1.7 million. And it is just in recent years that owners of Japanese enterprises have begun the mass introduction of robots into production. Thus several years ago, about 2,000 people used to work at a plant of the Tosibo [Toshiba?] Electrical Equipment Company in the Saitamo Prefecture. Today the plant is almost totally converted to automated assembly with the aid of robots and other automatic machines. As a result more than a thousand persons were fired.

In the industry of the Federal Republic of Germany at the present time, about 5,000 robots and manipulators have replaced welders, painters, assemblers, press operators and other workers. As we can see, the new equipment is forcing people out of production and making them "superfluous."

Robotization under the conditions of socialist production has quite different consequences. Its wide-scale introduction in our country is due not only to economic but also to social factors, first and foremost concern for the individual. Robotized systems, as a first step in the creation of industrial enterprises of the future, already at an early stage are cardinally changing the character of a worker's labor: they eliminate heavy, low-skilled physical labor and low-paid, low-prestige jobs and vocations. Furthermore, such systems operate practically around the clock.

The release of a person from tiring, monotonous and heavy work under conditions of dust, gas, high temperature, noise and vibration has a favorable effect on his health. Thus the use of industrial robotic equipment cardinally changes the entire social picture of labor activity in production and the occupational profile of workers and other specialists.

The use of robotic systems in production also significantly changes the employment structure. Their high productivity removes the question of shortage of manpower and provides the possibility of its reallocation in the service sphere where labor productivity by virtue of a number of special features is lower than in the main sectors of industrial production. We know that for the national economy at the present time an "industrial model" of the structure of the population's employment is characteristic. Experience shows that it is gradually yielding its place to the "scientific and technical" model. This means scientific and organizational-managerial activity of people will assume first place.

By reducing the need for people in the sphere of direct production of material wealth, automation gives rise to the need for people of creative and primarily of scientific labor. According to the calculations of the well-known English scientist John Bernal, it is already necessary today to bring in no less than 20 percent of the persons employed in public production for the solution of the most important problems of scientific and technical progress in the sphere of basic and applied science. Robotized production has to constantly experience the revolutionizing impact of new scientific ideas and employ essentially new technology and materials. Such production in essence will be a gigantic laboratory of science and its experimental base. The immediate process of production becomes in the words of K. Marx an "experimental science." This tendency finds its expression in the economic requirement: in order for the process of production to continue on a rising curve, development of science would have to be ahead of the development of equipment.

The production of material wealth depends on the spiritual richness of society's members and on the degree of their intellectual and cultural development. The education of the broad masses themselves is becoming an economic necessity. The measure of further develeopment of society is already becoming not worktime but free time.

Real prerequisites will be created for planned shortening of worktime length, expansion of vacations and the provision of wide-scale opportunities for free creative work for each worker in conformity with his individual abilities and desires in the interest of all society.

Wide-scale robotization of production requires development of the educational system. This is already taken into consideration in the plan of the CPSU Central Committee "Basic Directions of Restructuring Higher and Secondary Specialized Education in the Country."

At the Belorussian Polytechnic Institute, the first faculty in the country "Robots and Robotic Systems" was created. The task of graduates is to create and operate intricate automated complexes. At the faculty, it is planned to create a center for retraining engineers working in this field. Affiliates of all the specialized departments of this faculty will be organized at a number of Minsk enterprises. At many vocational and technical schoools, groups are being formed for training operators to service robotic complexes.

As a result, there will be provided a new quality in the training of specialist personnel in close connection with a radical improvement in their utilization, guaranteeing the emergence of our country in the forward positions of scientific-technical and social progress. The party sees in higher school an important part of the whole system of cadre policy. The task is being set of providing accelerating development of higher and secondary specialized education with respect to technical modernization of the national economy.

7697
CSO: 1823/127

HIGHER PRODUCTIVITY THROUGH INTRODUCTION OF COMPUTER AIDED OPERATIONS

Minsk NARODNOYE KHOZYAYSTVO BELORUSSII in Russian No 2, Feb 87 pp 19-20

[Article by K. Kanus, special correspondent of journal NARODNOYE KHOZYAYSTVO BELORUSSII: "Reliance on Flexible Production Operations"; first paragraph is source introduction]

[Text] The journal's correspondent K. Kanus has visited one of the enterprises whose production was discussed above [see article "Candidly Concerning Machine Tools" by V. Tarasevich] and became interested in what measures were being taken to more fully satisfy the needs and wishes of machine builders.

The collective of the Minsk Production Association for the Manufacture of Broaching and Cutting Machines imeni S.M. Kirov is developing the production of original equipment on the basis of plans of its special design bureau. In the forgings and castings shop of the head enterprise, an experimental sector for cutting metal, the likes of which so far do not exist in our country, is already in operation.

What is it like? What are its technical possibilities? I ask shop chief Yu.S. Mikhalev to answer these and other questions.

"The sector is operated with the help of a computer. It is serviced by two specialists--an electronics engineer and a programmer engineer," he says. "Two workers send ready blanks to the required addresses. And that constitutes the entire personnel.

"The rolled metal is moved on a special truck from the warehouse to a storage location. From there it is fed by a piler crane, operated from the computer, to one of five machines and then automatically directly to the cutting area. Cutting of the metal to required sizes is done with circular saws made of high-alloy steel. After this, the blanks go to packing by means of slides, a special device, and from there for further machining.

"In 2 shifts at the sector where 5 cutting machines are installed, there are prepared several thousand cut segments with a total weight of 15 to 20 tons. However, this is not the maximum. Depending on production needs and availability of free areas, the sector can be equipped with a larger number of machines.

"The operation of the experimental sector in the course of the year," Yu.S. Mikhalev said in conclusion, "confirmed its great effectiveness. Productivity increased severalfold and the standard of work improved."

By the end of the 5-year plan, the association will have produced a quantity of equipment that would be sufficient to take care of 25-40 automated cutting sectors.

The machine-tool builders also have developed a new gamut of broaching machines with higher cutting speeds, long strokes and tractive forces. This equipment is successfully operating in all machine-building sectors of our country. As a result, labor productivity has increased 1.5-1.6 fold and the economic effect amounts to as much as 34 million rubles a year.

In the last years of the 11th Five-Year Plan, the foundation was laid for the production of high-production machine tools, making it possible to establish a low-waste unmanned technology. First and foremost, it includes machine tools MPZ-994, MPZ-879, MPZ-1083, MPZ-921 and MPZ-926 with which such of the country's large plants as the Melitopol Tractor Spare Parts Plant, the Novosibirsk Tool Plant, the Vinnitsa Plant for Tractor Assemblies and the Pskov Khimlegmash Plant have been equipped with. Their introduction ensures a four to five times higher labor productivity and a reduction of metal intensiveness by 17-30 percent.

Dozens of model MP7-730 machines for pull broaching of plan bearing shell butt ends for motor-vehicle and tractor engines were delivered to plants of Chelyabinsk, Kuybyshev, Sverdlovsk and other industrial centers.

In recent years the special design bureau of PS [not further identified] carried out a number of studies on the designing and introduction of robots and manipulators, electronic control systems and unified technological complexes operated by computers.

"Considerable work on boosting the efficiency of machine-tool building equipment has to be done during the current 5-year plan," states V.F. Skizhenok, the chief engineer of the special design bureau of PS. "First of all, it is necessary to increase the output of automatic machine tools to 70-75 percent of the total volume of machine-tool production, to develop flexible production modules and systems, to introduce nigh-speed cutting of metals with circular saws made of hard alloys as well as a waste-free technology of metal cutting. In the immediate years ahead, we need to secure the transition to an electronic control system, to develop turning production, to achieve a further reduction in metal intensiveness and power intensiveness of machine tools and to increase their productivity, reliability and durability.

"Machine-tool makers of the Production Association imeni S.M. Kirov are developing for the first time in the country the production of broaching and cutting machines equipped with control systems utilizing programmed command equipment on a microelectronic base. By 1990, their output will amount to approximately 40 percent of total production volume.

"A lot of attention is being given paid to creation of designs and development of production of flexible production modules on the basis of broaching machines for series and large series multiproduct production. Production is specifically envisaged of 5 head models of machines. As a result, there will be secured the introduction of a highly efficient pull-broaching processes in series production, raising labor productivity two to three times. The level of automation of pulling and cutting equipment will grow through the creation and introduction of production of automatic lines of computer operated broaching machines.

"One of the principal directions in creating efficient equipment is carrying out design developments ensuring increased output of continuous-operation automatic tools for machining plain bearing shell butt ends and NC machine tools, and their robotization. In addition, their technico-economic indicators should correspond to or be higher than the level of the best foreign models.

"The successful solution of the set tasks will be abetted by the special-goal comprehensive programs 'Technical Level,' 'Reliability' and 'Quality' worked out at the association. Their fulfillment as well as change in the structure of production output, increase of the number of automatic machines, especially multi-tool ones, development of new types of pulling, equipping of machines with a high-efficiency cutting tool, microprocessor equipment and production robots will make it possible for the association to fulfill targets for growth of labor productivity, higher precision and reduction of specific materials intensiveness and power intensiveness. Individual types of equipment of priority designation, for example, broaching lathes, will secure twofold to tenfold higher labor productivity compared to existing technological processes."

7697
CSO: 1823/127

BRIEFS

ROBOTIC PAINTING COMPLEX AT MINSK AUTOMOTIVE PLANT--MINSK. A robotic complex began operation at the Minsk automotive plant. The electronic "painter" was given one of the most hazardous and labor-consuming jobs: painting driver's cabs of MAZ [Minsk automotive plant] trucks. The complex has a recognition system that makes it possible to paint various truck models on the same conveyor line and to change colors automatically. The quality of coating, applied by manipulators, meets world standards. The complex can handle the increased production volume of the new family of trucks during the current Five-Year Plan. [Text] [Moscow SELSKAYA ZHIZN in Russian 23 Dec 86 p 1] 12770

CSO: 1823/122

UDC [629.12.06:697.92].004.5:620.1.05

TECHNICAL DIAGNOSTICS OF SHIP ELECTRICAL FANS

Leningrad SUDOSTROYENIYE in Russian No 2, Feb 87 pp 32-33

[Article by V.M. Vasilyev]

[Text] Technical diagnostics, performed without disassembling equipment, is ever widely used in maintenance of machines, mechanisms and equipment in all branches of the national economy and results in great savings. In the marine cargo fleet, systems for observing operation and checking technical condition of main power plants have already been functioning [1]. However, the problem of diagnosing ancillary ship mechanisms and equipment is still in the solution stage. Therefore, choosing methods and means for diagnosing centrifugal and axial electric fans, widely used in a large number of ship compartments, is of certain interest.

The operating function of an electric fan is to supply a certain volume of air at a certain pressure. Both the volume and the pressure can decrease due to changes in the impeller geometry (deformation, blade break-off), whereas the complete absence of air supply is the result of impeller failure or motor outage. The objective of diagnostics is to identify, in the process of service maintenance, defects that impair fan serviceability, whereas its results serve as informative basis for answering the question of what type of repair (a maintenance repair, a medium repair or an overhaul) is required in each case. As maintenance repairs are performed, as a rule, in situ by the ship crew, diagnostic methods and means can also be used for checking quality of those repairs. In the case of on-shore medium repairs and overhauls, methods and means for quality control of individual parts, assemblies and complete fans are determined by specifications and are not examined in this article.

A fan is a very simple technical object that only consists of three parts: a housing, an impeller and a motor. The required housing tightness is assured by the strength and tightness of welds, whose design elements are specified at the design stage; quality is checked in vibration impact tests of assembled electric fans in accordance with specifications of the "Rules for Classification and Construction of Sea Ships" of the USSR Register before the series production begins and periodically during the production life. Therefore, no special technical diagnostic means are employed, as visual inspection takes over.

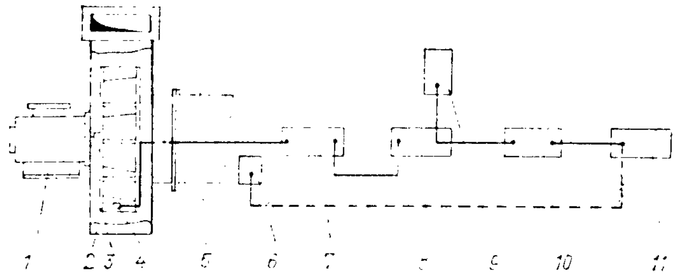


Figure 1. Strain Measuring Circuit:
1 - motor; 2 - housing; 3 - impeller; 4 - strain gauge; 5 - ship air duct; 6 - tachometer; 7 - current collector; 8 - switching device; 9 - dynamic calibration; 10 - strain amplifier; 11 - oscillograph

Practical experience demonstrates that the vast majority of failures are caused by fatigue of metal impeller elements are made of; these elements (blades, disks etc.) have several forms of natural vibrations with frequencies that depend on their stiffness, the latter changing when cracks develop and propagate. Some works [1, 2] give recommendations on application of the so-called resonance method for identifying rotor blades of turbo-machines with subcritical crack sizes; the solution of the problem is reduced to comparing relative changes of natural vibration frequencies to given settings.
Besides employing the resonance method, one can perform frequency analysis of impeller elements with the help of a very simple strain measuring circuit (Figure 1) that, in addition to protable equipment, must include a current collector. Such circuit can be used for studying fans under laboratory conditions for a period of up to six months, but it is unsuitable on ships because of its complexity and because, due to environmental effects, strain gauges lose their properties over the life of a fan, which can be ten years or more.

Impellers fail when the number of load cycles exceeds the critical value. Thus, it is not fatigue cracks, but the number of cycles and the magnitude of stresses, determining impeller condition in relation to its limiting, critical condition, that should be used as criteria of the technical condition of an impeller. The process of accumulating load cycles does not affect serviceability of an electric fan, thereofre their characteristics (the magnitude of induced variable stresses σ_p and frequency of changes n_p) can only be controlled with the help of strain measurements; in order to diagnose an impeller, one should determine the critical number of load cycles N_k.

It is well known that the relation between variable repetitive stresses σ_i and the number of cycles N_t until failure is characterized by a Weller curve. Parts fatigue curves for different diameters and designs of impellers are also different [3]. In order to determine the critical number of cycles for an impeller, one should run fatigue tests on them. Having a pattern of the dynamic stress state, obtained from strain measurements, one can switch from the critical to the nominal number of cycles and contend with sufficient confidence that technical condition of impellers in operation is a function of their service life. In order to save time and money, one determines fatigue

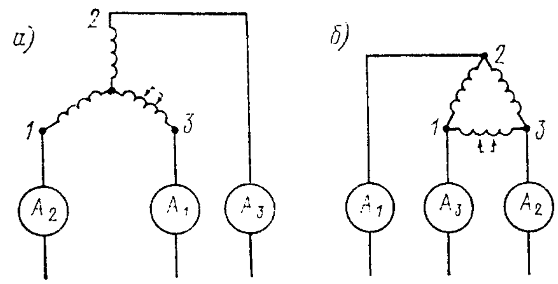


Figure 2. Circuit for Spotting Turn-to-Turn Short Circuits in Stator Windings of Asynchronous Motors With Y- (a) and Delta- (б) Connections

characteristics of impellers, using an accelerated method with forced load modes.

Three-phase asynchronous motors with squirrel-cage rotors are used most widely as drives for ship fans. Studies have demonstrated [4] that the majority of motor failures are related to bearings and stator windings (57.3 and 36.2%, respectively). In addition to natural wear that results in increased radial and axial clearances, various types of defects can develop in bearing parts, such as cracks and chipping. These defects are best of all spotted with the help of the impact pulse rather than vibroacoustic method, because the latter is affected by vibration and the mass of the mechanical system itself.

The technical condition of bearings can also be directly determined from the value of clearances; thus, it is possible to measure a radial clearance without disassembling a motor, employing a method, based on using sections of the stator with its winding as an electric magnet that attracts the rotor in certain radial directions. In order to do this, the motor must have an additional terminal in the connection between coils of one of the winding phases and linear displacement transducers. Of all known methods for determining the technical condition of rolling bearings without disassembling a motor, the impact pulse method is preferable, because the vibroacoustic method is rather complicated under ship conditions, whereas the method for determining bearings condition from a radial clearance does not produce enough information.

In the process of operation, physical and chemical changes occur in motor windings phase-to-phase and turn-to-turn insulation relative to the motor frame. This is related to natural aging and the presence of defects. Measuring leakage currents is one of the most efficient methods for determining the technical condition of insulation of motor windings relative to the motor frame and phase-to-phase. The technical condition of turn-to-turn winding insulation, whose defects are one of the most widespread causes of motor failures, can be determined, using several methods.

The phase that has turn-to-turn short circuits due to damaged insulation can be identified from asymmetry of current consumption. In the case of a Y-connection (Figure 2, a) current A_3 in the phase with a short circuit is higher than in the other two phases; in the case of a delta-connection (Figure

2, 6) currents A_1 and A_3 in two phases the defect phase is connected to are higher that A_2, and one should check the presence of a turn-to-turn short circuit at lower voltage (one-third to one-quarter of the nominal voltage). The phase with a short circuit can also be identified by its d.c. resistance (which is lower in the phase with a short circuit). If phases cannot be separated from each other, one measures three phase-to-phase resistances. In the case of a Y-connection, the highest phase-to-phase resistance is at the terminals of phases without short circuits, whereas the other two resistances are equal to each other and lower than the first one. In the case of a delta-connection, the lowest resistance is at the terminals of the phase with a short circuit, whereas the other two resistances are equal to each other and higher than the first one. The latter method requires disconnecting the motor from the ship supply line and is unacceptable for diagnostics without disassembling.

Conclusions. For diagnosing an electric fan impeller it is feasible to use an experimental-design method that makes it possible to determine beforehand the maximum service life; the share of impeller service life, measured by a 2SV meter during the impeller operation, makes it possible to prevent emergency situations. Determining the technical condition of bearing assemblies and drive motor windings, using diagnostic parameters (impact pulse, leakage currents and consumption current), is the most acceptable method for a period between ship sailings; portable instrumentation, such as bearing condition indicator ISP-1, megohmmeter M1102/2 and tong-test instrument Ts91 can be used for this purpose.

BIBLIOGRAPHY

1. Kollakot, R.A., "Diagnostirovaniye mekhanicheskogo oborudovaniya" [Mechanical Equipment Diagnostics], Leningrad, "Sudostroyeniye", 1980.

2. Zabolotskiy, I.Ye., ""Beskontaktnyye izmereniya kolebaniy lopatok turbomashin" [Contactless Measurements of Vibrations of Turbomachine Blades], Moscow, "Mashinostroyeniye", 1977.

3. Kubarev, A.I. "Nadyozhnost v mashinostroyenii" [Reliability in Machine Building Industry], Moscow, Izdatelstvo standartov, 1977.

4. Ryabinin, I.A., "Osnovy teorii i raschyota sudovykh elektricheskikh sistem" [Theoretical and Design Fundamentals of Ship Electric Power Plants], Leningrad, "Sudostroyeniye", 1967.

12770
CSO: 1861/168

UDC 629.011.1

USE OF MOVABLE JOINTS IN SHIP STRUCTURES

Leningrad SUDOSTROYENIYE in Russian No 2, Feb 87 pp 9-11

[Article by N.V. Barabanov and A.G. Chesnokov]

[Text] Observations of ship operation in the Far East basin that have been conducted by the Ship Design Department, DVPI [Far East Polytechnic Institute], over many years have demonstrated that the least reliable ship elements are connections with interruptions. According to statistical analysis, they have caused a significant share of all failures over a 20-years period. These are such structures as:

- end areas of superstructures, deck-houses, side coamings and various cut-outs;

- intersections of sheet metal elements forming stiff spots;

- areas where continuous side coamings are attached to deck-houses and superstructures.

Numerous theoretical and experimental (simulation and full-scale) studies of the stress state of structural elements, conducted by the Department, have demonstrated that under a combination of unfavorable conditions both brittle and fatigue cracks develop strips that are welded to deck-house walls and riveted to deck plating (see Figure 1, b) in some connections with interruptions, due to high stress concentration. The goal was formulated to develop design measures that would prevent origination of cracks and first of all reduce stress concentration as much as possible. One can eliminate dangerous defects in ships by either taking the traditional road of improving the shape of a connection with interruptions and installing various reinforcements or by employing a new method, wherein in elements with high stress concentration one installs movable joints that sharply reduce local peak stresses.

Long-time experience in operating ships that have elements with high initial stress concentration after ships modernization has demonstrated that the use of movable joints produces better results. Introduction of such joints in bulkheads, at ends of side coamings, at deckhouse corners and at ends of superstructures had produced positive results in the very first welded ships, but limited joint mobility was preventing significant concentration reduction.

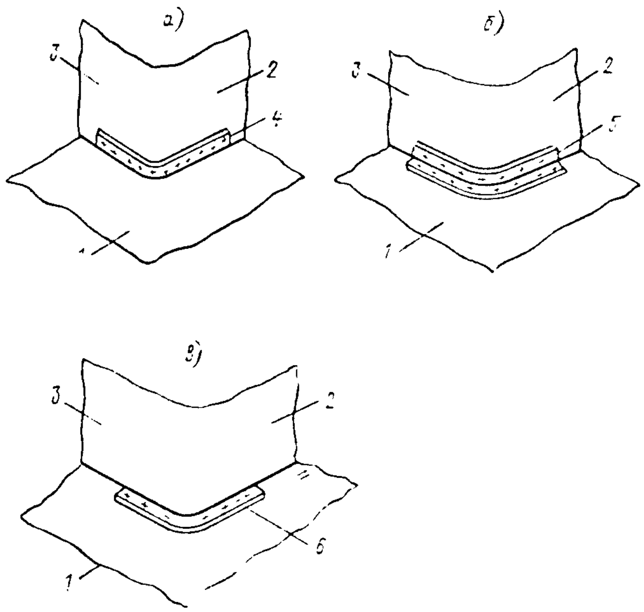


Figure 1. Design of Deck-House Corner:
1 - weather deck plating; 2 - deck-house front wall; 3 - deck-house side wall; 4 - vertical strip; 5 - angle; 6 - cover strap

In the mid-fifties, cracks in deck-house corners were detected in some cargo ships after sailing in severe storm areas. The USSR Register Rules and standard documents specify big radius rounding-off of corners; when a riveted joint is employed in deck-house corners, the Rules allow to lower the rounding-off radius, however, there are no recommendations available on the degree of the decrease.

Due to their compliance, riveted joints considerably decrease stress concentration. However, sometimes cracks appeared in these areas as well, which called for the need to formulate more specific requirements to such joints. For instance, on the diesel-electric ship "Yenisey" (of the "Ob" type) and on the expedition ship "L. Sobolev", a movable joint in the form of a vertical strip was used; the strip was welded to the upper deck and connected to deck-house walls by two lines of rivets (Figure 1, a). In this joint, defects often appeared after repairs, because in the course of common buckling deck-house side walls were resting against the strip, welded to the deck, the strip was torn off along the weld and cracks propagated over the deck plating. On ships "Odessa", "General Panfilov", and banana carriers "Olyutorka" and "De-Kastri" riveted angles were installed at deck-house corners (Figure 1,б); however, due to bending strain hardening cracks still were developing at angle corners, where the radius was the lowest. After these cracks had been repaired by welding, no new defects developed until the ships were written off, which makes it possible to assume that it is permissible to attach deck-house corners to the weather deck without big-radius rounding-off, if one employs riveted short angles. This assures sufficient compliance of the joint, both vertically and horizontally.

Because horizontal displacements of the lower edge of a deck-house are higher than vertical ones, it makes sense to use strips, welded to deck-house walls

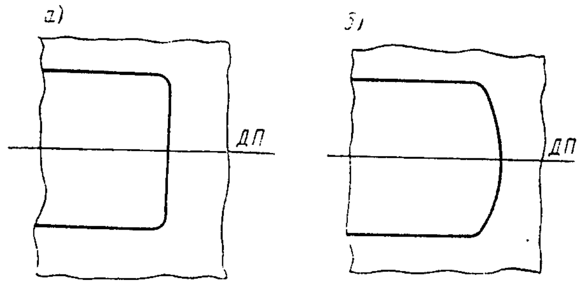


Figure 2. Shape (Plan) of Front Walls of Deck-Houses on Modern Ships:
a - rectilinear; б - curvilinear

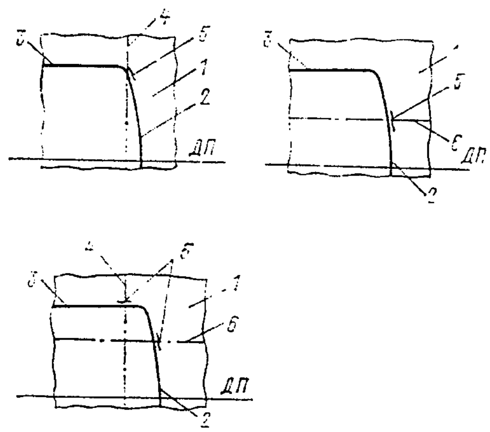


Figure 3. Defects in Structural Elements With Stiff Spots:
1 - weather deck; 2 - deck-house front wall; 3 - deck-house side wall; 4 - transverse bulkhead or frame beam; 5 - stiff spot and crack; 6 - longitudinal bulkhead or carling

and riveted to deck plating, for deck-house angles with small rounding-off radii. In this case, rivet holes are made oval, with the longitudinal axis being longer.

Above considerations are related to deck-houses with rectilinear walls in plan, whereas on a large number of modern ships deck-houses have curvilinear front walls (Figure 2). It is difficult to arrive at a calculated estimate of the stress state of these walls where they intersect hull bulkheads and at deck-house corners, because no trustworthy method for doing it is available. Inspections have demonstrated that no cracks develop in corners of these deck-houses. However, in the area where a curvilinear in plan front wall meets a rectilinear hull bulkhead, stiff spots are formed that cause a large number of defects (Figure 3). Similar results were noted in [1] and [2].

In order to eliminate stiff spots, the USSR Register Rules, 1981, propose installation of knees or brackets along the walls of subdeck braces in the deck-house walls plane (Figure 4, a). By doing this, one replaces a spot transfer of force by a transfer distributed over a larger area. However, the stress concentration factor at the stiff spot, derived from calculations that use the finite elements method, the stress state of an element with knees, was

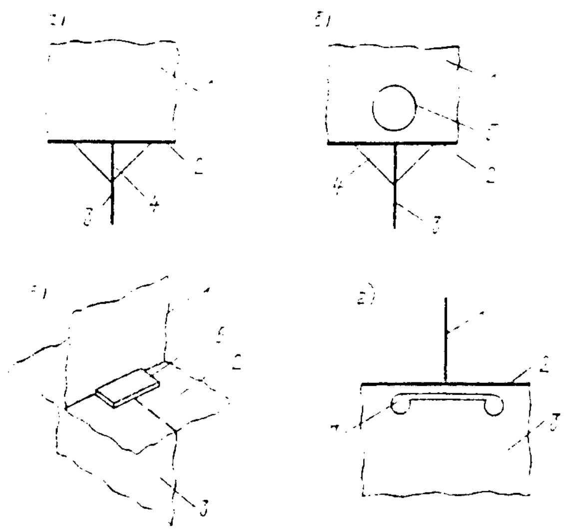


Figure 4. Methods for Eliminating Stiff Spots:
1 - deck-house wall; 2 - weather deck plating; 3 - stiff subdeck brace; 4 - reinforcing knees; 5 - cut-out (deconcentrator); 6 - cover sheet; 7 - slot

very high (4.6) [3], wheres at ends of knees this factor was higher than 2. Naturally, effective concentration ratios that characterize serviceability of these elements in the case of variable loads are also very high.

This method for eliminating stiff spots at end areas of deck-houses is unpractical, because high break-away forces act in these areas, both during the hull bending together with a deck-house and during vibration of a short deck-house under the influence of wave and ice loads. In order to ensure the required strength, very large knees must be installed, which in some cases is impossible. Thus, for instance, it has been determined by calculations that in order to achieve the strength at a face bulkhead intersection with a carling at a scientific-research ship 110 m long one had to install 950 mm knees, whereas the carling height was only 350 mm.

In order to more efficiently reduce stresses at a stiff spot, [4] proposed, in addition to installing knees, to introduce a deconcentrator in the form of a round cut-out (see Figure 4, *б*). In this case stresses are redistributed between the stiff spot, the knees and the cut-out. Studies demonstrated that the deconcentrator makes it possible to reduce knees size by more than 50%, but in this case a problem of closing the hole, in order to seal the inside space, comes up.

[4] also proposed to eliminate stiff spots by using wide cover sheets (see Figure 4, b). This version of a movable joint provides relief of a stiff spot and stress redistribution to adjacent structures. The most stressed element in the design under consideration is the cover sheet, wherein considerable bending stresses develop, due to the effect of an external force. Edges are also subjected to a complex stress state in the area where they rest on deck

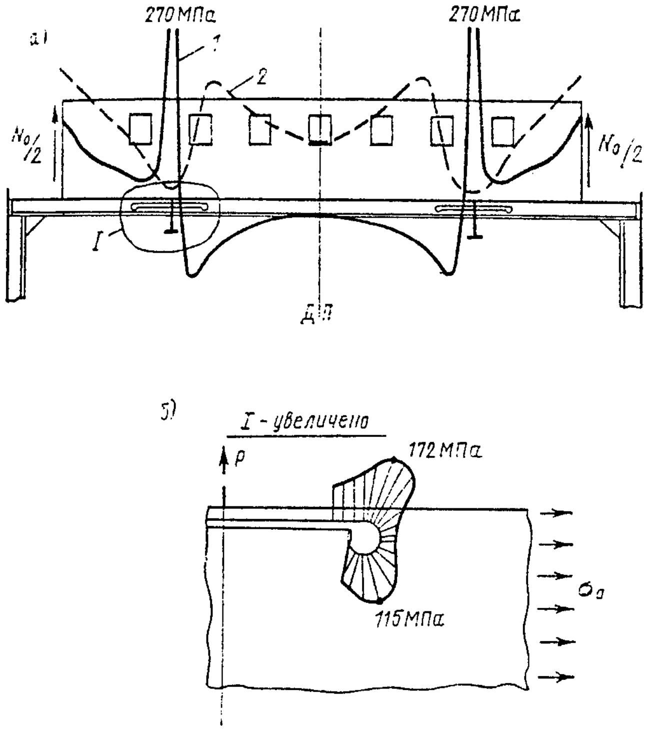


Figure 5. Stress Curves:
1 - with no movable joint; 2 - with movable joint

Key:
1. MPa
2. View I: enlarged

plating and the rigid subdeck brace. When the sheet bends, considerable concentrated break-off forces can develop in this area. Therefore, when choosing the size of a cover sheet, one should ensure both the necessary compliance and sufficient strength thereof. With the help of cover sheets, installed in accordance with drawings, developed by the Ship Design Department, DVPI, stiff spots on the "Vyborg" type ships were eliminated in 1975. Observations demonstrated that there were no defects in this structural element during 10 years of operation.

In 1978-1979 stiff spots were eliminated on scientific-research ships by using a movable joint that had the shape of slots in rigid subdeck braces (see Figure 4, г) (Certificate of Authorship No 952672). The stress state of this element at the front wall intersection with a carling, caused by common bending, was assessed according to the "Potentsial-2" program [5]. The assessment demonstrated that, due to redistribution of forces, stresses in the stiff spot decreased practically to zero (Figure 5, a). Considerable stresses act at slot ends (see Figure 5, б); however, by changing the slot geometry one can reduce the stresses.

Making slots in subdeck braces in the vicinity of stiff spots does not reduce the local strength of deck plating, because the front wall itself can be viewed as a deck plating beam that takes up the entire load, acting on the

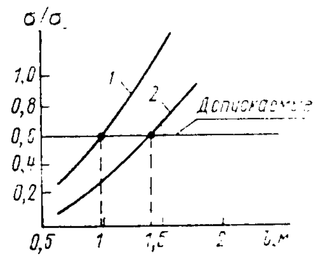


Figure 6. Stresses σ in Movable Joint as Function of Slot Length 1;
1 - beam idealization; 2 - plate idealization; σ_s - yield strength

Key:
1. Allowable stresses

section, weakened by the slot. A required strength of the portion of the beam adjacent to the deck plating can also be ensured. As an example, we calculated the strength of a movable joint in a transverse brace.

In the first version, the portion of the slot adjacent to the deck plating was represented by a beam, attached rigidly at a deck-house side wall and at the slot end; the load, determined in accordance with the USSR Register Rules, was evenly distributed along the beam length 1 and across its width, which was equal to transverse spacing.

In the second version, a portion of the slot was schematically represented by an elastic rib that reinforced the plate rigidly retrained along its contour (in order to increase the strength of an element, one should install reinforcing ribs at the slot ends).

It can be seen from the graph in Figure 6 that the beam idealization resulted in considerable errors by overestimating actual stresses. Therefore, when estimating the local strength of a movable joint, one should take into account the relieving effect of plates that distribute a load to adjacent structures (beams and stiffeners).

Investigations of serviceability of a movable joint with a slot resulted in developing an approximate method for assessment of the stress state thereof, which is in good agreement with results of a full-scale experiment, conducted on a scientific-research ship during sea disturbance of 5-6 points (the full-scale experiment was conducted by personnel of the Ship Design Department, DVPI, under the direction of V.I. Laktyunkin). Discrepancy of the results was under 20% on the safe side. Observations of the condition of such movable joints, conducted over a number of years, have indicated the absence of defects in the joints. This proves high reliability and serviceability of movable joints and brings one to a conclusion that it is feasible to use these joints in ship structures. The results can be used in designing end sections of deck-houses and structural elements in stiff spot areas.

BIBLIOGRAPHY

1. Vasilenko, V.D. and Sterpanova, N.N., "Analysis of Ship Hull Defects",

SUDOSTROYENIYE, 1982, No 10.

2. Gavrilov, M.N., Briker, A.S. and Epshteyn, M.N., "Povrezhdeniya i nadyozhnost sudov" [Defects and Ship Reliability], Leningrad, "Sudostroyeniye", 1978.

3. Barabanov, N.V., "Konstruktsiya korpusa morskikh sudov" [Design of Sea Ship Hull], Leningrad, "Sudostroyeniye", 1981.

4. Ivanov, N.A. and Novikov, V.V., "Problems of Design of Ship Structures With 'Stiff Spots'", NAUCHNO-TEKHNICHESKIY SBORNIK REGISTRA SSSR, 1981, No 10.

5. Veryuzhskiy, Yu.V., Sisengaliyev, M.K. and Yasko, V.V. "Application of Set of Universal Programs for Calculation of Stress-Deformation State of Machines and Structures", in collection of articles "Problemy prochnosti" [Strength Problems], 1984, No 10.

12770
CSO: 1861/168

UDC 631.312.021.3.004.67

PLOWSHARES WITH HIGHER DURABILITY

Moscow TEKHNIKA V SELSKOM KHOZYAYSTVE in Russian No 1, Jan 87, pp 53-54

[Article by V.N. Klyuyenko, Chief Engineer, GSKTB [State Special Design and Technological Bureau], PO [Production Association] "Odessapochvomash"]

[Text] GSKTB PO "Odessapochvomash" in cooperation with Electrical Welding Institute, AN UkSSR [Ukrainian SSR Academy of Sciences] has developed a new technological process of spot hardening of tools for tilling machines. The method is based on macroembedding hard alloy particles into the structure of metal subjected to abrasive wear.

Hard alloy is deposited onto the face surface of plowshares by means of arc spot welding. For this process one uses standard d.c. converters VDG-503, VS-600, VDU-1001 and cored wire, such as PP-AN170, 3.2 mm in diameter. The wire is melted by the electric arc and forms penetration cones, the so-called hardening spots, firmly held in the base metal due to active diffusion of the hard alloy.

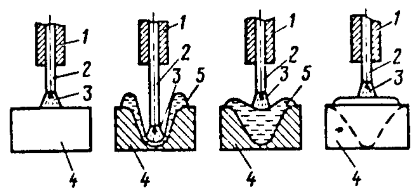


Figure 1. Spot Hardening Scheme:
1 - welding tip; 2 - cored wire; 3 - electric arc; 4 - workpiece; 5 - melt

For hard-facing (Figure 1) one sets up the required distance (25-27 mm) between the welding tip and the part to be hard-faced and turns on slow core wire feed (80-100 m/h). When the wire touches the part surface, the welding arc striking device operates. When the arc is stable and the base metal has heated up, fast wire feed (200-350 m/h) is turned on. The base metal is melted and a valley is formed, which is filled in with the hard alloy. At the third stage of hard-facing, wire feed speed is reduced to 65-80 m/h and is kept constant until the deposited layer has formed.

The arc voltage is 28-50 V, the current is 420-600 A, time for depositing one spot is 1.8-2.3 s, the depth of hard alloy penetration is 3.5-5 mm.

Hard alloy elements have a cone shape and are deposited onto the surface of a plowshare with partial overlapping (up to 1/5 of their diameter). The plowshare blade is sharpened on the back side.

During the initial operating period the softer, non-surfaced sections of a plowshare are wearing out faster than the hard-faced ones, so the blade takes a sharp saw-like shape that reduces draft resistance.

The Table below presents results of comparative field tests of hard-faced and regular plowshares in various climate zones.

Test Place and Time	Life, hectares Regular	Life, hectares Experimental	Wear Resistance Ratio
South Ukraine MIS [Machine Testing Station], 1985	28.65	41.6	1.46
Lvov MIS, 1984	25.26	39.83	1.57
Same, 1985	13.00	25.00	1.92
Kirgiz MIS, 1984	4.30	10.42	2.42
Same, 1985	5.50	7.92	1.44
Transcaucasia MIS, 1985	17.00	23.20	1.36
Central Chernozem MIS, 1985	54.00	66.00	1.22
A-U Agricultural Mechanization SRI, city of Armavir, 1983	13.00	26.00	2.00
Same, 1984	31.20	56.30	1.51
Same, 1985	33.80	64.20	1.90

Using the above data, it has been calculated that the number of hard-faced plowshares per a PLN-5-35 plow per year decreases by 15 pieces. Annual savings are equal to 1.74 R per plowshare.

Investigation of wear of hard-faced plowshares, compared to regular ones, when used on hard-loamy low-humus thick black earth soil with 16-18% moisture content and up to 3.2 MPa hardness demonstrated that plowshare wear rate changes, depending on the location of hardened spots. When they are spaced at 5-7 mm, plowshare wear (length-, width- and masswise) is higher than in the case of plowshares with a continuous hard-faced layer.

On the average, for regular plowshares that were tested until they completely wore out, the length decreased by 10%, the width - by 5-6% and the mass - by 13%.

Under the same conditions, the lengthwise wear of hard-faced plowshares on a PLN-5-35 plow was lower by a factor of 2-2.5 in the case of continuous spots (Figure 2,a) and by a factor of 1.5, when the spots were spaced at 5-7 mm.

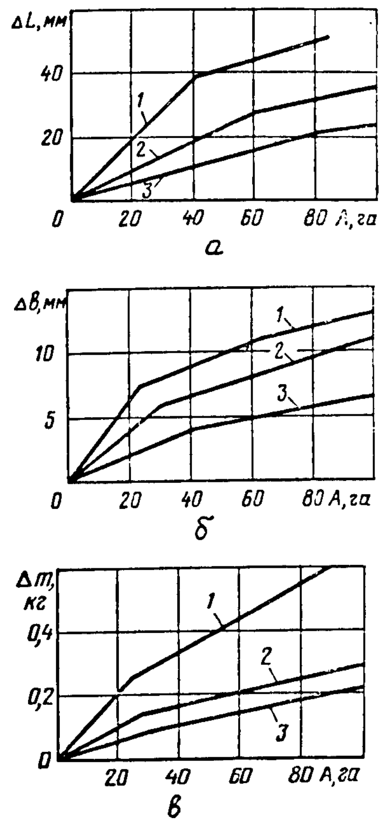


Figure 2. Comparative Wear Characteristics of Plowshares:
a - lengthwise; б - widthwise; b - masswise;
1 - regular plowshare; 2 - hard-faced plowshare, spots spacing 5-7 mm; 3 - hard-faced plowshare, continous spots

Key:
4. hectares
5. kg

Plowshare wear width- and masswise has almost identical character (Figure 2, б, and b).

The wear resistance ratio of hard-faced plowshares, tested on sandy soils with 5.5-16.1% moisture content and 0.2-1.69 MPa hardness, was 1.93 length-, 1.94 width- and 1.8 masswise. Wear curves for hard-faced and regular plowshares as a function of service life are presented in Figure 3.

Wear of hard-faced plowshares during the initial hours of operation is determined by their initial tool angles. It has been found that when the tool angle increases from 10 to 40°, the wear decreases, but stabilization of self-sharpening takes longer. The optimum initial tool angle is 20-25°. A plowshare angle of tooth point after its self-sharpening on various soils has stabilized is 2-4° lower than its angle of incidence relative to the bottom of a furrow. In this case the back chamfer angle is positive, which favorably affects plowshare operation and uniformity of its movement depth-wise. According to South Ukraine MIS data, draft resistance on dark chestnut

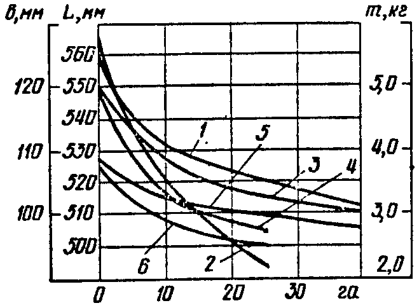


Figure 3. Wear of Plowshares as Function of Service Life for Sandy Soils: 1, 2 - lengthwise wear, hard-faced and regular plowshare, respectively; 3, 4 - widthwise wear, hard-faced and regular plowshare, respectively; 5, 6 - masswise wear, hard-faced and regular plowshare, respectively

Key:

4. hectares
5. kg

saline medium-loamy soils with 13.7-16.3% moisture content and 1.64-2.23 MPa hardness is 11.2-23.2% lower for hard-facing plowshares, compared to that of regular ones. It should be noted that spot-hardened plowshares performed well at soil hardnesses of up to 8.2 MPa in Kirgiz SSR on submountain gray earth soil and at soil moisture content of 27-31% at the Central Chernozem MIS fields and in Krasnodar Kray.

In cooperation with OKTB [experimental design and technological bureau], IES [Electric Welding Institute], AN USSR, an automated spot-hardening line has been developed and is being built. Its annual output is 500 thousand plowshares, production cycle time is 22 s. The hard-facing process is completely automated.

Spot hardening makes it possible to reduce electric power consumption for plowshare surfacing by more than 50% and to drastically increase labor productivity.

12770
CSO: 1861/157

- END -