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AUTOMATION OF SMALL AND MEDIUM-SCALE INDUSTRIES

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REPUBLIC OF KOREA

Technical report: Design of special purpose automation machinery*

Prepared for the Government of the Republic of Korea
by the United Nations Industrial Development Organization,
acting as executing agency for the United Nations Development Programme

Based on the work of Joe Minkwitz,
expert in assembly/manufacturing automation

Backstopping officer: R. Kaulfersch
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United Nations Industrial Development Organization

Vienna

* Mention of company names and commercial products does not imply endorsement of UNIDO. This document has not been edited.

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UNIDO's Substantive comments

The report covers the return mission of the expert from 12 October till 3 November 1990 and reflects the activities under this assignment. Technical assistance was requested by the counterpart in the area of automation of the manufacture of the Royal Metal Industrial Company, Sam Joo Machinery Co., Ltd. and Sung Rim Co., Ltd.

Based on the excellent job Mr. Minkwitz had already carried out during his first and second assignment he could establish a good relationship with the Korean counterparts. Therefore the expert was asked during the briefing meeting to support the re-establishing of direct contact between S.M.I.P.C. and UNIDO Headquarters personnel who are involved in the project implementation. Because of various changes on both sides this contact was lost and caused some uncertainties in the implementation of the project.

As it is stated in the report it was suggested to hold a tripartite review meeting to discuss the present status and the approach to further implementation in order to secure a successful completion. Provided that funds for a BSO-mission can be made available the tripartite review meeting will be prepared in connection with Mr. Minkwitz' next mission (end of March 1991).

The report itself shows in chapter IV. clearly the manufacturing areas (Royal Metal Industrial Company - page 2; Sam Joo Machinery Co., Ltd. - pages 3 to 6 and Sung Rim Co., Ltd. - pages 6 to 8) in which the expert provided the requested assistance. Based on his concept design different solutions for the automation of machining processes, mainly fixing and placing of components/parts (Royal Metal), clamping/machining/processing and unclamping (Sam Joo), loading into a fixture clamp and drilling; loading, processing and unloading (Sung Rim). The aim of the automation of certain manufacturing processes is to reduce labour and subsequently costs and to improve quality through higher accuracy in positioning and processing of the parts.

Based on a thorough knowledge of the theoretical fundamentals of industrial automation and many years of practical experience the expert carried out an excellent job which was highly appreciated by the counterpart.

From the substantive point of view it is strongly recommended that the counterpart should follow the advice of the expert in detail in order to upgrade and rationalize his manufacturing capabilities.

The successful implementation of this project might lead to further co-operation with the Korean Government in the area of factory automation.

THE MISSION

The mission began on Friday, October 12th, 1990 with a briefing at U.N.I.D.O. in Austria.

I had a very productive meeting with the backstopping officer, in which we discussed the Korea project as a whole, its importance and its efficiency and purpose.

There have been personnel changes on both sides of the ocean, in Korea at S.M.I.P.C. (Small and Medium Industries Promotion Corporation) and at U.N.D.P. in Seoul as well as at U.N.I.D.O. in Austria.

These personnel changes on both sides of the ocean created a serious communication gap so that there was discussion about abandoning the entire project because of the communication gap.

The backstopping officer pointed out the importance of the "Expert on Mission's" report in order to re-establish good communications again between the new persons.

We also came to the conclusion that is is necessary to conduct a meeting in Korea between the backstopping officer and people from S.M.I.P.C. and U.N.D.P. personnel preferably during the time an expert is on mission in Korea to take part in the meeting. A meeting of this nature shows promises to be very productive.

At my arrival in Korea I was picked up at the Seoul Kimpo International Airport by Mr. Won Jong, Kim from S.M.I.P.C. Mr. Kim took me to my Hotel in Seoul, where I had the opportunity to rest the remainder of the day, trying to overcome the time change.

The next morning, Monday, I travelled to the S.M.I.P.C. office and met with Mr. Nam, who is the Chief of the entire Automation Division at S.M.I.P.C. in Seoul.

I have reported to Mr. Nam what my meeting with the backstopping officer in Austria consisted of and I stressed the importance of a meeting with all people involved. He was in favour of such meeting and feels that such a meeting can only have a positive result.

I also relayed the message from the backstopping officer to Mr. Nam that, if in the future the line of communication breaks down for whatever reason Mr. Nam should contact the backstopping officer at U.N.I.D.O. directly by fax so that the communications can be re-established. However, as long as the communications through proper channels are possible, this is the preferred method. I gave Mr. Nam the Business card of the backstopping officer to insure that Mr. Nam has the correct telephone and fax number of U.N.I.D.O. in Austria.

Next, Mr. Kim and Mr. Hong of S.M.I.P.C. took me to the U.N.D.P. office in Seoul, where we met with Mr. R.V. Garcia, Deputy Resident Representative and with Mr. J.L. Lemahieu, Programme Officer. I presented my schedule for this mission. We briefly discussed each of the projects and the goals we were trying to achieve on this mission. We also discussed some of the earlier projects that were addressed on previous missions and the importance of the role that is played by U.N.I.D.O. and U.N.D.P. for the Republic of Korea as well as each individual client company and the production of their product.

The actual working session began on Monday, October 15th, after I returned to S.M.I.P.C. from U.N.D.P. and ended on Saturday, November 3rd, covering a period of three weeks with visits to three companies, addressing several problems during each visit, spanning a variety of different applications.

During this period I was working with Mr. Won Jong, Kim, Extension Officer of the Automation Services of S.M.I.P.C. He was assigned to be my translator and partner during my entire stay in Korea. Mr. W.J. Kim is a pleasure to work with. He is a true ambassador and a great asset to S.M.I.P.C.

Every time I come back to Korea I can notice a little progress in the Automation Department under the leading direction of Mr. Nam.

I am sure that some of the progress can be traced back to the assistance of foreign experts that have left some of their knowledge and skills with their Korean counterparts, thanks to U.N.I.D.O., U.N.D.P. and S.M.I.P.C. international.

Serving client companies through U.N.I.D.O. and S.M.I.P.C. in Korea gives me a feeling of appreciation, worth and accomplishment.

After reviewing the project in progress I would estimate that it will be necessary for me to return to Korea around the end of March of 1991.

Before leaving Korea, I had a conversation with Mister P. C. Park of U.N.D.P. in Seoul. We discussed some of the projects and my recommendations. I reported to Mister Park about each of the projects, specificly that the Royal Metal Project is shaping up nicely and that all fixtures and dial plate are manufactured. An indexer has to be purchased and the base has to be manufactured.

I also reported to Mr. Park that I have met with the backstopping officer in Austria and that we feel that a meeting should be scheduled. He also was in favor of such a meeting.

Mr. W. J. Kim asked me to gather information of purchased components for several client companies and assist in purchasing of the indexer and pneumatic components for the Royal Metal Project.

From Korea I travelled back to the U. S. A.

I think it would have been beneficial if I had stopped in Vienna for debriefing before my return trip to the U. S. A.

After my return from Korea, Mister J. B. Park from the S.M.I.P.C. in Chicago called me on the phone to wellcome me back to the U.S.A.. We briefly discussed some of my activities in Korea.

ITINERARY

Date	Day	Work Class	Name of Company	Location	Contents
10-14	Sun.	Arrival		Seoul	A. M.
10-15	Mon.	Meeting	UNDP, SMIPC	Seoul	Report to UNDP Discuss Problem areas, Introduction
10-16	Tue.	Visit	Royal Metal Ind.	Bucheon	Nail Clippers
10-17	Wed.	Travel from Seoul to Ulsan			
10-18	Thu.	Design	Sam Joo Mach.	Ulsan	Stud Runner
10-19	Fri.	Design	" " "	"	" "
10-20	Sat.	Other	" " "	"	Summerize Visits, Study, Design, etc.
10-21	Sun.	Rest		Ulsan	
10-22	Mon.	Design	Sam Joo Mach.	Ulsan	Stud Runner
10-23	Tue.	Design	" " "	"	" "
10-24	Wed.	Design	" " "	"	Riveting Mach.
10-25	Thu.	Design	" " "	"	" "
10-26	Fri.	Design	" " "	"	" "
10-27	Sat.	Travel from Ulsan to Taegu			
10-28	Sun.	Rest		Taegu	
10-29	Mon.	Design	Sung Rim	Taegu	Loading transfer
10-30	Tue	Design	" "	"	Drill.Fixt. Clamp
10-31	Wed.	Design	" "	"	Drill. Index. Mach.
11-1	Thu.	Design Travel from Taegu to Seoul	" "	"	" " "
11-2	Fri.	Visit	Royal Metal Ind.	Bucheon	Nail Clippers
11-3	Sat.	Depart		Seoul	Report and Depart

An account of the companies visited, the problems presented/discussed and the advisory recommendations.

ROYAL METAL COMPANY

(Production of Nail Clippers)

Mr. Won Jong Kim and Mr. Hong from S.M.I.P.C. and I went to see the Royal Metal Industrial Company. We met with Mr. G. S. Kim, Production Manager, who explained the progress of the finger nail clipper grinding machine.

The Machine was concepted and detailed on two previous trips. The purpose of this visit was to follow up on the progress of the manufacture of all machine components and to assist with any questions that may have come up and to assist with the purchased parts and the availability thru vendors.

We went to the shop area where the dial plate with its 24 fixtures mounted on it was stored.

When we went back to the manager's office, I assisted with the purchase order of the indexer with continuous motion. Manager Kim asked me to assist with the purchase of some of the pneumatic components also after I have returned to the U.S.A..

After we returned to the S.M.I.P.C. office in Seoul I designed the main base for this machine and released it for manufacture so that it can be welded and machined while the indexer is being shipped. In my estimation it will be approx. the end of March of 1991 when all components are assembled and the machine is ready for "Debug". This is the time period that starts when all is assembled and a few things need to be adjusted and fine tuned until the machine is operational and most of the "Bugs" are out of it.

I did not get involved in the power supply, controls and the pneumatic circuitry design. Manager Kim of Royal Metal Co. said that they have people available to take care of that portion of the project.

SAM JOO MACHINERY CO., LTD.

(Production of automotive components)

Mr. W. J. Kim of S.M.I.P.C. and I met with Mr. Soo Uk Chu, President and Choong Gi Kim, Chief Draftsman of Sam Joo Mach. Co.

Sam Joo Mach. Co. is an Automotive Components Supply Company that supplies Hyundai Motors with specific parts.

Our mission was to automate some of the operations on some of the manufacturing processes.

The first operation that was to be automated was the placement and torqueing of two studs into a motor mounting bracket for a car with power steering.

We went to the shop area where the part is being machined from a rough casting to the operation where the studs are inserted and torqued manually with an air impact wrench.

Our goal was to concept design the following:

The operator should load the motor mounting bracket into our automation equipment and push a cycle start button.

Our automation will do the following:

A) Automatic part clamp

B) Feed two studs and place them in front of two tools that will engage the studs

C) Return the placement tooling

D) Advance the tools with the studs and screw them into the motor mounting bracket and torque out

E) Dis-engage the tools and return to home position

G) Automatic unclamp part

H) Now the operator will manually remove the finished part out of the fixture and replace it with a new part.

A new cycle will start after the operator pushes the cycle start button.

The next project that was to be concepted is the sub-assembly of a clutch release fork and the riveting of a spring steel retainer to it.

I looked at the present, manual operation on the assembly floor, which is as follows:

An operator manually places a rivet thru the spring steel retainer and thru the clutch release fork. Then these sub-assemblies are placed into a box. After the box is full it will be transported to another building where a press is tooled up for this riveting operation.

The operator places the fork, retainer, rivet sub-assembly into a fixture under the press and the press is activated by the operator and by means of force the riveting operation is completed. When the press ram returns to the up position the operator removes the finished part and replaces it with a new one. The operator activates the press for a new cycle.

I was asked to concept design an automatic machine that will join the three parts together and perform the riveting operation. The concepted automation turned out to as follows:

A) The operator manually places the fork into a fixture and pushes the cycle start button. The retainer bracket is fed via a feeder bowl and a gravity track into a set of jaws that is mounted on a gripper at the end of the gravity track. The rivet is also fed via a feeder bowl and gravity track. A waiting set of gripper jaws will grip the first rivet out of the track and place it into the spring steel retainer below. The retainer gripper shuttles over to another set of jaws which grips the rivet & retainer sub-assembly and places the rivet into the hole in the fork below. Now the rivet goes thru the retainer into the fork. All grippers return to the home position and the fixture with the sub-assembly in it is shuttled over to the press position, where two opposing hydraulic cylinders, both tooled up with riveting tooling will perform the riveting operation. The vertically mounted riveting cylinder returns and the shuttle will also return to the loading position.

Now the operator will replace the finished part with a new part in the fixture.

The above automation is designed to handle two similar clutch release forks with a minimum amount of change-over on the part locating fixture. No other change-overs on the machine are required.

Both of the above clutch release forks are manufactured from a rough casting at the Sam Joo Mach. Co. all the way to its final operation, the riveting operation ready for installation in the car.

I was asked to concept an automatic machine that would receive the rough casting of the fork and perform all operations, such as milling and drilling and riveting, ready for shipment.

After a short study of the existing operations, a few sketches and dicussions with Sam Joo people, I came to the conclusion that there would be no significant savings of operators to design a machine that includes all the milling and drilling operations and also the riveting operation.

Therefore I suggested to design a riveting machine that could be added to the existing production line.

This machine would save having to transport the parts to another building for riveting and it would save one operator because the operator who is doing the last drilling operation has enough time to operate the riveting machine if it is added right to the existing machine.

After completion of the concept design I explained the design and its function to Sam Joo people.

The new riveting machine consists of a main machine base, where the top is 750 mm high from the floor. Two square tubing columns are mounted vertically on the base and a bridge above connects the two columns. One hydraulic cylinder is mounted vertically on the bridge above with the rod pointing downward.

Another cylinder of the same dimensions is mounted vertically on the main base with its rod pointing upward, inline with the cylinder above. Both cylinders are tooled with riveting tooling.

A fixture, which is adjustable to accommodate both clutch release forks is mounted between the upper and the lower tooling, fastened to both vertical columns.

The operator places the spring steel retainer onto the fork and inserts the rivet thru both parts. Now the operator will place this sub-assembly into the fixture of the machine and pushes the cycle start palm buttons, which will start the riveting cycle. The upper and lower cylinders are advancing simultaneously, operated by the same solenoid valve to insure equal tool pressure from top and bottom to prevent part bending. after the preset pressure is reached, both cylinders will return and the operator will remove the finished part and place it into a box, ready for shipping.

SUNG RIM CO., LTD.

(Production of automotive components and building of special purpose machines)

After arrival in Taegu, Mr. W. J. Kim of S.M.I.P.C. and I met with Mr. Un-Dong Choi, President and Mr. H. S. Kim, Systems Engineer of Sung Rim Co..
They gave us a brief run down on the company's history and on the standard product line as well as the type of parts that are being machined by the company on a contract basis.

Sung Rim Co. is a Special Purpose Machine Building Company and an Automotive Components Supply Company that supplies several automotive companies with specific parts. We were introduced to several problem areas in the production and in the design of the product. We chose a few of the most pressing and most current problems and concentrated on solving those.

The first problem area was the design of a drilling fixture that is part of a drilling machine that drills an oil hole .8 mm dia. and chamfering of the hole up to 3 mm dia. in a rocker arm of an automobile engine.

The casting is a very thin and delicate part and the portion where the hole is drilled into is very hard to reach because the way the part is shaped and the angle of the drilled hole collides with the only clamping method available.

Therefore I designed a concept of a workholding fixture clamp that would hold the part and is used as a bushing plate at the same time. This means we are drilling thru the clamp and are using the clamp as a bushing plate to guide the drill during the delicate drilling operation.

I pointed out that any severe variation in the part may cause the drill to break. The above clamp / bushing plate combination was to be adopted to the existing fixture design. This clamp change caused three other parts on the fixture having to be changed.

The sequence of operation is as follows:

A) Load part into fixture.

B) Chamfer drill hole 3 mm dia. to certain depth.

C) Drill .8 mm dia. drill through, using the chamfer drill point for a guide.

The second project was a loading device to load one of the standard facing / centering machines.

I went thru the shop and looked at one of the standard machines to get an idea how much room I have to design an automatic loading mechanism. The machine on the floor did not have the back open but I was told that the machine that this automatic loading mechanism will be used on will have the back open so that we can transfer the parts thru the machine in a horizontal direction.

The goal was to: automatically load and unload a standard Sung Rim facing and centering machine which centers and faces cylindrical parts from approx. 240 mm legth to approx. 700 mm length and diameters range from 20 mm to 35 mm.

I have concept designed a rotary transfer mechanism that transfers the parts in a rotary motion, keeping the axis of the part always horizontally.

The two parallel transfer bars are moved with two bellcranks on each end which are mounted on the dual output shafts of two worm gear reducers. The two gear boxes are connected with a solid drive shaft and only one of the gear boxes is driven with a motor. The parts are positioned with the axis horizontally on stationary "VEE" supports. The transferbars have "Vee" blocks on it also. As the rotary motion of the transfer bars contacts the parts, they will be lifted out of the stationary nests and will be carried on the transfer bar nests with the rotary motion and placed into the next set of stationary "Vee" blocks about 200 mm in direction of transfer.

The last project at Sung Rim was a request to concept an automatic machine to drill and tap up to six holes into seven different wheel brake cylinders for the manufacture of trucks.

Since all seven types of brake cylinders are different in size and hole location, it took a few hours to study to find out what is common about the parts. Therefore I decided to use the indexing machine concept with interchangeable fixtures and drill and tap heads.

Keeping in mind all the different parts and sizes I found that the following sequence of stations would be most suitable for this task.

Sta. #1 Manual unload and load

Sta. #2 Drill large port hole (first path)

Sta. #3 Drill large port hole (second path)

Sta. #4 Form ream large port hole

Sta. #5 Drill bleeder hole (First path)

Sta. #6 Step drill bleeder hole (Second path)

Sta. #7 Form ream bleeder hole (One type only)

Sta. #8 Drill (4) holes for later tapping (M-6 or M-8)

Sta. #9 Tap (4) holes (M-6 or M-8)

Sta.#10 Tap (1) M-10 (Port hole)

Sta.#11 Tap (1) M-8 or M-10 (Bleeder hole)

Sta.#12 Probe station

After the basic concept was done, we discussed the dimensional difference between the parts and I started going thru the sequence of changing the fixtures and in some cases even the drill or tap heads. In some cases I was able to get by with just moving the head a little. In two cases we have to move the spindle location as well as the drill bushing location by means of an eccentric bushing method.

Some drill and tap units have to have multi forward full depth stops to accommodate different hole depths with the same tooling setup that may be used on other parts.

We went thru the complete tool change, head change and all moves for three out of the seven parts to demonstrate the method. Sung Rim personnel will continue and extend the method with the remaining four parts. I suggested to build two machines and have one machine set up for the most popular model and change the other machine over for the not so popular models with a lesser production run while the first machine is producing. But this two machine method is only justifyable if the production requirement allows the expense of two machines.